The Catalina Recreational Area Highway

by

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FOREWORD

Interest in the Catalina Mountain Area apparently began in the days of the pioneers of this locality. Tradition seems to be the only source of information regarding the early knowledge and use of the mountains by the residents of Tucson.

There is one legend about the "Soldier Trail" that indicates that the trail was built for use of the soldiers in their campaigns against the indians who are said to have used the Catalina Mountains as a stronghold. This legend appears to be very doubtful. Indians probably did hunt in the Catalina Mountains, as these mountains must have sheltered more game than much of the surrounding territory. However, there is no sign of extensive occupancy of the mountains by indians, or of extensive skirmishes between indians and soldiers.

Another legend about the "Soldier Trail" indicates that the trail was built to bring timber from the mountains for use at Fort Lowell. A few pieces of broken logging chain along the trail at the present time substantiate this legend.

At the present time the "Soldier Trail" is deeply worn and shows extensive and long use, but does not appear to have been at any time more than a horse trail. Switchbacks are so sharp that it seems highly improbable that timber was ever brought down the trail.

Soldier Camp, near Mt. Lemmon, was used by the soldiers as a camp site. Early settlers in Tucson tell of soldiers off duty making frequent trips to the cool mountains to recuperate from the desert heat at Fort Lowell. It is probable that the soldiers used "Soldier Trail" in going to and from Soldier Camp, rather than some more precipitous route up Sabino Canyon or Bear Canyon.

For many years there has been a road from Oracle, up the north slope of the Catalina Mountains, to Soldier Camp and Summerhaven. This road was built by the Pima County and Pinal County Highway Departments in co-operation with the Forest Service. Though well maintained, this road is very tiresome to travel, as it is very winding with steep grades and is very narrow. It is many miles longer than it should be, as it is poorly located and crosses several washes and foothills with undesirable adverse grades, before the actual ascent is begun. Another objection to the present situation is the small recreation area available to the public. The only desirable recreation areas on the route are at Soldier Camp and Summerhaven. These are largely taken up by privately owned summer homes and there is very little chance of further developement of these areas.

Public use of all play grounds in the vicinity of Tucson has been rapidly increasing for many years. Growing public interest in the mountain areas caused the Forest Service to have a route to Mt. Lemmon surveyed by the U. S. Bureau of

Public Roads in 1916. Owners of cottages at Soldier Camp and Summerhaven showed more interest in the selection of the route than any one else, so the survey was made with the intention of locating the shortest possible route from Tucson to Soldier Camp. The survey was therefore made up Sabino Canyon and an estimate of the probable cost of construction prepared. Money to build the road was not available at that time and the project was apparently abandoned.

Continued demand for a road to make the Catalina Mountains more accessible and permit the opening of desirable areas for recreational uses again brought the subject to public attention in 1928. A bond issue of $500,000 to build the road up Sabino Canyon was submitted to the voters of Pima County at the General Election, November 6, 1928. The bond issue was defeated at that time for several reasons. It was believed that the road would cost more than the half million dollars of the proposed bond issue. Furthermore, the route traversed would not open much additional area to the use of the public so that few people would be benefitted other than those who already owned summer homes that could be reached by use of the road up the north side of the mountains. Another very reasonable objection to a bond issue to build a road over this route was that the road, while much shorter, would be as narrow and as tortuous as the road through Oracle and nearly as dangerous and tiresome to travel.

The proposed bond issue was again submitted to the voters

at the Primary Election, September 9, 1930. The issue was again defeated by a very large majority for the same reasons it was defeated in 1928.

A better highway into the mountains continued to be a desirable project. In June, 1931 the Pima County Highway Department started a reconnaissance survey to determine the feasibility of building a road up the south slope of the Catalina Mountains. The writer worked with the survey party from June, 1931 to December, 1931 to secure the notes and other data upon which the following discussion is based.

At a conference between representatives of the U. S. Forest Service and the U. S. Bureau of Public Roads at Flagstaff, Arizona, August 6, 1931, it was voted to appropriate funds for a reconnaissance survey of the Catalina Mountains to locate the route for a scenic highway through the mountains. After investigation by Engineers from the U. S. Bureau of Public Roads, the work of the Pima County survey was accepted and Pima County was later reimbursed for the entire cost of the reconnaissance.

The general location determined by this reconnaissance survey to be most feasible has been accepted by the Bureau of Public Roads and a location survey has been ordered. It is expected that construction of the road will be started as soon as the location survey is completed.

ATTRACTIONS OF THE AREA MADE ACCESSIBLE BY THE PROPOSED HIGHWAY

The route found to be most feasible follows the general course of the "Soldier Trail," entering the mountains through Soldier Canyon, which is approximately three miles east of Bear Canyon. From the mouth of Soldier Canyon the general direction of the route is northeast to the head of Bear Canyon, thence northwest along the south slope of the main ridge of the Catalina Mountains to Soldier Camp.

The survey was started at Soldier Camp since it is easier to take advantage of the terrain when working down grade. Stationing, therefore, starts at Soldier Camp and all distances are from this point.

The grade for the first two miles of the route is an adverse or plus grade of approximately six per cent. It follows the general course of Bear Wallow to the crest of the main ridge of the Catalinas, crossing at a low saddle. This saddle is the highest point over which the road will pass. The elevation is approximately 8280 feet above sea level.

The general direction of the first two miles is southeast. The alignment is winding, but the curves will not be sharp enough to make driving either dangerous or difficult.

Several low peaks within easy walking distance afford wide and varied views of the San Pedro Valley, and of the northern

slopes of the Catalinas. To the south the view includes all of the lower Catalinas, and the Rincon and Santa Rita Mountains in the distance, with more restricted views of the Rillito and Santa Cruz Valleys through notches in the lower mountains.

The student of Botany, or any lover of the woods and mountains will be interested in the variety of flowers, trees, and shrubs to be found at this altitude. Trees worth noting here include Pine and Fir on the hillsides, with Aspen, and Hard Maple in Bear Wallow.

In summer the days are mostly cool but sunny with occasional showers, while the nights are sometimes chilly. Snow falls here during the latter part of November, or during December, and usually remains on the north slopes of the ridges until late in April. It will be comparatively easy to build toboggan slides and ice skating rinks that can be used all winter at this altitude. This will give to Tucson, in addition to its balmy winter climate, the added attractions of a wonderful playground where winter sports can be enjoyed in the midst of beautiful winter scenery.

From the crest of the main ridge the general direction of the road is east. The few curves are of long radius, will be easy to drive, and will add to the attractiveness of the road, since a gently curving road is always less tiresome to drive than a straight road. For several miles the proposed grade varies from minus six per cent. to minus seven per cent.

Several of the cross ridges extending southward from the roadway along the third mile are desirable locations for summer cabins if water can be developed in this locality. The scenery is very attractive, as most of this country affords a view of Sycamore Canyon. Figures 1 to 4 are a few of the more spectacular views from this vicinity, while figure 5 illustrates the attractions of a camp among the tall Pines.

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

The fourth mile continues in a southeasterly direction passing one-fourth mile north of Camp Lawton, the summer camp of the Catalina Council of the Boy Scouts of America, which is three and one-fourth miles from Soldier Camp. The area surrounding Camp Lawton is an ideal area for all recreation purposes. The ravines are shallow alternating with low rolling hills, well timbered with large pines. If the Scouts had not already secured water rights to most of the available water, this area would be very desirable for summer cottages. The Forest Service Look-out Tower on Mt. Bigelow is approximately three-fourths mile north of Camp Lawton. The tower overlooks most of the Catalina Mountains. A look-out is stationed here during the summer months to locate forest fires.

