TLH

LAND MANAGEMENT MEETING
STUDY GROUP C - 9-4-36
Unit 17

R. Walker — It's about time for us to settle down now and come to order. I notice we have with us a few visitors and we are glad to have them set in with us on this discussion. The order or presentation is practically the same as in the last two meetings. One change, I think ECW has been put down just ahead of the engineering presentation - otherwise the order is as before. General description of area by Bewley; range management - McKinney; Forestra - Deppa; Biology - Phillips; Erosion - Kennedy; Soils-Bewley; Agronomy - Nicholson; ECW - McCray; Engineering - Moyes; Planting - Nicholson. Oh yes, that's right, Sociological surveys comes second and will be presented by Mr. Bell. I suppose everyone is here that is coming in today and suppose we had better get the number that wants to eat at the club. Will all of you that want to eat at the club raise your hand. I counted 18 is that right. Dick will you notify the club and find out what time they want us. Does anyone have anything they want to bring up before we start in. If not, we will have Mr. Bewley give us a general description of such facts as he thinks pertinent at this time.

Bewley: — District, or unit, 17 is located in parts of Apache and Navajo county Arizona and comprises the south central part of the Navajo Indian Reservation. The boundary of the area is roughly as outlined on the base map which we go by. The only changes that have been made are on the north from this mesa over to the rim of Beautiful valley bending to the south and over here by Pine Springs instead of following the road approximately ~~half~~ half mile difference. Otherwise the boundaries are as outlined on the map. The topography of the unit is undulating to hilly in the central region the topography is undulating and a little

hilly and hilly along the west side of the Defiance plateau. Mountains and shale appear on the southeast portion of the plateau. General elevation of the area is approximately 6500 feet for the central part of the area including Ganado, Klaag-E-Toh and Steamboat. The lowest elevation is found where LaRue wash leaves the area. 5200 is the general elevation for Defiance plateau and on east with the exception of Fluted Rock which is 8500 feet. There is a difference of 2800 feet in the whole unit disregarding the small area of Fluted Rock. There are no perennial streams on the unit, although a few springs up in the west side of the Defiance plateau that are perennial and the small streams ~~and black~~ running from them may be classed as perennial streams that extend short distances from the springs that dry up. With the exception of north of the south end of Chin Lee valleyand drain into Chin Lee wash, the rest of the area lies in the Little Colorado River watershed and is drained by Pueblo wash and leaves the area just east of Twin Mesa and LaRue wash just south of St. Michaels highway and drains down and leaves area in the southeast corner. Other important drainages are the Steamboat wash, the Pinon Springs wash, Klagatoh wash and a few sub washes. General direction as said before is to the southwest with the ~~exceptick~~ exception of that north end. There is no accurate information as to the climatic data on the Reservation, although here at Ganado some records have been kept and for a few ye s the average rainfall is 10.47 inches. We have from that in- ~~fro~~ formation we have estimated the general rainfall for the unit to be approximately 10½ inches per year; although up here on Defiance plateau the rainfall may be as high as 15 inches or more and in the Painted Desert region in the southwest corner around 8 inches but we estimated 10 inches for Painted Desert. Only figured the rainfall here at Fort Defiance for three months or 2½ months - July, August and first part of September. Rainfall during that period is 43% of total for year.

Roughly the same for the other stations located just around and off the unit. 43% of the rainfall occurred during that period. Most form of this precipitation occurs in the form of snow and estimating by the figures from these outlying weather stations the average depth of snow or average fall of snow on the unit is 30 inches per year. We have ~~mf~~ a growing season of (all these figures are estimated because of outlying stations) 133 days. From the middle of May to the first of October. The average annual temperature is estimated 48.4 degrees and a mean daily fluctuation of 32 degrees. The native vegetation of the unit varies from the upper to the transition and the ~~x~~ variation in these formations is due to the change in elevation and the rainfall. Rainfall is correlated with elevation. The desert grasses and shrubs are found in the southeast portion of the region. The sage brushes and blue grama grasses occupy the central portion and yellow pine and mountain muhlenbergia are up on the Defiance plateau. The population, as estimated last week, was 3500 with 510 consumption groups. The only population concentration is in the vicinity of Ganado and a very few in the Painted Desert region; otherwise, scattered uniform over the area. The main occupation is sheep herding, although a few work for the traders and Governmental agencies which are scattered over the unit. Most of the shifting in summer and winter is within the unit. They shift to the concentrated farm areas during the farming seasons and when the crops are in they shift to the higher wooded areas. Little shifting in the southeast corner and a little shifting into Chin Lee valley. A little flock from Crystol coming through the northeast corner and grazes down in the southwest corner. There are I think 11 ~~xxx~~ trading posts located on the area; 4 at Ganado, 1 at Steamboat, 1 Sun Rise, Pine Springs and Cross Canyon and Klagetoh. The day schools located at Steamboat, Cornfields, Greasewood, Klagetoh, Wide Ruins, Pine Springs and Kinlichee. There is one hospital and Mission

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school at Ganado. The whole area is accessible to automobiles. Roads and trails all over it. The four main roads are the St. Michaels-Steamboat road; Chambers-Ganado road; Ganado-Cornfields road; truck trails lead from approximately 100 miles of improved road and 100 miles truck trail; one trail reaches Ganado to Fluted Rock, comes down the plateau to the summit back down to Klag-E-Toh and then into Greasewood making a circle of the northeast part of the ~~xx~~ area. The summit-Klagetoh truck trail about 10 miles below Ganado-St. Michaels highway and goes through Pine Springs to Highway 66. Indian roads and truck trails lead to all parts of the unit. Agriculture is practiced over parts of the area; dry farming on top of the plateau; flood irrigation along the lower washes; and irrigation at Ganado. Approximately 4,000 acres of farms and 1700 acres potential land. There are three demonstration areas in the unit. Steamboat, Ganado, and Klagetoh. The areas occupied by demonstration areas approximately ~~36,187~~ 36,178 acres. The total area of the unit as outlined is 1,144,122 acres. I forgot to mention the area is well served with telephone lines. Forest Service telephone lines from towards St. Michaels up to mountains and by Fluted Rock; they come from St. Michaels to Steamboat, Chambers, Chin Lee, Ganado, Cornfields, Greasewood and reaching the area down past Greasewood. That roughly takes care of the location description of the area.

R. Walker: Any questions or discussions. I would like to, in regard to the boundary changes / you mentioned, are your figures that you list used in the discussion today - do they include the changes or not?

Bewley: Well we just took it for granted that they were the established boundaries because it was drawn on the small map; fluctuation we made would be along that.

R. Walker: Then there are no proposed boundary changes?

Bewley: No.

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R. Walker: If there are no other questions, we will hear from Bell in regard to the Sociological survey.

Bell: I might give a few words just why I happen to be doing all the talking for our group. Actually none of the reports we have presented are reports made by any one of us; everyone in the division help; some contributed more as in this case where Haske Noswood and Page did the most. We thought since everyone contributed, one person might present it. The total population is about 3600 with approximately 540 consumption groups. Happens to be about 700 lower than estimated before the studies were made. The population is divided in areas about as follows - if you can see the lines on this area the upper northeast corner of the area which includes what we call Kinlichee has a population of about 940 persons; in the Steamboat area in the northwest corner about 480 persons; in the southeastern and southwestern portions which include Klagetoh, Wide Ruins, and Pine Springs about 1130 and in the Ganado and Cornfields section about 620; and to the southwest of that in the general vicinity of Greasewood about 420. As I think Bewley mentioned there aren't very significant shifts out of the area; generally to slightly higher areas in winter from the farm locations. In summer most of the groups farming in these branches actually spread up. Slightly different situation from the Monument Valley district where stock were kept right around the farms. In this unit the average size consumption group is six which is one under what it was in the other two. Total incomes for this area include approximately $515,000 of which about 69% or $353,000 is commercial income and the remainder non-commercial income. As far as total income is concerned, 34% is from livestock; 34% from wages

The total income per capita in this area is $144 which is slightly under what it was in Monument Valley district. The total income excluding wages

per capita is about 95.00 which is very close to the other two districts $92 at Tsailee and $95 at the other. As far as commercial income, their principal source is wage work. $353,000 total with $176,000 coming from wage work in 1935, about 34% from livestock; about 13% from rugs and $7000 or 2% from agriculture. Very small amount from miscellaneous items. In terms of sheep units and acres, the figure we have on total livestock excluding horses is 60,000 sheep units. Total income from livestock about $120,000 which is about $2.00 per sheep unit. Separate figures for cattle and sheep and goats. On basis of our figures cattle figures $1.02 and sheep and goats $2.04 Dividing the total cultivated acres within the district, about $30 return per acres In terms of both commercial and non-commercial income; commercial consumption in this area totals $271,000 or $70,000 less than commercial income figures. We feel our figures are very accurate. About $70,000 spent outside the unit - probably in Gallup. This is quite a bit higher than Monument Valley. As far as the commercial consumption within the area is concerned, the division in various categories is very much the same. Food 60%; clothing 30%; Productive equipment 9%; and 4% household equipment. Of the food purchased at trading stores, again certain portions of it that could be raised within the area if there is agricultural land. This includes potatoes, melons, onions, corn, oats, and hay. Total amount spent at trading store for imports is not included, only actually imports $28,000 for raw agricultural products which, on the basis of the agronomist's estimates of yields, would take 530 acres to raise. Flour in this unit was about 640,000 pounds imported. On basis of 60 pounds to , 1,160,000 pounds or about 1600 acres. The amount spent for flour was $40,000. There is considerable import of blanket wool, generally from the mountain country. 2500 pounds during 1935 which is $570. Including flour, of all food purchased about 44% could be produced in the area if there were agricultural land. Actually only 1700

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acres potential in agricultural land which would not cover all those products and flour. That would take about 530 acres, leaving approximately 1170 for production if we raised wheat for flour. Don't know what the necessary stock adjustment is in this unit. Little difficulty to figure how many acres are necessary to replace that. On the basis of devoting some 530 acres to production of raw agricultural products now imported at $2.00 per sheep unit, 14,000 sheep units removed without change in income. We haven't at this time many accurate figures on distribution of farm ownership in the unit nor complete figures on distribution of livestock with in unit. On the basis of distribution in the Steamboat area which represent about 13% of the total population, we met about the same sort of distribution as in the other two land management units. About 50% owning one to one hundred; on the other hand, we have some 3% owning about 15% of the total livestock in the unit. This may or may not be representative of the unit as a whole. If there aren't any questions, I think that is all the material we can present at this time.

