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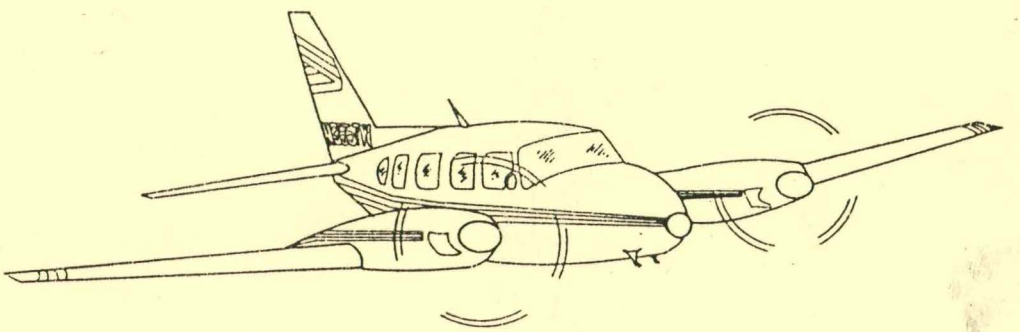
AIRPORT DEVELOPMENT PLAN

FOR

GREENFIELD, IOWA

1990



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I. BACKGROUND DATA AND FORECAST OF AVIATION DEMAND

-- GREENFIELD/AIRPORT SYNOPSIS --

Greenfield is a community of approximately 2,300 inhabitants located in the center of Adair County, at the crossroads of Iowa highways 25 and 92 in rural Southwest Iowa. It is the county seat for an area whose dominant occupation relies on agriculture. The community of Greenfield is able to provide residents with the essential services needed to insure a safe, comfortable, and organized way of life. Like many other rural communities, Greenfield offers a public school district, a regional hospital with medical clinic, a number of restaurants, motels, financial institutions, and several churches.

Even though Adair County is predominantly agricultural, the City of Greenfield has more to offer. Industries and manufacturing companies have been established providing a more diversified economy employing more than 500 people in the manufacturing sector alone.

TRANSPORTATION NETWORKS

Iowa Highway 25 is a N-S route that connects Greenfield with Interstate I-80, that lies 13 miles to the north, and runs east and west through Iowa. Iowa Highway 92 is an E-W route that connects Greenfield with another Interstate Highway, I-35, that lies 38 miles to the east, and runs north and south through Iowa. Both interstate systems provide a vital transportation function in and through Iowa on a controlled access, multi-lane, high-volume facility.

Trucking and Rail Services:

In addition to the two Iowa highways, transportation is also provided by the Burlington-Northern Railroad Company, and the public airport for the movement of people and goods through the Greenfield area. The movement of products and goods is a vital function for any community, and the combination of highways, rail, and an airport provide a good base for economic development if the appropriate facility requirements are met.

There are six motor freight carriers serving the Greenfield area that provide local, intrastate, and interstate transportation services that allows manufacturing and industrial companies to move goods easily in and out of Greenfield over the road. As mentioned previously, Burlington Northern Railroad Company also operates in the Greenfield area, providing alternate transportation services for the manufacturing and industrial firms. Some of the major cities served and the time schedules from Greenfield to these cities are shown in Table I-1 on the following page.

TABLE I-1 - RAIL AND TRUCK TIME SCHEDULES

CITY OF GREENFIELD

CITIES	MILES	DAYS BY RAILROAD	DAYS BY TRUCKLOAD
Atlanta	909	6	2
Chicago	392	2	overnight
Cleveland	717	4	1-2
Denver	632	3	1-2
Des Moines	60	1.5	overnight
Detroit	649	4	1-2
Houston	890	3	2
Kansas City	180	2	overnight
Los Angeles	1,690	5	3
Milwaukee	426	3	overnight
Minneapolis	325	3	overnight
New Orleans	1,034	4	2
New York	1,184	5	2
Omaha	90	2	overnight
St. Louis	372	3	overnight

Source: Greenfield Industrial Development Corp.