The fifth mile continues in a southeasterly direction around the head of Sycamore Canyon. The alignment is winding, affording wonderful views of Sycamore Canyon. This Canyon is rather steeply walled and narrow, but there are good locations for summer cottages in the canyon below the road location. Water flows in the canyon during the rainy season. Trees along the way are Pine, Juniper, Madrone, and Oak, with heavy Oak underbrush.

The sixth mile continues, by easy curves, in an easterly direction toward Green Mountain. The Mountains are rugged and well timbered. Deer and other wild animals are frequently seen. Figures 6, 7 and 8 are views taken near the location along this mile.

Fig. 6

Fig. 7

Fig. 8

The seventh mile bears in a southerly direction around the head of Rose Canyon, and along the west shoulder of Green Mountain. Rose Canyon flows southwest from the foot of Green Mountain. It affords one of the most attractive recreation areas to be found along the route. This area is approximately two miles long, and from one-eighth to one-fourth mile wide. The grade of the canyon is from four to six per cent. toward the southwest. The valley is well timbered with Pine and Fir trees, with Box Elder, Alder and Ash trees along the stream. Clear, soft water flows in the canyon most of the year. The elevation above sea level is approximately seven thousand feet. This valley is more sunny and pleasant than the area around Soldier Camp. The weather is pleasantly cool all summer, but the nights are not so chilly here as at Soldier

Camp, which is a thousand feet higher than the Rose Canyon basin. This should be an ideal location for summer homes.

Below this small valley, Rose Canyon narrows to a box canyon and flows into Sycamore Canyon, which is also a box canyon at this point. The scenery is very wild, the towering canyon walls and water falls contrasting sharply with the usual mountain scenery of southern Arizona. Water in Sycamore Canyon, below the junction with Rose Canyon, is said to be permanent, and the pools are stocked with trout.

The eighth mile winds south around the head of Willow Canyon, then east along the south slope of Green Mountain, and crosses the ridge between Willow and Bear Canyons just north of Lizard Rock. This rock, resembling a lizard in shape, forms the top of a rocky promontory on the ridge between Willow and Bear Canyons. It is a point from which the surrounding canyons and mountains can be viewed, and is within easy walking distance from the proposed highway. Figures 9 to 11 are typical scenes from the ridges south of the foot of Green Mountain.

Fig. 9

Fig. 10

Fig. 11

The area containing Willow Canyon and its tributaries is another desirable location for summer homes or picnic grounds. These canyons are shallow with low, rolling ridges between. There is flowing water in Willow Canyon most of the year, since Green Mountain seems to receive more rainfall than any other part of the Catalina Mountains. The timber is mostly Pine with thickets of Oak underbrush, and Willows along the stream.

The ninth mile bears east, along the south slope of Green Mountain, toward the head of Bear Canyon. The tenth mile bears in a northeasterly direction for one-half mile, then in a southeasterly direction, while the eleventh mile swings toward the southwest. These three miles form a great loop around the head of Bear Canyon. There is very little area suitable for summer homes, but most of the country near the proposed highway is suitable for picnics. Many of the

canyons are fed by small springs and carry a small flow of water. The trees are mostly Pine, with occasional Junipers, Pinons, Madrones, and Oaks. The alignment is winding, with long sweeping curves. All prominent points will afford wide views over the broad upper basin of Bear Canyon, and of the lower mountains. The grades will vary from less than one per cent. to a maximum of six per cent., making this section of the road especially easy and pleasant to travel.

The twelfth mile continues in a southwesterly direction along the southeast wall of Bear Canyon. There are several points along the lower end of this mile from which to start a side road down to the comparatively level area in Bear Canyon. This is a very attractive area, approximately one mile long by one-fourth mile wide. It is surrounded on the west, north and east sides by steep, tree covered slopes. At the southwest end of the valley the canyon narrows to a box and the grade of the canyon becomes very steep, flowing down long chutes and several fifty foot falls.

There is a large spring near the upper end of the basin. The largest tree in the Catalina Mountains grows near this spring. This tree, a Douglas Fir, is one hundred twenty-five feet tall, and more than six feet in diameter. Other trees growing in this valley are Pine, Juniper, Alder, Sycamore, Walnut, Ash and Oak. Shrubs, including Sumac and Prickly Ash, are abundant, and many of the trees support Wild Grape vines. The general elevation is about 5900 feet above sea level. This is the largest area suitable for summer homes

where there are Pines and other evergreen trees.

The thirteenth, fourteenth, fifteenth, and sixteenth miles maintain the general southwesterly direction following the hillside along the first canyon east of Bear Canyon. The alignment will be winding, but the curves are long and the grades will be from three to six per cent. This section of the road will be safe, and easy to travel. There are many good locations for camp and picnic grounds along the canyon, down which there is a small flow of water during the rainy season. There are Pine, Pinon, Juniper, Oak, and Wild Cherry trees growing along the canyon, with heavy Oak and Manzanita brush growing on the ridges.

The seventeenth mile first follows the side of a long ridge in a southwesterly direction, then swings around the end of the ridge in a southerly direction, later swinging toward the northeast. The top and northwest side of the ridge are well timbered with Juniper, Pinon, and Oak trees with heavy Oak brush. From the point of the ridge the traveler will be able to look out over the lower ridge of the mountains. The view will cover most of the Santa Cruz and Rillito Valleys, with the Rincon, Santa Rita, and Tucson Mountains in the distance. From this vantage point the location of most of the valley roads is clearly indicated by long streamers of dust raised by passing automobiles.

The eighteenth mile swings around the head of a small canyon, following southwest down the side of a ridge, thence

around the point of the ridge to the northeast into Soldier Canyon. After crossing Soldier Canyon the nineteenth mile follows a rather straight course, southwest, down Soldier Canyon through an area known as the Soldier Canyon Basin. Vail's Corral is located here. This is quite an extensive area of shallow canyons, and low rolling hills, wooded with Juniper, Pinon and Live Oaks. There is water in Soldier Canyon most of the year. Water can also be piped from a small permanent spring in Soldier Canyon approximately a mile above the recreation area. The elevation above sea level is about 5000 feet. The summer climate here is pleasant. While rather hot for violent exercise in the sun, it is always pleasantly cool in the shade, and the nights are cool. This area is only twenty-three miles from Tucson. Eighteen miles of this distance are valley road, but the remaining five miles will be mountain road. It is a good location for summer homes for those who wish a location as near to Tucson as possible. Bear Canyon Upper Basin is approximately seven miles above the Soldier Canyon Basin and the Rose Canyon Area is five miles farther than the Bear Canyon Upper Basin Area. Bear Canyon Lower Basin is approximately two miles northwest of the Soldier Canyon Basin, and is an area quite similar in every way to the area in Soldier Canyon. When there is a demand for more area at this elevation the cost of building a side road to it will be moderate.

The twentieth mile continues in a southwesterly direction

over a low saddle into a region of grass covered hills and ravines wooded with Live Oaks and Junipers. The grade varies from a level grade to a minus six per cent. The curves are easy with long tangents. Toward the valley the view is extensive. Toward the mountains, a tangle of canyons and ridges rises tier after tier to the crest of the main ridge. Figures 12 to 16 inclusive are views taken from the lower part of the route, looking toward the higher mountains. These scenes are merely a sample of the wealth of scenery, as yet inaccessible, though within a comparatively few miles of Tucson.

Fig. 12

Fig. 13

Fig. 14

Fig. 15

Fig. 16

The twenty-first and twenty-second miles first swing to the east, then south through a saddle, continuing to swing to the right around a low hill toward the north to Soldier Canyon. After crossing the canyon the route swings back to the southwest and continues on down the mountain side toward the valley to station 1053 + 03, the end of the survey December 31, 1931. Approximately a mile more of side hill location remains to connect the end of the line as run, with the Synder road, which is a County Road running east from the Bear Canyon Road.