R. Walker: Any discussion? This $1.02 per sheep unit for cattle, would that include the ones that were consumed at home?

Bell: Yes, in this sense, we have questioned a very high proportion and on all those we have a total of zero cattle consumed at home. The number of sheep and goats is high but no cattle what-so-ever.

R. Walker: Isn't that lower than income from cattle on other districts?

Bell: Yes that is. We get that by dividing total trade of livestock figures. Subject to question. Our figures on sheep and goats are subject to that same question.

R. Walker: It would probably indicate in the way they are handling them, don't you

think so Heggie? That is, there is less of the cattle sold than of sheep and goats don't you think?

Heggie: I don't know.

McKinney: Cattle on this unit sold rather efficiently. They mostly belong to the large owners. Quite a number of old cows and ~~xxix~~ bulls, but they are sold pretty clean.

Bell: Are they sold inside or outside?

McKinney: Outside.

Bell: That will account for our small figure.

R. Walker: Any more discussion?

J. Woods: I don't know whether this is in place or not, but how do you account for the lower income per sheep unit in this district we generally think of as one of the better units from a range management standpoint?

Bell: I don't know. Maybe as to how they are handled.

McKinney: Some of the large owners sell their sheep off the Reservation and not to traders. May be a band or two coming in from the north that are not included in ~~xx~~ the dipping records.

Bell: In that case, the fact he might sell off the Reservation as long as

J. Woods: The mere fact that these larger flocks are not included in stock counts there you have no record of sale might make a discrepancy in the total income from the district. They ~~Xhxk~~ may be getting quite a bit higher unit income than the ones you have a count on. You have a lower income figure on sheep units than on some we don't figure as being good from range

management standpoint.

Bell: Even some of these smaller owners are selling outside to Gallup, Holbrook, and Chambers.

McKinney: Outside people get a permit to buy a few head and take them out at Chambers and Holbrook.

R. Walker: I guess that is all of that. Now have Range Management studies by Mr. McKinney?

McKinney: Bewley has outlined the size of the unit and somewhat of the vegetation. We have a vegetative map here showing the different types of vegetation. (McKinney gave a description of the vegetative map at this point) In the yellow pine belt in the eastern part of the unit we have yellow pine, deciduous oak, blue grama, mountain muhlenbergia and pinon. We have the pinon juniper in the central part of unit. We haveblue grama and big sage as the principal species with pingua in the upper part of the pinon juniper belt and galleta and snake weed and some yellow brush. In the southwest portion in the grass land, the grasses - especially sacaton and galleta, snake weed and chamise in the upper Chin Lee valley. Blue grama, galleta, and snake weed in grass lan in southeast. Blue grama, snake weed, threeons and some chamise in some of the smaller drainages. The depletion map here with red showing the poorest type; blue medium and yellow good. Red includes land with forage factors from .01 to .09. The blue representing a forage factor of from 10 to 19 and 25. The yellow less than 14 acres per sheep ~~xxxx~~ or a forage factor of 20. The area showing the grazing depletion are in the Painted Desert Region in the southwest portion section of the unit around concentration of agricultural area and in northeast corner of unit. The red is there because of yellow pine and deciduous oaks

probably more from severe overgrazing at present than in past. 1936 dipping records for this unit are not complete. Steamboat has not the dipping records so far so the 1935 dipping records were used. From these, 53,949 grown sheep; 3,100 horses or 15,500 sheep units in horses, giving us a total of 73, . According to those records it is feasible to increase stocking in this unit as it has a carrying capacity of 75,341. From one source, the following information came from a man who should know livestock on this unit especially at vats. He said sheep are not coming in to be dipped; came in better last year than this year. One large owner who lives at Tsailee and Crystol - don't know how many sheep - moves into the southwest portion of the unit. Those have not been counted. One dipping vat which is not in our records in the extreme south portion of the unit. Also, I believe that the cattle and horse numbers are low. There are more horses and cattle than show up in the dipping records. 3,100 head of horses and 540 consumption groups. 5 head per consumption group would be 2,500 head of horses. 1936 dipping records excluding Greasewood gave 1,671 head of horses.Cattle are scattered all over the unit but more concentrated in the southwest portion of the unit. From my estimates, I believe this unit is 20% overstocked and 20% over utilized the past year. We have poisonous plants in many species but pingua in the yellow pine portion and upper portion of juniper pinon probably is the most abundant plant on unit has caused heavy losses from sheep - especially in the spring. Probably could be eliminated by not grazing the yellow pine too early. Probably causing the most loss is whorled milkweed. Abundant in Kinlichee, growing in many of the arroyos and fields and hay fields to the extent it is very damaging. There is some possibility in eradication of this in that area. In smaller concentrated areas to prevent further spreading. Also appears along LaRue wash around Wide Ruins. I think eradication will be well worthwhile in those concentrated areas. Also along

Steamboat drainage and Pueblo - Colorado wash. What can be done in the form of cradication will be up to someone else to say. It is also in vicinity of temporary lakes on the Sunrise area in small concentrations. In all other except Kinlichee drainage, they are able to herd around it and not suffer any great losses. This unit has been divided into six sub-units and these are laid out as near as could be determined on use and topography. One is Kinlichee in the northeast corner. (2) Ganado - central portion. (3) Steamboat sub-unit in the northwest. (4) Greasewood subunit. (5) In southwest corner of unit an area 210,348 surface acres practically controlled by Chee Dodge and Ring brothers. (6) Pine springs in the south east corner of the unit. The livestock concentration is as outlined by Bell. Certain times of the year the livestock are the most concentrated at farm areas; in summer top of Defiance Mesa through up Kinlichee valley and to grass lands in the southeast portion of the unit and west portion of the unit. One has an acreage of 134,000 surface acres; 8,000 sheep units year long is the carrying capacity. Lower portion of subunit one is somewhat broken and eroded with gullies and the whole subunit is easily accessible to livestock. Has been divided into summer and winter range. Divided practically the way it is used at the present time, the lower edge of the yellow pine being the boundary of the summer range. Yellow pine is strictly summer range. Grazing good on yellow pine. Probably is the best yellow pine in the unit. We arrived at an average date of what we might call range readiness of July 15th. The carrying capacity of from July 15 to September first. Winter range is five months from November first to July 15 It will be necessary to set up in this particular subunit for we have no place to move them for range. We are hoping that by July 15 it will be ready for grazing but this year it was not ready until after the tenth of August. With that set-up, we have room for 7,890 sheep units for $3\frac{1}{2}$ months on summer range and will come out of subunit two for $3\frac{1}{2}$ months. On sub-uni

one, I recommend a change in class of livestock which would be a shift from sheep to cattle. Sheep do not use yellow pine in that sub-unit to the best advantage. There are a lot of coarse grasses and the sheep wade through grass almost up to their backs and pick out yellow pine seedlings and take leaves doing damage to reproduction. Also recommend reducing the carrying capacity or stocking of sub-unit one 25% below the present carrying capacity for watershed protection. At Ganado lake we have two diversion dams. That would mean approximately 2,000 head sheep removed from sub-unit one year long which would make a cost to the Indian from three to five thousand dollars per year for watershed protection. It is the opinion of the study group that it would be worth that. How to take care of that decrease no one knows. That decrease would only be for a period of five years and we hope that in that time they could raise the stocking to the present estimated carrying capacity and still have watershed protection. Also possibility of development of wildlife on that watershed if we do reduce stock. Also shift from sheep to cattle would eliminate poisoning from pingua and lupine. Most poisonous in spring and when seed pods form. Sheep are most affected. Pingua effects sheep more than cattle but would probably decrease losses from poisonous plants if the shift were made. The vegetation of that sub-unit is for the most part pinon and juniper. On the east part of the sub-unit is strictly summer range with an area of 24,790 surface acres. In the extreme north end of the sub-unit upper Chin Lee valley have

Classifying upper Chin Lee valley as summer range as it is used that way today and is best used for that country. Sub-unit two. Carrying capacity of sub-unit two is estimated at yellow pine summer range 11,943; summer range 22,526 sheep units year long; 7,984 on up Chin Lee valley range. What few livestock can not be taken care of in sub-unit one can be taken

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care of in the summer range of sub-unit five where we have more summer range than winter range according to that basis of use. Sub-unit three in the northwest corner has 122,787 surface acres; 8,824 sheep year long. The northeast part could be grazed as year-long range. In sub-unit three the winter range is largely pinon juniper and summer range the upper portion northeast portion or upper Chin Lee valley. Summer - winter range ~~xxx~~ 10,500. Surplus sheep on winter range over there above summer range can take care of can be moved into four and possibly into five the longest shift from any summer to winter range. Sub-unit four or Greasewood sub-unit has an area of 206,596 surface acres. 14,941 sheep units year long. Winter range is pinon juniper part of the end is in the eastern portion. Winter range has an area of 93,242 surface acres and can handle 14,163 head for six months. 113,363 summer range. Probably one reason why the people in sub-unit one two three and four use that summer and winter range approximately as pictured - there is much fuel supply and an abundance of big sage in pinon. Also during the summer time an abundance of temporary water in the grass land in southern and southwest portion. Sub-unit five is practically controlled by Chee Dodge and Lynch Brothers. In the southeast portion to a small extent one or two owners in the vicinity of Greasewood. This area has also been divided into winter and summer range but probably does not conform to present use as nearly as other units. This part is known as the Chee Dodge winter range. Cattle are numerous in this summer range portion at the present time - also horses. This winter range includes the pinon and juniper has an area of 90,631 surface acres and can carry 10,700 head. 15,000 head on the summer range. Allowing then for some livestock to come off the winter range from units two and three to five. In six, the winter and summer ranges as here shown are approximately as used at the present time. Sumer range is the south

