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Volume II

FEASIBILITY STUDY FOR A 10 MM GPY FUEL ETHANOL PLANT BRADY HOT SPRINGS, NEVADA

Volume II - Geothermal Resource, Agricultural Feedstock, Markets and Economic Viability

MASTER

September 1980

Prepared by
Geothermal Food Processors, Inc.
Fernley, Nevada
and
The Andersen Group

For the U.S. Department of Energy
Office of Alcohol Fuels
Under Grant No. DE-FG07-80RA50354

DISCLAIMER

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SECTION 1

SUMMARY

This volume deals with the issues of the geothermal resource at Brady's Hot Springs, the prospective supply of feedstocks to the ethanol plant, the markets for the spent grain by-products of the plant, the storage, handling and transshipment requirements for the feedstocks and by-products from a rail siding facility at Fernley, the probable market for fuel ethanol in the region, and concludes with an assessment of the economic viability of the entire undertaking.

Volume 1 dealt with the design, capital cost, and operational aspects of the ethanol plant per se. The conclusion was that such a facility is technically and environmentally feasible in a location adjacent to the existing onion dehydrating plant of Geothermal Food Processors, Inc at Brady's Hot Springs.

The results of the work reported in Volume 2 indicate that the ethanol plant with the addition of a grain and by-product loading and storage facility at a rail siding at Fernley, can be made commercially viable for operations that would commence at the end of 1982.

The clearly positive factors emerging from the study are:

1. That very adequate supplies of feedstocks can be obtained and delivered to the plant at suitable costs for a profitable fuel alcohol manufacturing operation.

2. That extensive demand exists for the spent grain by-products of the plant in the animal feed supplement market sectors in Nevada and nearby Northern California.

3. That the introduction of a fuel ethanol manufacturing operation at Brady's Hot springs would significantly benefit the somewhat depressed farming communities in Northern Nevada.

4. That the use of geothermal heat in such an operation has the unique aspect of displacing imported fuel to a greater degree than a conventional thermal balance would indicate. This stems from the fact that geothermal heat is essentially renewable, and that the process converts a fixed energy source in a remote location into a commercially valuable, readily transportable, motor fuel.

The issues requiring further investigation pertain to the extent and producibility of the geothermal resource at the levels required by the ethanol plant, and the marketability of fuel ethanol within reasonable proximity of the plant.

The resource currently supports the largest existing geothermal food dehydration operation in the country. With further assessment the remaining risk of falling short of plant requirements can be avoided before large capital commitments have to be made.

The demand for ethanol in California and Nevada is currently marginal because of the lack of a developed market for gasohol in the region, and because there have been no state tax incentives to do so. However, the trends are favorable for a significant increase in demand for gasoline extenders to mitigate the economically damaging impact of future shortages in crude oil supplies. Baring such shortages, the market for ethanol will still increase as a function of pending state tax incentives and escalations in the price of gasoline. At current price levels for unleaded gasoline, the plant would break even if advantage were taken of a 50% goverment supported, 5% interest loan in the construction of the plant. At projected 1983 gasoline prices, when the plant would commence full scale operations, it would yield profitable operations. There is also a sizeable Federal Government market for gasohol in Nevada which would increase significantly if the MX missile were deployed.

The tax incentives provided under the Energy Security Act and existing geothermal legislation, are considered sufficient to attract the balance of private capital needed to implement the venture, notwithstanding the remaining moderate risks.

Should additional mitigation of the risks attendant to the further development of the geothermal resource prove necessary, recourse could be taken through the Geothermal User-coupled Drilling program to make the investment more palatable.

SECTION 2

INTRODUCTION

Volume I of this feasibility study dealt with the design and operation of the ethanol plant at Brady's Hot springs as prepared by the Morrison-Knudsen Company, Inc.

This volume, in Section 3, addresses the further development of the geothermal resource which was assessed on the basis of existing data by GeothermEx, Inc., Berkeley, California.

Sections 4, 5 and 6 present the results of that portion of the study conducted by AgWest, Inc. Section 4 examines the economics and availability of feedstocks for the ethanol plant. Section 5 assesses the market for distillers spent grain by-products of the plant. Section 6 identifies the physical requirements and capital costs of a rail-side grain and by-product storage and handling terminal at Fernley, from which point the plant will be serviced by a fleet of five trucks.

Sections 7 and 8 were prepared by the Andersen Group and their consultant, Johan Wassenaar. Section 7 evaluates the prospective market for ethanol as a gasoline extender in the form of 10% gasohol in the Nevada-Northern California region. Section 8 consolidates the results of the overall study in the form of an economic viability analysis.

The basic conclusions are as follows:

- The capital costs of the entire project, inclusive of the Fernley siding facilities, transport to the plant, further development of the geothermal resource at Brady's Hot Springs, the ethanol plant, and all necessary preparatory activities and organization, would be in the neighborhood of $26.6 million.

- The entire complex could be in operation by early 1983.

- There is an abundance of feedstock supplies available at acceptable plant gate costs to meet the requirements of a 10 million gallon annual ethanol production rate. Adding this feedstock requirement to existing agricultural commodity demand would have negligible impact on market behaviour. Agricultural extension programs to permit longer term contracting for feedstocks from local farmers would benefit both the project as well as the regional economy in the Northern Nevada farming community. However, this would not meet all of the plant's requirements, and approximately two-thirds to three-quarters of the annual feedstock needs would have to be brought in from neighboring states.

- Marketing of the plant's animal feed supplement by-product output presents no problem. There is some demand for wet stillage cake in the local beef and dairy feedlot industry. The rest of the distillers spend grains would be dried and pelletized for sale in the California animal feed supplement market, or for export to the Orient. There is an established demand in California for the distillers solubles produced by the plant as well.

- There are risks attendant to the further development of the geothermal resource, as there are with the extraction of most other earth resources. By phasing the project to address geothermal assessment and production development first, the capital risks can be kept within reasonable bounds.

- The market for ethanol in Nevada and California has been poorly developed, and there are no extensive gasohol retailing operations in existence. However, the trend for future gasohol demand is favorable. Legislation is pending in California, passed by a two-thirds majority, to provide limited state use and sales tax incentives for the public sale of gasohol. More importantly, there is an inherent need in both California and Nevada, particularly among independent oil companies to provide for extension of motor fuel supplies in the event of recurring shortages of imported crude oil supplies. This is particularly significant in Nevada, which depends in large measure on tourist mobility for its revenues. The military demand for motor fuel is also very significant in Nevada, and would increase substantially if the MX missile is deployed in the area.

- The total output of the ethanol plant represents only 0.8% of the combined gasoline needs of Nevada and California. Hence, only minimal penetration of the market is required to secure the economic viability of the project.

- The market price for ethanol will be geared to the price of unleaded gasoline for the forseeable future. Current ethanol prices in the region would ensure only marginal profitability for the plant. However, the price trends for gasoline continue sharply upward, and in the face of the present Iranian-Iraqi conflict and continuing Mid-East tensions, there seems to be little rationale to expect otherwise. The conclusion of the study, therefore, is that the price of gasoline would support profitable operations by the time that the ethanol plant would go on stream at the beginning of 1983.

- The risks are, nevertheless, sufficient to require government incentives and loan support in order to attract private capital for the remaining amount.

SECTION 3
RESERVOIR EVALUATION AND
PRODUCTION FEASIBILITY STUDY

3.1 ILLUSTRATIONS

3.2 RECOMMENDATIONS

To further assess the resource at Brady's and help resolve some of the unanswered questions pertaining to this reservoir, the following actions are recommended:

1. Design and contract for a high resolution active seismic survey. About 10 line-miles in a quadrangular layout with 2 northwesterly and 2 southwesterly lines are recommended.

2. Design and contract for a high resolution gravity survey. Three profiles at 0.4 mile spacing, with 0.15 mile-station spacings, aligned northwesterly, and one profile with 0.15 mile-station spacing, aligned perpendicular and joining the other profiles, are recommended.

3. Attempt to obtain proprietary data from Union Oil for wells drilled at Brady's Hot Springs.

4. Obtain low-angle photography from the west toward the fault.

5. Use data obtained for the sources recommended to make best possible quantitative reservoir models, and locate production and injection wells to intercept the Brady's fault in the deep reservoir thermal area at depths between 3,500 and 5,000 feet.

3.3 CONCLUSIONS

1. General conclusions concerning the nature of the shallow geothermal reservoir at Brady's are stated in the descriptive sections of this report. It is seen, however, that there is little knowledge about the deep source of the thermal fluid in the shallow reservoir, except the knowledge that it apparently rises within the Brady's Thermal Fault Zone, and that temperatures at 5,000 feet depth beneath the Brady's anomaly are as high as 400+°F. It is not known whether a deep, extensive reservoir exists at depth, confined to the geometry of the fault zone or with significant other lateral extent.

2. Temperatures of 400+°F at 5,000 feet are anomalous with respect to normal basin and range heat flow, which suggest heating by a hydrothermal convection system at a greater depth. The existence of such a system can only be confirmed by deeper drilling than has been done at Brady's. The detailed results of drilling, SP-Brady's No. 1 and 2, about a mile north of the production field, would help to evaluate the chances of success. The deeper of these tests penetrated to more than 7,000 feet.

3. Questions of sustainable productino flow rates and drawdown characteristics as posed in the Introduction to this study remain unanswered by the available data. Production testing has confirmed, with some doubt, that a 700 gpm pumped flow rate from the shallow reservoir is possible, that the 270°F production temperature will remain stable, and that production can be maintained for at least 15 years. The same cannot be said for a 2,400 gpm flow rate without actual flow testing of the wells proposed for production, for periods of 1000 hours.

4. Production rates and expected fluid temperatures also cannot be predicted without actual testing. However, there is currently no evidence of mixing of thermal and non-thermal groundwaters in the shallow reservoir, and the essential absence of meteoric recharge into the groundwater systems means that mixing is not likely to be stimulated by minor amounts of drawdown. If drawdown in the shallow thermal reservoir occurs until its surface drops below the piezometric surface in the adjacent basin, then infiltration with consequent cooling may result. Olmsted and others (1975) measured the altitude of the water table in the production area and in gradient holes drilled in the surrounding area, particularly toward the basin to the west. The maximum elevation in the production area was about 1,250 to 1,251 meters (4,101 to 4,105 feet), whereas one mile to the west the water table lay at about 1,235 meters (4,052 feet). The difference between these elevations is about 51 feet, which may be the maximum drawdown which can occur in the shallow production area without initiating infiltration from the basin. The wells in the field produce from much greater depths and a considerably greater drawdown may be necessary before effects of such infiltration are actually observed.

5. Reinjection is probably essential to maintaining the long-term productivity of this system, particularly if production exceeds natural discharge rates, as has been proposed.

6. New production and reinjection holes should be sited after seismic and gravity surveys integrated with detailed study of existing well logs and histories of each well have been made, and quantitative reservoir modelling has been completed.

7. An attempt should be made in future drilling to intercept the Brady Thermal Fault Zone at depth in order to best assure adequate production rates for the proposed ethanol facility with lessened chances of endangering production by excessive drawdown.

8. Adequate data probably exist in the study by Harrill (1970) to serve as a guide in siting a well for cool groundwater production for the facility. Indications are that water of low salinity will be hard to find in this area, and Na-Cl compositions with TDS of up to 2,500 mg/l may be anticipated.

9. Thermal water compositions may be expected similar to that currently produced from Brady's No. 8, both anywhere in the shallow reservoir, and at the deep source. The principal differences encountered at greater depth may be slightly higher silica concentrations and a slight shift in Ca-Na-K balance reflecting local temperature conditions. The pH of fluids produced under pressure (to prevent flashing and formation of scale) would be about the same from any source at the same pressure and temperature, and variations with pressure and temperature are not likely to be great.

3.4 INTRODUCTION AND PURPOSE

The purpose of this section is to review and evaluate available data for the geothermal system at Brady's Hot Springs, Nevada in relation to production objectives of Geothermal Food Processors, Inc. (GFP) to extract fluid from the hot water system for use in a facility to produce ethanol. GFP currently is the operator of an onion drying facility at Brady's, which employs 270°F (130°C) fluid pumped under pressure at 400 to 500 gpm from one of several wells at the site. A second well (Grace No. 1) has recently been completed. This facility first began operations in 1979, and functions on a 24-hr per day basis for about 150 days per year. Specific questions and tasks to be addressed within the scope of this evaluation are:

1. Can total fluid extraction from the geothermal system at Brady's be increased to 2,400 gpm, maintaining this rate continuously on a year-round basis, with minimum fluid temperature of 260°F, and without jeopardizing the flow to the currently operating onion drying facility for at least a 15-year period?

2. If production as described in #1 can be achieved, can this be sustained for a period of at least ten years? Will this deplete the resource by drawdown, pressure reduction and temperature decrease?

3. Can predictions be made of possible production rates and expected fluid temperatures under various drawdown conditions?

4. What will be the effect of fluid reinjection on the life of the resource and on extractable fluid temperatures? It is understood that the temperature of fluid return may be 230°F or 170°F, in light of the currently proposed plant designs and cascading uses.

5. Where should new production and reinjection holes be drilled?

6. Where and at what depth should a source of cold groundwater for use in the facility be sought?

7. What chemical compositions can be expected for the thermal and cool waters sought for production? Will the thermal waters be the same or different from those currently under production, and if different, how may this effect engineering design?

8. Are the currently available data sufficient to accomplish the tasks necessary to answer, in full or in part, the questions of items 1 - 7 above? If not, what further work is recommended, including but not limited to geological studies, geochemical studies, well drilling, tests on new and existing wells, and reservoir modelling?

9. What are the estimated time and manpower needs consequent to recommendations of item 8?

3.5 AVAILABLE INFORMATION

The information available to this evaluation has been limited in volume and scope, in spite of a relatively long history of geothermal exploration at Brady's Hot Springs. This is in part due to the short period of time available to assemble and review it and in part due to the fact that exploratory drilling at Brady's has been done in a restricted geographic area.

The data available for examination and study were included in the following:

1. Rudisell (1977) and Rudisell and Dykstra (1978) described a production reservoir assessment made on Brady's well No. 8 (the current producer) and injection tests made on well EE-1. Both tests included observations on the effects of production and injection on water levels in other nearby wells. Rudisell (1977) includes a brief review of the history of drilling at Brady's, a bibliography of information, and descriptions of the conditions of the various wells at Brady's as of 1977.

2. Energy Research and Development Administration (1977) produced an environmental impact assessment of the Brady's Hot Springs area relative to plans for construction of the onion drying facility. This includes a brief description of drilling history.

3. Olmsted and others (1975) reported results of temperature gradient drilling and water sampling at Brady's. Twenty-one shallow (30 meters) temperature gradient holes were drilled in order to define the shallow temperature anomaly. Hydrologic information was collected from these, and a summary of results assembled which includes a large-scale geologic map and estimate of total heat flux from the system.

4. Harrill (1970) appraised the water resources of a region which includes the Brady's Hot Springs area, providing estimates of storage and recharge in the basin of which it is a part.

5. Hiner (1979) described the geology of the Desert Peak geothermal anomaly which has been discovered and drilled by Phillips Petroleum Company immediately east of Brady's. His map includes the Brady area, and his thesis includes hydrologic and hydrochemical information which illustrate that the two geothermal systems appear to be isolated from one another.

6. U.S. Geological Survey (1979) prepared a report describing the blowout of Brady well No. 5, which occurred on June 19, 1979, during a clean-out as a result of corroded casing. This includes limited information on flow rate and more detailed records on the effect of the blowout on drawdown in adjacent wells.

7. Garside and Schilling (1979) summarized geology for the Brady's Hot Springs area. GFP has provided the Plant Geothermal Systems Performance Log for its production well Brady No. 8 for the period June 8, 1979 to December 17, 1979, when the facility was shut down for the winter season. This log includes backpressure, inlet water temperature at thr plant, and plant discharge pressure and temperature; appended to it are records of drawdown in wells Brady's Nos. 1, 3, 4 and EE-1 for July to October, 1979.

It should be noted that the data above are limited particularly for information on conditions at depth. Current production is from zones at less than 1,000 foot depth, and almost all of the information provided pertains to that part of the geothermal system. U.S. Geological Survey files are reported to include drilling and lithologic records from the two deepest wells at Brady's No. 8 (3,469') and EE-1 (5,061'), and from two deep wells, SP-Brady's No. 1 (7,275') and SP-Brady's No. 2 (4,446') drilled by Union and Magma about a mile north of the production area at the hot springs. The limited time available for this review prevented examination of these. Temperature surveys of No. 8 and EE-1 are included in Rudisell (1977) and Rudisell and Dykstra (1978).

Geochemical analyses of fluids from the spring and wells at Brady's are included in some of the reports above. The data are not detailed, but sufficient to enable a general description and application of geochemical geothermometers. Information on non-condensable gases is lacking. The well waters are known to produce calcium carbonate scale upon flashing. Current production is maintained under pressure to control this scaling.

GFP has recently completed the drilling of Grace No. 1, intended to be an additional production well at the site of the onion drying facility. Information gathered from this well and the production well operating history for 1980 will presumably become available to future evaluation of the geothermal system for a final feasibility and site selection report.

A final shortcoming of the database is that descriptions of well locations are of a general rather than a surveyed nature and are not always consistent, which hinders an independent consideration on our part of the locations relative to the Brady's Hot Springs Fault. Rudisell (1977) considered this question with emphasis on analysis of the part of the system above 1,000 depth. Detailed, small scale locations would be desirable for a more detailed analysis.

3.6 HISTORY OF EXPLORATION AND DEVELOPMENT

Table 1 provides a list of wells drilled in the Brady's Hot Springs region from 1959 to 1976. The list is essentially complete for 1980 as well, except for the recent drilling of Grace No. 1. The shallow temperature gradient holes reported by Olmsted and others (1975) are not included. Figure 1 shows the locations of those holes in the production area at the original hot springs site. The springs no longer flow as a result of lowering of the shallow water table by well production. It should be noted that the locations of wells Nos. 4 and 5 are not consistent in the table reproduced from the Energy Research and Development Administration report (1977) and the figure (Rudisell, 1977). Also, well depths are not entirely consistent, apparently as a result of the fact that some were deepened following original drilling. The table presumably reports original depth; depths and locations given by Rudisell are more probably currently correct.

Geothermal exploration has played little role in the development of the geothermal system at the spring. Virtually all of the production wells have been drilled simply on the basis of proximity to the easily observed manifestations of thermal activity and to the Brady Hot Springs fault, which has long been recognized as the conduit which carries the thermal fluid to the surface. Shallow temperature gradient drilling by Olmsted and others (1975) followed most deeper production drilling, and there have, apparently, been no detailed studies which attempt to correlate rock units penetrated by the deeper holes with surficial geology. Figure 2 is a geologic map of the Brady area prepared by Olmsted and others (1975), with an overlay showing the locations of wells at the site and heat flow contours defined by the shallow gradient study.

TABLE 1

List of wells drilled in the Brady's Hot Springs region from 1959 to 1976

Operator	Name	Location	Depth (ft)	Completion date	Well head pressure (psig)	Flow rate (gpm)	Steam (lb/hr)	Remarks
Magma Power Co.	Brady No. 1	NE1/4,NE1/4,SW1/4,S12,T22N,R26E	700	1959				
Magma Power Co.	Brady No. 2	NE1/4,NE1/4,SW1/4,S12,T22N,R26E	241	1959	14.5	542	13.9×10^3	BHT = 335°F
Magma Power Co.	Brady No. 3	SE1/4,SE1/4,NW1/4,S12,T22N,R26E	610	1961	9.5	313	12.4×10^3	BHT = 335°F
Magma Power Co.	Brady No. 4	SE1/4,SE1/4,NW1/4,S12,T22N,R26E	723	1961	11.0	524	19.6×10^3	
Magma Power Co.	Brady No. 5	NW1/4,SW1/4,NE1/4,S12,T22N,R26E	593	1961	18.0	1260	25.5×10^3	
Magma Power Co.	Brady No. 6	NW1/4,SW1/4,NE1/4,S12,T22N,R26E	770	?				
Magma Power Co.	Brady No. 7	NW1/4,SW1/4,NE1/4,S12,T22N,R26E	250	?				
Earth Energy Inc.	R Brady EE No. 1	S1/2,T22N,R26E	5062	1964				BHT = 414°F, prod. zone 3500–3900 ft
Earth Energy Inc.	Brady Pros. No. 1	S1/2,T22N,R26E	1758	1965				
Union Oil Co. of Calif.	SP-Brady's No. 1	NE1/4,SW1/4,SE1/4,S1,T22N,R26E	7275	1974				
Phillips Petroleum Co.	Desert Peak No. 29-1	SE1/4,SE1/4,S29,T22N,R27E	7662	1974				
Magma Energy Inc.	SP-Brady No. 2	NE1/4,NW1/4,SE1/4,S1,T22N,R26E	4446	1975				
Magma Energy Inc.	SP-Brady No. 8	NE1/4,SE1/4,NW1/4,S12,T22N,R26E	3469	1975				
Phillips Petroleum Co.	Desert Peak B No. 21-1	S1/2,SE1/4,S21,T22N,R27E	4150	1976				
Phillips Petroleum Co.	Desert Peak B No. 21-2	NE1/4,NE1/4,S21,T22N,R27E	3192	1976				390°F max

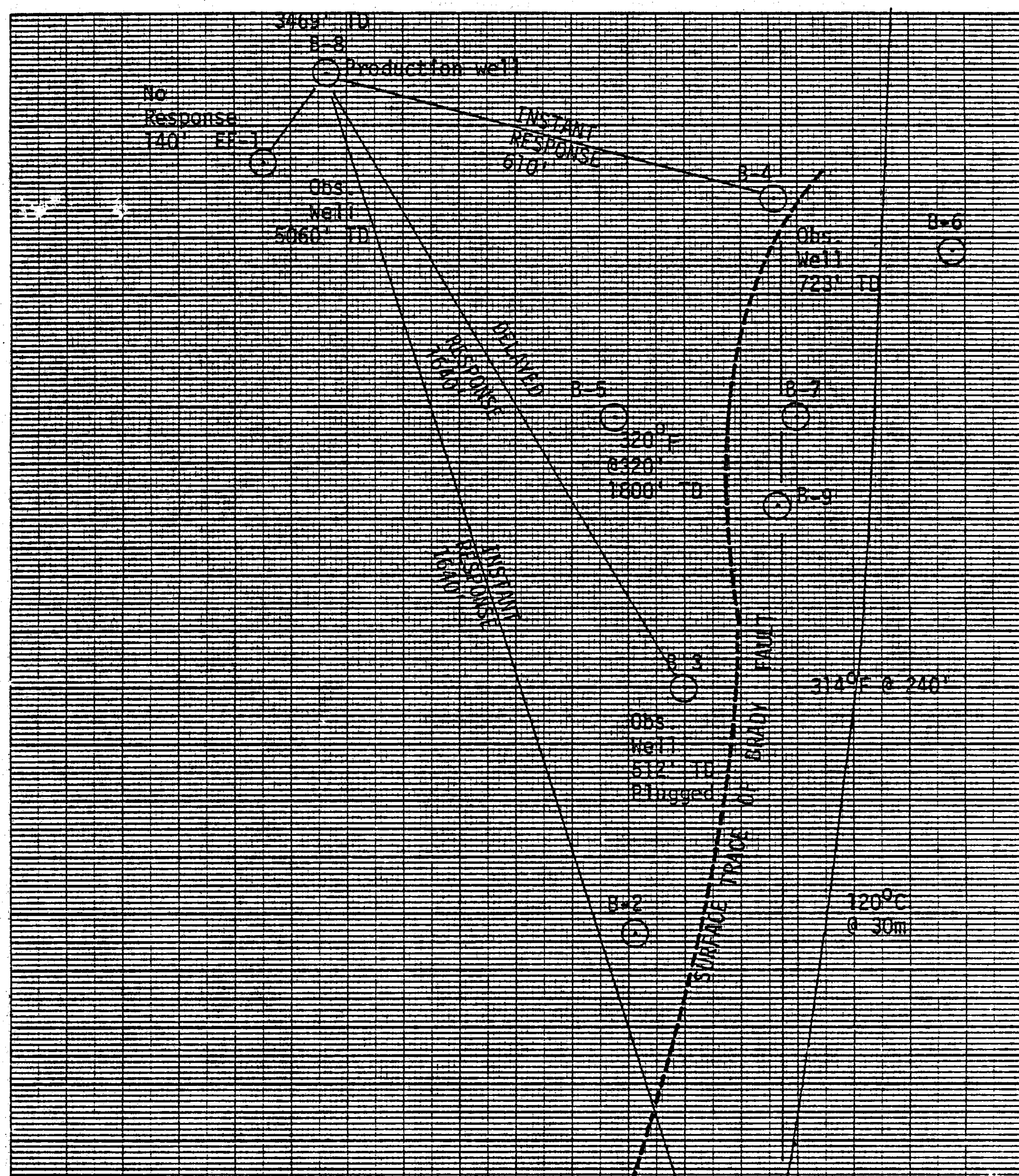


Figure -1
BRADY HOT SPRINGS
Scale 1" = 200'
HD 12/8/77

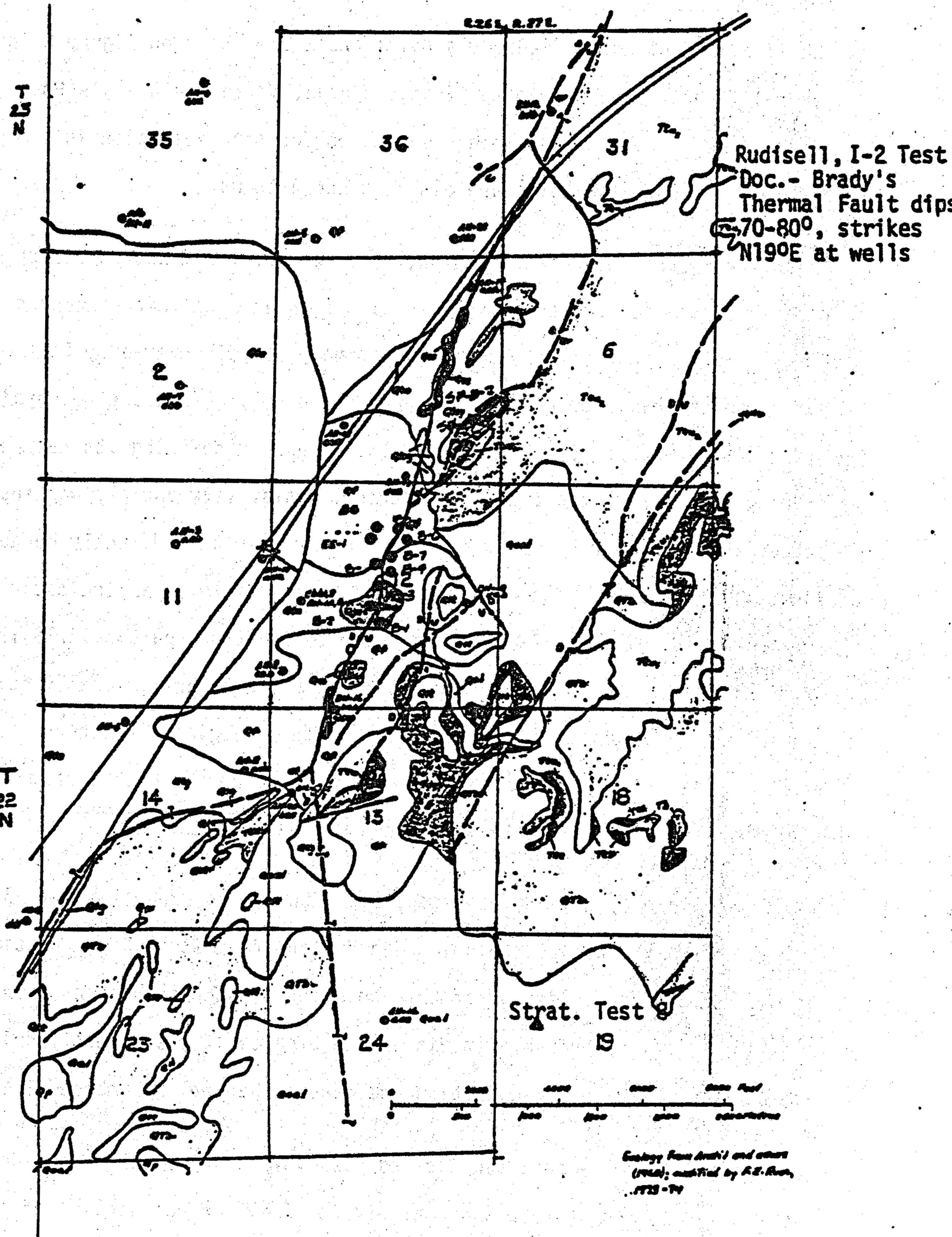


Figure 2 --Geologic map of Brady's Hot Springs thermal area showing location of test holes. Equal heat flow, HFU (olmsted and others,1975)

The locations of holes SP-Brady's No. 1 and 2 are shown on Figure 2 in a general fashion; their precise locations relative to the Brady's Hot Springs fault are not available. The bases for site selection in the drilling of these two holes are also not known to us.