-- AIRPORT FACILITIES --

GENERAL:

Land Area - 38.5 acres

Latitude - 41° 19' 37"N, Longitude - 94° 26' 55" W

Description - NW 1/4 Sec. 5 T-75N,R-31W

Elevation - 1360.35'

Average high temp. - 89°F.

Airport Classification - Basic Utility

NAVAIDS - lighted wind cone, rotating beacon, NDB

RUNWAY - 13/31

Size - 50'x2,500'

Surface - Asphalt

Cross section:

Activity	FAA Specification	Year
slurry seal	P-626	1986
bituminous surface	P-609	1965
bituminous prime	P-602	1965
6" aggregate base course	P-208	1965
3" sub-base course	P-154	1965
6" sub-grade	P-152	1965

Pavement Strength - 7,000 SWL

Gradient - .23%

Lighting - MIRL

Marking - Basic

PARKING

The parking facilities at the Greenfield airport consist of a 12,800 s.f. gravel lot that adequately serves the needs of the day-to-day users. However, for tourism-related events such as the air show and museum visitations, or business-related activities of the high travel tendency occupations, the parking is not of sufficient quality or size to accommodate operations of these natures. It is especially important for a community to be able to provide quality accommodations to those events that tend to give a conditional impression of the community as a whole.

HANGAR AREA

In the area designated for hangar and maintenance operations, there are eight buildings. Six of the buildings that are privately owned and maintained include: Schildberg Construction with two hangars, a storage building and the maintenance building/museum hangar; ADCO, an aviation club, that operates one hangar and provides plane rentals; and the City of Greenfield that operates a small office building, and leases a trailer house and another storage building to private individuals. Together, these buildings house 19 aircraft based at the airport.

Other aircraft storage that is available at the airport includes the tie-down area that can handle up to four aircraft at present.

Adjacent to the hangar area is the fuel storage area that is also privately owned/operated. Schildberg Construction owns one of the 100LL octane tanks, and the City owns the other 100LL octane tank. The City provides fuel sales to a limited number of private individuals by utilizing a key-operated pumping system available to those individuals who have purchased keys from the City.

SERVICES AND UTILITIES

The breakdown of services available and their representative sources are as follows:

Water - from an on-site well

Sewer - from an on-site septic tank

Electricity - R.E.C. to hangars and maintenance buildings, and City electricity to runway lights

Fire and Rescue - all police, fire, and rescue provided by City

ZONING

Approved on January 17, 1978, the City of Greenfield enacted Ordinance #259 which regulates and restricts the height of structures and objects in the vicinity of the Greenfield Airport. This height zoning requirement is to provide a clear and safe zone for all operations flying in or out of the airport.

However, at the present a parcel of land within this existing clear zone is in the process of condemnation proceedings to insure that the requirements of the Height Zoning Ordinance are met.

BUDGET

The following table is a brief history of the City of Greenfield's Budget Disbursements as it pertains to the municipal airport:

TABLE I-2 - GREENFIELD AIRPORT BUDGET DISBURSEMENTS ($)1980-1988

Description	1980	1981	1982	1983	1984
Legal	NA	NA	67.30	NA	NA
Maintenance	NA	NA	NA	NA	NA
Services	6,059.31	9,178.94	12,070.34	24,367.15	7,992.02
Utilities	NA	NA	NA	NA	NA
Fuel	NA	NA	NA	NA	NA
Capital exp.	18,028.00	17,268.31	7,852.72	NA	NA
TOTAL	24,087.31	26,447.25	19,990.36	24,367.15	7,992.02

	1985	1986	1987	1988
Legal	52.43	967.92	NA	2,150.00
Maintenance	NA	NA	826.35	476.00
Services	10,388.07	2,221.97	1,916.49	2,797.00
Utilities	NA	NA	1,377.52	1,939.00
Fuel	NA	4,801.22	4,291.68	6,759.00
Capital exp.	NA	NA	67,035.90	8,575.00
TOTAL	10,440.50	7,991.11	75,447.94	22,696.00

-- SERVICE AREAS --

The Greenfield service area is the region analyzed that lies within a 30-mile radius of Greenfield. It contains all or part of an eight county area that includes the counties of: Adair, Guthrie, Audubon, Cass, Adams, Union, Madison, and Dallas.