portion of six when they have water. The water there is temporary. It has a carrying capacity of 2,964 head. You might question why I have the summer range in all these units, why I should begin grazing that the first of May. That was to protect the woodland in the pinon juniper belt of this unit. If they could be moved by the first of May, it would be to the advantage of pinon juniper increasing seedlings and at the same time the summer ranges would be very nearly ready. Abundance of weeds. If they moved the first of May into those ranges they would be there approximately ten days before beginning to lamb. Those are just average times. The lower Defiance plateau has ~~21,97~~ 21,967 surface acres. In the east ~~portion~~ portion of sub-unit two and sub-unit six those sheep that move on to the yellow pine would have to ~~xxx~~ lamb on the winter range in those sub-units. I believe according to the foresters that the country is the best woodland country and has some reproduction and if reduced to the carrying capacity probably would not result in damage in those units. Mr. McCray will report all water developments. The water is fairly well distributed over the whole unit but more permanent water is needed in a few places for proper seasonal use and distribution of livestock. A shallow well at Tsailee wash; drilled well southwest of Satan Butte; a drilled well in the upper Chin Lee valley and development of a spring about six miles east of Klag-E-Toh demonstration area. There is some water there at the present time but it is undeveloped. Phillips will tell you about predatory animals. Coyotes do the most damage. Bear are very scarce. Prairie dogs are probably the most abundant of rodents and their control is necessary in some places. If we consider that this unit is 20% overstocked at the present time, there will have to be an adjustment and I recommend that the first adjustment takes place among the horses - culling the less servicable horses. Second, adjustment should take place among the sheep and goats; Third adjustment should be in the cattle that belong to the

larger owners and are sold rather efficiently. There is no large number of big steers but when they do adjust on cattle, the older and inferior type should be culled out first. This unit has a carrying capacity of 75,00 sheep units and would require 2,500 bucks. It was thought we would use buck pastures at first, but bucks should not be more than 500 in a herd in a pasture at the most. Should really be limited to 250 - 300 head that would be better. To get a pasture large enough to carry 500 bucks for 10 months would be so large that they would not move out to feed and ~~xxxxx~~ water enough to keep them in as good condition as they should. So, we have recommended that about six buck bands for this unit be made which is approximately one for each sub-unit. Sub-unit two and four have a larger carrying capacity than six or one. Possibly six would take care of that sub-unit. If in the future demonstration areas are to be no longer used as demonstration areas, there is a possibility of using them as buck pastures to take care of part of those bucks. Pastures have a large advantage over buck herds because if they are properly handled and watered they do better. Herding practices on this unit are somewhat the same as on the rest of the Reservation. They bed night after night at the same place and trail into water and out. They go up there and stay for a while to salt bush or chamise and are trailing back and forth quite a lot. However, they do sell quite a lot of salt in this unit to the Indians. Salt troughs are used in this dark yellow pine belt. In giving a brief summary I might say that over one million acres are easily accessibly; 75,321 sheep units is the carrying capacity. Dipping records have proved unsufficient source of information. On the unit, except Fort Defiance Mesa, we have winter or year long range. A shift from sheep to cattle on the top of the mountain is very desirable; also recommend shift from sheep to cattle in five because in what is mapped as summer range the ~~xx~~ grasses are coarse Cattle make more desirable utilization on that country than sheep can.

There are many small patches of grass too small for a band of sheep but excellent for ~~xxxx~~ two or three cattle. Eradication of whorled milkweed should be carried on to prevent further spread. With the development of three drilled wells, one shallow well, one tank on top of Ganado Mesa, one spring, we will probably come nearer to getting proper seasonal use and distribution. I believe that is all I have.

R. Walker: Any discussion of McKinney's presentation?

J. Woods: One question about using demonstration areas in the future for buck pasture. Klag-E-Toh wouldn't offer you much opportunity would it?

McKinney: Not much. It is ~~xxxx~~ laid out to take care of the horses that are farming those areas. Possibility of expanding it and using it as such. ~~Xxxxx~~ Steamboat is not desirable type of using for buck pasture because it would have to be fenced from predators and main highway. Ganado probably offers the best possibility.

R. Walker: You estimated that the whole unit was 20% overstocked. What about the sub-units as you have divided them - is that pretty evenly distributed?

McKinney: Pretty evenly. Lack of utilization from cattle but over-utilized from standpoint of sheep.

R. Walker: Do you have any estimate as to the amount of livestock loss from whorled milkweed?

McKinney: No. Just asked questions of traders and they said there was quite a loss in sub-unit one.

Deppa: I found about a dozen dead sheep in sub-unit five towards the top of the mountain.

McKinney: There is some whorled milkweed in small patches along there. There is a

very good possibility of eradication there so it wont spread.

Lovald: With the introduction of cattle in sub-unit one, would you recommend an additional 25% reduction there?

McKinney: Yes. That 20% is just an estimation on my part according to the records we are understocked.

R. Walker: What about your type of sheep in this district?

McKinney: For the most part very good. There are, however, among smaller owners sheep of very desirable qualities. Bucks at present in some cases are good but they are not taken care of properly. They are let run with the band and the only controlled breeding they have is the use of the docking of winter lambs not practiced in some cases. Many of them are docked longer than the ewe lambs and that is not so well. Probably unit 17 represents as good range land as on the Reservation.

R. Walker: Do you think culling would take care of a big part of overstocking?

McKinney: I think it would, yes. Just how many could be culled, I don't know. That is along with the horses and cattle.

R. Walker: Any more questions? We will hear from Mr. Deppa of the Forestry division.

Deppa: Two forest types occur in this unit - yellow pine over by the dotted line is occupying 100,000 acres in this portion. By the way, the yellow represents range, the blank areas are inaccessible or barren, with the exception of three demonstration areas; all other colors represent woodland. Due to our limited amount of time, we have to select certain objectives for this survey. Ability of forest habitat to produce tree growth as one phase and the other, the condition of stands as to utilization and general condition. I have attempted to show all information possible on these

maps. Some information is shown on data sheets which does not appear here. I classified all the forest land according to three site classifications. Site is merely the ability of stands to produce forest growth. Selected three. The poorest is classified as number three. This orange color scattered uniformly throughout the unit, except for the eastern portion, shows very good distribution of forest cover, very good distribution of forest cover more or less over the entire unit. The green is the first quality site and it occupies only the higher country in the east. This portion of yellow is first class and green portions first quality woodland. The mud color is the intermediate classification. This portion represents slightly less area. There should be patches of range scattered throughout. All of these areas are also classified as to the needs of the stand and utilization. Represented by the Hasher system. I selected three grades of utilization - A, B, and C. Have included on the map a number of factors in this determination because of necessity. They include cutting, grazing, insect and disease damage, fire, storm damage, density of stand and ~~xxxxx~~ age class representation. Have made those as I traveled through the stand as to value and giving them a classification of A, B, or C. These two elements are shown here in colors in Hashers. The acreage of it is rather interesting. The acreage which fell into these classifications, site classifications. 50% or one quarter of a million acres of them are in the poorest site classifications. That site classification is called three. 41% is second quality and 8% is of first quality. Most of our woodland stands are in the third quality site. That means that they are mostly valuable for watershed protection. Generally the topography is rough; soil shallow and growth of trees quite poor. It is very subject to damage by cutting, for grazing, difficult to reproduce because of erosion. Stand conditions also show a preponderance in lower quality, although the poorest qualities represent 18%; intermediate

66% and the satisfactory utilization 12%. In general, continuing the same matter, the forest conditions are probably generally decadent or poor; partly because of site and abuse. Grazing has been more damaging than cutting. In the Kinlichee drainage right in here, there is very extreme depletion. Has been due to the practices in the past and although there is a very good quality stand normally, at present it represents the very worst in extreme depletion - both from cutting and grazing. On these stands we have over-cutting in spots throughout. Throughout all stands, reproduction is quite absent. There is one exception, through the higher portions of woodland stands where sage is predominant, range cover, I find there large areas, probably several areas of range which is being converted to pinon juniper. That is very interesting. These stands of sage support large numbers of pinon seedlings and young trees which in the course of ten to twenty-five years will develop to
A certain amount of overgrazing leads to this condition. It is not necessary that they should be converted to woodland because of original areas of handling woodland. McKinney pointed out in his grazing units how it would tend to re-establish yellow pine and woodland reproduction. We could see if these recommendations will result in re-establishment - we think they should. July 15th in the yellow pine stands and May 15th in the woodland stands but we don't know whether that will be entirely satisfactor or not. Especially the Kinlichee watershed where 25% reduction was recommended in addition to the general reduction for a five year period. We hope that will result in improvement of prosperous cover. We are not likely to have much appreciable influence on the return of forest cover in that length of time. That watershed condition is leading to severe erosion as continuous woodland stand will be practically wiped out. I wish to add my approval to bringing about better conditions there. There is a possibility that should be considered as a deer range as will be

BROUGHT out by the Biology division. It will be desirable from a forest point of view and watershed protection to have a band of deer in substistutiôn for heavy sheep grazing. As pointed out, many of the present woodland stands are actually passing out of the picture as woodland stands because of lack of reproduction. That is more true in the yellow pine. In this 100,000 acres of yellow pine, only 20,000 in the extreme northwest eastern corner is being reproduced anywhere near satisfactorily. There is a small amount where reproduction is present but is not always sufficient. But in the remainding 80,000 acres through here, reproduction is actually entirely absent. You can drive through it all day long and you can't find one good seedling. This stand of yellow pine does have great possibility if as timber stand and all values that go with a timber stand. In general the site quality is sufficient to raise good quality trees but because of overgrazing the stand is now very decadent and full of disease - especially heart rots and the trees are quite generally over decadent. There is a smaller age classes which would make it feasible to carry on a timber operation if we had the reproduction class. McKinney brought out the necessity of a change from sheep and goats to cattle from a range point of view and I wish to do so from a forestry point of view. We lo have a problem there. These seedlings are probably forty years old and have been browsed all that time and are past the point of recovery. They never could amount to anything mainly in the northeastern corner. This is typical. I also found this oak browse good sheep and goat feed, especially goat - near this yellow pine indicating the type of animals. The animals are going through this grazing and hunting up these pine seedlings which explains why we don't have any reproduction in there, they are not the only cause but probably the determining factor. If grazing control is secured, sufficient to lead to reproduction, the next step needed is for these stands is sanitation salvage cutting which would proba

necessitate enough of an economic cut to make the project feasible. By this method we can bring about better stand conditions so far as disease and insect and general quality of the stand goes. Just conservatively estimating for what it may be worth - there are probably two hundred to two hundred fifty million board feet of timber that can be cut to benefit of the forest when we can secure the proper grazing and certain other things. If this improvement in condition can not be obtained no doubt the stand will pass out of the picture as a forest asset. The pine wont become extinct but will get decadent until it will be economically unfeasible to cut. In relation to the class of stock and the damage which sheep and goats do to pine and wrong class of stock in this area would lead me to ~~xxxxxx~~ recommend water developments, here, should not be considered until we have a class of stock that can utilize the forage that grows there Fire damage is prevalent ~~xx~~ all over the pine country. No place without finding evidence of fire. Probably caused by lightning as well as camp fires. Probably carried also by grass cover which is there. It has been very destructive of seedlings and small age classes. also noticed damage to mature trees by scars on logs. There is a certain amount of pealing done by the Indians which also leads to disease infection and also accentuates fire damage. Further loss of lightning scars and trees shattered this past year. Especially the spike top condition in many trees because fire burns more rapidly in this type of trees. The fire in the woodland stands is of different character. Instead of being carried by ground cover it is more likely to be caused by individual trees being fired by sheep herders who need a camp fire. That is very prevalent in all of the woodland stands. I want to point out we have both ~~xxxxxxxx~~ insect and disease problems. The most destructive insect is one of the common species of barl beetle, including dentroctenous. In some cases practically all the trees are killed progressively in all the trees. Right now their presence is