In exploring the Desert Peak region, Phillips Petroleum has obtained gravity, magnetic and resistivity studies over an area which includes Brady's Hot Springs. The Desert Peak anomaly was discovered by Phillips purely on the basis of temperature gradient drilling, and the geophysical studies are reported to have been of little use in defining its nature or extent. It is reported that an electrical resistivity anomaly was interpreted to occur near Brady's, but southward rather than directly beneath the spring. However, the reliability of this anomaly as an indicator of thermal fluids at depth is very much open to question, particularly in light of the fact that cool groundwaters in the area are generally quite saline, and in light of the complexity of its geological structure. Geochemistry played no part in the discovery of the Desert Peak system. The anomaly there is blind, with no surface discharge of fluid.

The first and only hole to be used for production at Brady's is No. 8, which currently supplies the onion dehydrating facility. Documentation of the reasons for selection of this hole for production has not been provided, but very probably it was chosen because it was recently drilled and presumably in better condition and deeper than wells numbered 1 through 7.

When Brady's No. 8 was tested for its capacity to supply the onion drying facility, plans existed to subsequently use EE-1 for reinjection of the thermal fluid produced (Rudisell, 1977). This well was, reasonably, regarded as more suitable for reinjection as its greater depth held the promise of avoiding thermal interference with No. 8. Unfortunately, however, subsequent tests showed that there is a severe leak in a lap seal of the casing of EE-1 at 371 feet which produces considerable interference with No. 8 (Rudisell and Dykstra, 1978). As a consequence, the fluid under currentproduction is disposed of at the land surface, via a "french drain."

3.7 GEOLOGY

Figure 2, the a geologic map of the Brady's area reproduced from Olmsted and others (1977). Anctil and others (1960) and Hiner (1979) have mapped the area, Hiner with the assistance of some deep drilling information from the Desert Peak tests, provided by Phillips. His map shows considerably less detail in the Brady's area than does Figure 2 and the two maps do not agree particularly well. Neither map includes sufficient structural information to allow projections of units exposed at the surface into the subsurface at Brady's, and reliable information concerning the extent of displacement on the Brady's Hot Springs fault is apparently unavailable, except as may exist in proprietary files of Union Oil Company.

In spite of the lack of detailed mapping, there have been numerous studies of the stratigraphy of the Hot Springs Mountains which enabled Hiner (1979), with the assistance of the Desert Peak test information, to describe the stratigraphic section there. This is shown in Table 2. The Desert Peak thermal reservoir is reported to principally occupy fractures in Mesozoic greenstones, although it locally extends into rocks above. There is also at Desert Peak a shallow reservoir, apparently fed by the deeper one, which lies mostly within the Chlorophagus Formation at depths between 500 and 1,000 feet.

Current production at Brady's is from zones of fractured and permeable volcanic rocks at depths above 1,000 feet, and water in the wells stands, boiling, at depths of only a few tens of feet below surface.

The U.S. Geological Survey, quoted by Rudisell (1977) has commented concerning the lithology of the reservoir area:

"The wells generally penetrate up to 50 m of alluvial sediments shed from the nearby volcanic peaks. Beneath that lies 200 m of lacustrine and alluvial tuffaceous sandstone and interbedded clay strata. Hard siliceous and calcerous layers within this zone make drilling difficult. Below the sediments are interfingering flows and tuffaceous strata, with the flows of dominately (sic) basaltic and andesitic composition and the tuffs of dacitic and rhyolitic composition. Highly permeable zones seem to occur in porous basalt flows, fractured vitric tuffs, and along recently active faults and fractures. These zones are marked by alteration products from reaction with hot water, and they are noted as lost circulation zones on the drilling logs. In several wells, a great deal of effort was made to plug these permeable zones while drilling, but without much success. A high permeability is necessary for high flow rates, and permeabilities of several darcies (sic) may exist in those zones. Fluid pressures in the reservoir rocks are somewhat below hydrostatic pressure, and the wells will not flow spontaneously."

It seems from Figure 2 and Table 2 that these shallow reservoir rocks are probably part of the Desert Peak Formation. This is a tentative conclusion.

TABLE 2

STRATIGRAPHY OF THE HOT SPRINGS MOUNTAINS

Thickness, ft	Unit
Limited, mostly on flanks	Quaternary sediments, alluvium, playa deposits, deposits of Lake Lahontan
max 100	Scattered, unconformable remnants of younger andesits and basalt, some less than 5 m.y. old
about 1,800	Desert Peak and Truckee Formations: pliocene tuffaceous and diatomaceous shales, conglomerates, limestones and thin basalts
400 - 2,600	Chlorophagus Formation: vesicular, locally scoraceous basalt and andesite, agglomerate, tuff breccia, minor water-laid tuff and shale. Appears to thicken southward
1,250 - 2,150	Silicic pyroclastic rocks of Miocene to Oligocene age. Only partly exposed at the surface, completely penetrated by the Desert Peak tests. Appear to thicken southward
--	Quartz diorite which intrudes the silicic pyroclastic rocks, age and extent unkown.
--	Mesozoic bedrock, weakly to intensely metamorphosed volcanic and sedimentary rocks and coarse-grained igneous intrusives: greenstone, meta-tuff, quartzite, phyllite, schist, hornfels, limestone, marble and granite. Poor correlations between wells at Desert Peak.

Total thickness of post-Mesozoic rocks in Desert Peak tests is up to 4,500 ft.

3.8 HYDROLOGY

Table 3 reproduces a set of preliminary estimates of the hydrologic characteristics of the Brady's Hot Springs drainage basin made by Harrill (1970). The extent of this basin is shown in Figure 3 and the estimates are reproduced herein to emphasize the fact that the total groundwater reserve in an area such as this one is not large, and that recharge from precipitation is minimal. The estimates do not consider the possible volume of fluid stored in the deep geothermal system, but do indicate that thermal water withdrawn is unlikely to be replendished by precipitation and that re-injection appears highly advisable. Possible replenishment of the thermal system may occur as a consequence of deep flow from adjacent areas, or even from deep parts of this same area, but the existence of such sources of recharge is a matter of speculation. The proposed production rate of 2500 gpm corresponds to 4,033 acre-feet per year, while natural recharge for precipitation is only 160 acre feet each year.

TABLE 3

Preliminary estimates of hydrologic characteristics of Brady's Hot Springs drainage basin

Area (sq miles)	178
Minimum altitude (ft)	4,010
Surficial drainage	To Fernley Sink
Subsurface drainage	None
Inflow from outside the area	Fernley area to Fernley Sink

Hydrologic estimates	Water quantities (acre-ft)	Remarks
Surface		
Precipitation	59,000	
Runoff	110	To Fernley Sink
Surface inflow from Fernley area	4,000[a]	To Fernley Sink
Subsurface		
Groundwater recharge from precipitation	160	
Intervalley leakage		
From Fireball Valley	220	
From Fernley area	1,000	
To other areas	0	
Evapotranspiration of groundwater	−3,000	Greasewood and salt grass (outflow)
Groundwater imbalance[b]	−1,620	
Perennial yield[c]	2,500	
Transitional storage reserve[d]	150,000	

[a]Equal to annual net evaporation from Fernley Sink.
[b]One or more groundwater budget elements may be in error.
[c]Assumes much of evapotranspiration losses can be eliminated by pumping. Water is too saline for irrigation.
[d]Estimated total quantity available on a one-time basis.

Source: J. R. Harrill, Water Resources—Reconnaissance Series Report 55, State of Nevada Dept. of Conservation and Natural Resources, Div. of Water Resources, Carson City, Nevada, 1970.

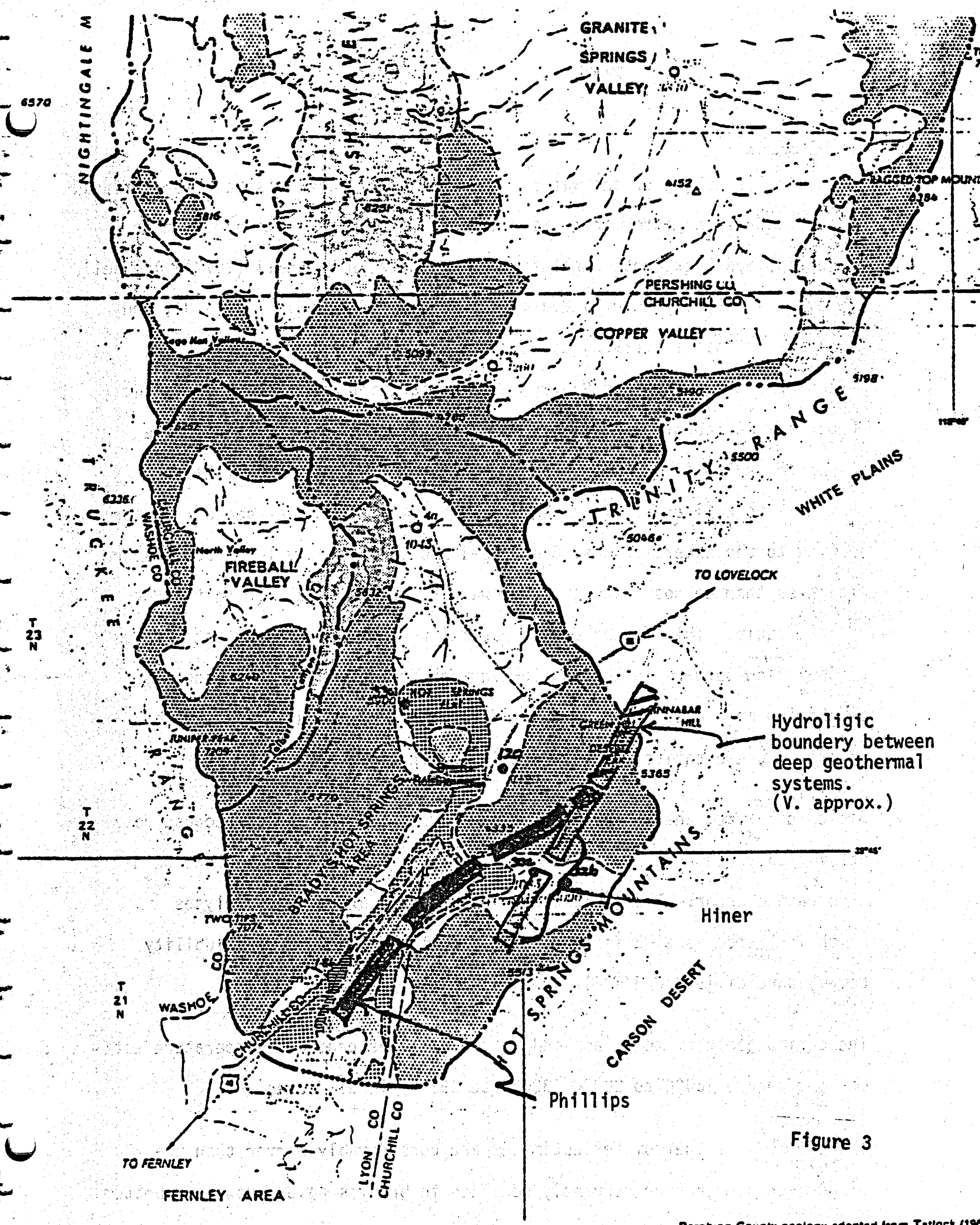


Figure 3

Pershing County geology adapted from Tatlock (19[illegible])
remaining geology by J. R. Harrill (1969)

3.9 GEOCHEMISTRY

Geochemical sampling of the waters from the wells at Brady's has been limited, and practically no information is available concerning methods of sample collection and treatment. Analyses are included in Rudisell (1977), Rudisell and Dykstra (1978), the U.S. Geological Survey (1979), Harill (1970), and Garside and Schilling (1979) as well as in file data available from the Nevada Bureau of Mines and Geology. In preparation of this review, about 20 partial and complete analyses from the various wells at Brady's were assembled and reviewed. There appear to be no significant variations from well to well or sample to sample, except that chemical geothermometers applied to the waters of Nos. 8 and EE-1 produce slightly lower temperature estimates than do most estimates for waters from wells closer to the Hot Springs fault. This may be due to partial re-equilibration of the waters as they flow outward in the shallow aquifer from the main fault conduit to the two more distant wells. But data are too limited to confirm this. Several representative analyses are listed in Table 4.

Silica data from the analyses reviewed are somewhat ambiguous because data are variably reported as SiO_2 and as Si. The latter may or may not be a typographic error. The highest concentration in any of the analyses which is listed as SiO_2 is 295 mg/l, which produces a quartz solubility temperature of 191°/C/376°F).

The cation geothermometer applied to the analyses produces temperature estimates of about 160°C to 200°C (320°F to 392°F) in all cases.

The chemical geothermometer estimates are considerably warmer than the 270°F production temperature currently realized in Brady's No.8. However, bottom

TABLE 4
REPRESENTATIVE CHEMICAL ANALYSES OF WATERS
FROM WELLS AT BRADY'S HOT SPRINGS

Well	Ca	Mg	Na	K	HCO_3	CO_3	SO_4	U	SiO_2	B	pH
Brady's No. 8	23	0.43	846	32.0	92.0	5.7	270	1000	140*	--	--
do.	46	0.50	980	47.0	57.6	9.1	314	1470	200	5.8	8.55
EE-1	80	0.24	680	34.0	195.0	--	310	910	200*	3.8	--
Brady's No. 8	22	0.00	817	60.5	--	--	358	1080	295	5.4	9.00

*Listed in source as Si

hole temperatures in most of the wells have been higher than this. A maximum 414°F has been measured at the bottom of EE-1 (5060). Hence, there is little doubt that deeper in the hydrologic system which feeds the shallow production aquifer there are waters at a higher temperature than 270°F. The production well waters have compositions which still retain the effect of the higher temperature even after having cooled in the shallow system.

3.10 WELL SURVEY AND TEST RESULTS

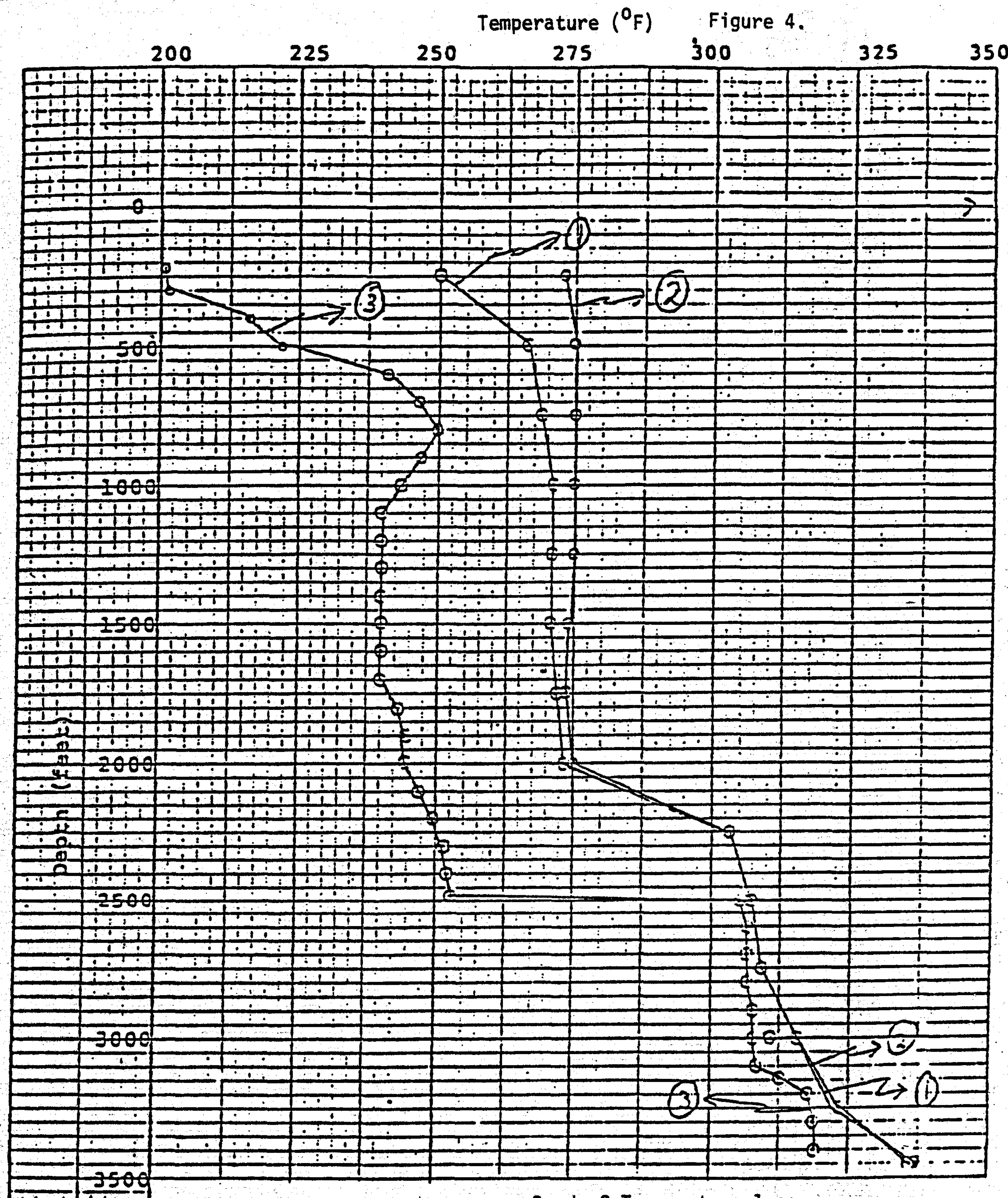
Well survey and test results available to this review are those reported by Rudisell (1977) and Rudisell and Dykstra (1978) for production testing of Brady's No. 8 and injection testing of EE-1. Rudisell (1977) refers to testing of Brady's No. 5 in 1969 and to test of SP-Brady's 1 and 2 (see his bibliography and Appendix III-2) but the extent of documentation of these tests is not known to the present reviewers. Limited testing of Brady's No. 1 through 4 is also implied by flow data which appear in Table 1 above.

Production testing of Brady's No. 1 was performed as two separate tests, the longer of which lasted 300 hours (12 + days) (Rudisell, 1977). The well was pumped at approximately 660 gpm with a pump set at 500 feet. Drawdown in the sell during pumping was not measured due to inability of the operator to install proper equipment for this, but recovery was measured immediately after shutdown. Wells Brady's No. 1, 3 and 4 were monitored for drawdown during the test and complete data of the test are included in Rudisell (1977).

From a study of information provided by Magma, Union and others plus the results of his testing, Rudisell (1977) concluded that the reservoir currently tapped by wells at Brady's lies in a zone between about 500 and 800 feet depth, fed by heated waters that rise along the western down-thrown Brady's Thermal Fault. The reservoir exists on both sides of the fault, as evidenced by temperature gradients and the very direct and rapid response of Brady's No. 1 to the pumping of Brady's No. 8. Cross-sections between Brady's No. 1, 5 and EE-1 apparently show that displacement across the fault is only "slight", so it may not be surprising that the fault does not act as a complete hydrologic barrier. Both cross-sections and temperature gradients suggest that the reservoir is gravity controlled and assymmethically skewed around the fault toward the west. The shallow reservoir is at low pressure, (below hyrostatic), and thus fractured and vugular basalts which it occupies apparently dip toward the west. Thus, hot water which rises through the fault zone tends to flow down-dip towards the west, rather than up-dip to the east, producing the skewed shape of the shallow temperature anomaly. As discussed in the section on geochemistry, water from the shallow reservoir is cooler than water at depth in the fault zone which feeds it. Exact production temperatures appear to be determined by proximity to the fault and local permeability factors. Permeable zones appear to exist at 300 to 400 feet in Brady's Nos. 1, 3, 4 and 5 on the basis of both production and temperature logs. Brady's No. 3 is apparently producible at 150°C (302°F) and Brady's No. 5 at 135°C(275°F). Brady's No.8 produces at 132°C (270°F), but apparently from behind the casing in a highly fractured and vugular basalt and tuff interval from 610 to 1,050 feet where large lost circulation losses occurred during drilling. This zone was not well cemented when casing was emplaced in the hole. From drilling histories and test results, this same zone was penetrated by Brady's No. 1, 4 5 and EE-1, and mutually produces into Nos. 1, 4 and 8 from about 610 to 800 feet. It has been cased off in EE-1.

Temperature logs of Brady's No. 8 and EE-1 are reproduced as Figures 4, 5 and 6. Survey No. 3 of Brady's No. 8 shows the effects of injection of

Figure 4.

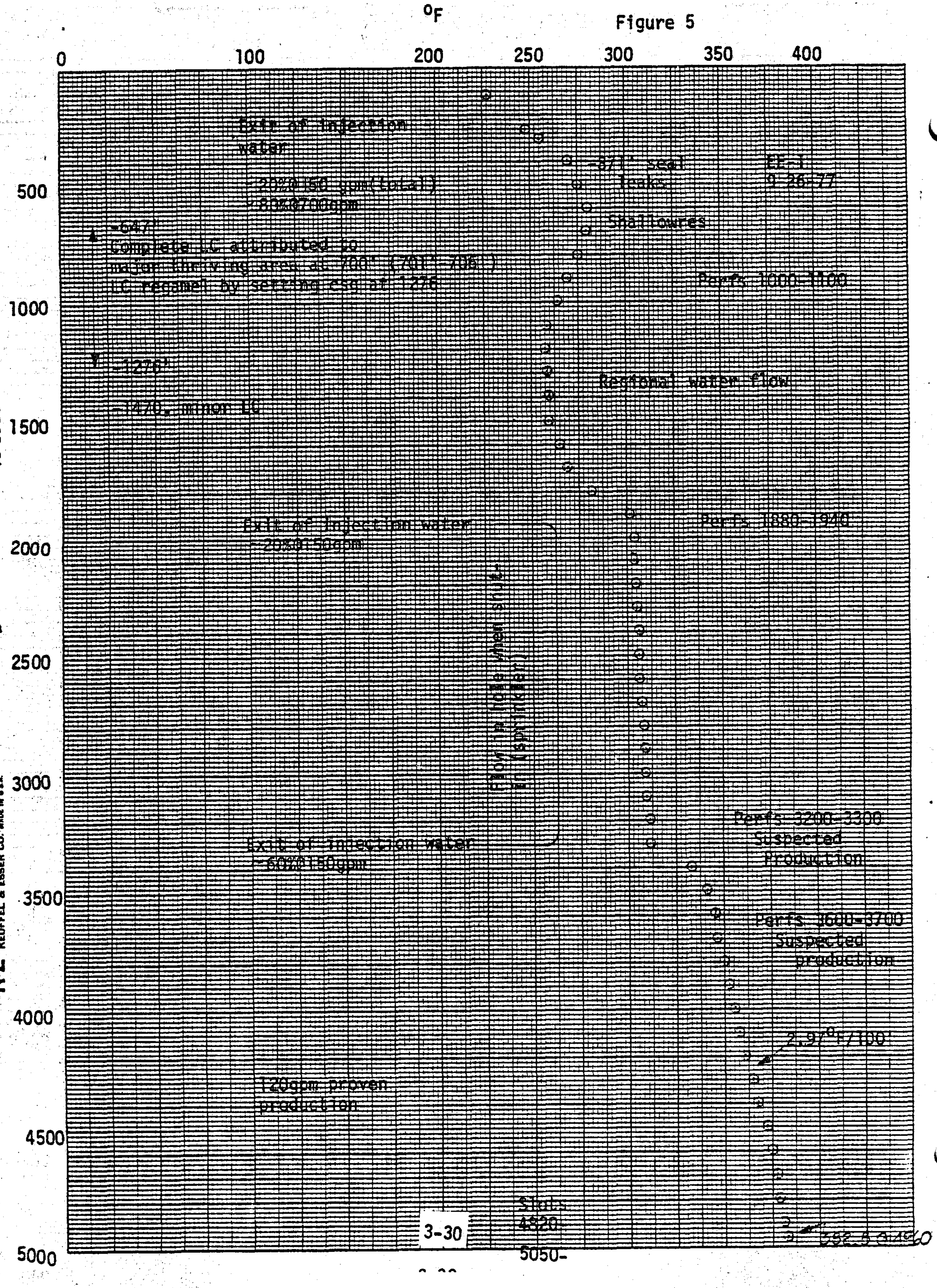


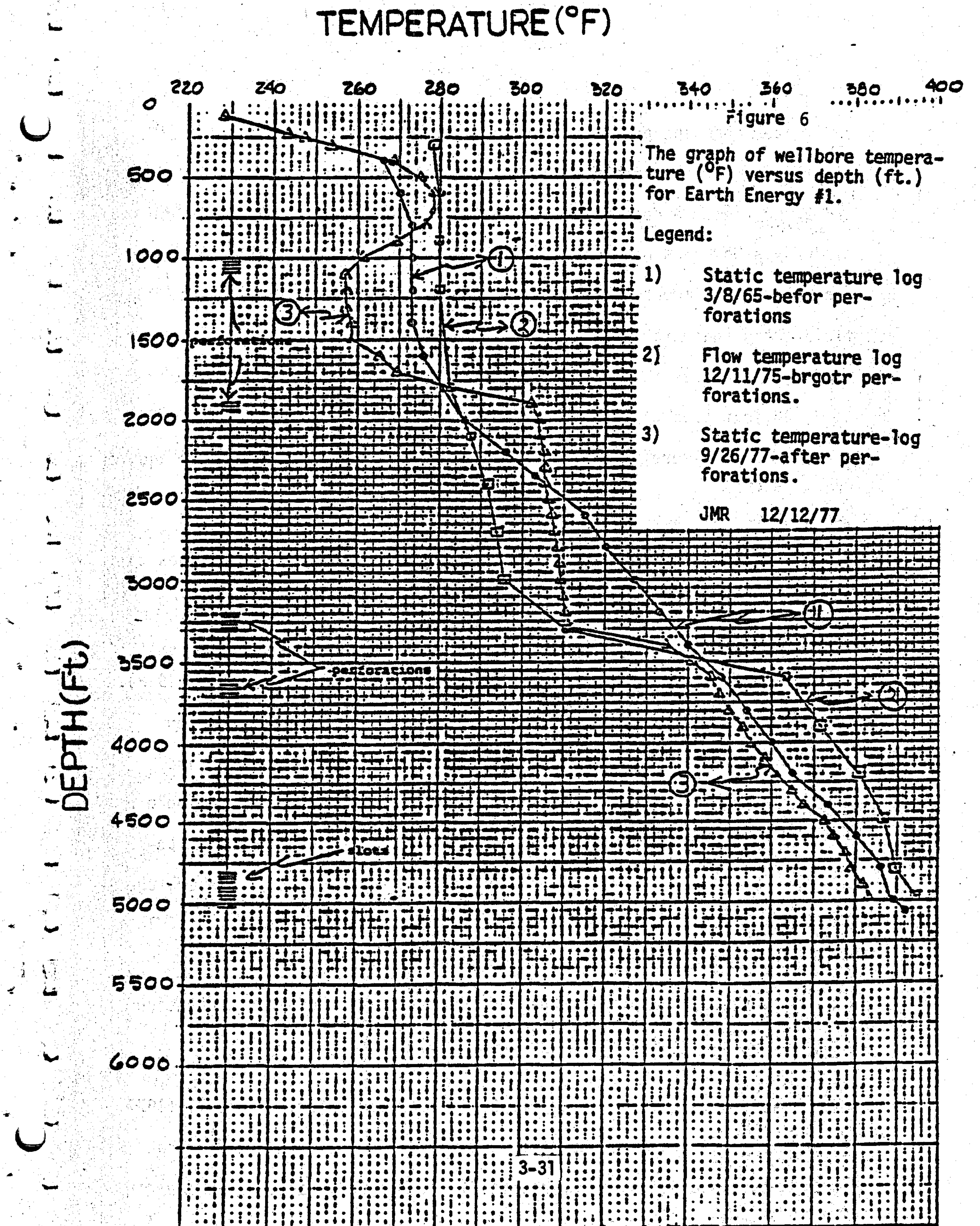
Brady 8 Temperature logs

The graph of temperature (°F) as versus depth in Brady 8

1. Static survey 4/26/75
2. Flowing survey 4/27/75
3. Static survey after water injection 9/26/77

Figure 5


°F
0
100
200
250
300
350
400
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Exit of injection water
~20%@150 gpm(total)
~80%@700gpm
~647'
Complete LC attributed to
-1276'
-1470, minor LC
~871' seal leaks
EE-1
9-26-77
Shallowres
Perfs 1000-1100
Regional water flow
Exit of injection water
~20%@150gpm
Perfs 1880-1940
Flow in hole when shut-in (spinner)
Perfs 3200-3300
Suspected
Production
Exit of injection water
~60%@150gpm
Perfs 3600-3700
Suspected
production
2.97°F/100'
120gpm proven
production
Slots
4920-
5050-



TEMPERATURE (°F)
220
240
260
280
300
320
340
360
380
400
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
DEPTH (Ft)
Figure 6
The graph of wellbore temperature (°F) versus depth (ft.) for Earth Energy #1.
Legend:
1) Static temperature log 3/8/65-befor perforations
2) Flow temperature log 12/11/75-brgotr perforations.
3) Static temperature-log 9/26/77-after perforations.
JMR 12/12/77
perforations
perforations
slots
1
2
3

cool water into the production zone at 600 to 800 feet depth and static and flowing surveys of the hole show an isothermal zone between 500 feet and 2,000 feet. A description of the casing and perforation condition of Brady's No. 8 is not available, so it is uncertain whether the isothermal zone is created by flow conditions within the hole, such as fluid entry and exit from different zones, or by natural isothermal conditions such as may occur in a convecting reservoir which continues to 2,000 feet depth. In the latter case, the production zone from 600 to 800 feet may merely be the most permeable part of a much thicker aquifer.