Communities in Service Area

When analyzing communities within the Greenfield service area, the following assumptions were made:

- communities listed have a population of 1,000 or greater
- the analysis is done in relationship to out of distance travel only, not whether or not services or facilities are available

The following table lists the communities found within the service area, airport availability, and population category.

TABLE I-3 - GREENFIELD SERVICE AREA COMMUNITIES

CITIES	AIRPORTS	1,000-5,000pop.	5,000-10,000pop.
Panora		X	
Guthrie Center	X	X	
Adel		X	
DeSoto		X	
Earlham		X	
Stuart		X	
Anita	X	X	
Winterset	X	X	
Creston	X		X
Corning	X	X	

Airports in Service Area

The service area of the Greenfield airport will not be a true representation of the attraction that the airport would generally receive in a rural area. This is due to the fact that the Des Moines International Airport lies less than 45 miles away, and provides a greater attraction with respect to the services provided and the air-carrier/commercial status designation. This restricts the smaller local service airports in the vicinity to provide chartered, training, and air service requests with the aircraft that is based at the respective airports. Itinerant services are highly unlikely at these small local-service airports due to the limited size of their runways.

The following table lists the airports found in the Greenfield service area, and the facilities found at each airport.

TABLE I-4 - GREENFIELD AREA AIRPORTS

CITIES	RUNWAY	SURFACE	SIZE	RUNWAY LIGHTS	REIL	VASI	ROT. BEACON
Greenfield	13/31	asph.	50x2,500	X			X
Winterset	14/32	asph.	50x2,980	X			
Guthrie Center	15/33	gravel	30x2,650	X			
Creston	16/34	asph.	75x4,900	X	X	X	X
Corning	17/35	conc.	50x2,700	X	X		X
Anita	5/23	turf	100x3,350	X			X

Greenfield, Iowa, exemplifies the trend rural communities are undertaking in the midwest with diversification from a dominated agricultural base to one mixed with industrial and manufacturing sectors. This alleviates the dependency on the depreciating agricultural base that these rural communities have relied on for generations. For these communities to remain economically stable, it is required that a good transportation network and business opportunities be developed.

Greenfield has taken strides towards economic development with improved infrastructure development and zoning for industrial sites comprising 67 acres on the north edge of the city. Iowa highways 25 and 92 provide transportation routes from Greenfield to Interstate highways 35 and 80. These factors are prime examples of the necessary components needed for a community to attract prospective business opportunities to the area and improve its economic base.

An estimated population of 2,250 provides an ample employment base not only for the existing manufacturing, industrial and business sectors, but also any additional employment opportunities that may arise in the future. Some of the major employers in Greenfield currently utilizing this employment base include the Cardinal Insulated Glass Company, Siegwerk, Inc., Gross Manufacturing Company, Schildberg Construction Company, G&H Motor Freight Company, Adair County Memorial Hospital, Greenfield Community Schools, any many others.

State and County Projections:

The following table is a summary of demographic information forecasts for the State and Adair County.