A location survey will change the length of the line somewhat, as minor portions of the route should be relocated to secure better crossings in some of the canyons. Running in curves will also shorten the line. The final location will probably be about twenty-four miles of mountain road between Soldier Camp and the point at the foot of the mountains where the road intersects the Synder Road. This intersection is about eighteen miles from Tucson, making the distance between Tucson and Soldier Camp approximately forty-two miles. The present road to Soldier Camp, through Oracle, is about seventy-five miles long.

A well constructed road over the proposed route will be entirely a high gear road. At the time the reconnaissance survey was made the standards of the Bureau of Public Roads for roads of this type allowed maximum grades of seven per cent. The minimum radius for open curves was one hundred

feet and for blind curves the minimum radius was two hundred feet. Even the most winding mountain road can be driven with entire safety and fair speed where the radii of all curves are as long as one hundred feet.

The reconnaissance survey was carefully made and the proposed location will permit the construction of the road to the above standards. The alignment will follow the grade contour closely, necessitating relatively small cuts around the points of ridges and correspondingly small fills across the heads of the canyons. The accompanying estimate has been prepared for construction to the above standards.

Mr. H. H. Woodman, Locating Engineer for the Bureau of Public Roads, who is in charge of the party making the location survey that was ordered several months ago, has recently stated that the standards of the Bureau of Public Roads for this class of highway have been raised. At present the maximum approved grade is six per cent., with a minimum radius of two hundred feet for open curves and three hundred feet for blind curves. Mr. Woodman states that his party is finding it very difficult to secure tangent distance for the curves of this increased radius. He also states that he believes the road over the proposed route will cost more than $1,500,000.

A study of the accompanying profile sheets for the proposed route indicates that the maximum grade can be reduced to six per cent. by relocating part of the line between control points. A change in the proposed grade alone probably will

not change the cost of construction materially.

Improvements in alignment, however, can only be accomplished by heavy cuts around the points of the ridges and longer and deeper fills across the canyons. Increasing the minimum radius permitted for curves on this route will increase the cost of the road enormously. It is believed that this increase in cost is not justified for this location as a good alignment can be secured at a much lower cost. The lower standards for the radii of curves, in effect at the time the reconnaissance survey was made, probably will be approved for this highway. The alignment for most of this route is very good. It is nearly all side hill location and oncoming traffic will usually be visible several curves away. It should thus be a pleasure to drive the entire route, since even the driver will not be too busy to enjoy the scenery. There is room to construct the roadway any desired width and there are many places along the route where parking places can be cheaply constructed.

Near each of the recreation areas there is at least one location where a small dam across a canyon will impound sufficient water to make a swimming pool. Just below the upper recreation areas in Bear Canyon and Sycamore Canyon, these canyons are narrow and deep box canyons. In the narrow parts of each of these canyons it should be possible to construct a series of pools large enough to furnish good fishing.

BENEFITS TO THE PUBLIC OF THE PROPOSED HIGHWAY

Good roads are unquestionably of value to the public. They are of value, not only to those who use them most, but also, to those who are so situated that they can not use the roads. Good roads increase travel materially since many of those who have the leisure and money to travel will indulge in this form of recreation more frequently when they can travel in comfort and safety. Good roads facilitate the movement of commodities by trucks, and this results in a more economical distribution of all products than can be accomplished by railroads alone.

Any increase in travel over the highways immediately increases the sale of fuel, oil, tires, accessories and repairs. Increased prosperity in any one line of business will be followed by increased prosperity in other lines of business.

Economic Benefits Of The Proposed Highway

The Coronado National Forest Area* is comprised of 1,300,000 acres in southeastern Arizona and approximately

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*Published report of U. S. Forest Service.

150,000 acres in southwestern New Mexico. This area includes all of the mountain systems in southeastern Arizona. The Catalina Mountain area is one of the largest of the Arizona areas.

The total number of visitors in the Coronado area for 1929 was 37,320. The number of visitors in 1930 was 55,821. The number of visitors in 1931 was 60,561, an increase of 8.5 per cent. Figures for 1932 have not been obtained. Since the general depression was seriously affecting all business in 1930 and 1931, these large increases in the number of recreationists are remarkable.

The increase in the number of visitors to the Catalina area* is even more remarkable. Picnicers at Sabino and Bear Canyons in 1931 totaled 5,500 persons. In 1932 the number increased to 26,600 persons, an increase of 384 per cent. The increase probably was caused by improved roads to these two recreation areas, and indicates that the Tucson public enjoys the mountains. In sharp contrast to the general increase in recreationists, the number who used the Mt. Lemmon road through Oracle remains the same for both years, namely 3,650. The estimates were for the period from May 15 to October 15, these being the months the road is usually safe to travel, and is open to the public.

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*Estimate from the Tucson Office of the U. S. Forest Service.

For purposes of estimating the average daily travel over the Mt. Lemmon road it is assumed that most of the 3,650 visitors to the higher area made the round trip in one day. This gives a daily average of twenty-four visitors for the time the road was open to traffic. At an average of four passengers per car, six cars made the round trip daily or twelve cars used the road daily.

It is estimated that the proposed highway, in addition to opening several large areas nearer to Tucson than Soldier Camp, would shorten the road to Soldier Camp thirty-one miles of two per cent. grade, and two miles of eight per cent. grade.

The approximate capitalized cost,* at five per cent., of operating twelve motor vehicles daily over thirty-one miles of two per cent. grade @ 0.12 x $15.10 per foot is $296,600. The approximate capitalized cost at five per cent. of operating twelve motor vehicles daily over two miles of eight per cent. grade @ 0.12 x $29.60 per foot is $37,500. The total capitalized cost of operating twelve cars per day over the thirty-three miles is $334,100. Therefore if six cars make the round trip daily, the sum that can, economically, be spent to shorten the road thirty-three miles is $334,100. It is reasonable to believe that the number of visitors to the higher areas would increase comparably to other increases if a better road, and

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*Location, Grading and Drainage of Highways, W. S. Harger, page 100.

a larger recreation area were available.

After considering the increases in traffic to other parts of the Coronado National Forest during the past year, it seems very reasonable to believe that the number of visitors to the higher areas will increase 100 per cent. during the first year the road is open to travel. Whenever the use of the road increases to as many as twelve cars making the round trip daily, the capitalized cost will become $668,200.

The capitalized cost, or justifiable expenditure is based upon the cost to the owner of $0.11 per mile of operating an automobile. This includes tires, fuel, repairs and depreciation. This cost to the owner seems too high for the present motor car and the present condition of the roads. However, the cost of operating the average automobile can be estimated as the more reasonable figure of $0.08 per mile,* which will reduce the justifiable expenditure to $485,900. This is still higher than the estimate for the road. The estimated cost** of the proposed highway plus fifteen per cent. for engineering expenses and contingencies is, in round numbers, $450,000.

It is believed that extensive travel in any locality has a stimulating effect on business in general. The cost to the owner of driving his car is a measure of this increase in business, although this increase will probably be larger than

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*Operating Costs of Automobiles and Trucks, by T. R. Agg and H. S. Carter.

**Estimate in detail, page 38

the mere cost of operating the car as incidental expenses usually increase the cost of travel materially.

The average grade of the twenty-four miles of the proposed highway is estimated to be five per cent. The average grade of the road between Tucson and the end of the mountain road is estimated to be one per cent.

The yearly operating cost* of one hundred average motor cars per day, (based on car mile operating cost of $0.11 on average grades) for three hundred sixty-five days per year for eighteen miles of plus one per cent. grade @ $0.76 per foot is $72,300. For eighteen miles of minus one per cent. grade @ $0.72 per foot the cost is $68,500. For twenty-four miles of plus five per cent. grade @ $1.45 per foot the cost is $184,000, and for twenty-four miles of minus five per cent. grade the cost is $72,300. The total yearly cost of the round trip per day for one hundred cars per day is $397,100. For twenty-four cars per day for one way or twelve round trips the yearly cost will be $47,650. At the more reasonable operating cost of $0.08 per mile the total yearly cost of operating the twenty-four cars per day over this road will be $34,650. This equals the interest at five per cent. on an investment of $693,000. This would indicate that those who do business with the traveling public might well afford to build the

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*Location, Grading and Drainage of Highways, W. G. Harger, page 99.

proposed road.