The Log of EE-1 (see Figure 6) also shows a gradient break at 2,000 feet, which supports the idea that the main shallow aquifer continues to that depth, but that permeability of the rocks below 2,000 feet drops considerably. Additional logs of EE-1 obtained after the well was perforated, plus the results of injection testing (Rudisell and Dykstra, 1978), indicate that there is some intra-wellbore flow which occurs between perforations at 1,000 feet and 1,900 feet and between 1,900 feet and 3,200 feet. The permeability at depth indicated by this intrawellbore flow to and from perforations led to hopes that EE-1 would be a suitable injection well for fluids produced from Brady's No. 8. However, the well casing was subsequently found to be poorly sealed at a lap at 371 feet, from which rapid communication developed with Brady's No. 8 during injection tests, in spite of the lack of response of EE-1 to production of that well. (Rudisell and Dykstra, 1978).

Production testing of EE-1 has not been well-documented. Rudisell (1977, Appendix III-2) reported that the well flowed an estimated 120 gpm hot water with a race of steam when initially completed, cased, with the only open section of the hole being slots from 4,830 to 5,060 feet (T.D.) (Dec. 12, 1964). The well was subsequenly perforated in November 1965, and "came in" or flowed during perforation of the interval 3,700 to 3,600 feet. This was the first interval peforated well head pressure apparently remained the same as other zones were opened, indicating that this is the main production zone of the well.

Major conclusions reached in production testing of Brady's No. 8 included:

1. The well is capable of supplying a 700 gpm flow rate without problems in pump operation due to excessive drawdown.
2. Continuous production water of at least 270°F is possible from Brady's No. 8 or, probably, any of the shallow wells in the field where interference between wells does not occur.
3. The water composition is of acceptable nature to be piped through conventional materials. Gas content appears to be low. Pressures above saturation must be maintained to prevent calcite scaling; the water forms scale in response to boiling.
4. Drawdown of Brady's No. 1 and 4 was observed during testing of Brady's No. 8 and was continuing even at termination of the 300 hour test, although at a decreasing rate. Rate of drawdown in Brady's No. 4 dropped from about 1 foot/30 hours to about 1 foot/135 hours, and that of No. 1 dropped from about 1 foot/5 hours to 1 foot/40 hours. Total drawdown in each well was about 5 feet. Drawdown of Brady's No. 8 was not measured during the test, but its recovery after shutdown was similar to that of No. 1, and it may have been dropping at a similar rate.

The observations in conclusion 4 infer that the shallow reservoir is similar to a big container fed by water rising through the Brady's Thermal Fault Zone. (Rudisell, 1977, pro) With decreased pressure at the feeding interval near 700 to 800 feet, this deep source will act to replenish the shallow reservoir with proportionally greater flow. Eventually, the outflow from production may be balanced by inflow from depth. If so, pressure decline of the field would be expected to be rapid at first, with a gradual decrease to a very slow or near zero decline rate over time. Only longer pumping times than the 300 hours of the test can confirm such a model (see next section). Build-up data at Brady's Nos. 1, 4 and 8 tend to confirm the model; all three display a continuously decreasing rate of recovery over time, presumably due to the increasing hydrostatic pressure in the shallow reservoir as it is "refilled" by the deep source.

The model above does not actually indicate whether the deep source feeding the shallow reservoir at Brady's actually can suppply 700 gpm or more, and it treats the drawdown curves of the wells only in a qualitative fashion. However, the noted drawdown, or pressure decline, of the shallow reservoir after 300 hours of testing was only about 5 feet (or 2 psi), and Rudisell concluded from this, plus the consistent temperature and composition of the water produced, that "it may be conservatively concluded that the reservoir has at least more than a reasonable chance of providing the required flow rate (700 gpm) for the 15 year life of the (onion drying) plant". (Rudisell, 1977, p. 21).

With respect to Rudisell's conclusion, Olmsted and others (1975) estimated the natural water discharge from the Brady's hydrothermal system to be about 1,385 acre-feet per year on the basis of heat flow, and stated that this may be an underestimate. Historically measured flow rates of the hot springs (now dry) were about 30 to 80 acre-feet per year, the Olmsted estimate shows that most of the discharge occurs in the subsurface as outward flow within the shallow aquifer. By way of comparison, a 700 gpm production rate corresponds to 1,130 acre-feet per year, or 464 acre-feet when continued over a period of 150 days. Thus, the production from the Brady's No. 8 for the onion dehydration facility may be about exactly equivalent to the historic flow rate from the deep source to the shallow reservoir. The system may flow at higher rates if its hydrostatic load is decreased by pumping of the shallow reservoir.

3.11 BLOWOUT OF BRADY'S NO. 5

On June 17, 1979 well Brady's No. 5 experienced a blow-out during a clean-out operation, as a result of corroded casing. A description of this by the U.S. Geological Survey (1979), treated a period to October 26, 1979, at which time the blowout remained uncontrolled. Wells Brady's Nos. 1, 3, 4 and EE-1 were monitored during the blow-out, and each experienced a much more severe drawdown than seen during the pump test. The results of the drawdown measurements are shown in Figure 7. Initial drawdown was rapid. The water level in each well began to level off and eventually began to rise very slowly as the blowout progressed. Drawdown measurements are graphed for a period beginning July 1. By about September 20, after (83 days) each well had reached a maximum drawdown of 22 1/2 to 35 1/2 feet with respect to the level on July 1. Between September 20 and October 22 each well recovered from about 1 to 2 1/2 feet.

Flow from No. 5 decreased during the blow-out. It could not be measured initially, but on July 1 the column of steam and water rising from the well reached a height of about 150 feet. By October 26 there was a column of hot water rising only about 15 feet, and the flow was measured as 307 gpm in an adjacent drainage channel.

It seem unclear whether the decreasing flow of the blow-out was due to restriction of the well bore by calcite deposits, a decrease in pressure or temperature and boiling in the reservoir, or both. The shallow thermal reservoir at Brady's is considered to be at pressures below hydrostatic, and it seems that the blowout was powered by flashing of fluid in the wellbore.

3.12 PRODUCTION PERFORMANCE LOG AND DRAWDOWN REPORT

The GFP plant geothermal system performance log for the period June 8 to December 17, 1979 shows that water temperature from Brady's No. 8 at the plant inlet point maintained a constant temperature of 267°F to 270°F. Backpressure at the well averaged about 150 to 160 psig during June through September, but thereafter increased to about 180 to 190 psig by the end of the period. The increase appears to have been gradual, but the data have not been graphically plotted to confirm this. Day to day fluctuations were as high as 15 psig. Total flow is estimated at 400 to 500 gpm, daily records of this are not available.

Drawdown records for Brady's No. 1, 3, 4 and EE-1 have been provided by GFP for the period June 23 through October 25, 1979. They cover much of the period of the blow-out of Brady's No. 5 on June 17, but do not provide drawdown information for periods of normal production. The drawdown records are very similar to those plotted by the U.S. Geological Survey (1979) for the same period, but appear to differ in detail. The extent of the difference is unclear; we do not have a good-quality reproduction of the U.S.G.S. data. Maximum drawdown relative to static conditions in each well was 38 to 48 feet.

The drawdown data show a very slow recovery in October. This may be compared with the section above on the blowout of Brady's No. 5). On October 26, Brady's No. 5 was flowing about 306 gpm, and No. 8 was being pumped at 400 to 500 gpm. From the slow recovery, it seems that the deep source was capable of supplying the shallow reservoir at a rate not much greater than about 800 gpm. Whether more rapid recovery would occur under a greater drawdown is unknown.

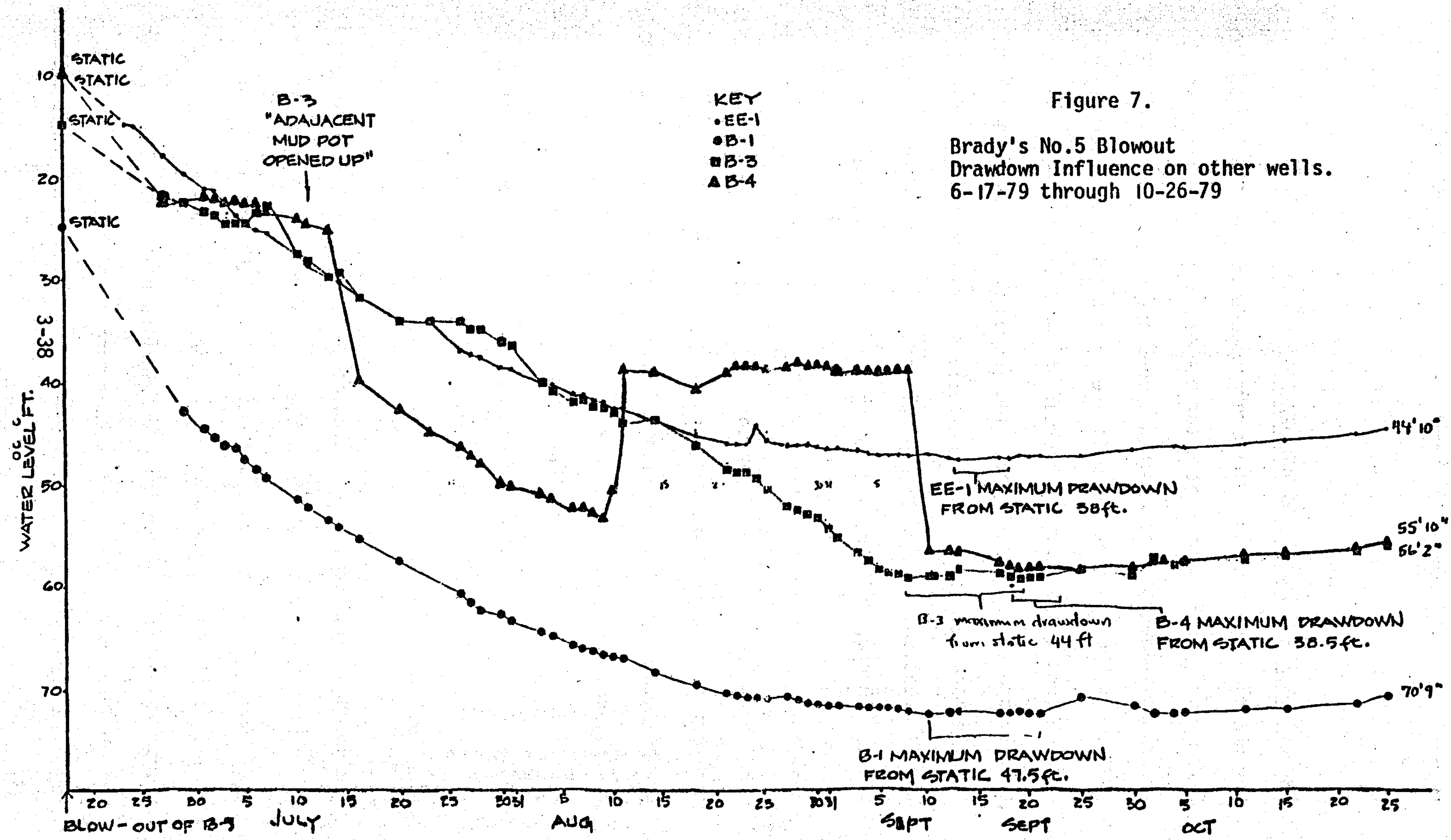


Figure 7.

Brady's No.5 Blowout
Drawdown Influence on other wells.
6-17-79 through 10-26-79

SECTION 4

AGRICULTURAL

FEEDSTOCK ANALYSIS

4.1 INTRODUCTION AND BASIS

This portion of the study provides an analysis of the regional agricultural feedstock availability and economics to support a geothermally heated fuel ethanol plant at the Brady's Hot Springs site of Geothermal Food Processors, Inc.

The plant has been sized for 10 million gallon per year production of anhydrous fuel ethanol.

The information presented in this study is based on independent research and a regional agricultural site survey done by Ag West, Inc.

4.2 FEEDSTOCK REQUIREMENTS

For the 10MMGPY fuel ethanol plant, between 109,000 and 113,000 tons of feedstock are required per year, depending on whether the feedstock is corn or barley. With the plant operating 330 days per year, the daily imput rates for corn or barley are as follows:

TABLE 4-1

10MMGPY - DAILY OPERATING BASIS - 330 DAYS/YEAR

	CORN	BARLEY
TPD Feedstock	330	343
TPD Concentrated Solubles Produced	116	148
TPD Dried Spent Grains Produced	60	76
Gal/Day Anahydrous Ethanol	30,300	30,300

TPD = Tons Per (24 hours) Day

TABLE 4-2

10MMGPY - ANNUAL OPERATING BASIS

	CORN	BARLEY
TPY Feedstock	109,000	113,000
TPY Concentrated Solubles Produced	38,142	49,000
TPY Dried Spent Grains	19,697	25,000
Gal/Year Anhydrous Ethanol	10,000,000	10,000,000

TPY = Tons Per Year

4.3 FEEDSTOCK CONVERSION AND ECONOMIC SELECTIONS

The analysis of feedstock conversion to fuel ethanol is presented in Table 4-3 for corn, wheat, barley and potatoes. Highest conversion is obtained with wheat and corn; the lowest conversion per ton with potatoes.

Included in the analysis of Table 4-3 is a preliminary estimate of the wholesale price for fuel alcohol in a 10% blend with gasoline. These costs reflect the following assumptions:

1. Feedstock costs at point of origin.
2. Rail or truck freight cost for feedstock.
3. Credit to processor for sale or by-product stillage grains.
4. Manufacturing costs to processor including freight to Reno and Capital recovery.
5. A federal entitlement of 4.5¢ per blend gallon of 10% "gasohol"; equivalent to a 45¢ gallon alcohol production subsidy.
6. An arbitrary 10¢/gallon fuel alcohol processor margin for risk profit and commodity price contingency.
7. Local feedstock priced at value to be competitive with existing regional alfalfa acreage revenues.

The following feedstock ranking shows the groupings of economic viability based on these assumptions:

1. Western Nevada barley, Fallon - Highly Viable @ $1.11/gal
2. Western Nevada Spring Wheat, Fallon - Highly Viable @ $1.13/gal
3. Western Nevada Barley, Lovelock - Highly Viable @ $1.16/gal

4. Western Nevada Spring Wheat, Yerington - Viable @ $1.33/gal

5. Western Nevada Winter Wheat, Fallon - Viable @ $1.34/gal

6. Nebraska Corn - Viable @ $1.36/gal

7. Western Nevada Winter Wheat, Lovelock - Viable @ $1.37/gal

8. Idaho Barley - Marginally Viable @ $1.47/gal

9. Kansas Corn - Marginally Viable @ $1.49/gal

10. Western Nevada Cull Potatoes - Marginally Viable @ $1.55/gal

11. Arizona Barley - Uneconomical @ $2.29/gal

12. Kansas Wheat - Uneconomical @ $2.30/gal

13. Idaho Potatoes - Uneconomical @ $4.20/gal

The most viable feedstocks are local grains, followed by Nebraska corn, Idaho barley, Kansas corn and Nevada cull potatoes.

TABLE 4-3

FUEL ETHANOL
FEEDSTOCK ANALYSIS - 1980

FEEDSTOCK	PRICE $/BU	PRICE $/TON	GAL/ TON	TON/ ACRE	GAL/ ACRE	FEEDSTOCK $/GAL ALCOHOL	BY-PRODUCT CREDIT $/GAL ALCOHOL	FT. & MFG. COST $/GAL ALCOHOL	TOTAL SUBSIDY $/GAL ALCOHOL	NET WHSL $/GAL ALCOHOL
1. Barley, Fallon, Nevada Base Price										
FOB Fernley Truck	2.88	120.00	83.4	2.18	182	1.49	.43	.50	.45	1.11
Frt. to Fallon	.10	4.16								
Total FOB Fernley	2.98	124.16								
2. Wheat, Spring Nevada Base Price										
FOB Fallon Truck	4.00	133.33	92.8	2.16	200.5	1.47	.39	.50	.45	1.13
Frt. to Fernley	.10	3.33								
Total FOB Fernley	4.10	136.66								
3. Barley, Lovelock NV Base Price FOB										
Lovelock Truck	2.88	120.00	83.4	2.18	182	1.54	.43	.50	.45	1.16
Frt. to Fernley	.20	8.33								
Total FOB Fernley	3.08	128.33								
4. Wheat, Spring Nevada Base Price FOB Yerington										
Truck Frt. to	4.00	133.33	92.8	2.16	200.5	1.52	.39	.50	.45	1.33
Fernley	.24	7.99								
Total FOB Fernley		4.24	141.32							
5. Wheat, Winter Nevada Base Price										
FOB Fallon Truck	4.15	138.33	92.8	2.16	200.5	1.53	.39	.50	.45	1.34
Frt. to Fernley	.10	3.33								
Total FOB Fernley	4.25	141.66								

*Approximate Net Wholesale Price FOB Reno inluding 10¢/Gal markup, 45¢/Gal. Fed. Entitlements.

Table 4-3 (Continued)

FEEDSTOCK	PRICE $/BU	PRICE $/TON	GAL/ TON	TON/ ACRE	GAL/ ACRE	FEEDSTOCK $/GAL ALCOHOL	BY-PRODUCT CREDIT $/GAL ALCOHOL	FT. & MFG. COST $/GAL ALCOHOL	TOTAL SUBSIDY $/GAL ALCOHOL	NET WHSL $/GAL ALCOHOL
6. Corn, #2 Feed,										
Nebraska Base Price										
FOB Nebraska Rail	2.79	99.64	91.8	3.14	288	1.50	.34	.50	.45	1.36
Frt. to Fernley	1.06	37.86								
Total FOB Fernley	3.85	137.50								
7. Wheat, Winter										
Nevada Base Price										
FOB Lovelock										
Truck Frt to	4.15	138.33	92.8	2.16	200.5	1.56	.39	.50	.45	1.37
Fernley	.20	6.67								
Total FOB Fernley	4.35	145.00								
8. Barley, Burley										
Idaho Base Price										
FOB Burley Rail	2.58	107.50	83.4	1.90	158.5	1.61	.34	.50	.45	1.47
Frt. to Fernley	.65	27.08								
Total FOB Fernley	3.23	134.58								
9. Corn, #2 Feed,										
Kansas Base Price										
FOB Kansas Rail	3.18	113.57	91.8	3.14	288.3	1.67	.38	.50	.45	1.49
Frt. to Fernley	1.11	39.64								
Total FOB Fernley	4.29	153.21								
10. Cull Potatoes,	N.A									
Nevada Base Price										
FOB Winnemucca										
Truck Frt. to	($1.00	20.00	23.8	3.30**	78.5	1.47	.22	.60	.45	1.55
Fernley	per CWT)	15.00								
Total FOB Fernley		35.00								

*Approximate Net Wholesale Price FOB Reno inluding 10¢/Gal markup, 45¢/Gal. Fed. Entitlements.

**Represents culls at 20% of total yield/acre

Table 4-3 (Continued)

FEEDSTOCK	PRICE $/BU	PRICE $/TON	GAL/ TON	TON/ ACRE	GAL/ ACRE	FEEDSTOCK $/GAL ALCOHOL	BY-PRODUCT CREDIT $/GAL ALCOHOL	FT. & MFG. COST $/GAL ALCOHOL	TOTAL SUBSIDY $/GAL ALCOHOL	NET WHS $/GAL ALCOHO
11. Barley, Chandler, AZ Base Price FOB										
Chandler Rail Frt.	2.31	110.80	83.4	1.85	154.0	2.40	.31	.50	.45	2.29
to Fernley	2.15	89.58								
Total FOB Fernley	4.46	200.38								
12. Wheat, Kansas City, KS Base Price FOB										
Kansas Rail Frt.	4.23	140.99	92.8	1.70	157.8	2.44	.34	.50	.45	2.30
to Fernley	2.55	84.99								
Total FOB Fernley	6.78	225.98								
13. Potatoes, Idaho Base Price FOB	N.A.									
Burley Rail Frt.	($4.00	80.00	23.8	14.5	345.0	4.50	.23	.60	.45	4.20
to Fernley	per CWT)	27.00								
Total FOB Fernley		107.00								

* Approximate Net Wholesale Price FOB Reno including 10¢/Gal markup, 45¢/Gal. Fed. Entitlements.

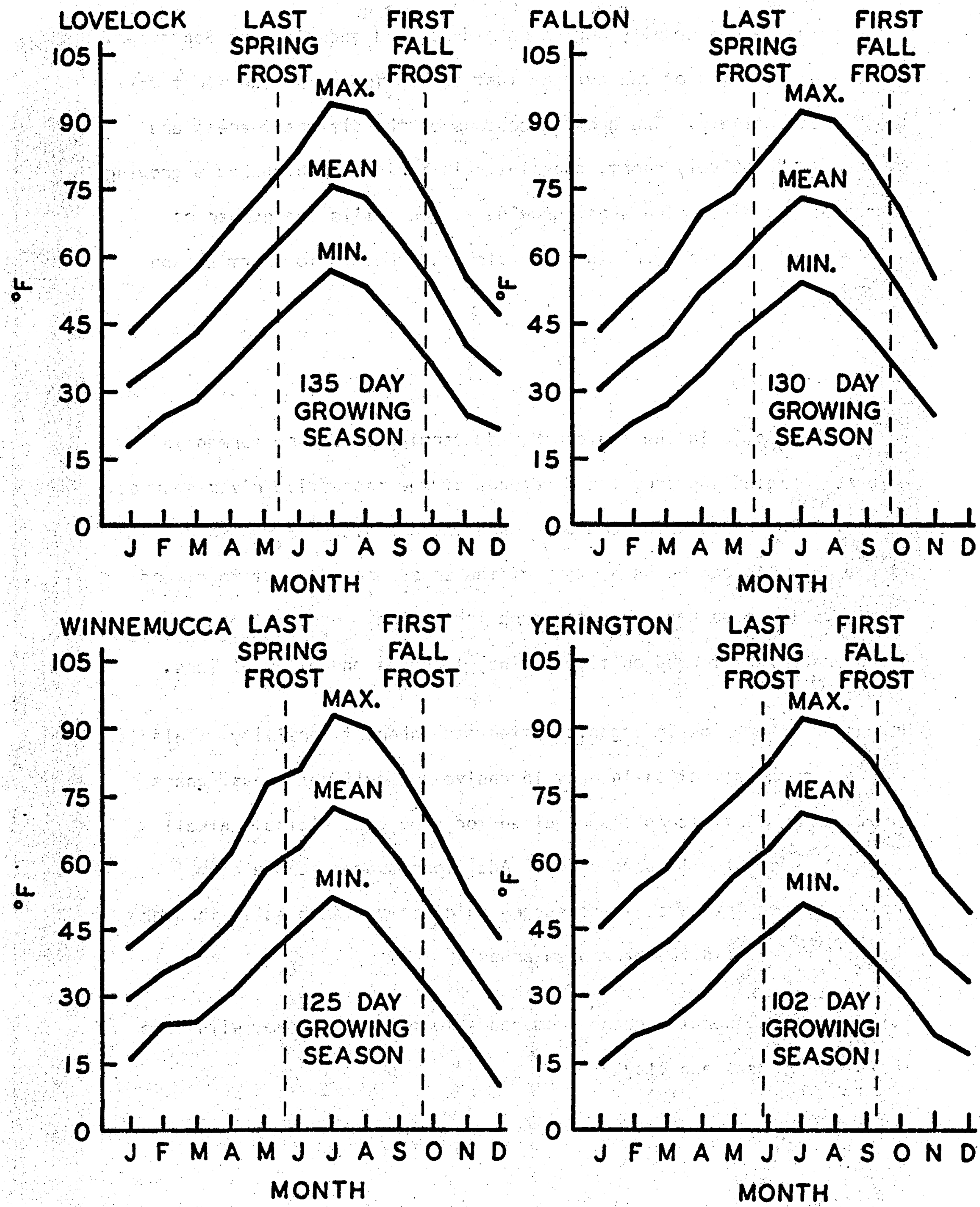
4.4 AGRICULTURAL ANALYSIS FOR FEEDSTOCK PRODUCTION IN WESTERN NEVADA

The climate in Western Nevada is characterized as an arid, continental type. The Sierra Nevada Mountains to the west influence precipitation in the area, where the majority of rainfall and snowfall occur during the winter. Nevada climate is also known for its bright sunshine, dryness and purity of air, and an extremely wide daily temperature range.

The cities which represent the chosen agricultural areas are Fallon, Lovelock, Winnemucca, and Yerington. In summer, days are hot while nights are cool (see Figure 4-1). Daily differences between the highest and lowest temperatures may range up to 50 degrees or more. Humidity is very low, ranging from 25 percent in the summer to 65 percent in the winter. The dry air and bright sunshine produces a high evaporation rate which means that more irrigation water must be supplied to compensate for that lost by evaporation.

Two main air flows influence the precipitation in Western Nevada. The Major one comes from the Pacific Ocean. As this Pacific air rises over the Sierra Nevada Range into Nevada, much of the moisture is lost, consequently, only a small amount of moisture reaches Nevada. the other air flow affecting the state comes from the south. This warm, moist air is the main source of summer thunderstorms. Average rainfall amounts range between five and ten inches in the specific cities (see Figure 4-2). Rain usually falls every month of the year though the annual total is low. Snow falls each year and ranges from 7.4 inches at Fallon to 28 inches at Winnemucca. Winter snow pack in the mountain regions is the major source of summertime irrigation water.

FIGURE 4-1
AVERAGE MONTHLY TEMPERATURES



The growing season usually begins in mid-May and ends in late September. These are the times of the average last spring frost and the first fall frost, respectively. The growing seasons of the different areas are considered relatively short, especially in Yerington which has a growing season of 102 days. The short growing season limits the number of alfalfa cuttings per year and restricts crop choices to short season varieties.