is very noticeable. Secondary insects are also present. The disease includes mainly heart rots - especially important in the yellow pine and in the juniper more intensive studies are needed in both these fields with recommendations for control - probably of a silvicultural nature. They can be controlled efficiently and satisfactorily by that means. Rodent damage I mention because it is important in all stands but possibly more important in the yellow pine because chipmunks, mice, rats, and squirrels and the pinon jay do take their toll. Especially in the yellow pine stands The first two years of seed and second two years of seedlings have to withstand attacks of rodents. Rox Rodents can get a large percent. In this connection, small predators would be helpful. They would help to control these rodents materially. Very interesting situation in LaRue canyon area about four miles south of the present Cross Canyon store there is first quality woodland site. Here a storm August first 1931 moving across this area from the southeast direction and it has completely wiped out about 3,000 acres of woodland. In the central portions the average tree is dead and on the outer margin mose of the trees are dead and partially killed and bit limbs off and tore bark off. That was a first quality site. Soil and moisture conditions quite favorable, quite a good ground cover of grass and we have very surprising as it may seem erosion conditions are not much accelerated above normal. Secondary diseases and insects are present and rapidly rotting trees out so that many of them are falling down. I would not recommend any attempt at artificial work in there in the way of check-damming or utilization of this material. It is very full of rot and would not be durable and the erosion conditions do not warrant any other work. Also the standing trees are important now in wind damage. I want to mention a condition which exists in the east central portion of the yellow pine belt because it indicates how forestry and range management can work together as we have to in devising the best use of the area. Can't recom-

mend such a change but there is a possibility that this area has a very high forage factor. One of the very best grazing areas in the unit - especially summer range. In the woodland, yellow pine transition is characterized by the ground cover of blue grama oak browse, pinon, and yellow pine trees scattered throughout. The area is badly needed for early summer range prior to July 15th. I don't believe the area is especially adapted to commercial production of timber. We might recommend a season of use for grazing which would tend to eliminate yellow pine and improve grazing values in this area. That would need careful consideration and all factors would need to be studied. This other map is the comparison of the three colors. (Deppa gave a brief description of the map but it was not such that anything could be gained from it from the notes). This map indicates areas where future products can be obtained with no damage to the stand. There are three colors on here - orange, blue and green which indicate three general utilization possibilities. The red areas are mainly of value for watershed protection function. They are quite generally scattered over the entire unit and take a large percentage of the area under this classification. No cutting of green materials can be carried on in this area. Dead material for fuel wood or posts could be removed. I have forgotten the exact acreage in these areas. One quarter million acres of the forest type, woodland type rather, are classified as watershed protection. At the other end of the scale of use are green areas which can stand full utilization of a sustained yield basis. Scattered mostly in the higher country and one large area in yellow can stand practically full utilization of annual increment. The blue areas are the ones from which most of the future needs of the people come from. Restricted use. Certain amount of materials can be removed from these places. Quite generally accessible to all the regions. In the

northwest and central portions there are quite large areas in the eastern portion. The residents of the western will have to move east to get any larger products and they will have to come from the eastern portions of the unit. Much of the restricted use falls in the yellow ~~xxxx~~classification and represents mainly a commercial possibility. That is, some hogan poles and house logs, but most of it will be of larger sizes. These three classifications were derived from this other map. Planting for forest purposes will be taken up by the planting committee report. This map showing large areas indicates there might be a possibility for planting to supplement the material which grows slowly. Such planting would be along the line of poles and posts with a dual value of a wind break. I believe that concludes what I have to say.

R. Walker: Any questions or discussion on the forestry situation?

Lovald: Will a portion of that material in that unit be available to other areas without it but near-by?

Deppa: With proper utilization ~~xx~~ there would be material to move to other districts. There are certain districts which do not have any green material but the eastern portion has quite a large supply. Especially if pine timber could be utilized.

R. Walker: I think this would be a good place to call a rest for about five minutes. The club asked that we come over around 12:30 for lunch.

5 minute recess.

R. Walker: Let's get down to business again. Now have the biology by Mr. Phillips as the next presentation.

Phillips: This is a biology map and I don't know whether all of you can see it or not. The first thing to take up from viewpoint of welfare of the

land is prairie dogs. I have tables here for each of these as designated on the map. The yellow means prairie dogs predominance. The highest concentration is just west of Greasewood where they run 16 dens por acre. Another type heavily infested in here southwest of Klag-EeToh where they run about 15 dens an acre. Type west of Greasewood runs 10 dens an acre. I would like to ellaborate on this type in certain localized areas. They are so concentrated the insects and smell are very obnoxious. Internal pressure probably caused these animals to boil over into areas otherwise never occupied by them. Pushed up there by so much internal pressure. Naturally, the pressure on vegetation in such places is very great. It is my sincere opinion that no amount of livestock adjustments would bring back the range unless you have prairie dog eradication. Type P-53 east of the Steamboat demonstration area in the northern part of the unit is also heavily infested. Past rodent control operations in this country is a little bit vague and we had no way to get definite information on that. They have been carried on at Steamboat and Ganado Demonstration areas. South of Steamboat and west to the unit boundary extending down to four or five miles south of the woodland area. It didn't do much good because the entire district is infested with prairie dogs and they came right back in again and caused terrific internal pressure. At the present time there is a rodent control crew around here. Begins about the same place the control discontinued and went on west. This area up here which has been treated is infested about 10 dens per acres. I have at hand a few figures which might interest you. They were first calculated by McKinney on the basis of the numbers of prairie dogs in this locality. He takes for granted there are a million prairie dogs and figures on the basis of 25 dogs per sheep which is a very conservative estimate. That would give 40,000 sheep units; then 2½

forage acres per sheep unit gives approximately 100,000 forage acres being utilized by prairie dogs. According to the agronomist's figures the average forage acre is worth $7.50 and that makes $750,000 being paid out for prairie dogs. I went ahead and figured more and there are about one and one-half million prairie dogs in the unit which utilize the equivalent of 100,000 sheep units which is 4% more than the livestock are utilizing in this unit. From the 15 prairie dogs equal one sheep unit which is the accepted ratio by the Biological survey and given to me by Mr. Heggie about a year ago - 25 may be as good as 15 - but I think 25 is a little too conservative. Besides that, the dens figured 10 square feet to a den and that would make them occupy 3,500 acres which is twice as much as ~~xx~~ all the sheep corrals in the unit. Figuring $7.50 per forage acre, the investment that the people are making there to maintain a balance of nature is $1,875,000 which is over one dollar an acre. It would cost to get rid of 2/3 of them about $[illegible],000 to clean them out four good treatments and that is a very liberal estimate. And, if they are worth $750,000 you would have $700,000 profit. Kangaroo rats are not quite as bad. It is estimated that they utilize 37,000 sheep units which in forage acre value is $200,000 a year, but their damage is much more serious because they eat seeds and roots and things much more valuable than common forage which is utilized by sheep. This condition is very serious, making it practically impossible to farm. They dig up seeds and when they sprout they cut off the young plant. The worst infestation is along the Pueblo-Colorado where they run about 15 dens to an acre. Engineering structures are sometimes destroyed by these rodents. Kangaroo rat dens occupy 25,000 acres. That is about 40 times as much as occupied by sheep corrals. I don't think ~~xxxxxxxxxxxxxxxxxxxxxxxxxx~~ there is any doubt that rodent control is needed in this unit. Ground squirrels

are numerous and are similar in destruction to kangaroo rats. Rock squirrels are pretty bad along canyons and where farm timber gives them opportunity for denning they do important damage to farming areas. They utilize large quantities of yellow pine cones. Sometimes you could see under the trees where the ground is literally covered with parts of seeds of cones that these squirrels had taken apart and utilized. Sometimes they were dropped on the ground and interaction of chipmunks resulted in destroying of the scarce wood. Where you take two animals into consideration they are pretty serious. Chipmunks also inhabit the woodland area. Chipmunks eat large quantities of pinion and juniper seed. Pocket gophers and porcupines are not very serious. Rabbits are reported pretty serious in certain places. In some areas as many as 10 to the acre. There may be some need for rabbit drives. The Indians carry on some themselves which should be encouraged. Predators - coyotes are worst. They are doing moderate damage probably because of the close herding methods of the Indians. Some sort of provision should be made to permit loose herding which is recommended by good animal husbandry. Some think coyote-proof fences would be advisable. That would involve a large initial cost but would be best in the long run. The bear comes into this country once in a while and a sheep killing indivual can destroy a lot of sheep and some provision should be made to get rid of these sheep killing bear. Range insects include ants which probably do more damage than the prairie dog. Army worms appear, grasshoppers, etc. Forest pests ad Deppa mentioned, he gave most of the material on that. These focal points inhabited by dentroctenous beetle are very serious. No telling when it will get a chance and destroy the entire area. Western heart-rot is serious and a great deal of damage is a result of it. Pinon jays utilize large quantities of potential reproduction of pinon trees but

there is a practical problem of use we can't do anything about. As long as woodland reproduction is at a low eb[illegible] Parasites include grub in the head which is probably the result of their practice of bedding down nite after nite in the same place. I believe that is the contributing factor in this disease. They should not bed down more than three nites in the same place. I have some material on game. Every body of water has been evaluated as far as one can tell as to migratory waterfowl. Ganado lake is probably the most important on down to small intermittant tanks ~~in~~ which are not worth very much. Planting possibilities are listed with proper species. Upland game birds in connection with the Kinlichee watersheed which can be developed into a very good wildlife habitat. Turkey could be carried very easily with some improved conditions. I have a table listing open water and its value to wildlife. Have two species of quail which originally inhabited this country. Gambble quail from the lower left to the upper right country we have scale quail. Desilting plots offer good places for resting. As far as deer are concerned, I wont make any definite statement because if this watershed is cut in carrying capacit for five years only, it is pretty hard to tell. However, if you put cattle in there, there will be less competition than if sheep were there. Cattle utilize grass and browse and deer wont injure vegetatior as much as sheep. If the conditions at Ganado were improved it could be made to produce large quantity of game fish such as bass. Prairie dog control is recommended in these areas indicated. It comes to a little over 300,000 acres which would cost about $30,000 for rodent control around planting operations and earth structures. General rodent control of farming area, would cost 11,250 dollars and maybe some forest salvage cuts to protect against spread of diseases and cut worm and grasshopper control is needed.