Many of our winter visitors own their own cars and these out of state cars are frequently seen at all of the points of interest surrounding Tucson. Residents of Tucson are often asked if there are other places of interest or scenic beauty near, and the complaint that there is no place left to visit is occasionally expressed. The temperatures in and near Tucson during the day, become unbearably hot to many of these winter visitors early in the spring, causing them to leave for the coast, or to return to their homes as early as the weather farther north will permit. If the agreeable summer climate of the nearby mountains is made available to these visitors, it is believed that many of them will either rent cabins in the mountains or spend the heat of the day there, returning to Tucson in the evening. In either case it is expected that a number of the winter visitors will spend more time and money in our locality than they have done in the past.

The largest and most remunerative industry of Tucson is that of caring for, and catering to the wishes of the tourist traffic, and our winter visitors and health-seekers. Tourist traffic will grow with the improvement of through roads, particularly roads into Mexico. Our wonderful winter climate attracts most of the visitors who make longer than a brief visit in Tucson. The Catalina areas offer a good opportunity to develope a winter play ground where winter sports may be enjoyed in addition to serving as an ideal summer play ground. This

addition to the winter attractions of Tucson may well be expected to bring numbers of healthy, active winter visitors to this locality. It seems probable that these active visitors will increase business in Tucson more than an equal number of health-seekers. Our greatest undeveloped resources are the mountain areas near Tucson. When these areas become accessible they will add a wonderful spring and summer climate to our climatic attractions.

It is evident that high officials in both the U. S. Bureau of Public Roads, and the U. S. Forest Service believe the expenditure to build this proposed highway is justified. The proposed route has been approved, and a location survey is now being made by a party of engineers from the Bureau of Public Roads. It is understood that immediate construction is intended.

Other Benefits Of The Proposed Highway

It is believed that the opening of the Catalina Mountains as a recreation area will bring increased health and pleasure to those who visit the area.

University work in Botony, Biology, Geology, and Plant Pathology may be made more profitable and interesting when this area is made accessible for field trips. Several distinct zones are available at different elevations and clearly show the effect of climate upon plant, animal and insect life.

The U. S. Department of Agriculture at one time maintained a station for the study of plant and insect life in Soldier Canyon, a few miles above Vail's Corral.

COMPARATIVE ADVANTAGES AND DISADVANTAGES OF THE SEVERAL POSSIBLE ROUTES

There are four possible routes through the first, or southern ridge of the Catalinas into the basin. These routes are first, up Sabino Canyon; second, up the steep side of the first ridge by switchbacks, thence through a series of high saddles south and east of Gibbon Mountain and down into the basin; third, up Soldier Canyon; and fourth, up Agua Caliente Canyon. These routes will be discussed in the above order.

The Sabino Canyon route has one advantage over all other possible routes, if the destination is to be Soldier Camp. This advantage is, that this is the shortest possible route into the basin and on up Sabino Canyon to Soldier Camp. Disadvantages of this route are, first, very little additional area made accessible; second, poor alignment for road; third, insufficient room on turns and switchbacks for roadway of adequate width; fourth, the high cost of building the road in this location; and fifth, a maximum grade of eight per cent. most of the distance. These disadvantages caused the defeat of the proposed bond issue to build a highway on this location, in 1928 and again in 1930.

The Gibbon Mountain route would pass through the basin above the large recreational area around the junction of Sycamore and Bear Canyons, thus opening a large and desirable area.

Disadvantages of this route are: first, poor alignment and expensive switchback construction; second, the pass above the basin is too high, resulting in the extra cost and length due to adverse grades; third, the route from this part of the basin toward Soldier Camp also has many disadvantages, as it must follow the ridge between Sycamore and Bear Canyons. This ridge is very steep and rocky, requiring a large number of switchbacks. Construction would be expensive for the whole route. A large part of the route would require a grade of seven per cent. This route was disapproved by a party of Engineers from the Bureau of Public Roads, the Arizona Highway Department and the Forest Service October 13, 1931.

The Soldier Canyon route is the route of the proposed highway. It has several distinct advantages. First, it passes through several desirable areas; second, all other desirable areas can be reached by comparatively short side roads; third, there is sufficient room so that only a few long and easy switchbacks are required to reach the necessary elevation of control points; fourth, only a few short distances are traversed where the mountain side slopes are steep enough to make construction expensive; fifth, this is a ridge route, crossing most of the drainage channels near the headwaters, and allowing the use of small, inexpensive drainage structures. This will also aid to keep maintainance costs reasonable. Sixth, the scenery along the route is unsurpassed by any scenery in the Catalina Mountains. Seventh, the maximum grade

can be reduced to six per cent., with an average grade of approximately five per cent.

One disadvantage is that the beginning of the route is about three miles farther from Tucson than the beginning of the Sabino Canyon route. The route is several miles longer than would be required to reach the desired elevation by the maximum permissable grade, but this is an advantage as it permits the building of easier grades.

The route through Agua Caliente Canyon has no advantages over the proposed route. The beginning of the route is several miles farther from Tucson than the proposed route. This route would have to swing toward the west, joining the proposed route in the vicinity of Vail's Corral. Using this route to reach Vail's Corral would add several miles to the distance to be traversed. Part of this route would require switchbacks to permit the construction of the road with a seven per cent. maximum grade. Any additional area made available can be more cheaply reached by a side road from the proposed route. The cost of constructing a road over the Soldier Canyon route will evidently be less than over any other available route. The easier grades on this route more than compensate for the difference in length between the Soldier Canyon route and the Sabino Canyon route.

COMPARATIVE COST ESTIMATES OF THE SEVERAL ROUTES

A number of estimates have been prepared for the Sabino Canyon route to Soldier Camp. The estimate prepared in 1916 by the Forest Service estimated the road would cost $300,000 with a fifteen foot roadway. This would be a one way road if frequent turn outs were not constructed. The 1916 location was checked by Mr. J. M. Brown, and the estimate was revised to 1928 prices, bringing the estimated cost up to $659,791.02. Opponents to the bond issue state that the Superior-Miami eighteen foot road cost $1,200,000 for a slightly shorter distance. Opponents of the measure expressed the fear that the road would cost $1,150,000.

In 1930 the estimate for the 1916 location was again revised, this time by Mr. Thomas Maddock and Mr. F. H. Flint, formerly in charge of location and construction of Forest Roads for the Bureau of Public Roads. The revised estimate for a fifteen foot roadway was $354,000, and for an eighteen foot roadway it was stated the cost would be less than the $500,000 of the proposed bond issue. It seems probable that an eighteen foot road can be built in this location if construction is not made too expensive by an attempt to secure better alignment in a poor location.

The accompanying detailed estimate for a twenty-four

foot roadway over the proposed route gives the approximate cost of construction of this road as $443,057. The addition of fifteen per cent. to the estimate to cover engineering expenses and contingencies increases the estimate to approximately $450,000. It is believed that the road can be built at a cost below the estimate if proper construction methods are used, as the unit costs used in the estimate are fairly liberal. This location was approved by the party of Engineers from the U. S. Bureau of Public Roads, Arizona Highway Department and U. S. Forest Service, October 13, 1931.

No estimate has been prepared for the Gibbon Mountain route, which continues up the ridge between Bear and Sycamore Canyons to Soldier Camp. Construction of a road over this route can not fail to cost more than over the approved location since the distances are approximately equal, and the difficulties of construction are much greater.