TABLE I-5 - DEMOGRAPHIC FORECASTS

	1980**	1990	1995	2000	2010
+State Population	2,913,808	2,913,500	2,913,800	2,965,000	----
*State Population	2,913,808	2,933,190	2,961,740	2,996,270	3,048,460
State Pop. Average	2,913,808	2,923,345	2,946,770	2,980,635	3,048,460
+County Population	9,509	8,700	8,500	8,300	----
*County Population	9,509	9,180	9,130	9,100	9,060
#County Population	9,509	8,704	8,475	8,245	7,746
County Pop. Average	9,509	8,861	8,702	8,548	8,403
*Total Co. Employment	----	4,310	4,200	4,170	4,120
*Employment Population Age Cohort(20-64)	4,817	4,750	4,660	4,680	4,690
*Median Age (yrs.)	----	38.2	39.7	41.5	44.9
*Income/Capita	----	$9,621	$10,171	$10,986	$12,602
*Mean Household Income	----	$23,907	$24,891	$26,532	$29,486
*State Income/Capita	----	$12,046	$12,854	$13,905	$15,572
*State Household Income	----	$32,124	$33,832	$36,276	$38,586
%Difference Income/Capita	----	-20%	-21%	-21%	-19%
%Difference Household Income/Capita	----	-26%	-26%	-27%	-24%

**Census Year
+State Demographer Data
*Woods & Poole Economics, Inc.
#I.D.O.T.

Regional Projections:

The following table is a summary of the eight-county service area regional population projections.

TABLE I-6 - REGIONAL POPULATION PROJECTIONS

COUNTY	1980	1990	1995	2000	2010	1980 % UNEMPLOYED
Adair	9,509	9,180	9,130	9,100	9,060	3.6
Guthrie	11,983	10,920	10,490	10,290	10,130	5.9
Audubon	8,559	7,270	6,590	6,200	5,760	3.4
Cass	16,932	17,010	16,920	16,900	16,840	4.1
Adams	5,731	5,480	5,370	5,300	5,140	2.9
Union	13,858	13,650	13,720	13,990	14,370	3.9
Madison	12,597	12,420	12,480	12,570	12,720	5.0
Dallas	29,513	29,680	29,410	29,630	29,760	5.6
TOTAL	108,682	105,610	104,110	103,980	103,780	4.3 average

One demographic trend that is not easily recognizable from these tables is the out-migration that occurred from Iowa's rural areas to the larger metro areas during the 1960's-1970's. This trend did reverse itself somewhat in the late 1970's, with a migration back to rural areas and smaller communities adjacent to the larger metro areas for the attractive residential environment that smaller Iowa communities offer within driving distance of work.

TRAVEL TENDENCIES

Many factors contribute to a region's tendency to utilize air transportation. Population, economy, major manufacturing, business, education, per capita income and economic development are some of the components of analysis of an area's compatibility to support an airport with air carrier services. Travel tendencies can be segregated by occupation according to high, medium and low travel tendencies.

Examples of each type of occupation can be described as follows:

High Travel: Manufacturing, Services, Federal Government and State Government.

Medium Travel: Construction, Wholesale and Retail Trade, Finance.

Low Travel: Mining, Agricultural Services, Transportation, Federal Military.

Businesses associated with high travel tendencies can generally classified as higher income-producing, economically stable, and vital to the community's or county's employment base. One distinct advantage for businesses or industries moving to an area is the availability of an airport capable of handling larger, faster aircraft for their business use. Greenfield demonstrates a need for this type of airport that provides the necessary services to encourage high travel related economic development.

Businesses that represent the medium travel tendency occupations are those that use the airport when it is necessary to move employees, employers or representatives from one location to another quickly, or according to an itinerary. The businesses that fall into this category are also vital to an area in that a majority of the population can easily find supportive employment in these representative occupations.

On a statewide basis, employment is projected to decline in low travel tendency occupations, while it has been projected to increase for those occupations that fall under medium to high travel tendency categories.

The following table provides data characteristic of each occupational category and its propensity to travel.