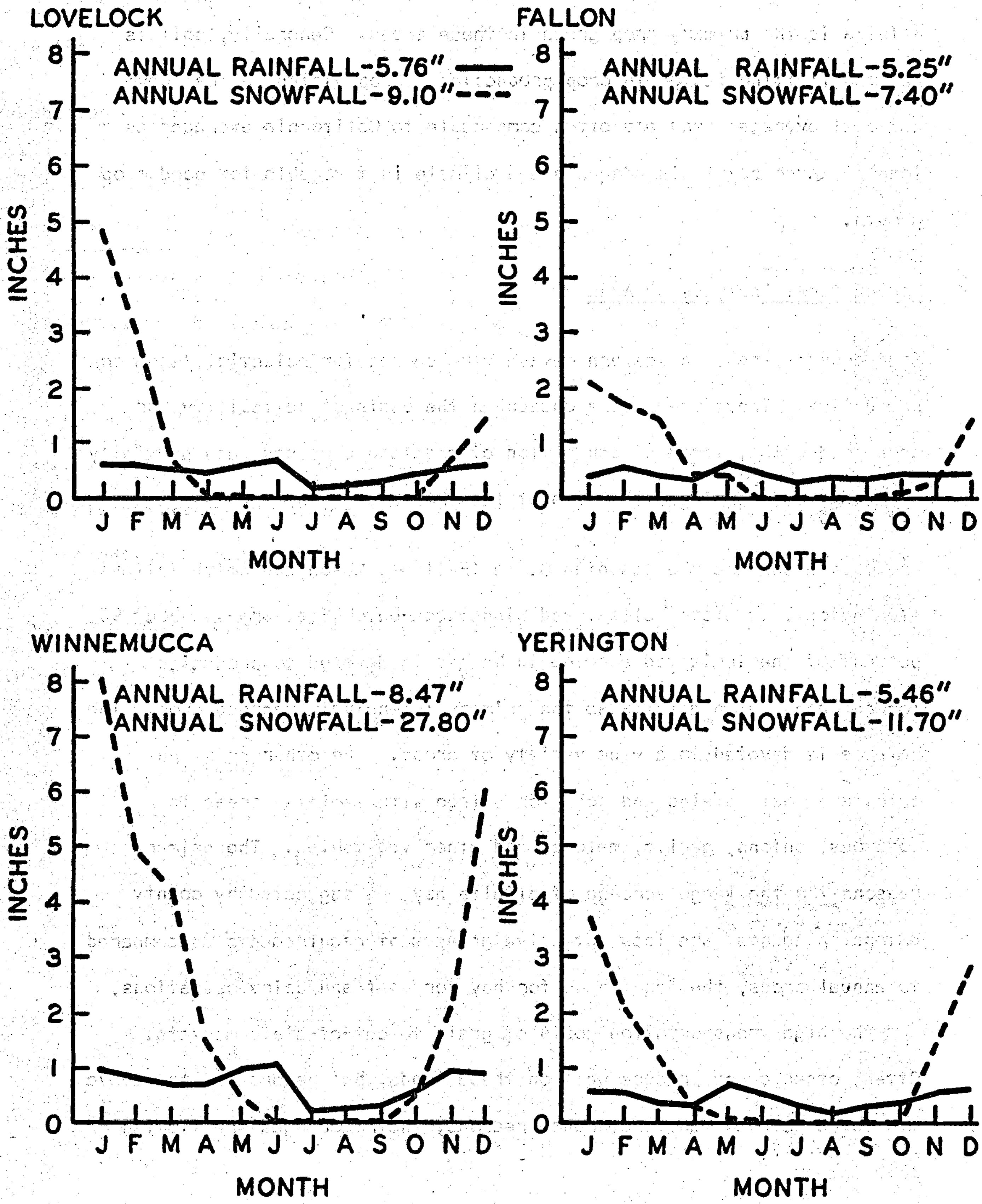
Soils

In general, soils in the Western Nevada farming area were formed in alluvium originating from the headlands of the respective river sources. The irrigated areas which are discussed in this study are shown on figure 4-3. As can be seen, many of the areas are adjacent to rivers which supply water necessary for crop irrigation. Hence, the soils in these areas were formed on floodplains, terraces and alluvial fans.

Nevada soils are low in organic matter and inherent fertility. This is similar to the situation in many intensive agricultural areas, where supplemental fertilizers are required for good crop yields. Alkali soils are a problem in some cases. Additional water, above normal irrigation requirements, is necessary in order to leach salts through the soil profile in these problem areas.

Soil textures generally range from sandy loam to clay loam, with some inclusion of sand and clay.

FIGURE 4-2
AVERAGE MONTHLY PRECIPITATION



The areas shown on Figure 4-3 are currently under agricultural use. Alfalfa is the primary crop grown in these areas. Generally, soil is not the limiting factor in crop production. Crop yields can be above national averages, and are often comparable to California averages as long as water supply is adequate and climate is favorable for good crop growth.

Agricultural Analysis by Area

Four general areas in Western Nevada were chosen for potential feedstock production. These areas were chosen on the basis of suitability for crop production, large concentration of cropland acreages, and proximity to Brady's Hot Springs, the site of the proposed alcohol plant.

The four areas are the Lahontan Basin (Fallon), Mason and Smith Valleys (Yerington), Lovelock Valley, and Winnemucca-Dutch Flat area. About 90 percent of the irrigated acreage in Nevada is devoted to producing forage crops, with alfalfa as the primary intensively managed crop. The balance is devoted to a wide variety of crops. The other principal crops are small grains and corn for silage with isolated areas in potatoes, onions, garlic, melons, and other vegetables. The primary reasons for the large acreage of alfalfa hay, as suggested by county extension agents, are less intensive management requirements as compared to annual crops, the local need for hay for beef and dairy operations, and the high transportation costs of grain to out-of-state markets. Often, other crops produce well on these lands, but because of the above mentioned economic and preference reasons, their acreages are limited or nonexistent.

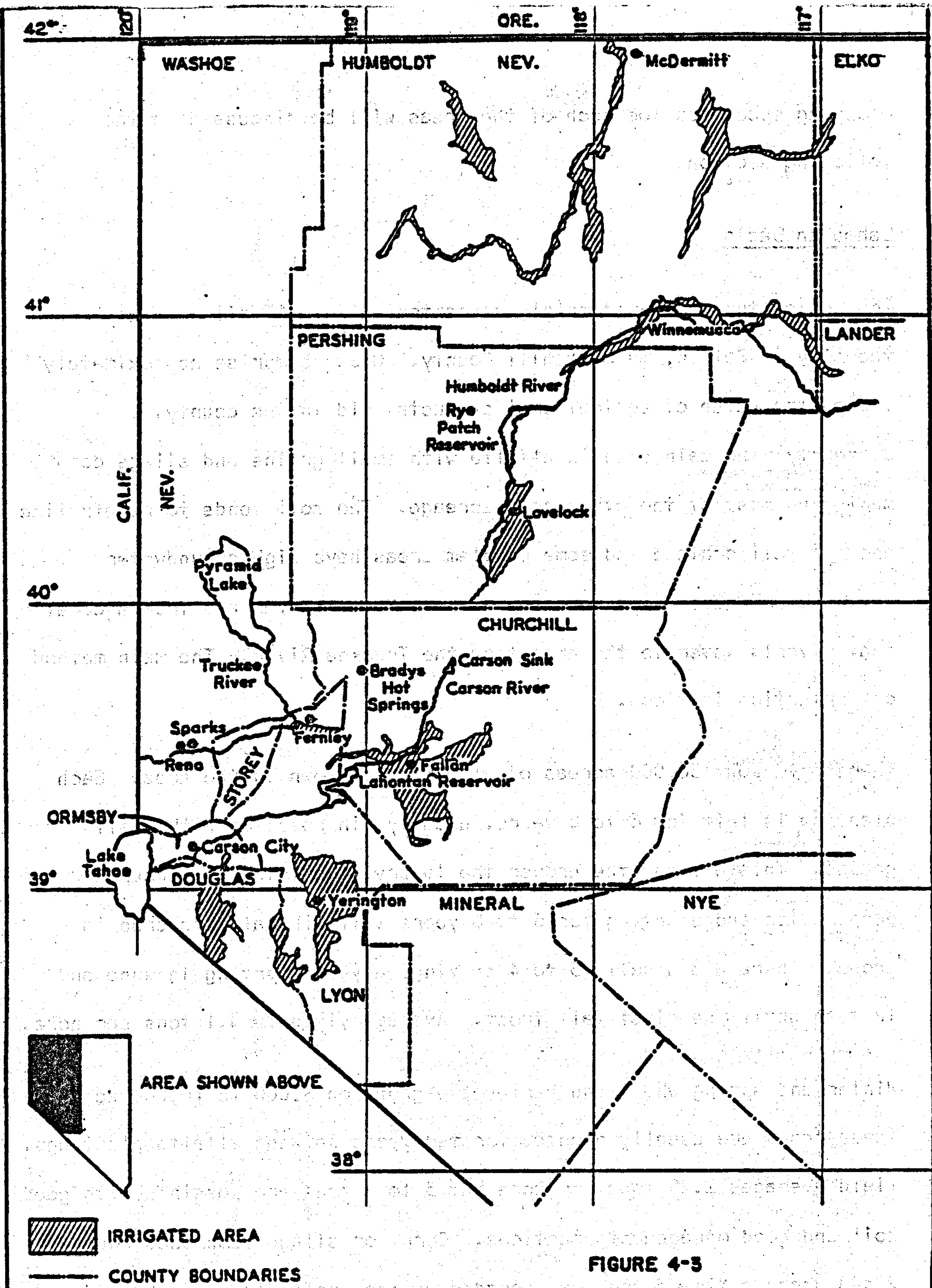


FIGURE 4-3

WESTERN NEVADA IRRIGATED FARMING AREA MAP

9-11-80

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SACRAMENTO, CALIFORNIA

PROJECT NO. AWI 36-22

Cropping specifics for each of the areas will be discussed in the following section.

Lahontan Basin

The agricultural area is mainly concentrated in a 15 mile radius around the city of Fallon, in Churchill County. Crops comprise approximately 16% of the value of agricultural products sold in the county. Currently, the main crop is alfalfa with small grains and silage corn making up most of the other crop acreage. The soil tends to be alkaline and not well drained and some problem areas have high groundwater levels. Irrigation water comes from the Carson River and from a canal that diverts water to the area from the Truckee River. The main method of irrigation is flood.

There are about 36,000 acreas of alfalfa hay grown in the area. Each planting is left for 6 to 8 years, usually, in rotation with small grains. This affords the grower the luxury of eliminating ground preparation and planting for 6 to 8 years while the alfalfa crop is grown. There are usually 3 to 4 cuttings a year starting in June and lasting until the first fall frost. Average yield is 4.1 tons per acre.

Winter and spring wheat and barley are grown on 8,000 to 10,000 acres. These crops are usually planted for two years between alfalfa plantings. Yield averages 2.25 tons per acre but 3 to 4 tons are possible with good soil and good management practices. Corn for silage comprises roughly 2,500 acres. Yields are not recorded as the whole plant is chopped and fed to livestock.

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Mason, Smith Valleys and Fernley Area

The Mason and Smith Valleys are situated in Lyon County. There are about 38,750 irrigated acres in these two valleys. Alfalfa is grown on approximately 32,000 acres, yielding 3-6 tons/acre with 3-4 cuttings a year. The rotation sequence is 6 to 8 years of alfalfa, then two years of an alternative crop, usually small grains. Average annual acreage of winter and spring wheat and barley are about 6,750 acres. Yields average 2.25 tons per acre and range up to 3 tons. Approximately 1,000 acres of onions and garlic are also grown in the two valleys.

The soils are slightly alkaline but generally deep. Some areas have a hardpan problem which can be solved by deep ripping once prior to intensive agricultural use. Irrigation water comes from the Walker River and a few farms supplement it with wells. Flooding is the major method of irrigation.

Fernley, also in Lyon County, has about 5,000 irrigated acres. Alfalfa and grass for hay comprise 3,500 acreas and small grains are farmed on another 1,000 acres.

Lovelock Valley

The concentrated agricultural area around the city of Lovelock, Pershing County, is approximately 24,000 irrigated acres. The largest area acreage is devoted to the production of alfalfa for seed (12,000 acres).

Alfalfa hay, 10,000 acres, and small grains, 2,000 acres, are the other major crops. Water is often the limiting factor in crop production.

Alfalfa for seed requires less water than alfalfa hay, which is one reason for its larger acreage in the area.

Yields of alfalfa hay range from 3 to 4.5 tons per acre with 2 cuttings a year. Wheat and barley yields average about 2.25 tons per acre.

The local crops all require irrigation, primarily by the flood method. Water is supplied by the Humboldt River through the Rye Patch Reservoir. Salts in the soil are a production problem in the valley. Additional water above normal irrigation requirements is necessary to maintain a low level of salts in the crop root zone. Twelve-foot deep drainage ditches are interspersed throughout the valley, their function being to divert the salt laden drainage water to the Humboldt sink.

<u>Winnemucca - Dutch Flat Area</u>

This area in Humboldt County has approximately 85,500 acres of irrigated land. Again, the majority of this area, 55,000 acres, is devoted to alfalfa hay production. This area is also the major producer of potatoes in the state, with 14,000 acres in potato production in 1979. Other major crops include small grains, 10,000 acres, and alfalfa for seed, 6,500 acres.

Alfalfa hay yields 3 to 5 tons per acre with 3 to 4 cuttings per year. Potatoes yield averages of 380 CWT per acre and wheat and barley yields an average of 65 to 70 bushels per acre. Part of the barley crop is used as malting barley.

Wells are the primary source of water for irrigation. Flooding is currently the major method of irrigation with some of the newer developed lands using sprinkler irrigation.

To the north of Winnemucca lies the Paradise Valley, where alfalfa hay and livestock are the main agricultural products. North and west of Paradise Valley lies the Orovada area, which raises alfalfa grains, garlic, potatoes and mixed crops. Two specialty crops are raised near Orovada with mint occupying 600 acres and dill occupying another 300 acres.

Irrigation

The need for irrigation water in this Western Nevada farming area is of major importance since rainfall is not sufficient for crop production. All of the above areas are near rivers or underground water sources. The source of the water is the melting snow in the Sierra Nevada Mountains on the west and runoff into the Humboldt River on the east. In years with adequate runoff, water is impounded in several reservoirs to maintain an adequate level for summer irrigation.

A large amount of water is usually applied to crops because of several factors. These factors include the low amount of annual rainfall, the widespread use of flood irrigation which is inefficient (vs. other irrigation methods), the high evaporation rate, and the necessity of leaching salts down into the soil profile.

4.5 POTENTIAL FEEDSTOCKS

The prime candidates for local feedstock production are barley and wheat. Corn and potatoes are also discussed in this section as possible feedstocks.

Barley is a strong contender for first choice regarding local production. Barley is tolerant to adverse soil and climatic conditions. It is well adapted to most irrigated soils of the region, including soils with moderate levels of salinity and alkali. In fact, barley is the most salt tolerant of the cereal crops. At 30 inches of water per annum, more water will be applied to barley than potatoes, but less than corn. The growing season is also adequate in all areas. Another important, positive factor is that barley is a familiar, proven crop with all necessary equipment available. The only disadvantage with barley is the low alcohol conversion rate compared to corn and wheat.

Wheat shows good potental as a locally-grown feedstock. Wheat has been grown for years as a feedstock for the production of beverage grade alcohols and it yields more alcohol per ton than does barley. Wheat prices in Nevada are higher than those for barley, but with its higher conversion rate to alcohol, it approaches barley as a economical feedstock. Wheat is well adapted to local soils, growing satisfactorily in moderately saline soils. More water is applied to wheat then to any of the potential feedstock crops. At 36 acre-inches per year, it is best grown in well-drained soils. However, even this use rate is less than alfalfa, which uses roughly 54 acre-inches per year.

Potatoes are a viable alternative as a feedstock crop. Potatoes yield more alcohol per acre than do any other crops considered in this analysis. This is mainly because of the high yield of tubers per acre. However, this alcohol costs more per gallon than does alcohol produced from any of the other feedstocks. Potatoes are irrigated with 25 acre-inches of water and are well suited to acidic soils. In fact, acidic conditions tend to limit potato scab diseases. Potatoes also grow well in light soils, since the light soils tend to promote more uniform temperatures during the growing season and make harvesting the crop easier.

The bulk of Nevada potatoes are grown in the Winnemucca area. Roughly 75% of total production is packed for the fresh vegetable market. In recent years the other 25%, the culls, have been used to make potato chips, but the company that was making the chips has recently gone out of business. Growers are currently seeking alternative uses for their culls.

Storage conditions are critical for potatoes: both temperature and humidity must be maintained fairly constant after harvest. Potatoes may be stored at 65°F with the relative humidity nearly 85% for several weeks after harvest, but after this two week period, further storage must be at 36-38°F and 90% relative humidity or sprouting and breakdown of the tubers will begin to occur.

Potatoes require more processing prior to fermentation than do the grain crops considered as feedstocks; thus manufacturing cost of alcohol is higher with potatoes than with the other potential feedstocks.

Corn is a viable choice for local feedstock production. Although little grain corn is currently grown in Nevada, there are several thousand acreas of silage corn grown, mainly in the Fallon area. In general, corn grows best in regions where for three or four consecutive months the average temperature is from 70-90°F. The Nevada growing season is not this long. Using short season varieties, as would be necessary in this situation, yields are generally not as high as with standard corn varieties. There also exists the possibility of late spring frost damage that can further decrease yield of early plantings. Trials have been conducted in Western Nevada with short season grain corn varieties and favorable results have been obtained.

Extension Agents feel that short season grain corn could be grown in their areas and would be accepted by farmers for use in a rotation with alfalfa if the corn price could be made to compete with alfalfa economics. One problem is that harvest equipment would have to be purchased by the farmers, necessitating a large capital outlay.

Corn is not as well adapted to saline and alkali soils as barley, but should do well on soils now planted to silage corn. Corn is very sensitive to minor changes in field fertility levels, requiring careful fertilization. At an annual irrigation rate of 34 acre-inches of water, corn is less demanding than alfalfa and wheat, but more demanding that barley and potatoes.

4.6 FEEDSTOCK PRICING AND PRODUCTION ECONOMICS

For the favored feedstocks of barley, wheat and corn to be produced in large tonnages in the region, they must compete and displace current production of alfalfa hay. Of the 216,000 irrigated acres in the four County area, about 154,500 acres are devoted to alfalfa production. Feedstock prices used for the economic analysis of Table 4-3 reflect a level sufficiently high to compete with alfalfa revenues. An estimate of the competing crop revenues is shown in Table 4-4. Corn and barley will have to be priced at $120/ton to compete. At this price, corn and barley can provide a crop rotation opportunity to regional farms although alfalfa net revenue still has the lead at $38.90/acre more than barley, $24.71/acre more than wheat, $33.50/acre more than potatoes, and $20.50/acre more than corn. It is possible that a price more in the range of $130-140/ton will have to be offered to secure the amount of long-term local acreage in feedstocks as shown in Table 4-8 in the following section.

Table 4-5 presents feedstock prices and transportation distances to Fernley. All feedstock materials that are imported from outside the local area will have to be transported via rail. Prices shown for material to be railed in are quoted F.O.B. shipping point, and include loading into rail cars for shipment.

TABLE 4-4

WESTERN NEVADA FEEDSTOCK FARMING ECONOMICS

CROPS	BARLEY*	CORN*	POTATOES	WHEAT	ALFALFA
Expected Yield per Acre (tons)	2.18	2.5	17.5	2.16	4.25
Revenue/Ton	$120.00	$120.00	$ 70.00	$133.33	$70.00
Total Revenue per Acre	$261.60	$300.00	$1,225.00	$287.99	$297.50
Production Cost per Acre	$165.00	$185.00	$ 948.00	$177.20	$162.00
Net Revenue/ Acre	$ 96.60	$115.00	$ 277.00	$110.79	$135.50

*Priced to compete with alfalfa revenues

TABLE 4-5

LOCAL COMMODITY PRICE AND TRANSPORTATION DISTANCES (MILES) TO FERNLEY, NEVADA

POINT OF ORIGIN	PRICE/TON F.O.B. SHIPPING POINT	TRUCK	RAIL
Burley, Idaho	$107.50	-----	721
Chandler, Arizona	110.80	-----	1,079
Winnemucca, Nevada	112.50	134	
Lovelock, Nevada	112.50	60	
Fallon, Nevada	112.50	30	
Yerington, Nevada	112.50	74	
CORN			
Kansas City, Kansas	113.57	-----	1,609
Lincoln, Nebraska	99.64	-----	1,468
Fallon, Nevada	-----	30	
Lovelock, Nevada	-----	60	

4-7 FEEDSTOCK PRODUCTION ANALYSIS - WESTERN NEVADA

As shown in Table 4-6, the total existing acreage now devoted to irrigated crop production in the four counties that make up Western Nevada's farming area is about 198,750 acres. The majority of acreage in the area is devoted to alfalfa production, some 78% of total local acreage. The bulk is devoted to small grains and potatoes.

As Table 4-7 shows, if all of the regional wheat and barley was used to produce ethanol, about 5.92 million gallons would result. Adding all alfalfa acreage and assuming conversion to barley in this acreage would increase ethanol production by 28.18 million gallons. Adding all regional potato production would add another 5.83 million gallons, bringing total regional alcohol production potential to 39.93 million gallons per year. However, this is a very optimistic situation. A more realistic five-year development situation is presented in Table 4-8. In this case, estimates are based on (1) a crop rotation program, and (2) only 15,000 acres being committed to fuel alcohol in the prime farming areas of Fallon, Fernley, Mason, Smith, Lovelock and Winnemucca. These areas are all within economical trucking distance of the plant site. In order to gain the desired 15,000 acres in the local region an extension program would have to be undertaken in which the local farmers are given information as to the suitability of the feedstock crops for their farms, and the long-term profitability of growing these crops for the fuel ethanol plant. Initial growers would need to be carefully selected for progressive practices and previous farming success in the area. They would then need to be given assistance with cultural practices to insure that their first crops for the plant have high yields and are profitable. These positive initial contacts would make it much easier to gain more acreage from subsequent area farmers when more acreage is desired.

Assuming the 15,000 acres is possible, about 2.9 MMGPY fuel alcohol could be developed in about five years. This would indicate a feedstock shortfall of about 7.1 MMGPY equivalent alcohol would have to be made up from outside the local region.

4.8 FEEDSTOCK PRODUCTION ANALYSIS - NEVADA STATEWIDE AND NEIGHBORING STATES

Since a local feedstock shortfall appears to exist for the 10 MMGPY plant, an analysis of statewide Nevada producing capability was prepared. The results of this analysis are shown in Table 4-9. Total statewide alcohol potential utilizing existing barley and wheat production only is equal to 7.3 MMGPY, assuming all state acreage in these two crops could be diverted to alcohol production.

Total statewide alcohol potential assuming all potato acreage and conversion of all hay acreage in addition to all barley and wheat acreage is equal to 75.2 MMGPY. An analysis of feedstock production and alcohol potential was also prepared for the neighboring states of Kansas, Nebraska, Idaho, Arizona and Montana. Imports of feedstock from these states would most probably be for the crops of barley and corn. As can be seen from Table 4-10, total alcohol potential of roughly 2,706.8 MMGPY from the two crops and the five states is far in excess of the demands of the alcohol plant under consideration. When Nevada potential is added, the total is 2,782.1 MMGPY, which means that the demands of the plant will use only .36% of total available grains grown within economical transport distance of Fernley, Nevada.

Included in this section are lists of potential suppliers of feedstock in each of the various states considered as potential supply points for corn and grain.

TABLE 4-9

NEVADA STATEWIDE FEEDSTOCK PRODUCTION
AND ALCOHOL POTENTIAL, 1979

	BARLEY	WHEAT	ALL HAY*	POTATOES
ACREAGE	22,000	27,000	465,000	15,000
YIELD	1.44	1.80	1.44	16.5
TOTAL TONNAGE	31,680	48,600	669,600	247,500
ALCOHOL POTENTIAL MM GAL/YR	2.8	4.5	62.1	5.9

STATEWIDE TOTAL ALCOHOL POTENTIAL - 75.3 MMGPY

* Alfalfa yield converted to Barley

TABLE 4-10

NEIGHBORING STATE FEEDSTOCK PRODUCTION AND ALCOHOL POTENTIAL, 1979

BARLEY	KANSAS	NEBRASKA	IDAHO	ARIZONA	MONTANA	TOTAL
TOTAL ACREAGE (1,000 acres)	60	28	850	43	1,040	2,021
TOTAL TONNAGE (1,000 tons)	62	28	1,134	74	973	2,271
ALCOHOL POTENTIAL (MMGPY)	5.5	2.5	100.6	6.5	86.4	201.5
CORN						
TOTAL ACREAGE (1,000 acres)	1,470	6,900	41	45	5	8,461
TOTAL TONNAGE (1,000 tons)	4,816	22,218	101	145	11	27,291
ALCOHOL POTENTIAL (MMGPY)	442.1	2039.6	9.3	13.3	1.0	2505.3
ALL ALCOHOL						
CORN AND BARLEY (MMGPY)	447.6	2042.1	109.9	19.8	82.4	2706.8

4.9. FEEDSTOCK PURCHASING

The farmer has a choice of several outlets for his grain. The major options are: local country elevators, terminal elevators, roadside buyers, farmers who buy to feed their livestock, or directly to processors.

While most grain is delivered at the harvest or shortly after, farmers are more and more frequently adding storage facilities on the farm, making it possible to await a more favorable market. A principal factor in this development has been the government support program.

The support program consists of acreage limitation under which farmers who curtail corn acreage receive payments and a government loan program under which farmers who participate in the acreage limitation program are eligible to place their crop under loan, thus guaranteeing them a certain price for their corn while at the same time financing yearly operations. Farmers having on-farm storage have the option of selling at harvest or holding the grain in hopes that prices will rise significantly in the ensuing time period.

Farmers located near a terminal market can truck their grain to market where they sell directly to terminal elevators equipped to unload the trucks. Although these various outlets for grain are available, the great bulk of marketable surplus grain goes to the country elevator. A typical country elevator today has a storage capacity ranging from 100,000 bushels to 1,000,000 bushels, depending on the area served. This type of firm obtains grain from farmers who generally transport it to the elevator by truck. The ethanol processor can purchase grain from farmers at the time of delivery, or by contract made in advance of delivery, or by accepting grain for storage with sale to be consummated at a later date, or by handling grain for the farmer's account without ever taking possession of it.

The method most widely used is outright purchase at the time grain is delivered to the elevator. In order to insure obtaining a considerable volume of grain, elevator operators are arranging more and more advance contracts with farmers for delivery of grain, often for grain not yet harvested. Conditions stipulated in contracts vary under different circumstances, but usually cover the grade of grain, the time of delivery, and the price. If a farmer believes that grain prices may move in his favor at a later date and he does not have storage facilities on his farm, he may make arrangements with the country elevator to store his grain.

The country elevator's grain can be sold locally, forwarded to a terminal market, sold to a processing plant or forwarded to an export point. The most common outlets for country elevators' grain are the terminal markets. Grain destined for terminal markets are either consigned to a commission merchant (cash merchant) or sold for deferred delivery on a to-arrive basis. When grain is sold on a to-arrive shipment basis, the contract is usually made before the grain is shipped from the country elevator. In addition to price, the time of shipment, the grade, and the terms of sale are specified in the deferred delivery contract. The time specified may be 5, 10, 20 or 30 days, or in some instances as much as 120 days. Discounts for grain grading lower than the contract grade may also be provided. Inasmuch as the price is fixed at the time the contract is made, the country elevator is relieved of all risk incident to fluctuations in the price of grain, the buyer assuming these risks.

In consigning grain, the country elevator ships the grain to his representative in the market to be sold after its arrival. The country elevator retains ownership of consigned grain and is liable for any loss occurring while the grain is in transit - such as adverse price changes or damage to the grain. The seller pays all costs of shipping the grain to the market, not knowing what will be realized on the grain until after it has arrived at the market, been inspected, and offered for sale.

There are two types of cash merchants, terminal market merchandisers and terminal elevator operators. The difference between the two is that, although they both take title to the grain, the elevator also operates storage facilities in the terminal market area.

Another type of commission merchant is the broker. Brokers differ from other types of merchandisers in that they do not take title to grain. They function strictly as agents and are usually paid commission fees by the seller of grain. After a broker has brought the buyer and seller together and the terms and conditions of the sale are mutually agreed upon, the brokerage service has been completed. Brokers deal mainly with volume movements of grain such as 100 hopper-car trains, barges and vessels.