Heggie: On that $7.50 per forage acre - $7.50 is the value of the land producing that forage acre. The increment you made off that would be 38¢ off that forage acre.

Phillips: That $7.50 would be your original investment wouldn't it?

Heggie: Yes, but your increment each year is 38¢ on that.

Phillips: They said $2.00 per sheep unit.

Heggie: That is gross income.

Phillips: With $2.00 per sheep unit that is $200,000. It is pretty likely there would be a lot more forage acres if there weren't so many prairie dogs. They use metabolic water which is derived from carbohydrates. The original investment for each forage acre is worth $7.50. With prairie dogs exterminated you can carry twice as many sheep there for the same range utilization.

R. Walker: If there is no more discussion of the biological phase, we will take up erosion by Kennedy.

Kennedy: The erosion survey was completed on 941,000 acres in this unit. Approximately 205,000 acres in the southwest corner of the unit are unsurveyed. Erosion condition as a whole over the unit is slight to moderate wind erosion; slight gully erosion which is less than 3 gullies to the acre. Geologic erosion occurs along the mesa escarpment, Ganado mesa, Twin mesas, deep narrow canyon designated as the Defiance plateau northeast portion is rough broken land. At the foot of Defiance plateau near ~~Kinn~~ Klag-E-Toh and the Paint ed Desert formation and some shale there represented throughout the unit. Slight sheet erosion and occasional gullies indicated by the light green area

on the map. Defiance plateau is of this erosion class. Soil is shallow but has good grass and forest cover. Gullies are all shallow but cut down to the parent material. The area south of the Pueblo Colorado wash has a deeper soil and erosion is slight gullies, although not numerous they are much deeper than on the plateau. Large areas of slight sheet and gully erosion occurs north of Satan Buttes and extends along the foot of the wash. Along Steamboat wash, gullies are narrow and deep and cut back to the steep hills along the side of the wash. Large area also occurs in the Chin Lee valley and extends south to Ganado wash. Small xxx portions also occur in the northeast corner of the unit. Slight sheet erosion and frequent gullying is presented by the dark green areas on the map. Deep canyons occur in the northeast portion of the unit here. One main gully extends the length of the valley and lateral gullies cut back to steep hills on both sides. Three small areas occur also in the Chin Lee valley. Moderate sheet erosion and occasional gullying is represented by the yellow. The main portions being located in the central portion south of the Pueblo wash and southeast portion of the unit at the foot of Balkai Mesa and some in the Chin Lee valley. This erosional class generally occupies slight rolling to low hilly topography. The vegetative cover is sparse in many of these areas and on the steep slopes the soil washing becomes very prominant when the vegetative cover is removed. Areas of moderate sheet erosion and frequent gullying is represented by brown on the map and they occur in the northwest, north central and west central portions of the unit. More generally occuring along the east side of the Wash and on the east side of Balkai Mesa and at the foot of Ganado Mesa. In these places then at the foot of Ganado and Balkai mesas, soil is of a heavy clay and very erosive, extending bakk to the mesa escarpment. Severe sheet erosion and moderate gullying may

be seen as represented by the dark brown on the map. That occupies only small portion of the area, being mainly on the low hilly topography - although some occurs on fairly steep mesa escarpments. Some of this is found on the mesa escarpment immediately south of the Pueblo Colorado wash and extends almost to Cornfields. Small portions are found in small drainage areas emptying into areas near Sunrise. Areas also occur west of Steamboat wash and small areas approximately seven miles southwest of Klag-E-Toh. Some at the foot of the mesa and some in the extreme southwest portion of the area; also some in the Kinlichee drainage. Much of this erosion is because the vegetative cover is almost entirely lacking, although there is some sparse woodland and sheep trails are numerous and further help to accelerate the erosion conditions. Wind erosion occurs mainly along the Pueblo Colorado wash a few miles south of Ganado on down past the Greasewood farming area. Wind sweeps sand out of the wash and deposits it in small hummocks along the sides of the wash. An area of slight to moderate wind accumulation is just north of Satan Butte. Slight wind accumulation also occurs in Wide Ruin valley and on the proposed extension at Ganado Irrigation project. One third of this area is affected by slight wind accumulations. Wild flooding practices on the Ganado Irrigation Project have caused moderate to severe sheet erosion. Water is left to run un-controlled down the slopes to the Pueblo Colorado wash. Numerous gullies making their appearance on agricultural land. Trails along main roads in the area from gullies in many places, causing considerable damage to roads. The Kinlichee drainage area is affected as a whole by moderate to severe sheet erosion; steep canyons and gullies. Large portions of this area is from Chin Lee shales and are very [illegible] Overgrazing is prevelant in portions of this area. It is recommended that wind erosion along the Ganado or Pueblo

Colorado wash affecting farming areas being controlled. Main areas arou Greasewood and portions of Corn Fields. Also the farming areas just nor.h of Satan Butte; portions of Wide Ruin Valley. Also suggested that if possible wind breaks be established along the Pueblo Colorado wash in order to prevent more wind accumulations. Also suggested that better control measures be established on the Ganado Irrigation Project to prevent further ruining of agricultural land in this vicinity and that small drainage area immediately above the farms should have g'lly control. Erosior work should be done on them to protect the main ditch and the land below it. It is suggested that, if feasible, to make drains of all main roads on contours as small hand made dams have proved very ineffective in doing this. Old Indian trails throughout the uni have caused much gully erosion and should be controlled. Proper range management practices will tend to stabilize much of the severe and moderate sheet eroded areas. It is recommended that as much from an erosio standpoint ~~as possible~~ that as much livestock as possible be excluded from the Kinlichee drainage area in order to allow this land to come back. That is all I have to say.

R. Walker: I wonder if you would explain what you mean by moderate and severe erosion.

Kennedy: By slight or occasional gully erosion means less than three gullies per acre; moderate sheet erosion means twenty-five to seventy-five percent of the top soil has been removed; frequent gullies being more than three per acre; severe sheet erosion means most all of the top soil has been removed and water eroded away part of the sub-soil. I have no areas mapped as totally destroyed by erosion. There is one area approximately 2½ miles northwest of Ganado where the soils are derived from Chin Lee formation and the gullies there are very severe

in this area. On the legend, the depth of the gullies are explained by a circle which means that the gullies have cut down to contact the parent material.

Bewley: Gullies means gully cutting through a deep friable parent material and will cut on deeper. Gullies without further symbols mean that the gullies are just shallow and have not caused much damage as yet. Here is a picture of one old Indian trail with gullies forming up both sides of the road. Several cases like this throughout the area, although most cases the gullies ~~in~~ are not that deep as yet.

R. Walker: Any more questions?

J. Woods: I wonder to what depth you consider the surface soil in calculating the percent of surface soil.

Kennedy: The soils of the unit have been mapped in soil series and the top soil varies with different soil series. On the uplands, top soil generally is 6 to 8" and the way it is determined is to find an area where erosion conditions have not set in and notice how deep the top soil is and make that as an example for the rest of the area.

Bewley: As a general rule, soil with this type climate has a top soil of five to six inches. We try to find native areas and judge the others accordingly.

R. Walker: This might be a good place to stop for lunch. Try to get back around 1:30 if we get you fellows fed by that time.

Lunch.

R. Walker: Does anybody have anything they want to bring up before we get started? If not, Mr. Bewley will lead the discussion on soils.

Bewley: The soils in unit 17 will fall into five major classes. The stony,

and hilly soils are on the Defiance plateau and the west escarpment the the plateau and Balkai Mesa. The valley fill soils, which occupy the greatest part of the area; recent alluvial soils and residual soils from shales; and (5) rough broken land and stony soils. Stony and hilly soils on the Defiance plateau because of rather uniform texture which varies from heavy fine sandy loam through loam to light clay loam have been mapped as undifferentiating loams, light clay loams, and heavy fine sandy loams. These soils mapped as stony and hilly soils of the plateau region are shallow and in general the soil cover is very seldom over eight or ten inches deep; although in a few of the canyons the soil washed in and is being farmed. These soils are also moderate to slightly acid on the surface due to the leaching and nature of the forest cover. Forest cover is acid, and together makes the soils slightly acid to moderate with a calcareous sub-soil. The valley fill soils occupy the greatest part of the area and are in between the hilly and stony soils and recent alluvial soils which are found in the valleys. The valley fill soils are derived from parent materials such as sandstone and shales which have been either washed in or on slopes of the hills. Topography is undulating to low hilly. Soil profile development has gone on further in the old valley fills than in any other soils in that unit. That is, more leaching and the horizons are easily differentiated. Recent alluvial soils are found principally in the Pueblo Colorado wash and the LaRue wash and at the mouths of the various and sundry canyons and in the old valley soils and hilly soils. Materials that make up these have been washed in from up above in the santstone regions and shales. The profiles of the recent alluvial soils in most cases is light textured with remnants of thin layers of clay throughout; although down below say from Cornfields on down to the Twin Mesas on the Pueblo Colorado

wash the soils are heavier because as the wash runs it drops its losses, its velocity and drop. the greatest part of its material from there Cornfields on up to Ganado as it mounts to Twin Mesas is just the final particles which are deposited as clay and are colloidal in soils. These soils are in most cases free from gravel. Not much gravel washes in. The residual soils are derived from shale and are located principally in the southwest part of the region in the Painted Desert area and there are one or two areas which are located about ten miles southeast of Ganado and another area by Fluted Rock. These soils are predominantly clay, heavy clays, and clay loams and have little value for grazing or any other agricultural purposes. Because of the characteristic swelling up and pealing off of the surface of these soils, sheet erosion is very severe on them. No water can penetrate them, it just runs off and carries with it any loose material and for that reason down in the Painted Desert Region you can see the bright colors of shale exposed. Rough broken and stony land is mapped along Twin Mesa and escarpments of Balkai Mesa and on the west hilly sides of the plateau, Defiance Plateau, and also down along the Mesa rims in this Painted Desert region. There are, however, areas scattered throughout the whole unit. The agricultural soils in the area of agricultural land in unit 17 is very small compared to the total areas. Potential and farming land in the unit amounts to .4 of 1% of the whole area. The soils in the unit that will produce agricultural crops under the present condition are the deep residual soils in the plateau and are located in the higher altitudes where dry farming id practiced and at the mouths of arroyos where we have alluvial fans and in the washes those soils are used for flood irrigation. In the vicinity of Ganado just south of Ganado demonstration area, extending about three or four