A road over the Agua Caliente Canyon route, also would cost more to build than the estimate for the proposed route, for the distance is longer to Vail's Corral where the locations join.

THE DETAILED COST ESTIMATE FOR THE MOST FEASIBLE ROUTE

The reconnaissance survey to locate the most feasible route for the proposed highway was made by a small party. Distances were measured with a tape. Horizontal angles were measured with a Brunton Compass. No cross-sections were taken but the average slope of the mountain side for each course, was measured with the Brunton. These side slopes were averaged for each five hundred foot interval and are recorded on the profile sheet for each fifth station. These recorded side slopes were further averaged to give the average side slope for each mile, and are recorded on the quantity sheet.

Figures A to F inclusive are balanced, theoretical cross sections, drawn to scale for each five degree variation of the side slope from twenty degrees to forty-five degrees, which includes all side slopes occuring along the route. Curve Number 1 was then plotted, using side slope in degrees as ordinates and the cross-sectional area of excavation from figures A to F as abscissas. The cross-sectional area of excavation for the average side slope for each mile may be read directly from this curve. This area, multiplied by the net length of side hill excavation gives the volume of side hill excavation for the mile.

Length and depth of cuts and fills are recorded on the profile sheets. The volume of each cut or fill was calculated separately and the totals for each mile are recorded on the quantity sheet. Culvert lengths depend upon the depth of fill needed at the locations. These lengths were calculated and totals for each mile are recorded on the quantity sheet.

At the time of the survey the classification of the ground for each course was recorded. The average per cent. of rock and earth for each mile was used to determine the proportion of the total excavation that should be classified as rock or earth.

Quantities of all pay items, together with the unit price and total price for the item are recorded on the final tabulation sheet. The sum of these totals is the estimated cost of the project, which is $443,057. The addition of fifteen per cent. for engineering expenses and contingencies increases the estimate to approximately $450,000.

Unit prices used in this estimate are believed to be fairly liberal, and were determined after investigating the usual prices paid for each type of work. It is probable that the unit price, for clearing, of $200 per acre is much too high. However, the only price available for this class of work was a bid submitted to the Forest Service of $200 per acre for clearing timber similar to that found on this project. Therefore this unit price was used in preparing the estimate.

SUMMARY AND CONCLUSIONS

Mountain areas near Tucson are important natural resources.

Recreational area highways are of value to the public, and are of especial value to nearby cities.

Expectancy of travel over such highways is increasing.

Expectancy of travel over the proposed Sabino Canyon highway did not justify a bond issue of $500,000 in 1928 or 1930 and would not warrant such a bond issue in 1934.

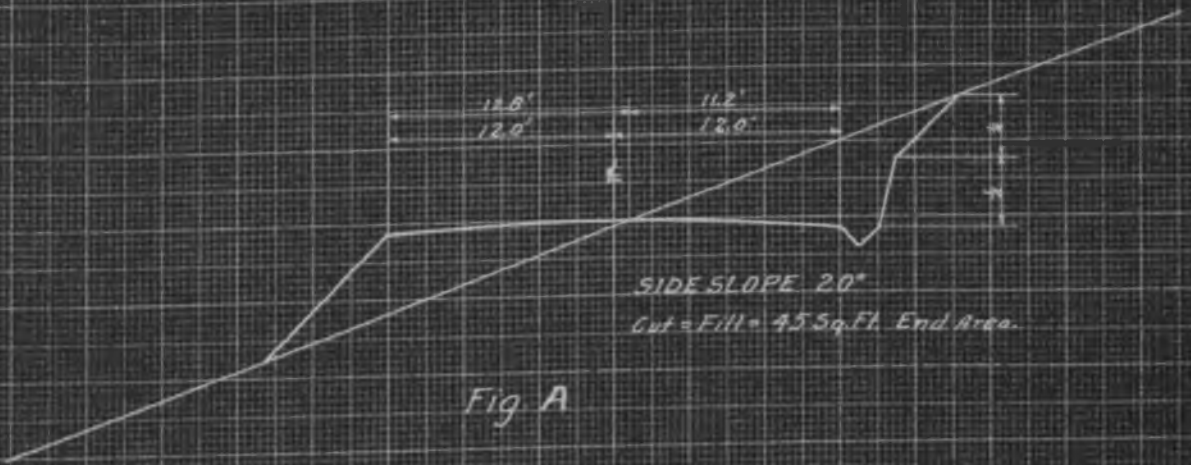
The route through Soldier Canyon selected for the proposed Catalina highway is the most feasible route available.

Opening of this area to the public may reasonably be expected to increase the use of this area.

Expectancy of travel over the proposed highway is high enough to justify the cost of construction.

TYPICAL SECTIONS

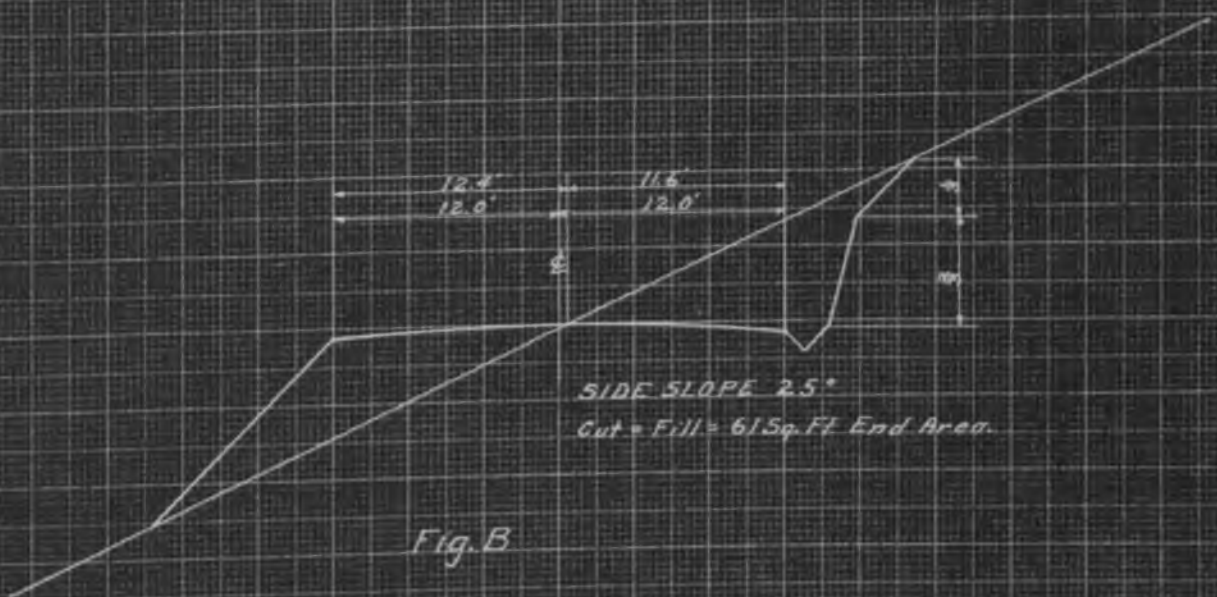
ROADWAY 24.0 Ft.



SIDE SLOPE 2.0°

Cut = Fill = 45 Sq. Ft. End Area.