The cash merchandiser is the major link between the country elevator and the later steps in the marketing process. Since a country elevator must pay the highest price possible to compete successfully with other elevators for farmers' grain, the most important service performed by the merchandiser is finding the highest bidder for country grain. Country elevator operators usually use the services of a cash merchandiser to shop and compare the bids of the various users and/or markets for grain, although some country shippers do sell directly to processors or terminal elevators.

Terminal elevators, as the name implies, are located in the principal grain-marketing centers and may vary in capacity from a few hundred thousand bushels to over 30 million bushels. The location of the elevator rather than its size determines its classification. The terminal elevator operator buys grain from other cash grain merchants, and country elevators. Depending on the facilities of the terminal elevator, grain may be received by rail, truck, barge, or, sometimes by boat. The terminal elevator, in turn, sells grain to processors, millers, distillers, feed manufacturers, exporters, and, sometimes, to elevators in other parts of the country. The elevator may provide for shipment by rail, water vessel, or barge, or, on rare occasions, may sell small quantities for truck shipment. If incoming grain arrives at the terminal elevator by hopper car, no unloading equipment is required. Hopper cars are spotted over the unloading pit, the doors or traps are opened, and the grain runs out the bottom of the car.

From all of the above sources, the grain flows to the processor who is the final user of the raw product. Processing industries tend to purchase the majority of their grain needs from terminal market elevator companies, although some grain is purchased directly from farmers and from country elevators. The desirability of terminal elevators lies mainly in their large storage volume and their capabilities for rail shipment.

Some of the larger processors retain their own buyers in the terminal markets to purchase grain from cash grain commission merchants or terminal elevators, wherever the most advantageous price can be obtained. Other processors purchase supplies in terminal markets through brokers, while a third group of processors buy solely from terminal elevators or grain merchandisers and do not have their own representatives in the market.

Processors usually do their heaviest buying at the time when crops are moving from the farm into storage. At this time there is a wider selection of grain to choose from and the price is usually more attractive. The extent to which a processor is able to purchase supplies at this time is limited somewhat by his storage capacity, although a processor may have the option of renting additional space.

4.10 USE OF THE FUTURES MARKET BY PROCESSORS

There are futures markets for many commodities, but for corn and wheat the major one is the Chicago Board of Trade. In a futures market, buyers and sellers congregate and agree to buy and sell various amounts of corn, for example, at different times in the future. If one buys a futures contract, or takes what is called a long position, one agrees to accept delivery of a specified amount of a certain quality corn on a specified future date. On the other side of the exchange, it is possible to sell a futures contract, or go short.

An interesting feature of the futures market is that contracts are generally not settled at maturity by actual physical delivery of the commodity to a warehouse. Rather, most futures contracts are settled by payment of the difference between the price stipulated in the contract and the spot price of the commodity at the date of maturity.

In buying grain and selling commodities, processors do not want to incur losses due to fluctuations in the grain market. Processors can surmount this difficulty by hedging in the futures market. Hedging is basically the elimination of risk. An example of the way in which hedging can help to eliminate risk to the ethanol plant operators follows.

If one is operating an ethanol plant, one wants to be able to budget the cost of feedstock for the following year, at a guaranteed rate. To do this, one seeks out an elevator who wants to sell a futures contract. After negotiation, one enters into the contract and is guaranteed a price throughout the following 12 months. Thus one has hedged oneself against possible price increases.

A list of grain suppliers is included in this section for the states of Utah, Idaho, Arizona, Colorado, Kansas and Nebraska. In most cases the firms listed are either individually or cooperatively owned elevators, although names of several grain trading firms also appear.

4.11. COMMODITY PRICES AND TRENDS

Figure 4-4 presents corn and barley prices for the period 1950-1980 and estimates of corn price through 1990. Actual average yearly corn and barley prices for the United States were obtained from the U.S.

Department of Agricultural for the period from 1950 to 1979. Current barley and corn price (May 1, 1980) was added to the list and the data for this 31-year period was plotted. Corn price was generally slightly higher than barley price, roughly 25¢/bushel higher during the period.

Linear regressions were performed on each of the two sets of data, the equations being of the form: Price = A + B (time).

The above form is commonly referred to as a time trend, and investigates what effect the passage of time has on the price of a commodity. After the regressions were run, the two parameters of the system, A, the entercept, and B, the slope of the relationship were found to be: For corn: A = \$.98 B = .035, and the functional relationship for corn was: Price - \$.98 = .035 T. This line that was fit by minimizing the sum of squared deviations about the line tells one that the base price in the period was \$.98 and on average one would expect a price increase of 3.5¢ per year through the period.

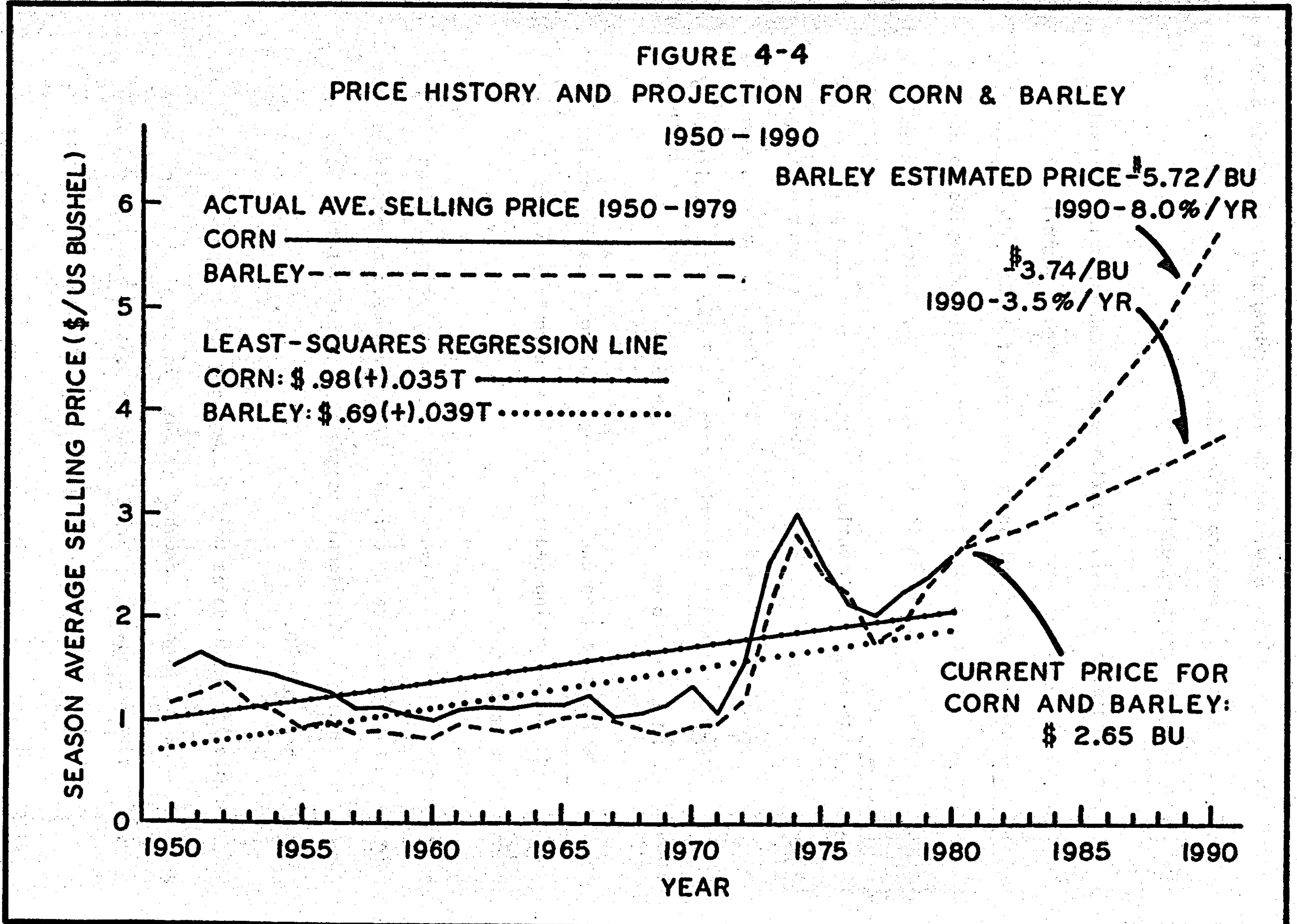


FIGURE 4-4
PRICE HISTORY AND PROJECTION FOR CORN & BARLEY
1950 – 1990
BARLEY ESTIMATED PRICE - $5.72/BU
1990 - 8.0%/YR
$3.74/BU
1990 - 3.5%/YR
ACTUAL AVE. SELLING PRICE 1950 - 1979
CORN
BARLEY
LEAST-SQUARES REGRESSION LINE
CORN: $ .98(+).035T
BARLEY: $ .69(+).039T
CURRENT PRICE FOR
CORN AND BARLEY:
$ 2.65 BU
SEASON AVERAGE SELLING PRICE ($/US BUSHEL)
0
1
2
3
4
5
6
1950
1955
1960
1965
1970
1975
1980
1985
1990
YEAR

For Barley: A = \$.69 B= .039, and the functional relationship was \$.69 + .039 T, or a price in year zero of 69¢ and an average price increase of 3.9¢/year could be expected during the period.

The above regression analysis translates to an annual price inflation rate of less than 1% per year, while in the economy overall GNP experienced an average annual inflation rate of 4.3%, indication a subnormal price increase rate for these commodities relative to all other commodities produced in the U.S. during the period.

Since 1970 much larger fluctuations in price appear than prior to 1970 and in 1974 all time high prices for both commodities were experienced, with corn at \$3.02/bushel and barley at \$2.81/bushel. At this same time the U.S. economy's overall inflation rate was 7.4%, also significantly higher than that for the entire 30 year period.

The above facts would lead one to believe that commodity price inflation will be high in the coming years or at least high relative to the historical average figure.

Also shown on Figure 4-4 is an estimate of barley price through 1990. Based on inputs from several reliable U.S. government agencies and from several University of California economists, price inflation was estimated through 1990.

Two possible inflation paths were chosen, one low or optimistic at 3.5% per year, and one high or somewhat pessimistic, at 8% per year. Both views are well grounded. The first view of 3.5% is based on the very low price inflation rate seen in the linear regression analysis of prices through the 30 year period. With the 3.5% rate a price of $3.74/bushel can be expected by 1990.

The high figure of 8%/year was chosen based on current experience. The U.S. is now experiencing double digit inflation for the first prolonged period in its history, and the major question is whether or not the current situation will persist during the coming years. Most economists say that it will not, but most do predict high single digit inflation through 1990. A high price inflation path of 8% was also predicted for barley, with price in 1990 at $5.72/bushel. The actual price in 1990 will probably fall somewhere between the two predictions.

4.12. RAIL FREIGHT RATES, SCHEDULE, AND CAR AVAILABILITY FOR GRAIN SHIPMENT

Freight rates for the shipment of grain by rail are based on factors such as fuel and handling costs and are set on a specially designed commodity rate structure approved by the ICC. The grain rate structure is in a constant state of flux, with changes coming from shippers and receivers, in addition to carriers, who propose changes to meet their competition.

Substantial reductions in the costs of grain transportation by rail can be made through the use of multiple car rates which result from greater use and larger fleets of covered hopper cars. Rates are available from single car to unit-train with various multiple car rates in between.

Unit-trains provide faster turn-around time, improve car-utilization, and greater efficiency in grain movement. Not all firms can take advantage of unit-trains, however. To use unit-trains, the rates must be available for the commodity in question. Also, the shippers and receivers must have equipment and facilities with the capacity to load the entire train within a 24-hour period before demurrage charges are assessed.

The best feature of unit-trains, from the buyer's point of view, is that grain elevators are willing to give sizeable discounts when selling grain by the unit-train. At 100 cars/train and 95 tons/car, a unit-train shipment would be 9,5000 tons and could be stored in the 9,500 ton capacity grain storage system proposed for the Fernley facility only if the bins were completely empty. However, due to the safety stock requirements of the ethanol plant, complete emptying of the grain system would never be feasible. This would require using fewer cars than a unit-train. A discounted grain price would still be possible, but at a lesser discount than the unit-train rate.

Southern Pacific estimates the following freight hauling rates for single and five car trains to haul barley or corn:

BARLEY

	Single Unit	Five-car Units
Burley, Idaho to Fernley, Nevada	$1.355/cwt	No rate available
Chandler, Arizona to Fernley, Nevada	$4.475/cwt	No rate available

CORN

	Single Unit	Five-car Units
Kansas City, Kansas to Fernley, Nevada	$1.98/cwt	$1.805/cwt
Lincoln, Nebraska to Fernley, Nevada	$1.895/cwt	$1.72/cwt

The availability of covered hopper cars is a problem during peak grain shipment periods. Southern Pacific states that 95 tons minimum weight is required unless the barley is loaded to full space capacity and an accurate measurement is possible. However, cars cannot be ordered for a barley shipment if shipping less than 50 tons.

Rail car availability determines grain storage requirements for feedstock grains rather than train scheduling. The following possibilities exist for shipping grain by rail to Fernley, Nevada.

Union Pacific serves both Kansas City, Kansas and Lincoln, Nebraska and is the shortest route to Fernley, Nevada. Union Pacific would transport the grains from the eastern points to Ogden, Utah and connect with Southern Pacific for shipment to Fernley. Estimated total distance from Kansas to Fernley is 1,609 miles versus 1,468 miles from Nebraska to Fernley.

Burlington Northern, Inc. also serves both Kansas City, Kansas and Lincoln, Nebraska. However, connections must be made in Denver, Colorado with either Union Pacific or Denver & Rio Grande Western railroads for transportation to Ogden, Utah and final connections made with Southern Pacific for transporation to Fernley, Nevada. Mileage for this option is estimated to be 1,778 miles from Kansas to Fernley and 1,595 miles from Lincoln, Nebraska to Fernley.

Santa Fe is another railroad serving Kansas City, Kansas and would connect with Denver & Rio Grande Western Railroad in Pueblo, Colorade. D & R G W would then transport the grain to Ogden, Utah for final transportation to Fernley via Southern Pacific. This distance would be approximately 1,772 miles.

Grain shipment of barley from Chandler, Arizona would be routed directly to Fernley by Southern Pacific, a distance of 1,079 miles. However, shipping rates from Chandler ($4.48/cwt) make this an uneconomical alternative.

Barley from Burley, Idaho would be shipped via Union Pacific to Ogden, Utah for connection with Southern Pacific and forwarding to Fernley. Total rail distance is approximately 721 miles. This option is viable as current rates were given as $1.36/cwt for single car units.

ARIZONA GRAIN SUPPLIERS

By City:

COCHISE

GRAIN CO-OP OF ARIZONA; Dragoon Elevator; 85606; (602) 384-3675.

HARQUAHALA VALLEY

FEEDERS GRAIN COMPANY; E. Harquahala Valley; (602) 372-4223.

MARICOPA

FEEDERS GRAIN COMPANY; 200 E. Casa Grande Hwy; 85239; (602) 568-2235.

PHOENIX

FEEDERS GRAIN COMPANY; 310 S. 24th Avenue; P. O. Box 6738; 85005; (602) 254-62266.

WILCOX

BONITA CO-OP ELEVATOR, INC.; Stewart District; 85643; (602) 384-3611.

GRAIN CO-OP OF ARIZONA; 530 S. Curtis Avenue; 85643; (602) 384-2219.

YUMA

BARKLEY SEED & GRAIN COMPANY, INC., 20th St. & Pacific Avenue; Box 5540; 85364; (602) 782-2571.

COLORADO GRAIN SUPPLIERS

By City:

<u>CRAIG</u>

CRAIG GRAIN COMPANY; 786 Industrial Avenue; 81625; (303) 824-6310

<u>DENVER</u>

CARGILL INCORPORATED; 1451 Cargill Drive; 80221; (303) 433-7425

KELLOG GRAIN COMPANY; 5600 Brighton Blvd.; P. O. Box 16045 (Stockyards Sta.); (303) 244-6515

<u>GREELEY</u>

NORTHERN COLORADO GRAIN COMPANY; 448 16th Street, Box 908; 80631; (303) 352-0738

<u>HOLYOKE</u>

REIMER-SMITH GRAIN COMPANY; 220 N. Baxter Avenue; 80734; (303) 854-2231

IDAHO GRAIN SUPPLIERS

By City:

AMERICAN FALLS

FARMERS GRAIN COOPERATIVE; 109 Van Buren Street; 83211; (208) 226-2110

POWER COUNTY GRAIN GROWERS; 138 Elevator Avenue; 83211; (208) 226-2422 1,110,000 Bu. Cap.

BURLEY

FEEDERS GRAIN SUPPLY, INC., Box E; 83318; (208) 678-5546; 950,000 Bu. Cap.

DOWNEY

DOWNEY GRAIN GROWERS, INC., 83234; (208) 897-5207; 269,000 Bu. Cap.

IDAHO FALLS

JACK THOMAS GRAIN & LIVESTOCK COMPANY; Box 836; 83401; (208) 523-0746

MALAD

ONEIDA COUNTY GRAIN GROWERS, INC.; Depot Street; 83252; (208) 766-2261

MOSCOW

LATAH COUNTY GRAIN GROWERS, INC.; Box 9086, 317 W. 6th St.; 83843; (208) 882-7581; 4,200,000 Bu. Cap.

PAUL

FEEDERS GRAIN SUPPLY, INC.; Box E; Burley, Idaho; 83318; (208) 438-4815; 350,000 Bu. Cap.

PRESTON

FRANKLIN COUNTY GRAIN GROWERS, INC.; 83263; (208) 852-0384

REUBENS

LEWISTON GRAIN GROWERS, INC.; 83548; (208) 924-6861;
980,000 Bu. Cap.

RICHFIELD

RIRIE GRAIN & FEED, INC.; 83443; (208) 538-6712; 400,000 Bu. Cap.

KANSAS GRAIN SUPPLIERS

By City:

ALEMENA

ALEMENA GRAIN COMPANY; 67622; (913) 669-2161

BIRD CITY

McDOUGAL-SAGER GRAIN COMPANY; Box 246; 67731; (913) 734-2731

COLBY

COOPER GRAIN INCORPORATED; Box 566; 67701; (913) 462-3327

THOMAS COUNTY GRAIN COMPANY; P. O. Box 391; 67701; HO2-2632

DAMAR

DAMAR GRAIN COMPANY, INC.; 67632; (913) 839-4363

HUGOTON

PARKER GRAIN COMPANY; P. O. Box 906; 67951; (316) 544-2631

MARIENTHAL

WEST PLAINS GRAIN INC.; P. O. Box 35; 67863; (316) 379-3211

MONUMENT

BERTRAND ELEVATORS, INCORPORATED; P. O. Box 687; 67747; (913) OR2-3681

QUINTER

QUINTER GRAIN INCORPORATED; 67752; (913) 754-3681

SCOTT CITY

SCOTT CITY GRAIN COMPANY, INC.; 67871; (316) 872-3456

NEBRASKA GRAIN SUPPLIERS

By City:

ALLIANCE

DEAVER GRAIN COMPANY, INC.; Box 764; 69301; (308) 762-2590

CENTRAL CITY

CENTRAL GRAIN, INC.; P. O. Box 507; 68826; (308) 946-2031

HASTINGS

GARVEY ELEVATORS, INC.; P. O. Box 1107; 68901;
(402) 463-2446

LAWRENCE

LAWRENCE GRAIN COMPANY; Box 186; 68957; (402) 758-3331

LINCOLN

LINCOLN GRAIN, INC.; P. O. Box 80269; 68501; (402) 432-2704

NEVADA GRAIN SUPPLIERS

By City:

FALLON

DODGE BROTHERS ISLAND RANCH; 455 Dodge Lane; 89406; (702) 423-3987

KENT BROTHERS SUPPLY CENTER; 260 North Main; 89406; (702) 423-2126

WINNENUCCA

GENERAL MILLS; East Fourth; 89445; (702) 623-3998

UNION SEED COMPANY; 710 Grass Valley Road; 89445; (702) 623-5053

September 22, 1980

R. C. Johnson
Morrison-Knudsen Co.
954 W. Jefferson St.
Boise, Idaho 83701

Dear Mr. Johnson:

Following a recent visit with Robin Grace of Geothermal Food Processors she asked that I address you with our interest in supplying feedstock for a potential ethanol plant to be located at or near Brady Hot Springs, Nevada.

As a agricultural entity farming 13,500 acres of irrigated ground next to Winnemucca we are extremely interested in nearby markets which can help to alleviate extreme freight costs. We grow 8-10,000 ton of grain annually and must move the bulk of it to California for more favorable markets.

To answer a question of potential acreage in the area posed by Miss Grace records indicate approximately 18,000 acres of small grains grown in Humboldt County a year ago. This is down some 2-3,000 acres due to increased acreage of alfalfa. Across the northern counties of Nevada acreage is available for, I would guess, 40,000 plus acres and perhaps 50,000 but two factors are limiting: 1. Available water is quite limiting. 2. Power costs have to date generally kept irrigated grain from being an economical crop except as a rotation crop. You will find further that local markets (freight into consuming areas has been prohibitive) for grain have not been such to entice growers to either plant heavy to grain nor to provide the cultural practices for higher yields. Those giving attention do indeed yield up to 3 ton per acre.

We will be most supportive of any such local industry and will consider growing contracts as well as supplies on the open market for both wheat and barley.

Please advise if we can be of any further assistance in your endeavors.

Very truly yours,

A. J. Evans
General Manager

cc: Robin Grace
Geothermal Food Processors

WINNEMUCCA FARMS, INC.
P. O. Box 312
Winnemucca, Nevada 89445
Phone 702 623-2900

ALFALFA

CLOVERS

GRASSES

SEED GRAINS

UNION SEED COMPANY

Serving Agriculture Since [illegible]

710 Grass Valley Road • Winnemucca, Nevada 89445 • Phone (702) 623-[illegible]

September 29, 1980

Ms. Robin Grace
Geothermal Food Processors
Los Angeles, California

Dear Robin:

In reference to your letter dated September 26, 1980, pertaining to the supply of feed grains to your proposed facility, it is my opinion that Union Seed Co. could furnish approximately 20,000 tons of grain initially. This figure could probably be increased as the market becomes more firmly established. Storage for the grain could be arrainged at a rate of $1.50 per ton per month beginning at the end of the normal harvest which is usually about September 15.

As to the contract price, this would have to be negotiable on a yearly basis, but a reasonable figure to use for planning purposes would be the published Los Angeles spot feed price f.o.b. your plant. This should cover freight and handling charges from the production area to Brady Hot Springs and still give the growers a small premium for their crop. (Which would insure a long range supply of grain.)

I hope this memorandum is sufficiently informative to be of use in your planning. Please inform me if I may be of any further assistance.

Sincerely,

Jim R. Hall
Manager
Union Seed Co.

For clear transcript of letter, see next page.

September 19, 1980

Ms. Robin Grace
Geothermal Food Processors
Los Angeles, California

Dear Robin:

In reference to your letter dated September 16, 1980, pertaining to the supply of feed grains to your proposed facility, it is my opinion that Union Seed Co. could furnish approximately 20,000 tons of grain initially. This figure could probably be increased as the market becomes more firmly established. Storage for the grain could be arranged at a rate of $1.50 per ton per month beginning at the end of the normal harvest which is usually about September 15.

As to the contract price, this would have to be negotiable on a yearly basis, but a reasonable figure to use for planning purposes would be the published Los Angeles spot feed price f.o.b. your plant. This should cover freight and handling charges from the production area at Brady Hot Springs and still give the growers a small premium for their crop. (Which would insure a long range supply of grain.)

I hope this memorandum is sufficiently informative to be of use in your planning. Please inform me if I may be of any further assistance.

Sincerely,

Jim R. Hall
Manager
Union Seed Co.

SECTION 5

AGRICULTURAL BY-PRODUCTS MARKETS

5.1. BY-PRODUCTS FROM ALCOHOL FERMENTATION PROCESS

Approximately one-third of the feedstock is returned as a by-product in the form of stillage grains and distillation slops. In order to avoid a large waste disposal problem, the distillation slops are centrifuged and the suspended solids are either reduced to 65% moisture or dehydrated to 10-12% moisture. The final products are termed concentrated solubles and spent grains or stillage cake. Because most of the priten passes, unchanged, through fermentation the final spent grains are a high protein, economically valuable feed for animals.

The spent grains can be fed as a 20% protein supplement in cattle diets, at a rate of roughly 7 pounds per day per animal. The supplement can be fed to either growing animals, as in a dairy operation, or to animals that are being attened in a feedlot type operation. At the 7 pound per day figure, 1.28 tons could be fed per year per animal. The 19,697 to 25,000 tons per year stillage grains output of the plant could feed 15,388 to 19,351 animals annually.

The spent grains can be marketed through several different marketing channels, depending on final product form. If they are not dried the spent grains are sold as a wet stillage cake. In Nevada the best markets for the spent grains are local users - mainly feedlots and dairy operations. In selling this market, timing is critical, as the wet stillage cake can only be stored for 24-48 hours before being fed. If held longer than the 48 hour limit spoilage will begin, implying that if this market is served, daily deliveries would have to be made to customers. Handling of wet stillage cake is more difficult than with either of the dry products, further limiting the market to those firms with the correct materials handling equipment. Decisions by feedlots and dairies as to inclusion of the spent grains in the feeding ration is based mainly on prices. Their concern is to fulfill the animals' feed requirements using the least expensive feeds. Spent grains will be an alternative to other concentrates, for example, corn, barley, oats, soybean mean, and linseed meal. The relative price difference between these spent grains will determine spent grains' acceptance and marketability in the local industry.

Price for wet stillage cake is $25-30 per ton delivered. Several feedlot operators have been contacted and have indicated interest in purchasing a product of this quality and in this general price range.

A much larger gross revenue could be obtained by selling the dried spent grains in either bulk or pelletized form. Pelletized alfalfa meal at 17% protein currently sells for $145 per ton on the West Coast, and the spent grains, being a material of similar composition and quality, could bring an equal price in pelletized form, while dried spent grains sell for $100 per ton.

Table 5-1 illustrates the reduction in total feedstock costs that can be gained by sales of the concentrated solubale and spent grains. Net foodstock costs are reduced significantly. Using barley as an example, feedstock costs are reduced 32% by sales of concentrated solubles and dried spent grains, 27% by sales of dried spent grains, and 39% by sales of pelletized spent grains and concentrated solubles.

TABLE 5-1

REDUCTION IN FEEDSTOCK COST

BY STILLAGE GRAINS SALES

Input	Corn	Barley
TPY - Feedstock	109,000	113,000
Cost/ton	$ 135	$ 130
Total Annual Feedstock Cost	$14,715,000	$14,690,000
Output		
TPY - Concentrated Solubles	38,142	49,000
Price/ton - C.S.	$ 45	$ 45
Total Revenue, concentrated Solubles	$1,716,390	$ 2,205,000
Alternative Outputs		
TPY Dried Spent Grains	19,697	25,000
Price/ton	$ 100	$ 100
Total Revenue, Dried Spent Grains	$1,969,700	$ 2,500,000
TPY Pelletized Spent Grains	19,697	25,000
Price/ton	$ 140	$ 140
Total Revenue, Pelletized Spent Grains	$2,757,580	$ 3,500,000
NET FEEDSTOCK COST PER YEAR, AFTER SALES OF:		
Concentrated Solubles and Dried Spent Grains	$11,028,910	$ 9,985,000
Concentrated Solubles and Pelletized Spent Grains	$10,241,030	$ 8,985,000

TPY = Tons Per Year

The dried bulk and dried pelletized spent grains can be sold through sales to feedlots and dairies in the local area that feed dry feed. Telephone and personal conversations with area Extension Agents and feedlot owners indicate a sizable demand for bulk dried spent grains (see letters of interest enclosed), although the demand was not quantified for this Study. Half a dozen large feedlots and 20-30 dairies are located within economical trucking distance of the plant, all of which can be considered potential buyers.