miles of areas approximately three or four hundred acres irrigated from water caught in the Ganado reservoir and about one hundred square miles. The best agricultural soils in the unit under the present conditions of farming are the fine sandy loam soils with a heavy loam or light clay loam sub-soil. This type of soil has an open and friable surface which permits rapid penetration of flood and rain water and the heavier sub-soil x holds the accumulated water and saves water for plant g use. Take sandy soils with moderate heavy sub-soils and they are usually free from alkali. These occuring more in the vicinity of Klag-E-Toh west of Pine Springs at the lower end of the Ganado Irrigation project and at the proposed extension of the Irrigation project where potential land has been mapped on the agronomy sheet. In the vicinity of Cornfields, Greasewood, and lower end of Staamboat wash and small area below LaRue wash just below Wide Ruin bridge, extensive areas of fine sandy loam varying up to eighteen inches in depth over a heavy impervious clay. This type of soil is well suited for agricultura if properly handled. Care must be taken in subjugating to prevent water leaking in the sub-soil. If not, alkali will accumulate and as a result soils will be ruined for agricultural purposes. Up in the sage House canyon which heads up by Fluted Rock and comes down by Ganado Irrigation reservoir, there is quite a canyon and the soil is a clay loam. Usually these ~~wx~~ are not recommended for agricultural development or farming but due to fragments of sandstone that have broken off and are included in these clays, these soils have an ~~xxxxx~~ open surface soil and the soil is heavy but these small fragments which continually disintegrate give the soil an open structure/ but it is still a clay loam. It has a high water-holding capacity and the depth of the top soil that is influenced by this disintegrated rock is eight to ten inches and this heavy sub-soil. You have poor

sub-soil drainage but the slope is about two or three percent. Some clay soils are fine, but we do not recommend that for farming. The two main areas of clay that are farmed are in the vicinity of Kinlichee where the Indian Irrigation Service has built a rock concrete drop dam and ditches but ~~iiiiiexha~~ the land hasn't been subjugated but the land is ready for flood irrigation and that in that vicinity there and the north end of the Ganado Irrigation project. The soil profile in these two regions is composed of heavy clay derived from Chin Lee formation. They have low water penetrating possibilities and the alkali concentrations usually are sufficient to condemn these lands. Chin Lee formation is an alkali formation. The low water penetration and alkali sufficient to condemn these for agricultural use. Generally the soils are free from harmful concentrations of black alkali. General survey of area and according to appearance, we found two or three areas that indicated a possible alkali area where the salts may be too highly concentrated for development but on examination we found the alkali wasn't very high. The samples examined were ~~xxx~~ in the vicinity of Greasewood and Corn Fields. Heavy soil and Steamboat wash south of the proposed area here at Wide Ruin in the LaRue Wash and several other areas that are scattered over the unit. In general the alkali concentrations in the surface foot was about .13 of 1%. That is negligivle in agricultural practices. The next layer, from 12 to 36", concentration was around .18 of 1%; that is getting into the slight accumulation group. From 36 to 72" the accumulation was of .32 of 1%. That is the general average of accumulation although in the surface foot accumulations would go as high as .18 and went a little higher in corresponding depths below. These areas are in the agricultural lands and present a problem if developed. However, there are other areas in the unit within the agricultural lands which presen

problems to the drainage engineer as well as the agronomist. These alkaline areas are usually in the Chin Lee formations and near or adjacent to the Chin Lee. The Chin Lee contains large quantities of alkaline salt. Three areas within the unit that have alkali too high they are the Kinlichee, upper end of Ganado Irrigation project, and the flats in the Steamboat demonstration area. Other areas indicate alkali at the present but are ~~xxxxxxxxxxx~~ in the Greasewood and Kinlichee area. If these areas that give indications of alkali but where the concentrations are not too high at present - if they should ever be ~~xxgj~~ subjugated, the alkali accumulations possibly would become too high. As a general rule, less than ~~x20~~ .2 of 1% is not harmful; from .2 to .3 is placed in the moderate ~~xxx~~ class; and over .4 of 1% is considered high and it is a safe general rule is that any land should not be farmed or considered for ~~agriculture~~ agricultural land. Black alkali is found in the area; especially in the vicinity of Kinlichee and north end of Ganado in those heavy cleys. Black alkali is more serious that white salts. Areas which show the presence of black alkali should ~~be~~ exclude them from any type of agriculture. Also from spreading water. Black and white alkali accumulations are ~~xxxxxxxxxxxxxxxxxxx~~ associated with poor drainage in the sub-soil. This is true for this unit. The area at Kinlichee that has been subjugated by the Indian Irrigation Service is very alkaline; especially on the northwest side of the wash that divides the project and on the southeast side of the wash, especially in the north there. The alkali accumulations run up as high as ~~x6%~~ .6 of 1% and that is too high for plants. There are spotted areas distributed over the whole area. I have some pictures I will show you in a minute. Because of the alkali condition and the heavy soil further subjugation is not recommended for the most part of the Kinlichee area

Then there is approximately forty or fifty acres in the Kinlichee district of fine sandy loam just north of the day school that can be subjugated and the water diverted by the present dam and ditch should be used only on that part of the area. Just wasted on clay and alkaline soils. Another thing that should be taken care of is the water that is left over after irrigation. In the past, excess water has been allowed to drain off the fields into the main wash in th valley and has resulted in severe sheet erosion and gullies being developed there. It is recommended that the water be used on that forty acres and a ditch should be constructed to take the water around the rock outcropping and brought back through the wash in the proper way. These pictures I have show some conditions of these black alk- ali and of the white alkali of the unit. That is the area that is farmed that is spotted with black alkali. Here is a slick spot caused by black alkali. On this side around that alfalfa is 12 to 18 inches high and here a little water came in due to a flood and has killed all the alfalfa that was there. Here is another that is characteristic of black alkali or high concentrations of white alkali shows the melting or sloughing away of soil. Seeps down through a crack and finds its way into canyon. Here you have pictures that show what I am trying to put over. These holes are just big holes some ten to twenty feet or more in diameter just sink down in the ground and there is a tunnel that leads to Kinlichee wash. They gradually become larger and work their way to the main canyon. This shows destroyed soil and gullying as a result. This other picture here shows where the Indian Service has again gone in and developed ridges there for flood irrigation and these pictures were taken a week before last when crops should be at their highest and there is not even good grazing for sheep and goat. Another

picture here shows the comparison of an alkali area . Here the soil was moist and the alkali concentrations were so high that it was leaving the plant and not even going in. So, from the results of the alkali and the things mentioned before, I do not recommend any further development in the Kinlichee district where the soils are heavy or in that part of the Ganado Irrigation project that is located in the Ganado demonstration area along the wash. Alkali in Wide Ruins would be low. The proposed area is not at present considered as alarming. The vicinity in which we propose work is relatively free from alkali. Soils are sandy on top of the clay and can be taken care of without any harmful effects. I do not know whether its ~~wkerk~~ worthwhile to pass these around but if any of you care to look at them and see the results of alkali they will be here.

R. Walker: Any questions on soils?

Bewley: I might say approximately half the area has been surveyed and classed as to the soil series and texture. Several series have been described and mapped according to profile development. Two-thirds or three-fourths of the Kinlichee area now farmed is affected by alkali.

R. Walker: If there is no more discussion on soils, we will have the Agronomy report by Mr. Nicholson.

Nicholson: 5,666 acres of agricultural land is scattered over 2/3 of this unit. There are no farms in the southwest corner. The elevation of this unit ranges from 5200 feet in the southwest corner to around 8000 feet in the northwest around Fluted Rock. The average rainfall is about 9½ inches. In the southwest it very gradually increases until it reaches ~~xxx~~ over 14 inches. The growing season varies from 120 to 140 days. There are two main drainages in this unit - the Pueblo-Colorado and LaRue washes. You will find concentrations of agricultural land along

these two drainages. The area of concentration are one in the vicinity of Satan Butte on the Steamboat wash in the vicinity of Greasewood and one in the vicinity of Corn Fields; old Ganado irrigation project and small concentration at Kinlichee and concentration at Wide Ruins. Small concentrations at various other points such as Pine Springs and in some of the valleys. Crops grown in this unit are mainly corn, alfalfa, oats, melons, and in xxxx one part some truck gardening. The Canado Irrigation project has agricultural land which is - Agricultural land is flood,irrigated, dry farmed, and irrigated. The irrigated land is that which has permanent water xx available. Flood irrigated depends on water from intermittent streams. Dry farms depend entirely upon the direct rainfall for their moisture. We have 3,100 acres of flood irrigated land; 341 acres of irrigated land; and 515 acres which are dry farmed. The potential land includes 1,130 acres of flood irrigated land; 500 acres of irrigated land; and 80 acres which can be dry farmed. The farms were numbered the same on this survey as was given xx on the agricultural survey conducted during the summer of 1935. Any new farms were given the next consecutive numbers. I wish to say that the cooperation of the different parties of the survey group was certainly appreciated in xxxx locating farms in this survey that were not located in the agricultural survey of 1935 Now I will take up the concentrated areas. Will try to xxxx take them up in order of the largest ones. The Ganado irrigation project in the only irrigation project and 341 acres depend on water from the Ganado lake. There is 115,200 acres drainage above the Ganado lake. Last year they had 1900 acres of water available for irrigation which was more than was necessary. The soil varies from heavy clay to a sand but the average is probably around a heavy sandy loam. The northern portion of the Ganado project upper portion which is in the demonstra-