Fig. A



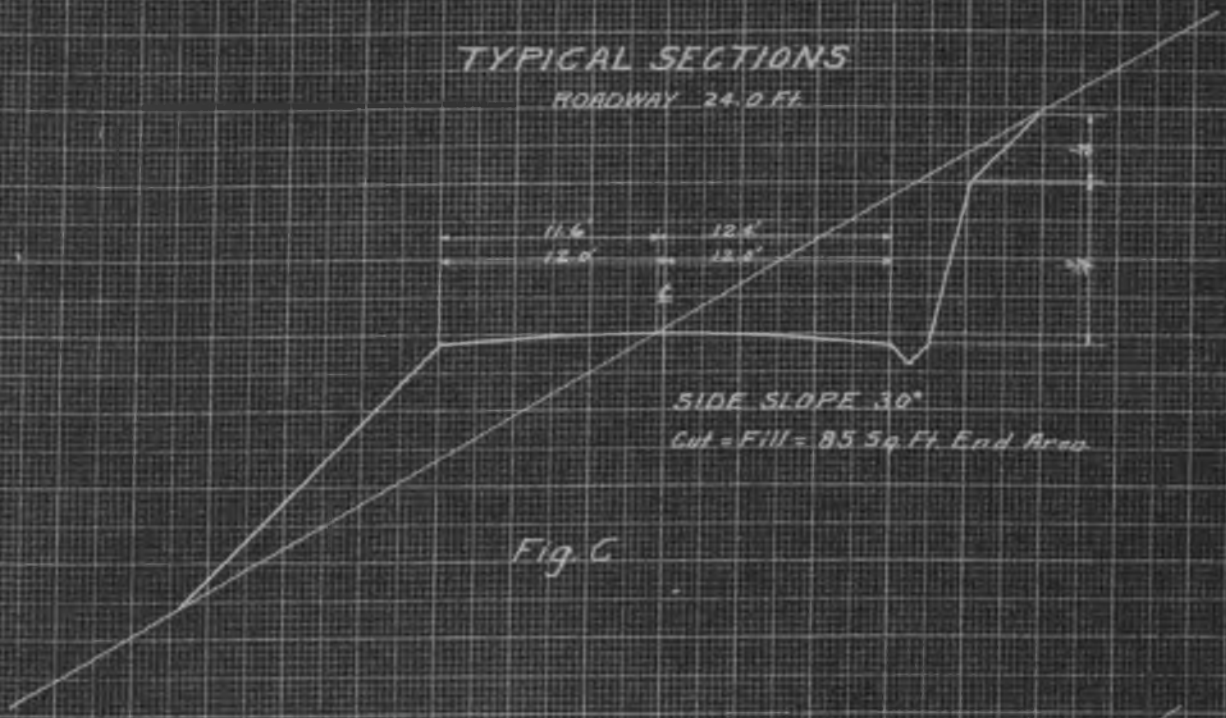
SIDE SLOPE 2.5°

Cut = Fill = 61 Sq. Ft. End Area.

Fig. B

TYPICAL SECTIONS

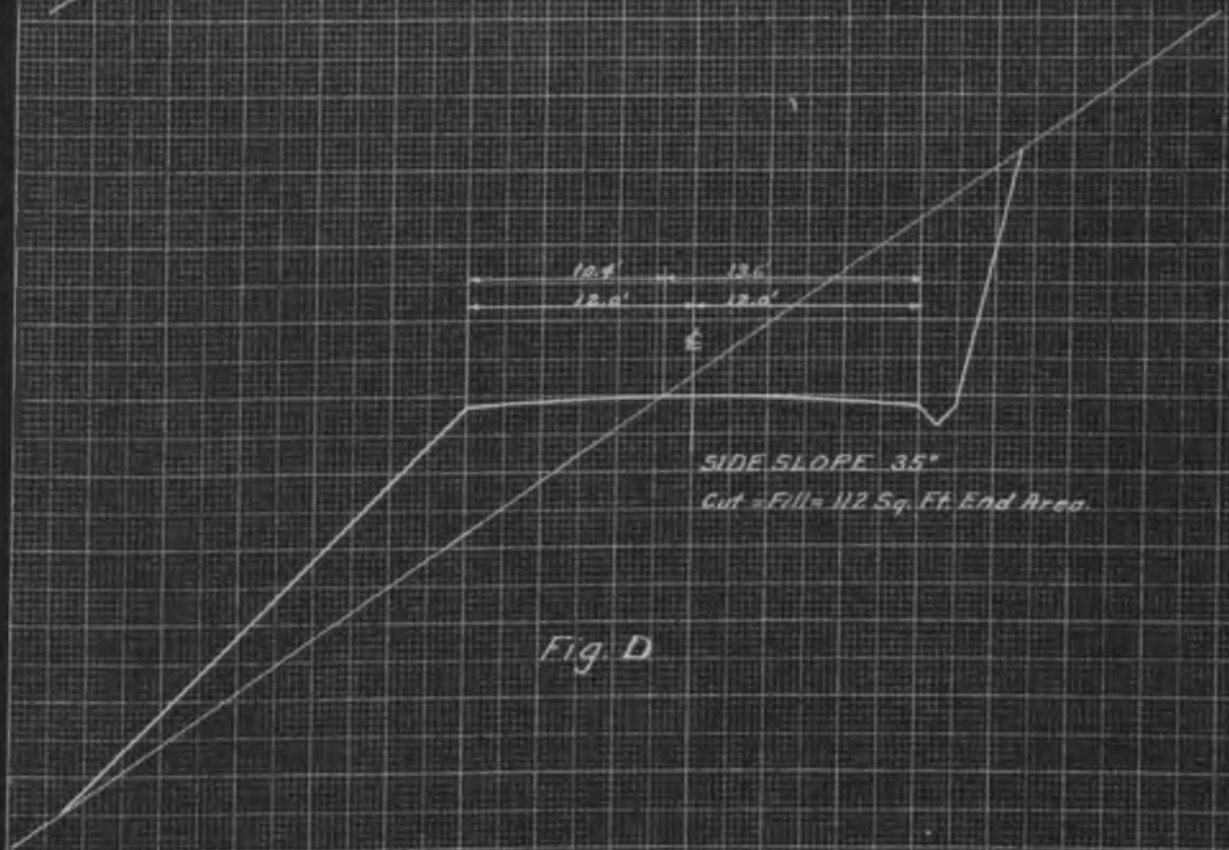
ROADWAY 24.0 Ft.



SIDE SLOPE 3.0°

Cut = Fill = 85 Sq. Ft. End Area.

Fig. C



SIDE SLOPE 3.5°

Cut = Fill = 112 Sq. Ft. End Area.

Fig. D

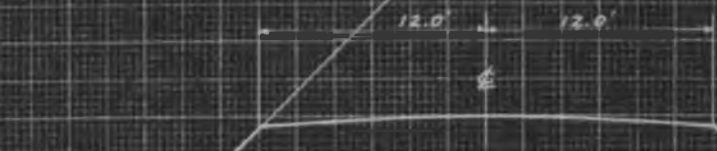
TYPICAL SECTIONS

ROADWAY 24.0 Ft.

SIDE SLOPE 4.0°

Cut = Fill = 165.5 sq. Ft. End Area.