TABLE I-7 - PROJECTED EMPLOYMENT BY TRAVEL TENDENCY

STATE	1970	1980	1990	2000	2010	1990-2010 % CHANGE
high	608,470	709,850	811,790	885,930	898,240	10.6
medium	390,360	465,470	524,270	549,920	550,540	5.0
low	279,530	257,430	229,450	211,030	194,280	-15.3
total	1,278,360	1,432,750	1,565,510	1,646,880	1,643,060	5.0
REGIONAL						
high	15,360	18,495	21,630	24,670	26,400	18.1
medium	12,740	15,320	16,410	18,260	19,810	17.2
low	3,650	3,435	3,220	2,980	2,820	-12.4
total	31,750	37,250	41,260	45,910	49,030	15.8
ADAIR CO.						
high	1,150	1,280	1,410	1,490	1,550	9.0
medium	1,090	1,195	1,300	1,240	1,230	-5.3
low	270	295	320	310	320	0.0
total	2,510	2,770	3,030	3,040	3,100	2.3

Source: Woods & Poole Economics, Inc., Washington, D.C.

MAJOR EMPLOYERS

In spite of its small size, Greenfield is the home of four manufacturing industries that employ over 500 individuals. The industries and the number of respective employees are as follows: Cardinal Insulated Glass Company with an average of 250 employees; Schildberg Construction Company with 225 employees; Siegwerk, Inc., with 20 employees; and Gross Manufacturing Company with five employees.

As a complement to the industrial manufacturing sector of employment, Greenfield also has a wide array of wholesale and retail businesses, construction and financial firms, and service sector employment opportunities to offer residents of Adair County.

-- AIRCRAFT ACTIVITY ESTIMATES --

Measurement of aircraft activity at the Greenfield municipal airport during 1988 and 1989, was conducted periodically by the Iowa Department of Transportation using a sound-activated recording device. This recording system was utilized in place of the traditional methods of visual observations and/or pneumatic counters at airports without air traffic control towers. The automated recording device was placed at the end of the runway and was activated when a pre-set level of noise, representative of departing aircraft.

This method of monitoring is not as time-consuming or as limited to favorable weather conditions as were the previous methods. The result is a system that is much more cost-effective and accurate when estimating the volumes of air traffic for single-engine, twin-engine, jet aircraft, or rotorcraft. Listed below, are the estimated numbers of operations per season of monitoring.

TABLE I-8 - ESTIMATED CURRENT OPERATIONS

SEASON	OPERATIONS/SEASON
Spring	434
Summer	338
Fall	484
Winter	246

SUMMARY

There were an estimated 1,502 total annual operations that resulted in 99.2% single-engine aircraft operations, and .8% multi-engine aircraft operations, while there were no recorded jet aircraft or rotorcraft operations. The dramatic decrease in numbers of multi-engine aircraft and jet operations can be attributed to the fact that these representative operations require a longer runway and stronger pavement strengths for safety reasons.

-- FORECAST OF AVIATION DEMAND --

The forecast of aviation demand provides a basis to estimate those airport facilities needed to accommodate future activity at the airport and the probable schedule for development. Forecasts are normally provided for the short, intermediate, and long term periods, or 5, 10, and 20 years respectively. It should be recognized that as the range increases the accuracy of forecasts decreases. Therefore, a 20-year forecast is very approximate.

The methods of forecasting airport activity at the Greenfield airport are dependent on current facilities offered at the airport and the need for this type of transportation within this service area. These characteristics were assessed by the circulation of an airport user's survey distributed to existing businesses and industries, aviation organizations, and community economic development representatives in order to identify all aspects of aviation activity with their respective needs that could be identified with the Greenfield airport facility.

This survey was one aspect of the planning process to forecast the demand for aviation in this region. Other methods included the analysis of historical trends of aviation such as the types of local aircraft operations, categories of aircraft capable of operating at Greenfield, state registered aircraft data, regional aircraft data, based aircraft data, and regional air transportation needs within the defined Greenfield service area.

User's Survey

As part of the data collection, an extensive survey of airport users was conducted. This survey was accomplished through a mail-in survey form. The survey form was mailed to those individuals or corporations known to be using the airport or who might use the airport.