tion area is very heavy and high in alkali. The lands adjacent to the wash are getting some very good yields in the upper portion. The crops grown are, I think, 160 acres of alfalfa; 341 acres corn is the next highest. There are some melons and beans planted, but corn and alfalfa are the main crops. Very serious problem at Ganado of irrigation. Their system is not very ellaborate and is resulting in serious erosion of soil along the main ditch, it is really not so bad but laterals are forming deep gullies. Also another problem and that is erosion in side drainages which extend up in the bad land country and during the flood period comes down and washes out the main ditches and cuts gullies and should have immediate attention. There are three areas very much alike. That is, one at Satan Butte, Greasewood and Cornfields. The area at Cornfields and Greasewood both depend on their flood water from the Pueblo Colorado wash and have to have points of diversion in these two areas and divert water onto their farms. It would probably be best to plan borders for this land with the slope so that the water will not deposit too much silt. The area at Satan Butte depends on its water from the Steamboat wash and the problems the are very similar to those previously mentioned. Small area at Kinliche has 75 acres actually being farmed there now. There are about 30 acres of what you might say the north side of the wash and 45 acres on the south side. On the north side you find the heavy soil and high concentrations of alkali. Probably the best idea would be to not subjugate any more land on the north side and the 45 acres on the south side can be subjugated and water diverted into that area. It probably would not be a good idea to divert all the water to the south there until those Indians move we will have to give them some water. Yields of crops in this area are below the average. The next area of importance is at Klag-E-Toh and with the demonstration area there has been pre-

viously surveyed. There are 279 acres farmed in this area. The soil is very well adapted to agriculture and the yields of the main crop, which is corn, is very high. Below Kinlighee area we have Wide Ruin area which is a problem at the present time to the ~~kkm~~ fellows in the survey group. Considerable potential land there and we have enough water that we must do something with it and still there is not sufficient to really go in there and do something. We decided after several days argument that we would have a survey made of this area and study it for a few years and know definitely what we have there. This small concentrated area at Pine Springs of individual fields are a problems and also on these small drainages in the valley leading from Fluted Rock and Ganado. There are no big projects that can be located in here. The crops grown over the unit are 77.6% corn; 6.5 oats; 1.7 beans; 6.9 alfalfa; 2.7% ~~mxkkm~~ melons; and .6% potatoes. This percent planted in melons may be slightly higher. Many places where there are a few hills but they are not large enough to put down but in the end may amount to quite a bit. The farms on Defiance plateau are well adapted to growin of small greens and vegetables. It is likely that potatoes could be planted in considerably larger quantities than at the present time and I think it would be a good idea to encourage planting of more potatoes in this part of the unit. The west half necessitates the growing of different kind of crops. Corn is well adapted to all except the area around Fluted Rock. In the lower part can be grown cane and they need some kind of roughage for livestock which was quite apparent in the spring. Many times they only plant two acres where if their horses were in better shape they would probably plant more acres and do a better job of farming throughout the growing season if their work stock was in better shape. The cost of subjugation of the farm land is $37,985 and for potential farm land $19,246. This does not include

the cost of subjugation of the land in the Ganado irrigation project which was estimated at close to $5,000 and this may be too low. The insect pests in the unit as a whole has been mentioned by Biology, cut worms, grasshoppers, and army worms. Cut worms are quite serious and I can only recommend plowing of farm land in the fall. Also another problem where they are growing alfalfa is the presence of whorled milkweed in the drainage area above the Ganado lake above Flutted Rock and you can find it ~~xkm~~ almost any place in very scattered areas on down the drainages and I don't know ~~xx~~ how practical control for whorled milkweed is, but something should be tried out. Erosion is quite serious at Ganado irrigation project and at Wide Ruins and along the Pueblo Colorado clear down until it goes out of the unit. Down below the Ganado irrigation project there is a problem of wind erosion also at Wide Ruins. This can partially be controlled by contour listing of the lighter soils. Also recommended that wind breaks be planted on these areas. Since the building of one equalizing dam and one diversion dam above the Ganado lake, the capacity of the Ganado lake has been increased considerably. Therefore, there has been 500 acres of irrigated land added below the present farm land of the Ganado project. This may be more than is needed for subjugation but that will depend on further study. This holds considerably more water than was necessary to irrigate the farm land in this project. By prope irrigation practices we also will have more water for this potential land. It might be that ~~xxx~~ this land is rather high in alkali contents and heavy soil can be left not farmed and those farmers moved on down to the potential area where water can be used more efficiently. In brief summary, there are 3,956 acres of farm land; 1,710 acres of potential farm land; cost of subjugating the farm land is $37,985; the cost of subjugating the potential farm land is $24,246. The main

crops grown are corn, alfalfa, oats and melons. The yield of proper farming practices and introducing of plants, yields can be increased 25 to 50%. I believe that is all.

R. Walker: Is this 1,720 acres of potential land in one large area or is it scattered in small tracts?

Nicholson: I suppose the major part is what might be called concentrated areas, while small scattered areas are found over the entire unit that is farmed.

R. Walker: Do you have this listed in order of priority? Recommended development?

Nicholson: Only to the extent that it is classed as A, B, and C farm land. Outside of that it is not listed by priority.

Question: Can wheat be raised in that area?

Nicholson: Wheat can be raised in that area and your main difficulty is getting the Indians to raise it. Sutton grass has been grown in the vicinity of Klag-E-Toh and the Indians who grew it have been asking for seed several times since.

Lovald: What would be the possibility of introducing white clover in some of those areas which are more or less alkali?

Nicholson: I think it would be a good idea. It is known that white clover will stand more alkali salts than a good many plants.

Lovald: That would also tend to break up the heavy textured soils and possibly be a means of reclaiming some of those soils.

Nicholson: Yes, with proper irrigation, etc.

Lovald: What sort of a root system does rye have?

Nicholson: Shallow.

J. Woods: Not so shallow but fibrous.

Nicholson: Rye is well known as about the hardiest of the smaller greens.

Lovald: What I have in mind ~~and~~ there evidently is a dam for the outlet of some of that water thas has been arranged for through the construction of a diversion and considering the investment that has been made laready. If we can economically subjugate that land we will save the investment that is already in there.

Nicholson: Thinking of Kinlichee?

Lovald: Yes.

Nicholosn: The area on the north side of the wash is pretty bad. Even that area on the south side there has some alkali problems that may be where we can use some plants that are more tolerant of salts.

Lovald: Parts of Ganado area might possibly be used that way.

Nicholson: There is a better possibility there.

J. Woods: We tried that last fall on some of that heavy soil and also resistance to alkali. Did you check on that?

Nicholson: Yes. That wheat made an average growth. I just saw the stalk there and didn't get any estimate on how big a yield they got.

J. Woods: Its possible, someone asked the question about wheat. It is possible that some of that heavier land where there is an abundance of water some of that heavier soil might be changed to wheat production.

Nicholson: Just one other statement. It was found that the ~~unit~~ yield of corn

in this project was just about the average of the whole unit. Adaptability of corn would make it more possible to grow ~~xxxxx~~ alfalfa than smaller greens.

R. Walker: Anybody have any more questions?

J. Woods: I assumed that this potential land recommended in the Ganado project was more suitable for agriculture than the main section of the land now being farmed.

Nicholson: That is true.

Bewley: It is better than that portion north of the Pueblo Colorado wash which is located in the demonstration area.

Nicholson: That land is on a uniform slope which will make it subjugate a lot nicer.

Bewley: There are a few gullies there in that area but engineering says it is both feasible and economical to subjugate.

J. Woods: Was a comparison made between the proposed extension ~~x~~ there and some additional land in the past proposed by other people as an extension to the Ganado project across the wash and west of Hubbell's store?

Bewley: If it is in there, I wouldn't recommend it.

Nicholson: There was no comparison in respect to alkali made.

Bewley: It will be in there because that Chin Lee formation in it the salts are high.

R. Walker. Next we have the report of E.C.W. by Mr. McCray.

McCray: The first part of this report will be on the water and developments

of all kinds that have been made in this district. I will list those as assets. Stock water - there are 70 reservoirs approximately, built by the Indians themselves; there are 46 reservoirs in this unit that have been constructed in the past three years by ECW; there are 19 springs developed by ECW and the Indian Irrigation Service; there are some 30 springs that have been visited that are undeveloped; there are 25 shallow wells developed by ECW and the Indian Irrigation Service; there are 36 undeveloped - that is, they are developed springs by the troughs
Indians themselves, no permanent ~~drops~~ at these wells; also 21 drilled wells in this district. The water survey was made by Mr. ~~McGuch~~ McKinn all I did was look over the maintenance work and the new construction. Mr. McKinney made all the rest of the surveys and I took his figures and I think they are probably as right as anybody's. If you will notice by the map, these circles on the map represent wate of one kind or another and there is a fair distribution over the entire district. In the southwest portion there is not much, many waters that we have shown there, those waters that are in here though are permanent and off of the district here there is also more water but we do not propose to do much development down in this southwestern corner at the present time because as far as the Navajo tribe is concerned, it wouldn't help them but very little. As McKinney pointed out, this entire range is owned and controlled by one man and if he wants more development, he has the money to put it in. As Bell mentioned, there are several roads through the district and adequate roads or trails as the case may be. ECW has constructed something like 100 miles of truck trails in this district. The biggest percent are in the timber and woodland district. They were built for fire protection mainly. There is a through trail connecting Greasewood and Klag-E-Toh which is for administrative purposes and there is a connection between here

rather than having to go around through Ganado to get to Greasewood. Telephone lines have been constructed to every day school on this unit. In this unit there is not a single day school that isn't connected by telephone lines and very few places you can't get to a telephone line in short order. For immediate work, there are 9 shallow wells that the Indians have developed that we wish to go ahead and develop them better and put in troughs so there will be better utilization; Mostly th. . are 4 up in this di.triot, 1 over in north of the Steamboat road, there is one shallow well to be put down in Tsailee, and a deep well east of Twin Mesas. We will also try to get a well there I am told it is possible to get a fairly shallow well about 140 feet east of the Tsailee Mesa. This water in this district here is all tempora. water and we need some permanent water there. The work that will be done in there was the maintenance work that will be done will be taken care of by the ~~Irrigation Service~~ Irrigation Service water department and their maintenance crew or one of their crews which has headquarters at Klag-E-Toh is there now. They will take care of all permanent water. Also in this district they will take care of reservoirs that are built that need maintenance of one kind or another. Roads or truck trails, both ECW and Roads department roads, need quite extensive erosion control work on the sides. The rains in the last month have shown the weaknesses and in several places the roads have gone out. As far as any new construction on roads by ECW - there will be none. ECW has gone out of the road business. I believe that is about the size of it. Unless you want more detail.

R. Walker: You have all of the maintenance work and proposed developments listed?

McCray: Yes.

Jonas: What about those truck trails that aren't finished?