The second potential marketing channel for the stillage grains is that of selling to cattle feeding operations in neighboring states. Table 5-2 presents feedlot capacities for the major cattle feeding states in the region. As can be seen, with a six-state feedlot capacity of slightly less than 3.6 million animals, demand for the spent grains through this marketing channel is almost guaranteed. Western Nevada alfalfa growers currently export a large percentage of their crop to Southern California dairies and feedlots operations, so as the amount of alfalfa produced in the region fell because of increased acreages of barley and corn, stillage grains would replace a portion of the lost alfalfa tonnage. Included in this section are lists of feedlot operations that are considered potential buyers of the dried grains output of the plant.

Table 5-3 presents dairy capacities in Nevada and neighboring states.

TABLE 5-2

FEEDLOT CAPACITIES, NEVADA AND NEIGHBORING STATES, 1979

STATE	AVERAGE CAPACITIES
ARIZONA	382,500
CALIFORNIA	706,000
COLORADO	911,666
IDAHO	242,000
KANSAS	1,267,417
NEVADA	59,000
TOTAL	3,568,583

Nevada dairies, with 15,000 animals, would not be able to consume all the spent grains output of the plant, implying exports to neighboring states. As the table shows, animal numbers in the neighboring states are far in excess of those required to provide demand for the spent grains. The six-state total is 1.33 million animals in dairy operations.

A third potential marketing channel for the stillage grains would be (shipment to California seaport cities for) the international export market. Penetration of this market would best be accomplished using a pelletized product. Japan has excellent possibilities as an export buyer. Contact has been made with:

1) Mitsui Inc., a Japanese trading company with offices in San Francisco. They have expressed interest in marketing the product in Japan and have requested a sample of the stillage grains for analysis.

2) Newhall Land and Farming Company, Dixon Drier Division, Dixon, California. Newhall currently dehydrates and pelletizes stillage grain from the Anheuser-Busch brewery in Fairfield, Califronia for export to Japan. Initial contact has been made (see letter) to determine export interest for the dried spent grains feedstuff from this project and Newhall has indicated interest.

The distiller's concentrated solubles come out of the process as a 35-40% moisture content liquid feed supplement and are considered to be a good protein source. Dried, they contain 28% protein, 20% carbohydrates, and 52% minerals.

Products of this type are currently marketed by several West Coast firms, which have indicated interest in marketing the plant's output of 38,000-49,000 tons per year. Price for the concentrated solubles is $45/ton F.O.B. the plant site.

TABLE 5-3

DAIRY CAPACITIES, NEVADA AND NEIGHBORING STATES, 1979

STATE	NUMBER OF COWS MILKED
ARIZONA	78,000
CALIFORNIA	860,000
COLORADO	72,000
IDAHO	140,000
KANSAS	165,000
NEVADA	15,000
TOTAL	1,330,000

5.2 CUSTOM FEEDLOT OPERATION

A custom feedlot operation owned in conjunction with the ethanol plant would be another alternative use of spent grain from the plant. The following discussion deals with considerations in initiating and maintaining a feedlot.

A feedlot operation is a stage of beef production in which the main objective is to fatten feeder cattle to a quality grade of good or choice. The operation is based largely on concentrated feeds as distinguished from rangeland grazing. In the custom feedlot operation, the customer furnishes cattle to the feedlot and pays a charge per ton of feed consumed, plus veterinary services. The feedlot is responsible for feeding the cattle and, normally, for providing the marketing service as well. It is not uncommon for the feedlot owners to also have cattle being fed in the feedlot.

A feedlot capacity of 15,000 head was chosen for the determination of investment costs and feed requirements. This size is considered fairly large for the Nevada region. Greater efficiencies and economies of scale can be realized as size increases. Labor is a major factor in reducing per unit costs.

Theoretically, the total annual amount of feed required for a 15,000 head feedlot ranges 47,000-60,000 tons. Cattle entering the feedlot may go in as 450-500 lb. calves, 600 lb. yearling steers, or as heavier animals. Animals in each group remain in the feedlot for different lengths of time and have different daily feed requirements.

The then current situation at any given time dictates the proportion of these different cattle groups in the feedlot, and hence, the total annual feed requirement.

A feed ration consists of a certain amount of dry matter, digestible protein, total digestible nutrients, vitamins, and minerals required by cattle of each size group. The total daily feed amount is not as important as supplying the correct amounts of feed nutrient in order to satisfy the diet requirements. Feedlot feed rations are based heavily on concentrates which supply a majority of the protein and some of the digestible nutrients. Spent grain from the ethanol plant is high in protein content (about 18%) and can be substituted for currently used concentrates. Approximately 4 lbs. of wet spent grain equals 1 lb. of concentrate.

Spent grain can be fed either wet or dry. The determining factors in choosing will probably be the cost of transportation of wet grain versus the cost of drying the grain. The costs of drying equipment and the costs of special storage and handling equipment for wet grain are other factors.

Pelletizing the grain is another alternative feed process. As a preliminary estimate, 27,000 tons of dry spent grain can be fed at a feedlot operating at full capacity.

Initial investment for a feedlot of this size is large. The cost is estimated to be $1.65 million for fixed cost items such as pens, corrals, hay storage facility, scales, feed mill, and others. About 80 acres of land is required for the entire feedlot. An investment breakdown is presented in table 5-4.

The risk factors in operating a feedlot in Nevada are such that the alternative of establishing a custom feedlot to absorb the by-product output of the ethanol plant is not under serious consideration. Alternative markets for the by-products are abundant, and no real need exists to pursue the custom feedlot approach.

TABLE 5-4

FIXED INVESTMENT

for

CUSTOM FEEDLOT OPERATION

(15,000 head)

PENS	$292,500
TRACTORS	39,000
HAY STORAGE	390,000
OFFICE	78,000
SCALES	97,500
FEEDMILL	195,000
FEED WAGON	156,000
CORRAL	253,500
WATER SYSTEM	39,000
TRUCKS	48,750
SQUEEZE	15,600
SPRAYER	19,500
CONTINGENCY	13,650
TOTAL	$1,638,000

MARICOPA COUNTY

A TUMBLING T RANCHES; Ronald F. Rayner; Rt. 1, Box 21; Goodyear; 85338; (602) 932-1834.

DANA CATTLE COMPANY, INC.; 1700 S. Val Vista Drive; Mesa; 85201; (602) 832-1220.

HAGGARD FEEDLOT, HAGGARD ENTERPRISES, INC.; P.O. Box 626; Buckeye; 85326; (602) 386-2982.

HUGHES & GANZ CATTLE COMPANY; Bill Sawyer; 5001 E. Washington; Phoenix; 85034; (602) 275-5471.

RAY KILLIAN & SON RANCHES, INC.; 440 E. First Avenue; Mesa; 85204.

PENDERGAST, C.C. & COMPANY; 6474 N. 91st Avenue; Glendale; 85305; (602) 937-7608.

PRODUCERS LIVESTOCK MARKETING ASSOCIATION; 5001 E. Washington; Phoenix; 85034; (602) 267-0505.

R & B RANCHES, R & B RANCHES, INC.; P.O. Box 1035; Litchfield Park; 85340; (602) 935-2114.

UPTON & DORSETT CATTLE COMPANY; A.C. Upton, M.A. Dorsett; Baseline Road, Rt. 2, Box 174; Tempe; 85281; (602) 967-0283.

CALIFORNIA FEEDLOTS

FRESNO COUNTY

HARRIS FEEDING COMPANY; Rt. 1, Box 400; Hwy. 145 & Freeway 5; Coalinga, CA; 93210; (209) 884-2435.

IMPERIAL COUNTY

BRADENBERG FEED YARD; 903 W. Highway 98; Calexico, CA; 92231; 8 Mi. W. of Calexico on Highway 98; (714) 352-8721.

BRANDT CATTLE COMPANY; P.O. Box 118; Brawley, CA; 92227; 7015 Brandt Road; Calipatria, CA; (714) 348-2452.

D & S FARMS CUSTOM FEEDERS; 666 Marilyn Avenue; Brawley, CA; 1/2 Mi. W. of Forrester; (714) 344-0780.

FAIRLINE FEEDING CORPORATION; P.O. Box F; Calipatria, CA; 92233; 612 E. Simpson Road; (714) 348-2284.

FOSTER FEED YARD; 3403 Casey Raod; Brawley, CA; 92227; (714) 352-4171.

IMPERIAL CATTLE COMPANY; P.O. Box 218; Imperial, CA; 92251; 2820 Hwy. 86; (714) 355-1138.

JACKSON CATTLE COMPANY; P.O. Box 2130; El Centro, CA; 92243; 485 W. Heber Road; (714) 352-2996.

L & S CATTLE FEEDERS; 601 E. Main; Imperial, CA; 92251; (714) 355-1187.

ALAMO CATTLE FEEDERS, INC.; dba Meloland Cattle Company; 907 Brockman Road; El Centro, CA; 92243; (714) 352-4531.

MERTEN LAND & CATTLE CO., INC.; 1350 E. Keystone Road; Brawley, CA; 92227; Plum Canal, Gate 30; (714) 356-4939.

McCABE CATTLE COMPANY; P.O. Box 1420, El Centro, CA; 92243; McCabe & LaBrucherie Road; (714) 352-4164.

NEW RIVER CATTLE FEEDERS, INC.; 420 West Kubler Road; Calexico, CA; 92231; (714) 357-3235.

ORITA LAND & CATTLE CO.; P.O. Box 6; Brawley, CA; 92227; 1504 East Hwy. 78; (714) 344-2944.

SEELEY CATTLE FEEDERS; P.o. Box 805; Seeley, CA; 92273; 1597 W. Evan Hewes Hwy.; (714) 352-5143.

TRIPLE H CATTLE FEEDERS, INC.; P.O. Box 1141; Brawley, CA; 92227; 601 E. Rutherford Road; (714) 344-4210.

WESTMORELAND CATTLE COMPANY; 2205 Westmoreland Road; Imperial, CA; 92251; (714) 352-9251.

IDAHO FEEDLOTS

CANYON COUNTY

JOE ALBERTSON; West of Roswell, Idaho (in Oregon); 25,000 head capacity.

J. R. SIMPLOT; Caldwell; (208) 459-4785; 40,000 head.

CASSIA COUNTY

INTERSTATE FEEDERS; Malta; (208) 645-2221; 10,000 head.

MINIDOKA COUNTY

RICH BLINCOE FARMS; Paul, Idaho; (208) 532-4144; 15,000 head.

J. R. SIMPLOT; Norland (Burley-Rupert); (208) 532-4508; 20,000 head.

OWYHEE COUNTY

J. R. SIMPLOT; Grand View; (208) 834-2231; 40,000 head.

TWIN FALLS COUNTY

ED EUHLIG; Hansen; 10,000 head.

KANSAS FEEDLOTS

BARTON COUNTY

GREAT BEND FEEDING, INC.; R.R. #1; Box 220-A; Great Bend; 67530; 38,000 head.

FINNEY COUNTY

BROOKOVER FEED YARDS, INC.; Box 917; Graden City; 67846; 40,000 head.

MASTER FEEDERS II, INC.; Box 1629; Garden City; 67846; 50,000 head.

FORD COUNTY

FORD COUNTY FEED YARDS, INC.; Ford; 67842; 33,000 head.

GRANT COUNTY

GRANT COUNTY FEED YARD; Box 447; Ulysses; 67880; 50,000 head.

PRATT COUNTY

PRATT FEEDLOT, INC.; Box 945; Pratt; 67124; 35,000 head.

SEWARD COUNTY

SUPREME FEEDERS, INC.; Box 608; Liberal; 67901; 42,500 head.

WICHITA COUNTY

CAPROCK INDUSTRIES #3; Box 938; Leoti; 67861; 80,000 head.

NEVADA FEEDLOTS & DAIRYS

By Counties:

CHURCHILL COUNTY

BAR ALE: 8375 Reno Highway, Fallon 89406.

CIRCLE D. FEEDS: Carl F. Dodge
Box 31, Fallon 89406 or 455 Dodge Lane
(702) 423-3987 or (702) 423-2545

CREAMLAND DAIRY: 510 Harrigan Rd., Fallon
(702) 423-3247

KENT'S SUPPLY CENTER: 260 N. Maine, Fallon 89406
(702) 423-2126

LAHONTAN VALLEY FEED: 1252 Auction Rd., Fallon 89406
(702) 423-2767

MATLEY, DAVE: 4155 Allen Rd., Fallon 89406
(702) 423-7202 (5,000 head)

MILLS FARM & INDUSTRIAL (MFI): 4675 Sheckler Rd., Fallon 89406
(702) 867-3000 (Feed Dealer - liquid supplements)

NEVADA CATTLE FEEDING COMPANY: Sam Broyles, Kenneth Mebane
3500 Cushman Rd., Fallon 89406
(702) 423-2757 (10,000 head)

RED BARN FEED AND SUPPLY: 121 Allen Rd., Fallon 89406
(702) 423-5800

SORENSEN, JOHN DAIRY BARN: 755 W. Corkill Lane, Fallon
(702) 423-5832

VENTURACCI, ED: 445 Venturacci Place, Box 384, Fallon 89406
(702) 423-2473

HUMBOLT COUNTY

COCKEYE LAND & LIVESTOCK COMPANY: 330 E. Minor, Winnemucca
(702) 623-5574 (3,000 head)

MODEL DAIRY: Hanson, Winnemucca
(702) 623-5346

SMITH, NATHAN: 241 W. 1st, Winnemucca
(702) 623-5373 or (702) 529-0536

WINNEMUCCA FARMS INC.: S.P. Reserve, Winnemucca
(702) 623-2900

LYON COUNTY

LARRY MASINI: Yerington, (702) 463-2904

MINISTER RANCH: B.F. & R.R. Minister
Rt. 1, Box 8A, Yerington 89447
(702) 463-2835

PEOPLE'S PACKING COMPANY: Richard N. Fulstone
Box JJ, Yerington 89447
(702) 463-2341

SNYDER LIVESTOCK COMPANY: Ed Snyder, Jim Snyder
P.O. Box 1022, Yerington 89447
(702) 463-2677

ORMSBY COUNTY

BENSON'S FEED & TACK: 2760 Highway 50 East, Carson City
(702) 882-3999

CARSON VALLEY FEED & RANCH SUPPLY: 3179 A.S. Carson, Carson City
(702) 882-7766

MODEL DAIRY: 888 Corbett, Carson City
(702) 882-3775

WANDLER CLETE: 305 Winnie Lane, Carson City
(702) 882-7067 (Dairy)

PERSHING COUNTY

BATTAGLIA - FREY, INC.: Ken Cliff, Charles Reid
1300 Marietta Way, Sparks 89431
(702) 358-1520

McDOUGAL LIVESTOCK: Edward Bris (Buyer)
Maridon Rd., Lovelock 89419
(702) 273-2646 (10,000 head)

MODEL DAIRY: 500 Gould, Reno 89501
(702) 329-3191

NEVADA CATTLE FEEDING COMPANY: I East Ist, Reno 89501
(702) 849-0819

NEVADA SUPPLEMENT: Edward Bris (Buyer)
N. Meridian Rd., Lovelock 89419
(702) 273-2070 (feed mixing & pelleting or feed mixer & Mfgs.)

OLSON FARMS, INC.: 2335 Dickerson Rd., Reno 89501
(702) 322-7880

STORY DISTRIBUTING COMPANY: 1435 Franklin Ave., Lovelock 89419 (702) 273-2238

VALLEY FEED & RANCH SUPPLY: 3135 East Lake Blvd., Valley
(702) 849-0819

WASHOE COUNTY

ALBERS FEED & RANCH SUPPLY
ALBERS RANCH & GARDEN CENTER: 755 Timber Way, Reno 89501
(702) 322-8625

THE NEWHALL LAND AND FARMING COMPANY
PROCESSING DIVISION

P.O. Box 217
Dixon, California 95620
(916) 678-2301 · (916) 441-1068

September 18, 1980

Mr. R. C. Johnson
954 W. Jefferson Street
Boise, Idaho 83701

Dear Mr. Johnson:

We are presently very active in the production, handling and marketing of by-products in Northern California. Our company produces and/or markets approximately 350,000 ton/year of by-products and alfalfa to customers throughout Northern California and Japan. As I indicated to Mr. Johan Wassenaar, the 25,000 ton of dried grains from the proposed ethanol plant in Fernley could be marketed in Northern California. Preliminary estimates indicate its highest and best use to be in the poultry layer rations. That market would be large enough to absorb your proposed tonnage. We base this on product dried to 10% moisture and pelletized for handling and storage purposes.

Should your project progress to the point of implementation, we would be very interested in discussing some sort of marketing and/or handling arrangement.

Thank you for your consideration.

Yours truly,

Gary Cusumano
Vice President

GMC:kg

cc: Jim Beaman
Rich Mueller

PACIFIC MOLASSES COMPANY
ONE CALIFORNIA STREET
SAN FRANCISCO, CALIF. 94111
(415) 445-1400
CABLE ADDRESS: CANEMOLA
TELEX No. 34-0896

August 29, 1980

INDUSTRIAL DIVISION
MORRISON-KNUDSEN CO., INC.
SEP 02 1980
RECEIVED

Mr. Robert C. Johnston
Morrison & Knudsen
P.O Box 7808
Boise, Idaho 83729

Dear Mr. Johnston:

Thank you for your phone call early this week regarding the gasohol project you are working on for the Department of Energy and Geothermal Food Processors of Fernley, Nevada. According to our conversation we understand that the proposed plant would be built near Brady's Hot Springs, and there is a possibility that this plant would produce 200 tons per day of condensed grain distillers solubles.

This letter is to let you know that Pacific Molasses Company is active in the distribution of condensed solubles nationwide and we would be most interested in discussing with your principals a program to handle the distribution of this product for them.

Enclosed for your information is a copy of a brochure we developed on condensed molasses solubles which might be of interest to you.

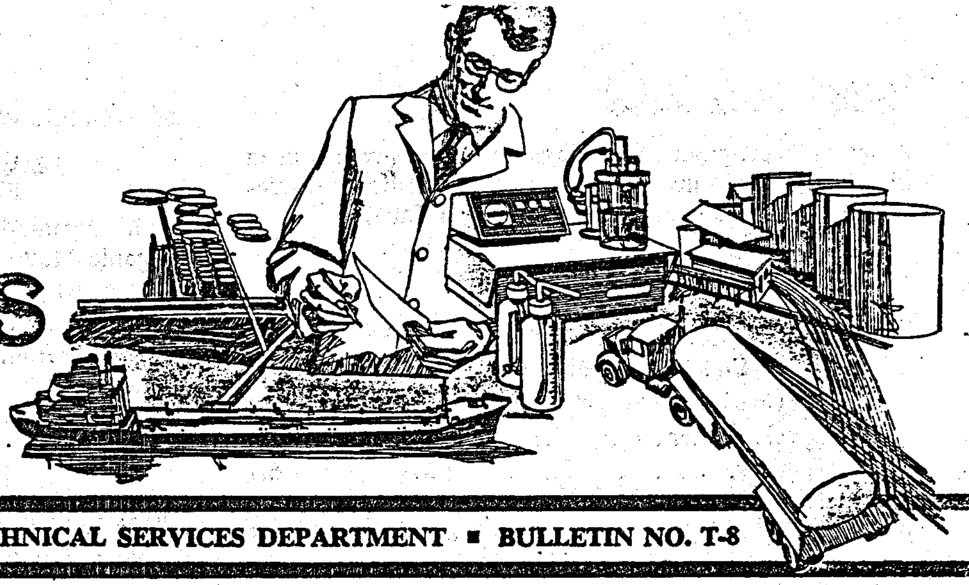
Most sincerely,

Joss Edwards

J. Y. Edwards
Vice President

JYE/mc
Enclosure

PM
MOLASSES FACTS



PACIFIC MOLASSES COMPANY ■ TECHNICAL SERVICES DEPARTMENT ■ BULLETIN NO. T-8

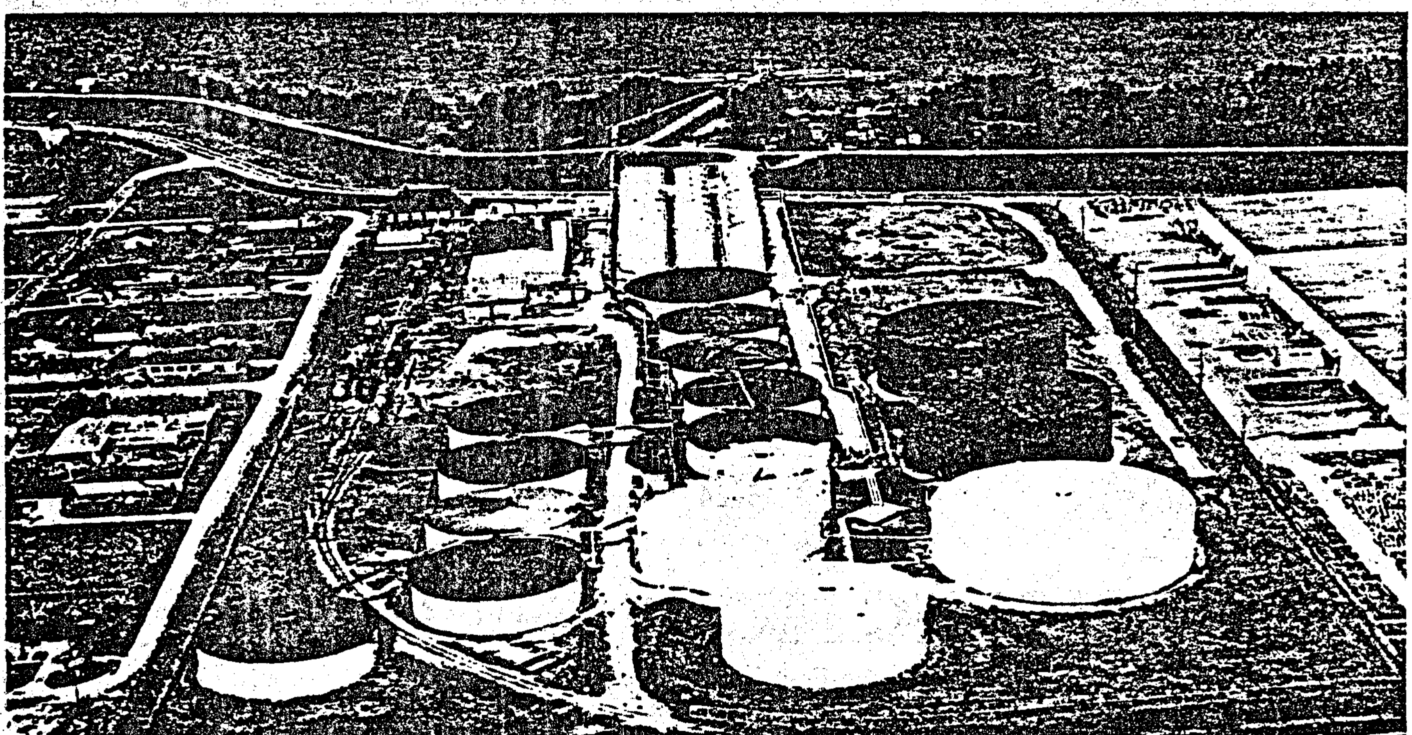
Condensed Molasses Solubles

Condensed Molasses Solubles, or C.M.S., is the name given collectively to the evaporated by-products from molasses-based fermentation industries. During the manufacture of alcohol, yeast, citric acid, monosodium glutamate, pharmaceuticals and other fermentation products, the fermentable sugars of molasses are used by micro-organisms. The remaining non-sugar organic matter of molasses and the inorganic solids are left untouched. The composition of C.M.S. is less related to the process that has been used than to the initial molasses used... the greatest differences being whether the input material is beet or cane molasses.

Pacific Molasses believes C.M.S. to be a nutritious, reasonably priced liquid feed ingredient. It is available in most livestock areas and can be delivered, received and handled with existing molasses equipment.

Physical Properties

Physically, C.M.S. is a dark brown, free-flowing liquid. It is less viscous than molasses, but retains much of the appearance and odor of the molasses from which it is derived. Naturally, because of the fermentation of sugars, it is less sweet than the original molasses, and the taste ranges from that of a rather neutral product to a somewhat salty tasting one. In extensive tests at up to 15% in pig and poultry rations, and up to 20% in ruminant rations, there have not been any palatability problems. When mixed with molasses, up to 50% presents no palatability problems. C.M.S. is normally marketed in the 60-65% solids range and has excellent biological stability at that level.



Westwego, Louisiana, one of twenty-three coast-to-coast Pacific Molasses terminals.

Test Results

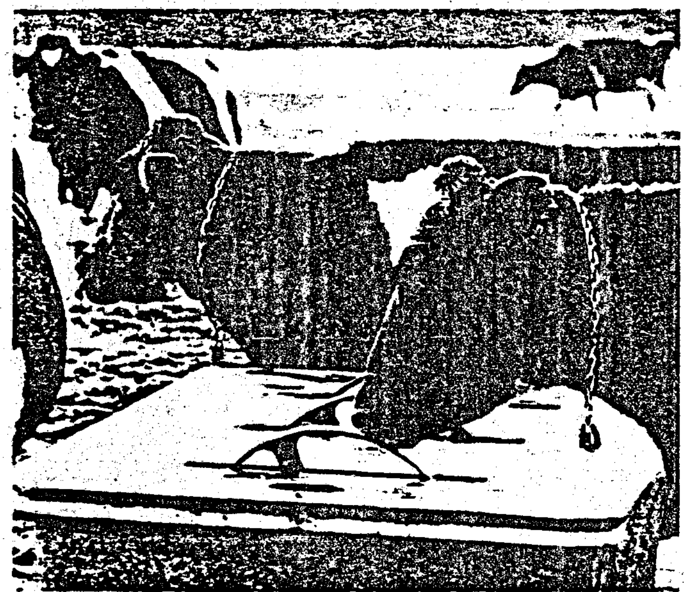
A research program at Nottingham University has been directed towards investigation of the nutritional values of C.M.S. Typical analyses are shown on Table 1.

TABLE 1.

Condensed Molasses Solubles
(% of constituents @ 65% dry matter)

Total Organic Matter	39.5	to	43.5
Sugar	2.3	"	6.7
Ash	21.5	"	25.0
Potassium	4.8	"	6.8
Calcium	0.2	"	1.1
Sodium	0.4	"	2.5
Chlorine	1.2	"	2.1
pH	4.5	"	6.7
Protein (6.25 X N)	8.0	"	26.0

This research has shown that the energy value of C.M.S. is associated with total organic matter—either sugar, other carbohydrates, or both. As with molasses, the research program derived certain factors for the calculation of energy values of C.M.S. for ruminants, pigs and poultry. Some average values, as calculated, are shown on Table 2.



When blended with molasses, C.M.S. makes an inexpensive, nutritious, liquid feed for cattle and other livestock.

TABLE 2.

Condensed Molasses Solubles
Energy Values (65% dry matter)

Total Organic Matter	42%
Organic Matter Adjusted[1]	41%
Ruminants	
ME	1357Kcals/kg
Starch Equivalent	36%
Pigs	
TDN	39.5%
Poultry	
ME	1590Kcals/kg
Gross Protein	6.8% to 24.4%

[1] Note: Adjusted for ammonia lost during ashing process. Only significant when ammoniacal nitrogen content of C.M.S. is high.

Nutritional Value of Nitrogen

The nitrogen content of C.M.S. varies from fairly low values for cane-based C.M.S. to significant levels of 3% or more for beet-based C.M.S.

Investigations into the value of this nitrogen have been carried out and show that it is a highly digestible form of nitrogen which is readily available for ruminants and may be compared to Urea as a source of non-protein nitrogen.

Availability

Pacific Molasses buys C.M.S. from companies that use both its cane and beet molasses in their fermentation processes. It is available as straight C.M.S., or blended with molasses to any specified percentage ratio.

Typical and/or specific analysis of the product available in your area can be provided. P/M sales representatives are prepared to review your requirements and propose a usage program designed for your needs.

P/M PACIFIC MOLASSES COMPANY
One California Street, San Francisco, California 94111
120 Wall Street, New York, New York 10005
660 Labauve Drive, Westwego, Louisiana 70094
Knappen Division, 13550 S. Indiana Avenue, Chicago, Illinois 60627

SECTION 6

FEEDSTOCK AND BY-PRODUCT HANDLING FACILITIES

6.1. FEEDSTOCK AND BY-PRODUCT STORAGE

Locally produced feedstocks are seasonal in production and must be largely stored at the plant site. Since little on-farm or commercial storage capacity exists in the area, a large storage complex must be provided. Winter weather in the area also will delay rail shipments to and from the plant, making storage necessary.