Fig. E

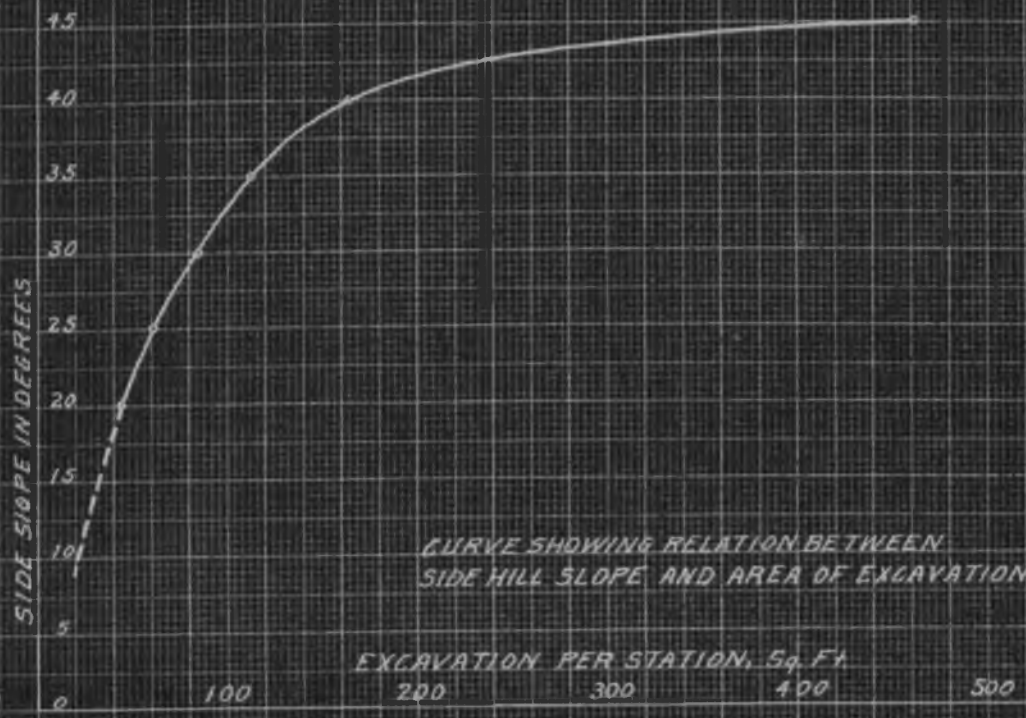


SIDE SLOPE 4.5°

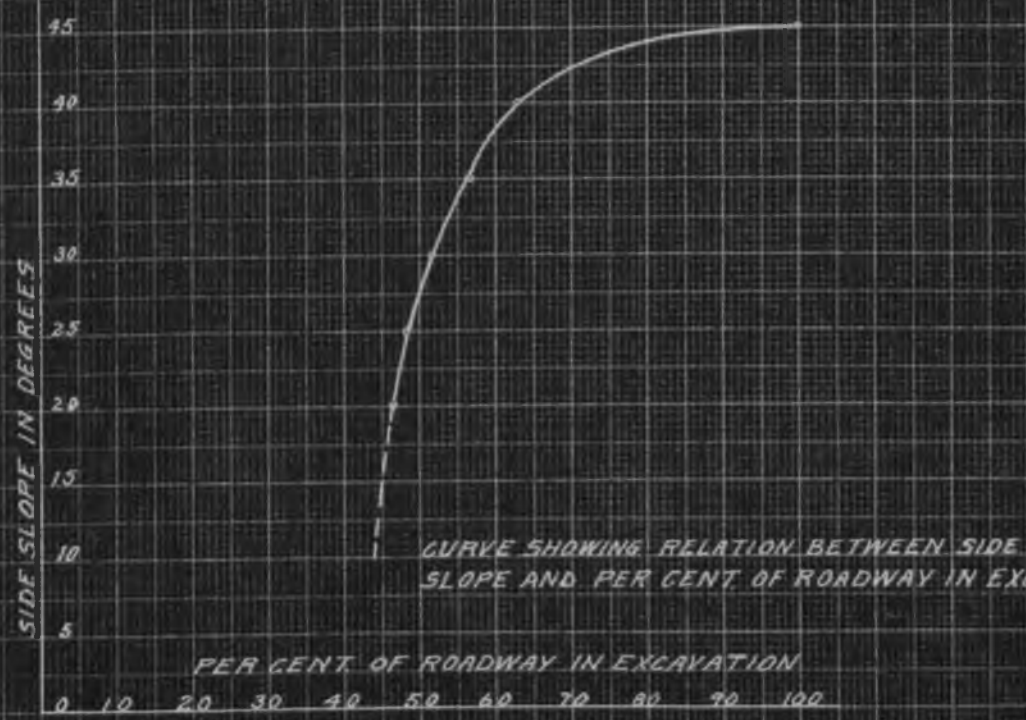
Cut = 462.5 sq. Ft. End Area.

Fill = 0.0 " " " "

Fig. F



CURVE No. 1



CURVE No. 2

Item	Quantity	Estimated Unit Price	Totals
Side Hill Excav., Earth	95670 Cu Yds.	$ .35	$ 33484.50
" " " Rock	215880 " "	1.00	215880.00
End Fill " Borrow	101110 " "	1.15	116276.50
Thru Cut " Earth	5630 " "	.50	2815.00
" " " Rock	28690 " "	1.25	35862.50
C.M.P. Culverts 18"	3186 Lin. Ft.	1.75	5575.50
" " 24"	1246 " "	2.50	3115.00
" " 30"	2058 " "	4.00	8232.00
Clearing + Grubbing	109.1 Acres	200.00	21816.00
			$443,057.00

COMPLETE ESTIMATE FOR THE PROPOSED HIGHWAY

Mile	Average Side Slope	Excavation, Cu. Yds.			Corrugated Metal Pipe, Lineal Feet		
		Earth	Rock	Borrow	18"	24"	30"
No. 1	22.6°	5240	5240	2080	168	28	
" 2	21.0°	4450	4450	3770	28	136	192
" 3	22.2°	4825	4825	1770	92	44	
" 4	17.2°	3655	3655	300	130		
" 5	27.2°	6040	6040	6760	236	136	74
" 6	28.5°	3515	10545	3035	234		
" 7	21.5°	4390	4390	6340	142	190	
" 8	28.9°	5670	8500	3820	106	52	52
" 9	31.1°	7845	7845	4105	106	114	
"10	24.1°	2580	7750	3400	28	200	162
"11	20.2°	1630	6510	5420	290	36	270
"12	31.4°	1540	13860	5220	130	56	98
"13	34.6°	0	18500	1450	288	130	94
"14	31.5°	3540	10640	9380	316	60	72
"15	29.3°	3800	10600	7520	124		142
"16	34.6°	5220	15680	1440	54		120
"17	32.7°	4740	14210	0			
"18	29.9°	3300	13200	220			102
"19	22.2°	4760	4760	5520	64	24	468
"20	24.4°	2510	7540	3940	135	44	
"21	23.1°	2380	7150	2440	114		
"22	25.2°	6065	6065	2680	123		
"23	33.2°	4650	13950	7450	166		264
"24	26.8°	3325	9975	0	112		
Totals	28.6° (Av.)	95,670	215,880	101,110	3,186	1,246	2,058