The purpose of the survey was to document who is currently using the airport, what type of aircraft they are using, how many operations they generate, what their future usage might be, and what types of facility improvements they might require. A summary of the responses follows.

NAME, ADDRESS, TELEPHONE, AND TYPE OF BUSINESS: 47 responses.

DOES YOUR BUSINESS OWN ANY AIRCRAFT? YES 13 NO 37

IF YES, LIST NUMBER(S) AND MODEL(S) OF AIRCRAFT. 28 total

DOES YOUR BUSINESS CURRENTLY USE THE GREENFIELD AIRPORT FOR AIR TRANSPORT AND/OR TRANSPORTATION? YES 23 NO 27

IF YES, PLEASE LIST AVERAGE NUMBER OF YEARLY ARRIVALS. 880

(880 x 2 = 1760 operations)

DOES YOUR BUSINESS CURRENTLY USE THE GREENFIELD AIRPORT FOR HANGAR FACILITIES? YES 10 NO 40

IF YES, PLEASE LIST TOTAL NUMBER AND TYPE OF AIRCRAFT CURRENTLY BASED AT THE GREENFIELD AIRPORT. 17 Based Aircraft

IF A 4,000 FT RUNWAY WAS AVAILABLE AT THE GREENFIELD AIRPORT WOULD YOUR COMPANY'S USE OF THE AIRPORT FACILITIES INCREASE?

YES 10 NO 32

DO YOU HAVE ANY CLIENTS CUSTOMERS OR VENDORS WHO USE OR WOULD LIKE TO USE THE GREENFIELD AIRPORT? IF SO, PLEASE LIST.

ANY ADDITIONAL COMMENTS CONCERNING EXISTING FACILITY OR PROPOSED IMPROVEMENTS YOU WOULD LIKE TO SEE AT THE GREENFIELD AIRPORT?

Some of the concerns that were expressed through the survey include: lengthen the runway, provide an additional cross-wind runway, additional hangar space, new T-hangars with electric doors, FBO or mechanic, VASI, full-service fuel, wider and shorter threshold lights, and museum facilities for the antique aircraft collection.

The results of this survey were instrumental in establishing trends in the numbers of aviation operations and the types of aircraft that could be expected to use the airport facilities at the Greenfield Airport. For instance, a considerable amount of the aircraft activity is itinerant in nature with the flights originating out of another airport. Most of these flights are of a business nature, transporting personnel or clients in and out of the Greenfield area.

Relative to this type of operation, many survey responses commented of the necessity to travel from Greenfield to such places as Omaha, Des Moines, Atlantic, or Creston to transport customers or clients back to Greenfield to conduct their business. This is due to the fact that a majority of corporate aircraft cannot land at airports with runways less that 4,000 feet in length due to safety and insurance reasons. Loss of time and money are direct results of the out of distance travel needed to conduct business in these specific high travel tendency occupations.

REGISTERED AND BASED AIRCRAFT

The total number of based aircraft at an airport is an important factor in determining the size, type, and number of facilities necessary to accommodate the airport's anticipated activity.

State Trend - Statewide forecasts anticipate future growth in the number of registered aircraft in the state. According to the 1985 Iowa Aviation System Plan, "Aircraft registrations were found to be closely tied to the manufacturing, transportation, and public utilities sectors and the Real Gross State Product." This in conjunction with national trends indicate the anticipated Iowa registered aircraft data as follows:

TABLE I-9 - REGISTERED AIRCRAFT, STATE OF IOWA

1970	1980	1990	2000	2010
2,565	3,500	3,200	3,800	4,400

The statewide forecast reflects an anticipated increase from 11 registered aircraft per 10,000 population in 1990 to nearly 15 registered aircraft per 10,000 population in 2010.