Rail service to the plant is vital in order to make available low cost corn and barley feedstocks from Idaho, Nebraska, and Kansas. Fortunately, the city of Fernley, Nevada has rail connections to the Northwest and Midwest. Southern Pacific and Union Pacific lines serve the region from Idaho, Kansas and Nebraska. Preliminary investigations with Southern Pacific Railroad indicated they have land and existing sidings available at Fernley and would be willing to lease these facilities at a nominal cost.

The agricultural analysis of the area indicates that in a long run situation only 29% of the needs of the plant can be grown locally; accordingly, rail deliveries will have to account for 71%. In the short run, while the local area's production is geared up, it is anticipated that in excess of 90% of the plant's feedstock inputs will have to be railed in.

Due to the uncertainty of weather conditions and supply fluctuations, it will be necessary to build a grain storage facility with a capacity large enough to hold 25 days' worth of feedstock, or approximately 9500 tons. This facility will be built on Southern Pacific land east of Fernley. A detailed site plan has not been completed insofar as the exact location has not yet been defined and agreed upon with Southern Pacific Railroad. The facility will be a modern automated grain storage plant, using (8) 48 feet in diameter grain bins for its main storage area. Incoming rail and truck shipments will occur on opposite sides of the facility, minimizing traffic problems. The system will feature enclosed belt conveyors as the main mode of grain movement. These conveyors use less horsepower and generate less friction loss than do conventional auger systems. They also shatter less product and consequently generate much less dust than auger systems.

The Fernley storage facility will also house storage for up to 20 days' worth of stillage grains. The tanks used will be (10) 27 foot in diameter, 8-ring hopper tanks built on 20-foot superstructures. This will be advantageous in that power outage occurrances during loading-out of either pelletized or bulk stillage grains will not affect the gravity-feeding tanks which can continue to fill either trucks or railcars. Fifty percent of the capacity of the stillage storage will be for bulk spent grains and 50% will be devoted to the storage of pelletized material. The facility will be complete with railcar and truck scales for incoming and outgoing material.

Stillage grains leaving the ethanol plant will first be dried to 10% moisture and either stored in bulk, or pelletized using a 16.8 ton per hour California pellet mill, after which they will proceed to a 40-hour outgoing storage that will consist of (3) 15 feet in diameter hopper tanks built on 14-foot superstructures. These tanks will feature gravity-loading into trucks for backhauling to the 20-day storage at the main storage area in Fernley.

Table 6-1 presents the storage requirements in operating days and in tons for both storage facilities.

6.2 LOCAL TRUCK HAULING OF FEEDSTOCK AND BY-PRODUCTS

From the Fernley storage facility, feedstock will be trucked to the plant. Spent grains will also be trucked back to Fernley from the plant. Five tractor-trailers are needed for hauling feed and spent grains the 30-mile round trip between Fernley and the plant site. The grain hauling trailers are 35 feet long, 40 yd. capacity, hoist-operated end dump trailers. They will be covered with tarpaulins in transit to prevent grain losses. Carrying capacity is 25 tons of barley feed grain and 20 tons of spent grains. Actual capacity of the trailers is 30 tons of barley, but 25 tons is used since this is the legal limit. On this basis, fifteen trips are needed per day, six hauling barley from the rail siding and backhauling spent grain and nine hauling barley and returning empty. Cycle time is estimated to be 1 hour and 45 minutes and 1 hour and 15 minutes for these two types of trips, respectively. For the purpose of this study, it was assumed that the trucks are operated on an 8-hour day, 7 day week basis for the 330 days per year the plant is operated. Total trucking cost for feed and spent grains is $0.013/lb. This cost includes operating and mechanical labor, parts, fuel and depreciation for the truck replacement. Maintenance is assumed to be done during the second shift thereby reducing the number of trucks required. Seven drivers are needed for the five trucks, since the drivers work 240 days during the year whereas the plant operates 330 days annually. Comparable rate estimates received from contract grain haulers are $0.01/lb. for hauling and $0.006/lb. for backhauling.

If the costs of purchasing trucks and contract hauling are similar, as the above analysis would indicate, purchase would be more desirable because of the greater measure of control obtained thereby.

TABLE 6-1

STORAGE REQUIREMENTS (IN TONS)

<u>Rail-Side Storage</u> --

Fernley

	BARLEY		CORN
A. 25-Day Feedstock Storage	9,500	12,000 (Available)	
(8) 48-foot, 9-ring storage bins		8,500 (Needed	
B. 20-Day Stillage Grain Storage			
50% Bulk	1,350		1,100
50% Pellets	1,350	1,100	
Total Stillage Storage	2,700	2,200	

(10) 27-foot, 8-ring hopper tanks or flat storage, including 1-150' x 40' bldg.

Plant-Site Storage --

Brady's Hot Springs

A.	40-Hour Feedstock Storage	605	550
	Anticipated flat storage		
B.	40-Hour Stillage Storage	223	174
	(3) 15-foot, 7-ring hopper tanks with 14' super-structures		

TABLE 6-2
DETAILED COST ESTIMATE, FEEDSTOCK AND BY-PRODUCT STORAGE

FERNLEY RAIL SITE

Feedstock Storage Bins	Mat'ls of Const.	Elec. HP.	WT Tons	Price
8 WSL 48'/9 Ring Bins	Galv. Corrug. Metal	80	186	$490,000
8 Power Sweep Unloaders	Glav. Metal	120	6	49,000
			Subtotal	$539,000
Stillage Storage				
10 NP 27'/8 Ring Hopper	Corrug. Metal & M.S.	20	75	$890,000
			Subtotal	$890,000
Conveyors				
Fernley #1 Roof	Galv. & M.S.	20		$ 35,000
Fernley #2 Roof	Galv. & M.S.	20		35,000
Fernley #3 Roof	Galv. & M.S.	15		25,000
Fernley #4 Feedstock out	Galv. & M.S.	20		35,000
Fernley #5 Feedstock out	Galv. & M.S.	20		35,000
Fernley #6 Roof	Galv. & M.S.	20		35,000
Fernley #7 Roof	Galv. & M.S.	15		38,000
Fernley #8 Truck Pit	Galv. & M.S.	20		35,000
Fernley #9 Railroad Pit	Galv. & M.S.	15		25,000
Fernley #10 Railroad Roof	Galv. & M.S.	20		38,000
Fernley #11 Railroad Roof	Galv. & M.S.	20		38,000
			Subtotal	$374,000
Bucket Elevators w/Unloading Pits				
#(1) Fernley Main Building	115'Ht. 10,000 Bu./hr.	30		$30,000
#(2) Fernley Stillage Tanks	115'Ht. 6,000 Bu./hr.	25		25,000
#(1) Fernley Main Building	100'Ht. 10,000 Bu./hr	30		30,000
			Subtotal	$ 85,000

TABLE 6-2 (Cont'd)

Buildings	Mat'ls of Const.		Price
Central Building	(240'L x 36'W x 50'H)@$40		$346,000
Maintenance Building	(40' x 24' x 12') @$55		53,000
2 Scale Houses	(15' x 25' x 12') @$35		14,000
1 Dust Control	(48' x 20' x) @$55		53,000
1 Plant Stillage Loadout Shelter			7,000
		Subtotal	$473,000

Miscellaneous Equipment	Elec.HP		
Bin Electric Panels, Starters, Wiring, etc.			$ 50,000
2 ea. Digital Alarm Systems			8,000
2 ea. Bin Level Control System w/Wiring			25,000
5 Catwalks & Towers w/Safety Equipment			180,000
2 Leg Towers			30,000
2 scales (RR Pit & Truck)			210,000
1 Truck Hyd. Dump	50		175,000
2 Dust Control Systems	300		305,000
		Subtotal	$983,000
Site Preparation, Utilities, Fire Protection, Etc.			$265,000

TOTAL COST, FERNLEY SITE
Priced F.O.B. Nevada w/Assembly and Erection Costs — $3,609,000

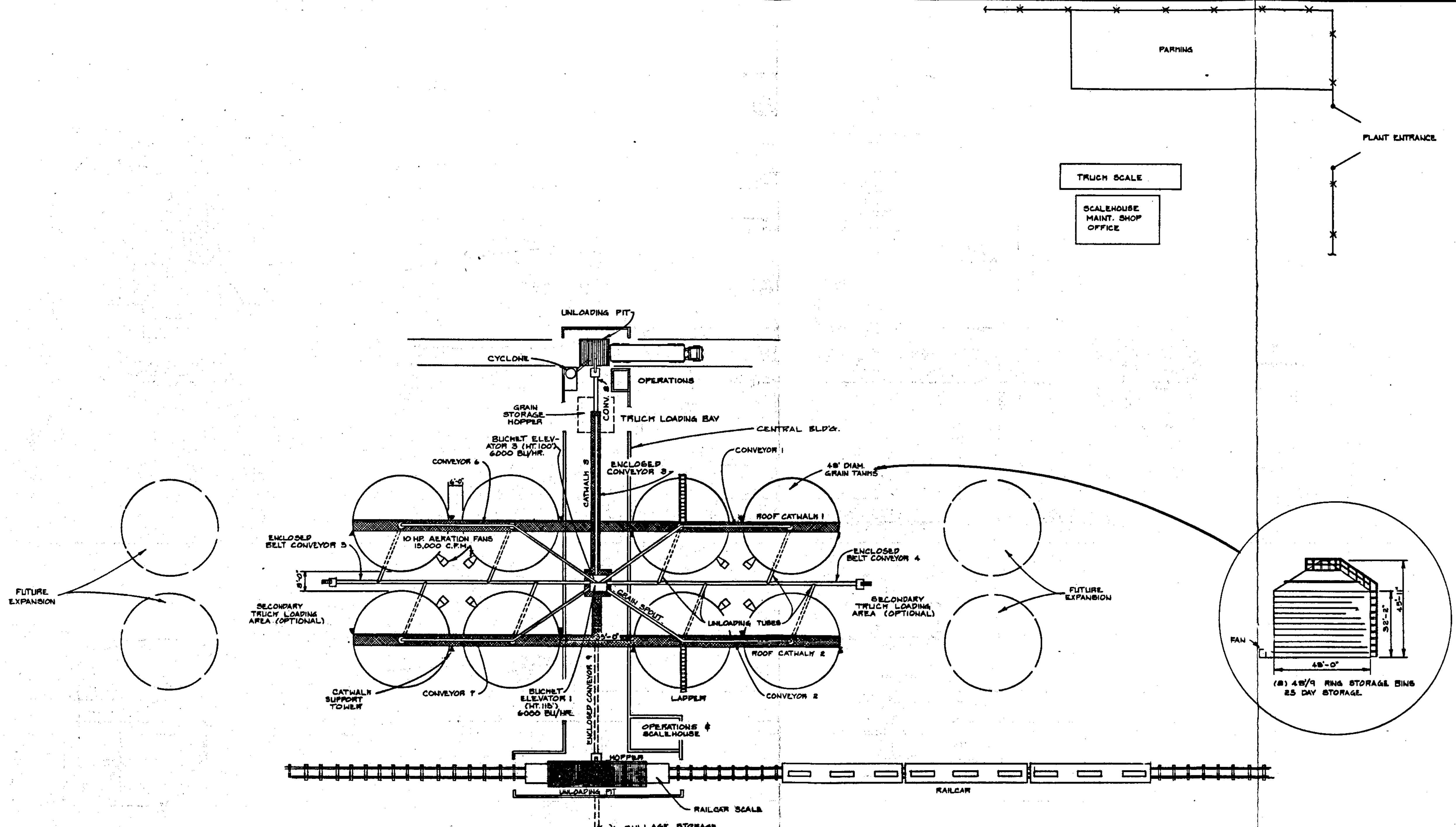
TABLE 6-2 (Cont'd)

BRADY PLANT SITE

Conveyors	Mat'ls of Const.	Elec. HP	WT Tons	Price
#12 Pellet - Pit Storage	Standard	10		$ 15,000
#13 Roof - Plant Stillage	Standard	10		15,000
			Subtotal	$ 30,000
Bucket Elevator				
#(4) Plant Pellet Mill	60' Ht. 4,000 Bu./hr.	10		$ 15,000
			Subtotal	15,000
Miscellaneous				
1 Leg Tower				$ 15,000
			Subtotal	$ 15,000
Plant Bulk or Pellet Stillage				
3-H-15'/7 Ring Hopper Tanks w/.4' S.S. & 60' Bottoms (Storage prior to backhaul)				$190,000
			Subtotal	$190,000

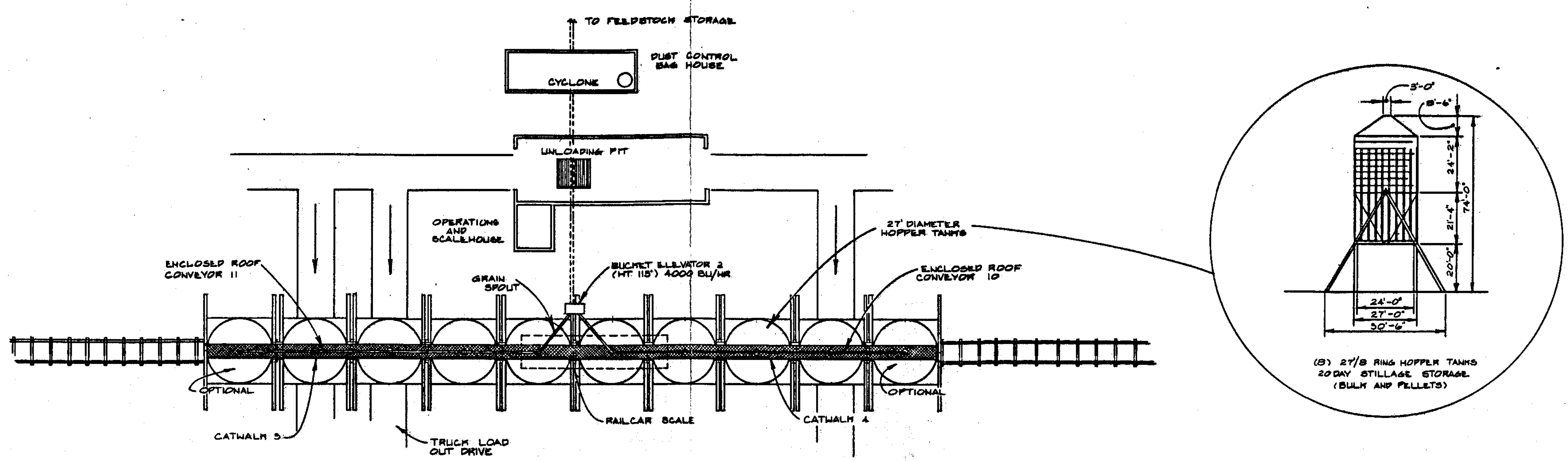
TOTAL COST, BRADY PLANT SITE
Priced F.O.B. Nevada w/Assembly and Erection Costs, w/o Seismic 4-5 Construction Considerations — $250,000

TOTAL COST, BOTH FACILITIES
(Plus Sales Tax when applicable) — $3,594,000

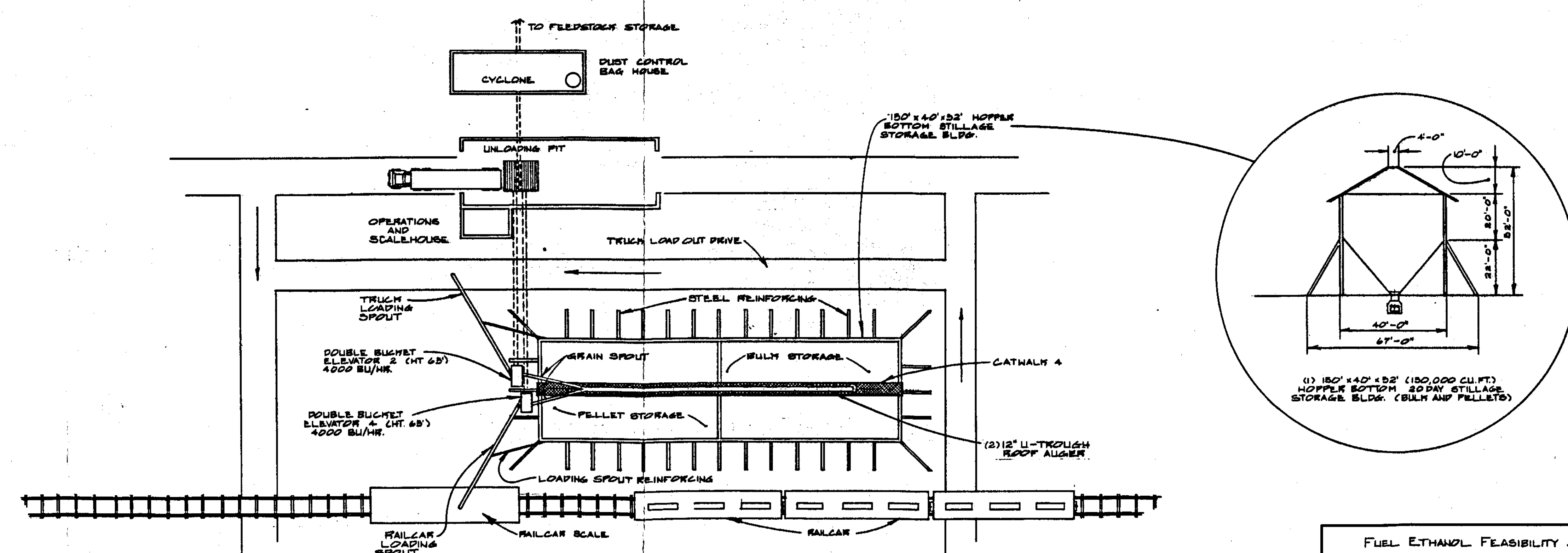


FEEDSTOCK – 9,500 TON (25 DAY) STORAGE

FUEL ETHANOL FEASIBILITY STUDY	
SCALE: 1"=25'-0"	APPROVED BY:
DATE: 9-15-80	DRAWN BY:
AG WEST, INC. SACRAMENTO, CALIFORNIA 95815	
AWI 36-EE	



ALTERNATIVE ONE — STILLAGE-2600 TON (20 DAY) STORAGE



ALTERNATIVE TWO — STILLAGE-2600 TON (20 DAY) STORAGE

6-12

FUEL ETHANOL FEASIBILITY STUDY
SCALE: 1" = 24'-0"
DATE: 9-17-80
AG WEST, INC.
SACRAMENTO, CALIFORNIA
AWI 3½-22

SECTION 7

FUEL ALCOHOL MARKET ASSESSMENT

7.1 ETHANOL PRICE MECHANISM

In the long run, the market will not pay higher prices for gasoline than for alcohol without demand shifting to alcohol. During a transitionary period when alcohol availability is limited, such a two-tier pricing system may not reduce gasoline demand by the amount required in free market conditions. Such a situation appears to be developing in the United States with respect to methanol. Methanol can be economically produced from a variety of feedstocks as a replacement for gasoline, and at market prices will below those in prospect for gasoline. However, methanol faces technical barriers that first must be overcome. Engines and indeed distribution facilities need to be made compatible with neet methanol, which does not mix well with gasoline. The preponderant use of methanol as a motor fuel will, therefore, not occur within the next decade.

Ethanol, on the other hand, is readily introduced into the gasoline market as an additive, and offers the bonus of increasing the mixtures' octane rating, permiting engines to run cooler and cleaner with livelier performance and no "dieseling" when the ignition is turned off. There are also no significant material incompatibilities that would inhibit the use of gasohol in motor vehicles. Ethanol must, therefore, be treated as an integral constituent of the gasoline trade. As such, the price movement of ethanol can be expected to parallel the price movement of gasoline as long as demand for ethanol exceeds available supply.

The price of gasoline in real terms can only be expected to rise. Estimates by various qualified sourses vary only in degree. The most optimistic prediction from a consumer viewpoint is that it will rise at the refinery gate at a rate of 3 1/2% per year. The pessimists claim figures as high as 15%. At that rate, gasoline prices at the pump would reach approximately $3.00 per gallon by 1985 (1980 dollar).

The gasoline blender or independent distributor/dealer currently pays around $1.00 per gallon for gasoline at the refinery. The prevailing price for ethanol is in the range of $1.60 to $1.80 at point of origin. With transportation included, the West Coast blender has $1.80 to $2.00 per gallon invested in ethanol before he can begin dispensing gasohol. He, therefore, is subsidizing each gallon of gasohol to the tune of 8 to 10 cents per gallon. The federal gasohol tax exemption reduces this dealer subsidy by 4 cents to 4 to 6 cents. Attempts by gasohol retailers to pass this cost on to the motorists have not always been successful, including some dealer experiences in California. In states where gasohol sales and user taxes have been exempted, this barrier is currently largely removed. This has yet to happen in California and Nevada.

However, as the price of gasoline advances, this relationship changes in favor of ethanol. The current supply surplus of crude oil cannot be expected to last in the world market. Any reasonable prognosis concludes that there will be a return to a supply limited equilibrium in the market. In the longer term, the resulting higher price umbrella will bring more expensive sources of oil on stream from offshore operations, production of marginal fields by secondary recovery, extraction of shale oil, conversion from coal, and so forth. The general consensus is that at a level of about $1.80. By 1985, the comparable figure would be over $2.00 (all in 1980 constant dollars).

However, this scenario does not take into account the beneficial effect that ethanol additive has on the octane rating of regular unleaded gasoline. In general, a 10% addition of ethanol raises the octane rating of regular gasoline from 87 to 90 or 91. The resulting gasohol then becomes the equivalent of premium gasoline which commands a 6 to 8 cent higher market price. alternatively, the dealer or blender has the option of using a lower octane gasoline feedstock, such as 84 octane, to produce 87 octane gasohol. The cost of producing lower octane gasoline is inherently lower than producing a higher octane product. Unfortunately, the sunk costs in refining plants are geared to making regular gasoline, and so the inherent cost advantage in buying lower grade gasoline is not usually translatible into a price discount over the short term. If there had been a sustained demand of some size for lower octane product to blend into gasohol, it would be more reasonable now to expect price concessions. The advantage to the refinery of having a significant market for lower grade gasoline would become emphasized as the trend toward heavier crude oil supplies develops further. For instance, a shift in Californian refineries from light Indonesian crude to heavier crude feedstocks to accomodate more heavy oil from Kern County and Alaskan crude would result in substantial capital investments to add reformers to meet the demand for gasoline. The ability to produce more, lower octane, grades may have some influence in mitigating the extent of the investment required. This could result in the acceptance of long-term contracts for lower octane gasoline at lower prices. If one can use the oil industry's own pricing criteria for the market value of there remains about as much oil to be discovered in the world as has been found to date. However, it is also known that the new oil will be more costly to discover and produce. Hence, the expectation is that the underlying cost of future crude supplies will gradually come into balance with the price structure artificially being preserved by the foreign low-cost oil producers in the interim. This has all the appearances of a reasonably stable upward thrust in oil prices, upon which an alternative fuels industry can be based.

Without subsidy by the gaoline dealer, and given the proviso that gasohol must compete directly with the price of unleaded, 87 octane gasoline in order to be acceptable to the consumer, ethanol cannot theoretically be sold for more than 40 cents over the refinery price gasoline. In states with gasohol tax exemptions the gifure would be commensurately higher. In today's market the theoretically sustainable price of ethanol, exclusive of state tax incentives would, therefore, be in the order of $1.40 per gallon. Interestingly, this corresponds reasonably closely with the current landed price of imported Brazilian ethanol. Posted domestic ethanol prices have been higher; in the range of $1.60 to $1.80 per gallon. This probably comes about because of the state subsidies in states close to the predominant U.S. manufacturers of ethanol. Most of these states are far enough inland to shield them from cheaper ethanol imports.

By 1983, when the ethanol plant at Brady's Hot Springs would begin production, the average refinery price of unleaded gasoline will probably have risen to around $1.35 (1980 dollars). The theoretically sustainable price of ethanol, exclusive of state gasohol tax subsidies, would then be unleaded gasoline octane number, as manifested at the gasoline pump between 87 and 90 octane gasoline, each point of octane rating is worth 2 cents. On such a basis 84 octane gasoline should sell at the refinery for 6 cents less than 87 octane gasoline. This would amount to a 60 cent gain in ethanol price, which would make the study project quite profitable in the 1983 timeframe.

The basic scenario also neglects the buying preference of the public. In a venture of the kind described in this study, one is inclined to overlook the fact that gasohol has to be marketed and merchandised like any other consumer product, before it can command a price differential. The perceived superiority of gasohol compared with ordinary gasoline does not become real until the driver of the automobile has experienced at first hand an improvement in mileage, better response, no knocking or "pinging," and a disappearance of the car's previous tendency to continue running after the key is turned off. After prolonged experience the driver may discover that the car's plugs last longer, or that it requires less frequent muffler replacements. At that point an ardent gasohol convert comes into being, which progressively adds to build momentum. Of course, modern merchandising methods have yet to be applied to the sale and promotion of gasohol, since it is still an industry in its infancy. If the public could be induced to pay a nickle extra for gasohol, which would mean 50 cents more on a gallon of ethanol, the bio-mass motor alcohol industry would be on its feet quite rapidly. That this is possible through mass merchandising methods has been well proven by TCP which captured a large market even though its manufacturer signed a consent decree when the FTC claimed that the gasoline additive made no real difference to engine performance or gas mileage.

If gasohol's advantages are real, and outweigh its occasional incompatibilities with automobile accessory component materials, a public following will develop, and as the industry grows, its promotion will become more aggressive too. During its early growth, gasohol promotion will most likely start with independent dealers, seeking to gain the benefits of assymetry in their contest with the major oil companies. Once it is accepted, the large companies will follow. Texaco and Amoco have already hedged their ethanol bets to some degree, and more will follow as the industry matures.

7.2 CALIFORNIA GASOHOL MARKET

Gasoline consumption in California during the first six months of 1980 averaged around 31 million barrels of oil equivalent in gasoline per day. This amounts to about 11 billion gallons of gasoline per year. The ethanol output from the plant under study would provide 100 million gallons of gasohol per year; about 0.9% of the state's requirement. Hence, very small market penetration is required to ensure this venture°s success.

Gasohol is virtually unavailable in the state on a commercial level. Only two oil companies in the Fresno area offer gasohol for sale to the public at a rate of about 60 million gallons per year. The California Energy Commission and the Governor are basically opposed to ethanol production from agricultural products, and favor the use of neet methonal in dedicated vehicle fleets. Fleet testing is being conducted by the Bank of America and other state agencies.

A California Alcohol Fuels Commission has been formed to promote the use of gasohol within the state legislature. This has resulted in the passage by the legislative branch of two important measures. Assembly Bill No. 2004, herein reproduced, exempts gasohol for three years from the State Air Resources Board requirements for maximum Reid vapor pressure, which would otherwise inhibit the use of gasohol under hot summer conditions. This Bill was signed into law on June 13, 1980. Senate Bill No. 1324 would exempt gasohol from state sales and user taxes to the extent of 5% of tax in 1981, 4% in 1982, and 3% in 1983, the year that the plant under study would go on stream. This measure, also herein reproduced is still on the Governor's desk. Since it passed with a two-thirds majority it is thought unlikely that Governor Brown will veto the bill, thereby letting it become law on October 1, 1980.

The two active gasohol dealers, Beacon Oil of Hanford, and Martin Oil of Fresno see passage of this bill as essential to the survival of their gasohol business. However, if it becomes law, they believe that gasohol sales will grow, and that other dealers who withdrew from the gasohol market when gasoline supplies became reliable again after the shortages of 1979, will also return as a result of this incentive. Presumably other independent dealers without prior gasohol experience will follow. In this event, it would be reasonable to expect that gasohol will establish a foothold of greater significance in the state.

However, should the Governor veto SB No. 1324, there is still reason to believe that gasohol will intrude into the California market, but on a different time scale determined by the crude oil supply conditions to the state's refineries. It is fairly predictable that tight supply situations are not too distant in the future, and when this becomes clear tot he independent dealers, the rush will be on again to find additives with which to extend their supplies. It happened in 1979, and it will most likely happen again. The difference is that this time it will occur at a higher gasoline price level relative to the price of ethanol, which should make the trend to gasohol more permanent. While this study can claim no access to omniscience, the political situation in the Middle East gives little comfort to the belief that this will not occur before 1983 when the plant will need a market.