McCray: They may be finished by someone else but not ECW. We have gone out of the road building business.

R. Walker: If that is all that discussion, we will have the Engineering by Mr. Moyes.

Moyes: The Pueblo Colorado or Ganado Wash is the largest in the unit, draining about one half of the area and has been given number one. It heads in the higher area of the Defiance Plateau around Fluted Rock. The numbrous branches are confined in deep narrow canyons which converge before reaching Ganado. Here the gully averages 200 feet wide with vertical banks ten to twenty feet high. The yearly expentancy is figured at 1200 acre feet. From Ganado to Greasewood, the tributaries are short with the exception of number 1.18 which enters from the east one mile southwest of Cornfields. Most of these tributaries fan before entering the wash and contribute little to it. Figuring a stream bed loss of 10% per mile and adding the flow of side drainages we get the annual expectancy at Greasewood to be 550 acre feet. These figures check closely with water marks on the banks and the statements of residents living along the wash. One mile below Greasewood the wash fans over an area about five miles long and one-fourth to one-half mile wide. Below here it enters a gully 30 to 50 feet wide and six to eight feet deep. It then runs to the southeast for about five miles where it leaves the unit. This is representative of the main drainages. Steamboat wash which heads above the Steamboat demonstration area and enters the Pueblo Colorado just inside the unit boundary has been numbered 1.1.

The Leroux or Wide Ruin wash drains about 9.4 of the unit. This drainage, given number 2, heads near the eastern boundary and leaves the unit near the southwest corner. Drainages 3 and 4 drain the small area of Padres Mesa. The upper part of the Chin Lee drainage has been designated as number 5 and is located between the Steamboat demonstration area and the south end of Beautiful valley. It is a wide valley sloping .5% to the south with a few places where there is a defined channel. The side drainages start on the steeper slopes, have cut gullies for a distance of two to six miles then fan before reaching the main valley. In calculating runoff factors, the following method was used. Ten points were selected upon representative drainages throughout the unit. The annual and maximum expectancies were calculated by measurements of the wash relying somewhat upon the word of residents as to the flow. The amount of runoff was obtained as near as possible and from the drainage area above the factors were worked out. These were then compared with the factors sent out as a guide and then factors were arrived at to use on drainage areas of like nature over the unit. It will be necessary to make a more detailed study than the time element allowed in this survey at the following locations: Ganado Irrigation project - present and proposed; Klag-E-Toh demonstration area; and a potential storage reservoir for irrigation two miles south of Wide Ruins. Provisions should be made for the protection and completion of the projects at Ganado and Klag-E-Toh before construction of proposed projects are started. Proposed jobs are numbered on the map in the following manner. Farms and water spreading areas are marked on the map and numbered from one up by quads. Such areas are numbered and cross hatched in the conventional manner. Areas for erosion control will be outlined by a dotted line and numbered E. C. No. 1 and up by quads. Other jobs as water con-

servation, equalizing reservoirs, etc., are called special and will be recorded on the map as S. No. 1 and up for each quad. Recommendation plans and estimates for work projects have been listed covering all of the above types and in all sections of the unit. There is one erosion measure which covers the entire unit with the exception of inaccessible mesas and bad lands. All roads, old and new, need "thank-you-mams" and drains. These are estimated at 1.5 miles of road per square mile of area over most of the unit. The following are some of the projects representative of the work planned on the unit. Estimates are available and will be included in the final report. First, we take Wash number two from the junction of wash 2.25 downstream to the unit boundary. At the upper end of this area a survey party is working on a detailed map for the purpose of making estimates and calculations on a proposed irrigation project. Tentative plans include a dike to deflect water to a desilting reservoir. A system of drains or weeps will lead the water from this to a storage reservoir. Directly below this storage the valley is suitable for farm land. About two miles below the project there is an area of actively cutting gully heads. These will get water from a small side drainage and also the excess flood water from the above project. At this point we plan diverting the water around the heads and use it for range irrigation. In the vicinity of Tanner Springs another gully is cutting back up the valley. Here it is planned to construct a dike across the drainage and to spill the flood water over a natural rock spillway. Below here there are no plans for the wash as it goes through bad lands of the Painted Desert type; however, two projects on side drainages are located here. One is a small drop structure to prevent head cutting which is endangering the road. The other is a small water spreading area of about 200 acres. Several projects are located along the drainage numbered 1.2.10 Job S

No. 1, Quad 54. This job is maintenance of an Indian stock tank at the suggestion of range management. It includes raising the dam and construction of a spillway. Capacity of the reservoir will be approximately 8 acre feet. Excess water will be spread over about five acres of range land. About a mile below this reservoir a gully head four feet deep and fifteen feet wide is cutting through the valley. The steep side slopes of 3% and over eliminate the possibility of spreading the water. This job E.C.#3 calls for a rock sausage drop with deflector dikes at each end. Job S#2 Quad 54 consists of the combination of an equalizing reservoir and gully control. It is located at the site of an old Indian Reservoir which has washed out. An actively cutting gully starts 50 feet below the dam site. Water stored in the reservoir will be available to twenty acres of potential farm land. Are there any questions?

J. Woods: Question about the expentancy of water at Ganado. This annual 1200 acre feet, is that assuming that is the total amount?

Moyes: Yes. I think I see what you are driving at. This section is below the diversion dam.

J. Woods: That is the watershed now supplying water to the Ganado lake you are calculating?

Bewley: We calculated Ganado below the dam.

Nicholson: Comes in below the storage dam.

Moyes: The annual expectancy of the Ganado diversion is 115,200 acres; factor of .018 which equals 4,171 acre feet; 1,030 acre feet at the diversion dam. Does that seem too low to you?

J. Woods: Yes, it is low, compared to the amount of water they have now and

and the amount they had last year.

Moyes: That was taken more or less north. This checks more or less with what the inhabitants expect that live on the wash.

Bewley: Berry was the engineer in charge but because of his appendicitis operation, Mr. Moyes came down and picked up what he could and got information from Berry and made this report.

Moyes: This matter of water runoff in this country is a question and I guess nobody knows much about it and I think places like that should be checked a lot more accurately than has been at the present time.

J. Woods: Do you know the amount that was stored at Ganado at the beginning of this year or at any time?

Moyes: No, but I think Berry had that as 2,400 acre feet. I am not sure.

J. Woods: If I remember correctly, Mr. Campbell of the Indian Irrigation Service told me that last year he had 1800 acre feet of water in the reservoir according to their calculations.

R. Walker: On these diversions of that type, what percentage of water can you collect for storage? In big storms a large part has to be by-passed doesn't it?

Moyes: Yes. The annual expectancy Berry has figured that on the area as usually as little water as can be expected.

R. Walker: That would be a minimum would it?

Moyes: Pretty close to it. As to how much you can take of that, I couldn't say. That is governed by the number of days runoff and the size of your ditch. With a desilting reservoir, you could probably get enough

water to fill it.

R. Walker: I have listed here next a report on planting possibilities by Mr. Nicholson.

Nicholson: As you have probably already observed by the report given by Range Management and Forestry, this unit is pretty well covered with vegetation at the present time. There are a few barren areas around the Painted Desert and I know of no recommendation for that type of soil. However, erosion control and planting for refuge of game has been considered. There is an area north of Kinlichee where erosion is serious and the runoff from that area will carry considerable silt to Ganado lake. It has been recommended that erosion control work be carried out there along with that the planting of some type of vegetation should be carried out. Erosion control work that will be carried out on both sides of the Ganado Irrigation project will also be made more efficient if grass is planted along those structures and some vegetation probably should be planted along the edge of the wash. Because every flood that comes down cuts away a portion of the agricultural land. Two areas in the vicinity of Cornfields - one area around the windmill where the stock are coming in to water has killed all the vegetation and serious erosion exists in that country. This should be fenced and most of that area at the present time is covered by Russian thistle and the planting ~~ax~~ of some grass in there might hasten up the forming of sod. Also an area close to Cornfields which should be fenced and recommended planting on that. I don't think that practical. The present vegetative cover consists of galleta, blue grama close to this ~~dune~~ dune and if it is fenced and stocked exclusively in order to hasten ~~it~~ it up. It may be practical to plant some of these native grasses over on the winded side

of the dune. Similar area near Greasewood where the dune may sometime in the future move down on the day school and this area should also be fenced and treated in a like manner. There is a necessity of wind break plantings in the Pueblo Colorado wash below the Ganado Irrigation project until it ~~gxix~~ goes out of the area and was recommending the planting of windbreaks in the valley of Satan Butte and down Wide Ruins wash as far as it is possible to plant due to the concentration of alkali in the soil. Planting of some type of vegetation for the improvement of wild game in those areas where stock is excluded is necessary. That is all of the planting.

R. Walker: ~~X~~ Do you have these proposed areas located on a map?

Nicholson: No, not at the present time.

Phillips: Present stock exclusion areas are on the biology map.

Nicholson: Another thing. It is thought best by the different parties of the survey group that all areas where planting is to be carried out should be fenced and total exclusion of livestock for a few years ~~x~~until it is far enough along to stand controlled grazing and probably the planting of windbreaks, it would be a good idea down in the southwest part of the area where there is no woodland to keep in mind that the growing ~~xxx~~ of posts, etc., for the consumption of the Indians would be a good thing to keep in mind.

R. Walker: This completes all of the reports for district 17. Is there any question or discussion anyone would like to bring up in regard to any part of the reports?

Phillips: Maybe everyone knows it, but at Steamboat they planted grass and got Russian thistle and that soil will produce russian thistle better than

grass. I think that should be considered in recommending grass to be planted on denuded areas.

R. Walker: In making your reports, I think the group should follow the outline as given by Mr. McGinnies in one of the earlier meetings. I think all of you were present and have a copy. I will only mention the four points. The completion of the reports by this group will make the completion of all the initial studies by each group. We have found some changes may be necessary. To begin with, we found it possible to standardize our methods to a certain extent and Mr. McGinnie met with the Branch chiefs recently and this has been gone into in detail and that probably will have their schedules for making surveys completed before you start on your next district and it will be taken up with you by your branch chiefs. They will advise you of any change. I assume you will be working in the Gallup office working up the final report and Mr. Maddox will be incharge of the stenographic help and if you will contact him, he will make whatever arrangements he can to assist you. I think there is room enough at the old post-office building for all of you to work. There is space that is not being used and if necessary we will make arrangements to give you more room. The final integrated report is due the 15th of September. That includes division reports too. If there is nothing else the meeting is adjourned.