TABULATION OF PAY QUANTITIES

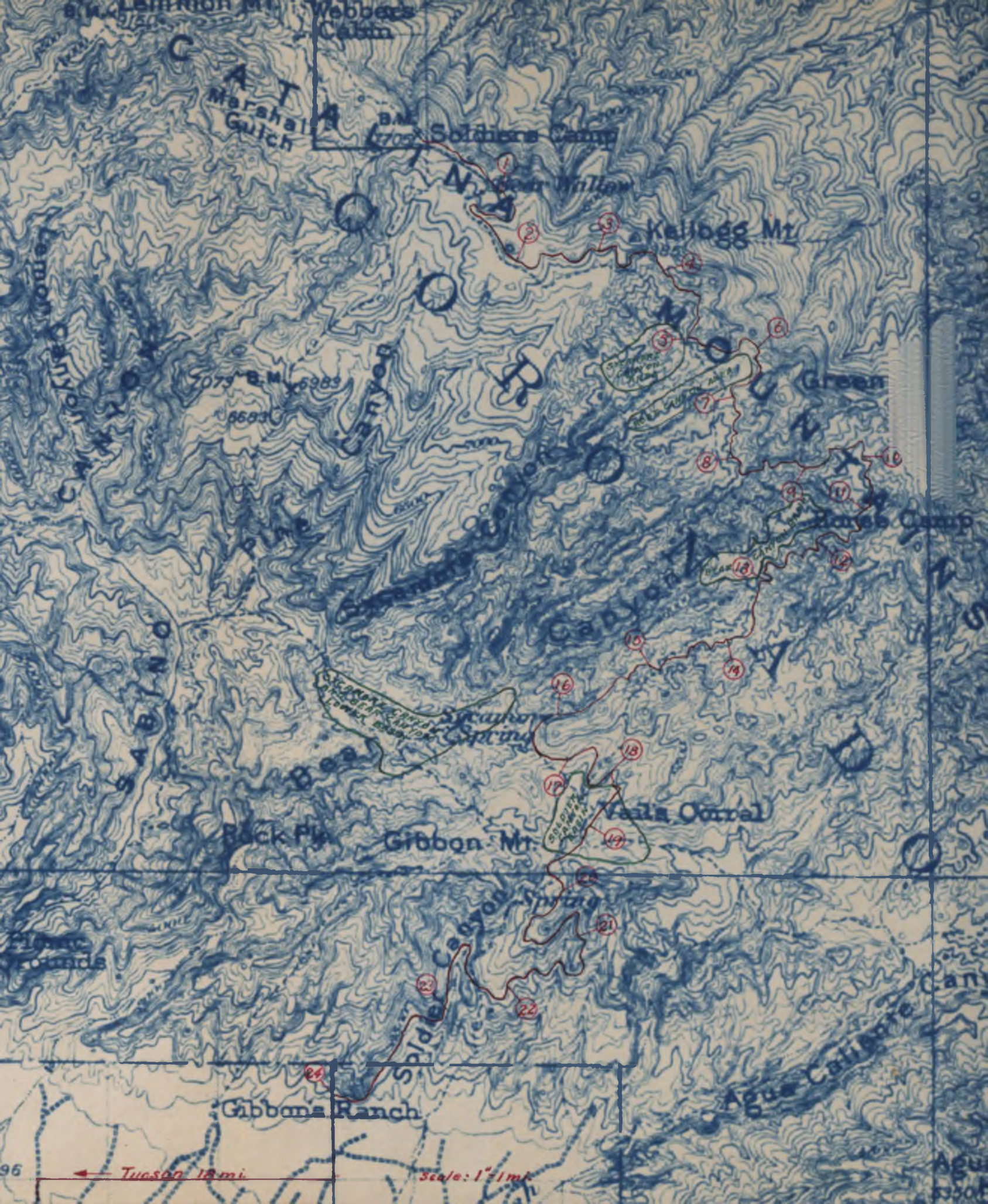
From Station	To Station	Length Feet	Grade, Per Cent.
0+00	1+75	175	+4.22%
1+75	19+80	1805	+7.00 "
19+80	32+70	1290	+3.43 "
32+70	42+00	930	+7.00 "
42+00	57+00	1500	+6.12 "
57+00	64+00	700	+7.00 "
64+00	66+00	200	+7.00 "
66+00	75+00	900	+6.25 "
75+00	80+00	500	+2.57 "
80+00	87+00	700	+5.00 "
87+00	95+50	850	+5.75 "
95+50	98+10	260	-0.22 "
98+10	106+00	790	-4.20 "
106+00	108+00	200	-3.50 "
108+00	121+00	1300	-2.80 "
121+00	127+00	600	+0.25 "
127+00	143+00	1600	-6.33 "
143+00	156+00	1300	-7.00 "
156+00	161+50	550	-6.22 "
161+00	170+69	919	-0.15 "
0+00	17+00	1700	-3.00 "
17+00	46+00	2900	-5.55 "
46+00	60+00	1400	-6.89 "
60+00	66+00	600	-4.33 "
66+00	78+00	1200	-5.60 "
78+00	100+00	2200	-6.36 "
100+00	105+00	500	-4.60 "
105+00	110+25	525	-6.16 "
110+25	127+00	1775	-5.45 "
127+00	142+00	1500	-6.66 "
142+00	153+00	1100	-6.00 "
153+00	169+00	1600	-4.50 "

From Station	To Station	Length, Feet	Grade, Per Cent.
169+00	179+00	1000	-5.15%
179+00	187+30	830	+4.34"
187+30	204+00	1670	-3.71"
204+00	217+00	1300	-4.26"
217+00	222+00	500	-1.33"
222+00	229+00	700	-4.11"
229+00	240+00	1100	-3.67"
240+00	248+00	800	-1.45"
248+00	258+00	1000	+1.66"
258+00	261+50	350	0.00"
261+50	266+00	450	-3.20"
266+00	275+00	900	-5.56"
275+00	288+00	1300	-0.61"
288+00	294+00	600	-4.50"
294+00	307+00	1300	-0.75"
307+00	318+00	1100	-5.25"
318+00	328+00	1000	-3.50"
328+00	347+00	1900	-5.72"
347+00	352+00	500	-0.33"
352+00	361+00	900	-3.60"
361+00	368+00	700	-5.38"
368+00	380+00	1200	-5.15"
380+00	390+00	1000	-4.00"
390+00	404+00	1400	-0.25"
404+00	415+00	1100	-2.66"
415+00	430+00	1500	-4.40"
430+00	439+00	900	-2.44"
439+00	447+75	875	-2.89"
447+75	450+65	290	-0.66"
450+65	453+00	235	-5.50"
453+00	458+00	500	-4.45"
458+00	467+00	900	-5.71"

From Station	To Station	Length Feet	Grade Per Cent.
467+00	470+00	300	-4.00 %
470+00	488+00	1800	-5.50 "
488+00	500+00	1200	-5.71 "
500+00	509+00	900	-2.57 "
509+00	516+00	700	-5.60 "
516+00	528+00	1200	-5.04 "
528+00	539+00	1100	-4.40 "
539+00	553+00	1400	-5.50 "
553+00	560+00	700	-4.86 "
560+00	570+00	1000	-5.11 "
570+00	580+00	1000	-4.80 "
580+00	587+00	700	-5.60 "
587+00	599+00	1200	-4.50 "
599+00	618+00	1900	-3.00 "
618+00	627+00	900	-4.40 "
627+00	644+00	1700	-5.33 "
644+00	651+00	700	-4.60 "
651+00	668+00	1700	-5.00 "
668+00	680+00	1200	-6.00 "
680+00	688+00	800	-5.00 "
688+00	708+00	2000	-6.00 "
708+00	720+00	1200	-5.50 "
720+00	730+00	1000	-4.80 "
730+00	743+00	1300	-6.00 "
743+00	756+00	1300	-5.66 "
756+00	765+00	900	-6.00 "
765+00	770+00	500	-5.00 "
770+00	773+00	300	-3.33 "
773+00	782+00	900	-5.77 "
782+00	789+00	700	-4.33 "
789+00	799+00	1000	-5.00 "
799+00	805+00	600	-3.60 "

Per Cent. Grade	Length, Feet	Length, Miles
0.0%	3870	0.73
0% to +1.0%	600	0.11
+1 " " +2 "	1000	0.19
+2 " " +3 "	895	0.17
+3 " " +4 "	1290	0.25
+4 " " +5 "	1705	0.32
+5 " " +6 "	850	0.16
+6 " " +7 "	6035	1.14
0 " " -1 "	5969	1.13
-1 " " -2 "	2650	0.50
-2 " " -3 "	8675	1.64
-3 " " -4 "	7520	1.47
-4 " " -5 "	26390	5.00
-5 " " -6 "	44645	8.46
-6 " " -7 "	13675	2.59

TOTAL LENGTH, IN MILES, OF THE PROPOSED GRADES


Lemmon Mt.
Webbers Cabin
CATALINA
Marshall Gulch
B.M. 6705
Soldiers Camp
Bear Wallow
Kellogg Mt.
Green
Horse Camp
Pine
Canyon
Sycamore Canyon
Sycamore Spring
Wash Corral
Black Pk.
Gibbon Mt.
Spring
Soldier Camp
Gibbons Ranch
Agua Caliente
Tucson 18 mi.
Scale: 1" = 1 mi.

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