7.3 NEVADA GASOHOL MARKET

There has been no legislation in Nevada to exempt gasohol from state gasoline taxes. It would be most helpful to the proposed project if such a measure were adopted, and this possibility will be pursued on a political level. The availability of adequate liquid motor fuel supplies in Nevada is critical to the tourist industry which accounts for 35% of the state's revenues. In recognition of this fact, the state legislature appropriated $10 million in standby funds in 1979 to create emergency gasoline reserve supplies. The presence of a 10 million gallon annual source of alcohol fuel in the state will have the same impact in any given year on state motor fuel supplies as this emergency reserve. There is, therefore, some political significance to the construction of the plant in the state of Nevada; a fact that should provide natural support for the project from the state government.

Nevada currently uses close to 500 million gallons of gasoline per year, and consumption is growing at an annual rate of 10%. A 20% gasohol penetration of the Nevada gasoline market would, therefore, equate to the design capacity of the ethanol plant.

Reno is the terminal point closest to the plant on the gasoline supply grid. Major refineries supply motor fuel to Reno from Martinas, California over the Soutehrn Pacific pipeline. From the Reno/Sparks distribution center, gasoline is then trucked south to Bishop, California, east to Winnemucca, north to Alturas, California, and west to Lake Tahoe.

Independent dealers who are not participants in the pipeline, bring their gasoline in from California by truck and rail at significantly higher freight costs. About 50% of the states filling stations are independent dealers, often operating with minimal storage facilities, and, therefore, vulnerable to supply interruptions. These dealers would benefit most from a local supply of gasohol.

The price structure within which these dealers operate, appears to be approximately as follows:

o	Unleaded 87 octane gasoline at wholesale	$1.10	($1.05-1.15)
o	Federal excise tax	.04	
o	Nevada state tax	.06	
o	Service station markup	.10	
o	Unleaded gasoline at retail	$1.30	($1.20-1.40)

By purchasing lower octane unleaded gasoline and raising the octane rating by the introduction of 10% ethanol, the independent Nevada dealer could offer gasohol competitively with unleaded gasoline within the following alternative pricing structure:

o	Unleaded 84 octane gasoline at wholesale, 9/10 gallons	$ .96
o	Federal excise tax	-0-
o	Nevada state tax	.06
o	Station mark-up	.10
o	Ethanol, 1/10th gallon	.18
		$1.30

This equates to a $1.80/gallon price for ethanol, which except for the Federal tax exemption, is entirely dependent upont he price differential that exists between higher and lower octane unleaded gasoline feedstocks. The octane rating spread is determined by the degree to which the additions of 10% ethanol improves the octane number of a specific blend of gasoline. The price differential between higher and lower octane feedstocks, depends basically on the higher refinery costs required to achieve the higher octane number. This is influenced by the blend of crude oil being supplied to the refinery, and the prices design of the refinery. In general, it is more expensive to generate high octane gasoline fractions from heavy crude than from light crude. due to supply shortages on the world market, the tendency in most refining centers is toward heavier blends of crude feedstocks, which should increase the commercial value of ethanol as an octane enhancing additive still further.

The California refineries which also supply nevada, are geared to light Indonesian crude, and the trend toward heavier feedstocks will require very substantial investments in hydrocracking facilities to continue to produce an adequate proportion of high octane gasoline. The availability of ethanol could be used to good advantage to mitigate some of the cost impacts of this inevitable development.

Government

Region 7 is required by IFB-DLA600-80-13-0007 to purchase a little over 4 million gallons of "hard" gasohol in FY 1981. This is to be distributed to the states in region 7 in the following proportions:

California	84.4%	3.3936 million gallons
Arizona	10.2%	.4088 million gallons
Utah	3.3%	.133 million gallons
Nevada	2.1%	.085 million gallons

Distribution between Federal government services will be as follows:

U.S. Air Force	38.5%	1.5384 million gallons
U.S. navy	36.9%	1.475 million gallons
FCA	24.6%	.987 million gallons

Unleaded gasoline "hard" requirements in the same year will be 25.962 million gallons distributed as follows:

FCA	48.5%	12.573 million gallons
U.S. Army	25.4%	6.601 million gallons
U.S. navy	20.4%	5.285 million gallons
U.S. Air Force	5.2%	1.359 million gallons
DOD	.5%	.144 million gallons

The Federal government has a very large presence in Nevada relative to its population, and it must be viewed as an important potential market for the plant's ethanol output. This would particularly be the case if MX deployment is authorized.

CONCLUSIONS:

1. There is an abundent potential market for ethanol motor fuel within easy transportation distances of the plant.

2. The development of a consumer gasohol market in te region lags behind many states in which gasohol use has grown dramatically.

3. It is most likely that state tax incentives for the promotion of gasohol sales will occur in some measure, at least in California.

4. There are strong political reasons for the State of Nevada to encourage the development of the proposed plant.

5. The military presence in Nevada represents a considerable market for gasohol.

6. Price competition between gasohol and regular unleaded gasoline, and ethanol competition from low-cost producers such as Brazil, will make it difficult initially to achieve the average $1.90 per gallon ethanol price upon which the plant's pro forma is based.

7. However, as gasoline prices rise relative to the cost of ethanol, the price for ethanol will improve significantly.

8. Even in the marginal gasohol market situation in California for the present, commitments can be obtained for the purchase of the total plant output, at prices that would break even with production costs.

9. By the time that the plant could be brought on streamin early 1983, the gasoline price umbrella should be high enough to permit profitable ethanol sales.

10. The long-term market outlook for ethanol in the region of the plant appears to be highly favorable.

Assembly Bill No. 2004

CHAPTER 179

An act to amend Section 43830 of the Health and Safety Code, relating to air pollution, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor June 13, 1980. Filed with Secretary of State June 13, 1980.]

LEGISLATIVE COUNSEL'S DIGEST

AB 2004, Boatwright. Air pollution: motor vehicle fuel.

Under existing law, the State Air Resources Board is required to establish by regulation specified maximum standards for the volatility of gasoline sold in California at 9 pounds per square inch Reid vapor pressure.

This bill would exempt from any law or regulations, for the 3-year period commencing with the effective date of the bill, any blend of gasoline consisting of at least 10% ethyl alcohol, if the gasoline used in the blend meets the 9 pounds per square inch Reid vapor pressure standard.

The bill would require the Legislative Analyst to submit a report to the Legislature 2 years after the effective date of the bill on the impact of the use of gasohol on the ambient air quality in the state.

The bill would take effect immediately as an urgency statute.

The people of the State of California do enact as follows:

SECTION 1. Section 43830 of the Health and Safety Code is amended to read:

43830. The state board shall establish, by regulation, maximum standards for the volatility of gasoline at nine pounds per square inch Reid vapor pressure as determined by the American Society for Testing and Materials test D 323-58, or by an appropriate test determined by the state board, for gasoline sold in this state.

The state board, in adopting such regulations, shall give full consideration to climatic conditions and may provide that the maximum standards imposed thereby shall be applicable only during those periods of time and only in those areas which the state board determines necessary in order to carry out the purposes of this division.

Notwithstanding any other law or regulation, for the three-year period commencing with the effective date of the act amending this section at the 1979–80 Regular Session of the Legislature, any blend of gasoline of at least 10 percent ethyl alcohol shall be considered a legal fuel in California if the gasoline used in the blend meets the standard of nine pounds per square inch Reid vapor pressure.

SEC. 2. Two years after the effective date of this act, the Legislative Analyst shall report to the Legislature on the impacts of gasohol on the ambient air quality in California. The report shall be limited to a review of available literature and shall not include any original analysis of data.

SEC. 3. This act is an urgency statute necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting such necessity are:

In the face of decreasing supplies of gasoline, the immediate widespread use of blends of alcohol and gasoline could reduce gasoline consumption by 10 percent. In order that this be encouraged at the earliest possible time, it is necessary that this act take effect immediately.

O

AMENDED IN ASSEMBLY AUGUST 21, 1980

AMENDED IN ASSEMBLY JULY 4, 1980

AMENDED IN SENATE MAY 13, 1980

AMENDED IN SENATE APRIL 15, 1980

SENATE BILL No. 1324

Introduced by Senator Campbell

(Principal coauthor: Assemblyman Boatwright)

~~(Coauthor: Assemblyman Filante)~~

(Coauthors: Assemblymen Filante and Stirling)

January 15, 1980

7-14

An act to add and repeal Section 6357.5 to the Revenue and Taxation Code, relating to taxation, and making an appropriation therefor, to take effect immediately, tax levy.

LEGISLATIVE COUNSEL'S DIGEST

SB 1324, as amended, Campbell. Sales and use taxes: gasohol.

Existing California Sales and Use Tax Law imposes a sales or use tax on the sale or use of tangible personal property in this state, unless such sale or use is exempted from such tax. The sale or use of gasohol or methanol is not exempted from sales or use taxes.

This bill would ~~exempt~~ *provide a limited exemption* from sales and use taxes, until January 1, 1984, *on* the sales or use of gasohol, as defined, under specified circumstances.

The bill would transfer the revenues lost as a result of this act to the General Fund from the Energy and Resources Fund, if created, and if that fund is not created, from tidelands revenues prior to COFPHE allocations pursuant to Section 6217 of the Public Resources Code.

This bill would require the Legislative Analyst to report to the Legislature on January 1, 1984, on the impact of the exemption.

Counties and cities are authorized to impose local sales and use taxes in conformity with state sales and use taxes. Exemptions from state sales and use taxes enacted by the Legislature are automatically incorporated into the local taxes.

Section 2230 of the Revenue and Taxation Code provides that the state will reimburse counties and cities for revenue losses caused by the enactment of sales and use tax exemptions.

This bill would appropriate $1,000,000 to the Controller to make the reimbursements to counties and cities specified in Section 2230.

This bill would take effect immediately as a tax levy but its operative date would depend on its effective date.

Vote: ⅔. Appropriation: yes. Fiscal committee: yes. State-mandated local program: yes.

The people of the State of California do enact as follows:

SECTION 1. Section 6357.5 is added to the Revenue and Taxation Code, to read:

6357.5. (a) There are exempted from the taxes imposed by this part the gross receipts from the sale of and storage, use, or other consumption in this state of gasohol.

(b) *This exemption shall not apply to that amount of gross receipts in excess of the amount of gross receipts, subject to sales or use tax, that would result in a sales or use tax of:*

(1) Five cents ($.05) per gallon of gasohol sold on and after January 1, 1981, until January 1, 1982; and

(2) Four cents ($.04) per gallon of gasohol sold on and after January 1, 1982, until January 1, 1983; and

(3) Three cents ($.03) per gallon of gasohol sold on and after January 1, 1983, until January 1, 1984.

(c) For purposes of this section:

(1) "Gasohol" means a motor vehicle fuel composed of a blend of motor gasoline and not less than 10 percent

alcohol. The alcohol component may be methanol or ethanol.

(2) Commencing on and after January 1, 1981, the alcohol component in gasohol shall be distilled from agricultural commodities, renewable resources, or coal.

(3) Commencing on and after January 1, 1981, the alcohol in gasohol shall be rendered unsuitable for human consumption at the time of its manufacture or immediately thereafter.

(4) Gasohol shall be dyed a color that is different from the color of other gasolines. The State Board of Equalization shall designate the color of gasohol.

SEC. 2. The Legislature declares that in order to promote the use of a renewable energy source in California, it is in the public interest to encourage the participation of the private sector in the development of a production and distribution system for agriculture-related alcohol fuels. The development of alcohol fuels will reduce American dependence upon foreign sources of energy; provide a clean, efficient and renewable energy source that will contribute significantly to California's motor vehicle pollution reduction goals; aid California farmers in providing incentive to produce alternate cash crops and to use farmlands more efficiently; and encourage public participation in energy conservation, motor vehicle fuel economy, and pollution control.

SEC. 3. On or before May 10, 1981, and on or before each May 10 thereafter, the Franchise Tax Board shall transmit to the Controller an estimate of the annual revenues which will be lost as a result of enactment of this act.

SEC. 4. The sum estimated by the Franchise Tax Board for the first year in which this act is in effect shall be transferred from the Energy and Resources Fund to the General Fund on or before May 15, 1981, to replace revenues which will be lost as a result of the enactment of this act.

This section shall become operative only if Assembly Bill No. 2973 of the 1979-80 Regular Session of the

7-15

Legislature is enacted and creates the Energy and Resources Fund.

SEC. 5. If Section 4 of this act does not become operative, the sums which would otherwise be required to be transferred pursuant to Section 4 shall be transferred from revenues received by the State Lands Commission and allocated under the provisions of Section 6217 of the Public Resources Code; this appropriation to be payable immediately prior to allocations made for the 1980-81 fiscal year pursuant to subdivision (e) (the Capital Outlay Fund for Public Higher Education) of Section 6217, and after allocations made for the 1980-81 fiscal year pursuant to subdivisions (a) to (d), inclusive, of Section 6217 of the Public Resources Code.

SEC. 6. The revenues lost for the second and subsequent years in which this act is in effect shall be transferred to the General Fund pursuant to the Budget Act on or before May 15, 1982, and on or before each May 15 thereafter.

~~SEC. 3.~~

SEC. 7. Section 1 shall remain in effect only until January 1, 1984, and as of such date is repealed, unless a later enacted statute, which is chaptered before December 31, 1983, deletes or extends such date.

~~SEC. 4.~~

SEC. 8. The Legislative Analyst shall report to the Legislature on January 1, 1984, on the economic impact of the sales and use tax exemption for gasohol.

~~SEC. 5.~~

SEC. 9. The sum of one million dollars ($1,000,000) is hereby appropriated to the Controller from the General Fund to make the payments to counties and cities required by Section 2230 of the Revenue and Taxation Code to reimburse them for revenue losses caused by Section 1 of this act in the initial fiscal year in which this act is effective. The appropriation made by this section shall be allocated in the manner specified in Section 2230.

~~SEC. 6.~~

SEC. 10. This act provides for a tax levy within the meaning of Article IV of the Constitution and shall go into immediate effect. However, the provisions of this act shall become operative on the first day of the first calendar quarter commencing more than 90 days after the effective date of this act.

REFINERS · MARKETERS · PETROLEUM PRODUCTS

BEACON OIL COMPANY

525 WEST THIRD STREET, HANFORD, CALIFORNIA 93230
AREA CODE (209) PHONE 582-0241

September 19, 1980

Geothermal Food Processors
P. O. Box 768
Fernley, Nevada 89408

Attention Mr. Wasseuar

Gentlemen:

It's exciting to learn that you are planning to build a plant at Bradys Hot Springs to distill fuel grade, 200 proof alcohol from Bio-Mass, and to use geothermal energy for your heat source.

The Beacon Oil Company is a small, independent refiner and marketer located in Hanford, California. We have been selling Gasohol for over a year through our Beacon branded dealers, and Company operated service stations. Our stations selling Gasohol make up well over two-thirds of all the stations in California dispensing Gasohol. Such sales require us to purchase approximately 150,000 gallons of 200 proof alcohol each month.

With the present plentiful supply of gasoline, the extra cost of Gasohol is making it's sale more difficult. The product itself is well accepted by the driving public. However, to expand, or even maintain, the market for Gasohol, we are going to need some State incentives or else get our buying price for 200 proof alcohol down to the rack price of unleaded gasoline, plus the 36¢ incentive furnished by the federal government.

Our Company is looking forward to staying in the Gasohol business. We should like to make a connection with a nearby Ethanol producer. Under the right situations, our monthly requirements could be 500,000 to one million gallons. The main conditions would be the price, quality, and, of course, assured delivery.

Mr. Wasseuar, when your organization gets closer to assured production and delivery of 200 proof Ethanol, we will appreciate being considered as a buyer of your product.

Yours very truly,

BEACON OIL COMPANY

John D. Robertson

Department of Energy
Nevada Operations Office
P.O. Box 14100
Las Vegas, NV 89114

September 25, 1980

Morrison-Knudson Company
ATTN: Mr R. C. Johnson
954 West Jefferson Street
Boise, Idaho 83701

Dear Mr. Johnson:

The purpose of this letter is to outline the Nevada Operations Office's current plan to use gasohol in the DOE fleet of gasoline fueled vehicles at the Nevada Test Site (NTS).

The NTS is the only NV operating location where automotive and equipment gasoline fuel is stored and dispensed. Our ultimate goal is 100 % utilization of gasohol by the end of this calendar year. Inasmuch as we consume approximately 2,000,000 gallons of unleaded fuel annually, our goal is that 10% (or 200,000 gallons) of this fuel be alcohol. The DOE/NV gasoline vehicle fleet consists of approximately 2,350 vehicles.

The NTS general support contractor, Reynolds Electrical and Engineering Company, Inc., (REECo), is (at this time) purchasing ethanol from out of state supplies, to be delivered to Las Vegas by railroad tank car. The ethanol is transported to the NTS in DOE-owned trucks where it is held in aboveground storage. As the underground gasoline tanks are pumped down, commercial vendors deliver unleaded gasoline to the test site and the tanks are refilled; at which time, a metered amount of ethanol also is fed into the tanks. This allows for a continuing service station operation without the necessity to shut down for additional mixing time. (Eventually it is expected that gasohol may become commercially available from southern Nevada suppliers at which time other modes of operation will be considered.)

REECo's gasohol operations, as briefly described herein, are to begin soon at the main motor pool and then will be extended throughout the entire test site operation. REECo's bulk purchases of ethanol are consistent with federal procurement regulations.

We would look forward to additional supply sources for ethanol (and/or gasohol) particularly those from within the state of Nevada.

Sincerely,

John O. Cummings, Director
Energy Resource Coordination &
Conservation Office

cc: Robin Grade, Geothermal Food Processors

SECTION 8

ECONOMIC VIABILITY

The projected operating statement on page 8-3 provides some insight into the profit structure of a geothermally powered ethanol facility remotely located in the desert of Northern Nevada. The salient features are as follows:

- The absence of any significant fuel costs
- $2.54 of capital investment per gallon of ethanol capacity
- Operating costs two-thirds determined by feedstock landed price at the plant
- A 12% interest cost component in the cost of sales
- Ethanol revenues comprising three-quarters of overall revenues
- The remaining revenues derived from by-product sales with prices fluctuating in proportion to feedstock costs

The operating statement assumes 100% debt financing, which is not realistic. The figure on page 8-2 gives a better idea of the potential profitability of the plant with approximatley 20% private equity financing, 30% commercial debt financing at 14.5% interest, and 50% through a 5% interest DOE loan under a cooperative agreement. In these calculations a ten year debt retirement program was assumed. The result is a series of retained earnings curves that vary as a function of price escalation assumption. Scenario C is a worst case, combining high (8%) feedstock cost increases with low (6%) annual gasohol price increases. Scenario B represents the most optimistic combination of slowly (4%) rising feedgrain prices with rapid (10%) gasohol price advances. It can be seen that the assumed

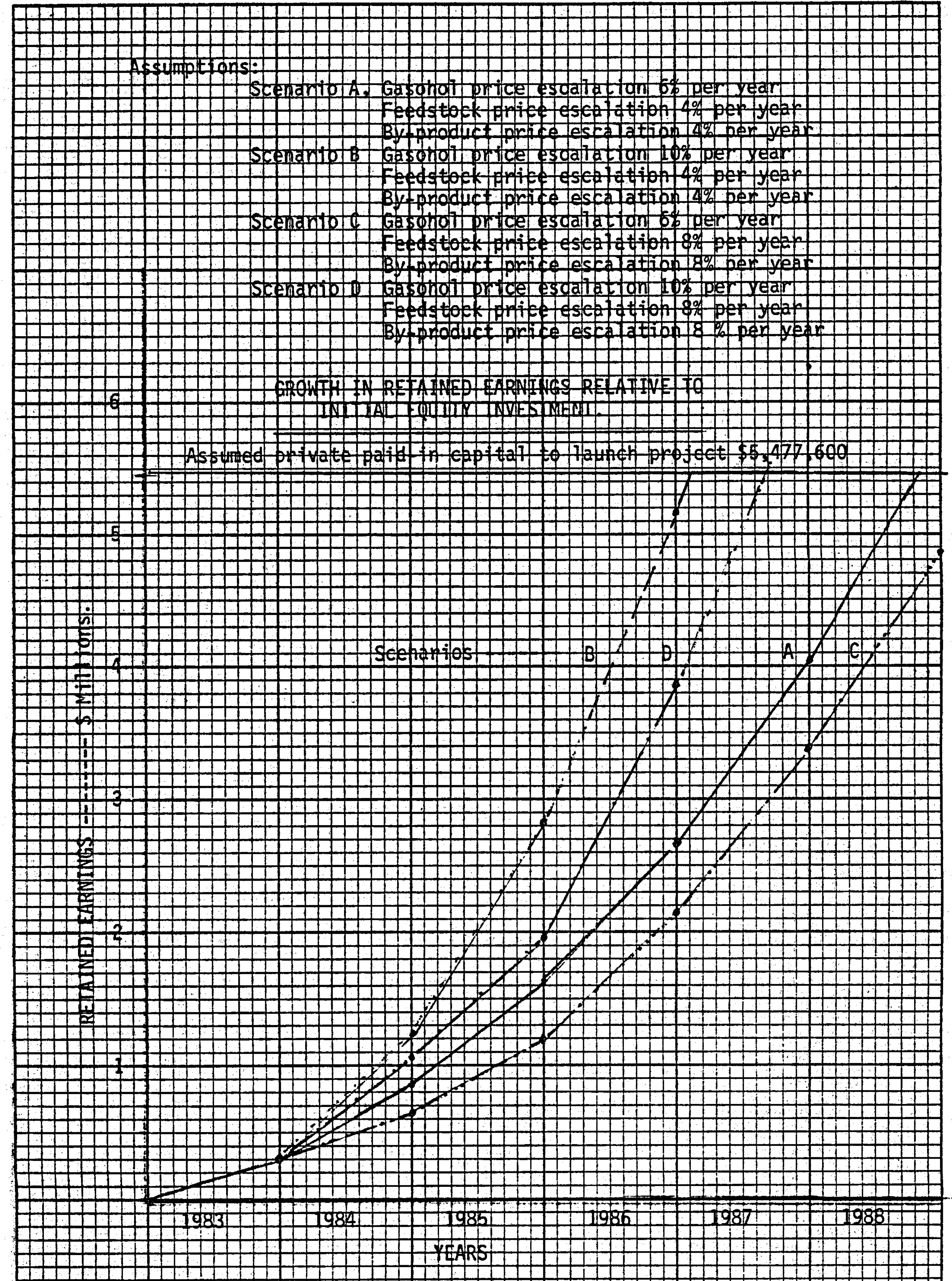

Assumptions:
Scenario A. Gasohol price escalation 6% per year
Feedstock price escalation 4% per year
By-product price escalation 4% per year
Scenario B Gasohol price escalation 10% per year
Feedstock price escalation 4% per year
By-product price escalation 4% per year
Scenario C Gasohol price escalation 6% per year
Feedstock price escalation 8% per year
By-product price escalation 8% per year
Scenario D Gasohol price escalation 10% per year
Feedstock price escalation 8% per year
By-product price escalation 8 % per year
GROWTH IN RETAINED EARNINGS RELATIVE TO
INITIAL EQUITY INVESTMENT.
Assumed private paid-in capital to launch project $5,477,600
Scenarios B D A C
RETAINED EARNINGS ------- $ Millions.
6
5
4
3
2
1
1983
1984
1985
1986
1987
1988
YEARS

Figure 8-1

10 YEAR CASH FLOW ANALYSIS - ESCALATION COSTS
10.55 MMGPY FUEL ETHANOL PLANT - BARLEY BASED
(FIGURE IN 1000 U.S. DOLLARS)

Interest: Gov't. 5%
Private 14.5%
Allowable Depreciation = 10 years
Tax = 46%

Plant Capital: Private = $13,381,000
Gov't = 13,381,000
$26,762,000
Working Capital = $2,000,000
Debt Repayment = 10 years

	Yearly Escalation Rate	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Ethanol Price/Gal. FOB Plant	10%	1.90	2.09	2.30	2.53	2.78	3.06	3.37	3.70	4.07	4.48
By-Products Price/Ton FOB Plant:											
Distillers Concentrated Solubles	6%	.45	47.70	50.56	53.60	56.81	60.22	63.83	67.66	71.72	76.03
Distillers Dried Grain	6%	1.40	148.40	157.30	166.74	176.75	187.35	198.59	210.51	223.14	236.53
Feedstock Cost/Ton FOB Plant	6%	1.35	143.10	151.69	160.79	170.43	180.66	191.50	202.99	215.17	228.08
SALES											
Ethanol Revenue		20,045	22,050	24,265	26,592	29,329	32,283	35,554	39,035	42,939	47,264
By-Products Revenue:											
Distillers Concentrated Solubles /49,000 Tons		2,205	2,337	2,477	2,626	2,784	2,951	3,128	3,315	3,514	3,725
Distillers Dried Grain/25,000 Tons		3,500	3,710	3,933	4,169	4,419	4,584	4,965	5,263	5,578	5,913
$.045/gal. DOE Entitlement		475	475	475	475	475	475	475	475	475	475
TOTAL SALES REVENUE		26,225	28,572	31,150	33,962	37,007	40,393	44,122	48,088	52,506	57,377
COST OF SALES											
Raw Materials	6%	15,016	15,917	16,872	17,884	18,957	20,095	21,300	22,579	23,933	25,369
Logistic Materials	6%	124	131	139	148	157	166	176	186	198	209
Plant Maintenance Materials	6%	467	495	525	556	590	625	662	702	744	789
Utilities	6%	1,187	1,258	1,334	1,414	1,499	1,588	1,684	1,785	1,892	2,005
Labor & Administration	10%	1,861	2,047	2,252	2,477	2,725	2,997	3,297	3,627	3,989	4,388
Freight	6%	1,708	1,810	1,919	2,034	2,156	2,286	2,423	2,568	2,722	2,886
Grain Storage Maintenance Materials	6%	34	36	38	40	43	46	48	51	54	57
Miscellaneous Expenses	6%	388	411	436	462	490	519	550	583	618	656
Interest: Private Capital		1,940	1,842	1,730	1,602	1,455	1,287	1,094	873	621	331
Federal Capital		669	616	560	501	440	375	307	236	161	83
Working Capital		290	290	290	290	290	290	290	290	290	290
TOTAL COST OF SALES		23,684	24,853	26,095	27,408	28,802	30,274	31,831	33,480	35,222	37,063
Profit Before Taxes and Depreciation		2,541	3,719	5,055	6,554	8,205	10,119	12,291	14,608	17,284	20,314
Depreciation		2 676	2,676	2,676	2,676	2,676	2,676	2,676	2,676	2,676	2,676
Subtotal-Profit (Loss) Before Income Tax		(135)	1,043	2,379	3,878	5,529	7,443	9,615	11,932	14,608	17,638
Corporate Income Tax		-	460	1,075	1,765	2,524	3,405	4,404	5,469	6,700	8,094
Net Profit (Loss)		(135)	583	1,304	2,113	3,005	4,038	5,211	6,463	7,908	9,544
Working Capital Loan - Renewal		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Working Capital Loan - Retirement		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Plant Debt Principal - Retirement		1,739	1,890	2,058	2,245	2,454	2,687	2,948	3,239	3,567	3,935
Plant Net Cash Flow (Sales - Cost of Sales - Taxes - Debt Retirement)		802	1,369	1,922	2,544	3,227	4,027	4,939	5,900	7,017	8,285

ten year debt retirement schedule still provides for equity capital payback periods of between 4 and 6 1/2 years. The most probable expectation would seem to be a 5 year equity doubling period. This should be attractive to investors by normal standards, especially if advantage can be taken of the investment tax credits available for alternative fuel and geothermal installations.

The enterprise has the further advantage of spinning off cash. This comes about because of an assumed ten-year depreciation schedule. Even in scenario C, the high feedstock-low gasohol case, the plant produces cash flows in the order of 6% on revenues.

After-tax returns (profits) on sales rise from initial levels in the area of 2.5% to 12% at the end of the ten-year debt retirement cycle, as debt service costs decline. Return on equity, assuming all earnings are retained, would be fairly steady at 20%.

In summary, the relationship between gasohol and feedgrain prices is most important to the economic performance of the proposed plant. However, the analysis shows that it would remain viable under a remarkably wide range of price variations on the input and output side of the plant.