It should be noted, however, that actual I.D.O.T. aircraft registration in 1989 shows a greater decline than projected in the 1985 study. However, in comparing the state list of registered aircraft with actual known aircraft at selected airports, a number of discrepencies are noted. In general, there are usually more aircraft based at an airport than are indicated by the state list.

Regional Trend - Table I-10 indicates the number of registered aircraft in each of the eight counties surrounding Greenfield and the ratio of the number of aircraft per 10,000 population. At the present time the region averages 10.4 aircraft per 10,000 population.

TABLE I-10 - REGISTERED AIRCRAFT - EIGHT COUNTY REGION

County	Population	Current Registered Aircraft	Aircraft Per 10,000 Population
Adair	9,180	9	9.8
Adams	5,480	9	16.4
Audubon	7,270	11	15.1
Cass	17,010	18	10.6
Dallas	29,680	29	9.8
Guthrie	10,920	15	13.7
Madison	12,420	10	8.1
Union	13,650	9	6.6
TOTAL:	105,610	110	10.4 average

Three trend lines have been determined to estimate future regional registered aircraft. The low trend line anticipates that the current ratio of 10.4 registered aircraft per 10,000 population will be maintained through the year 2010. The high trend line anticipates that the regional registered aircraft will increase over the next 20 years from the current 10.4 registered aircraft per 10,000 population to the nearly 15 registered aircraft per 10,000 population which is the statewide average. The middle trend is simply the average of the high and low forecasts. These forecasts are presented in the following table.

PROJECTED REGISTERED AIRCRAFT - EIGHT COUNTY REGION

Year	Low	Medium	High
1990	110	110	110
1995	118	119	120
2000	117	125	132
2010	117	137	156

GREENFIELD BASED AIRCRAFT

Table I-11 is a schedule of historical data gathered from the Advance Planning Division, I.D.O.T. on the number of based aircraft at the Greenfield airport per year.

TABLE I-11 - GREENFIELD HISTORICAL BASED AIRCRAFT DATA

YEAR	# OF AIRCRAFT
1976	12
1977	16
1978	12
1979	12
1980	12
1981	21
1982	16
1983	21
1984	21
1985	19
1986	17
1987	14
1988	14
1989	14*

*14 is the number reported by I.D.O.T., however 19 is actual count. For the purposes of based aircraft forecasts, the D.O.T. figure of 14 will be used to establish the trend.

Since 1976, there has been an approximate 15.4% increase of based aircraft, averaging an increase of approximately 1.2% per year.

BASED AIRCRAFT PROJECTIONS

The projected number of aircraft based at the Greenfield airport is difficult to determine, since population projections are showing a decline while the number of medium and high travel tendency occupations in Adair County are increasing. This travel tendency trend predicts that the number of aircraft based at the Greenfield airport can be expected to grow at a faster rate than anticipated for the rest of the region, providing economic opportunities exist for the higher travel tendency businesses and industries. Applying this optimistic notion, the number of based aircraft at the Greenfield airport is expected to exceed the current rate of increase for the state as a whole for the based aircraft per 10,000 population rate.

By following a trend line established according to D.O.T. based aircraft data of 12.6 based aircraft per 10,000 population in Adair County in 1980, to 15.3 based aircraft per 10,000 population in 1990, an increase of 21.4% is noted. This rate is higher than the figure established for the state trend which is currently 14.7 based aircraft per 10,000 population.

The following table represents the estimated based aircraft projections for the Greenfield airport. The Greenfield based aircraft projections have been forecasted on the basis of the historic data provided by the D.O.T.'s Air and Transit Division with respect to the rate of based aircraft per 10,000 population for Adair County.

TABLE I-12 - PROJECTED BASED AIRCRAFT, GREENFIELD AIRPORT

1990	1995	2000	2010
19	24	28	35

-- AIRCRAFT OPERATIONS --

An aircraft operation is a landing (arrival) or a takeoff (departure) from an airport. A "touch and go," for example, is considered to be two operations. The total number of operations is an important element in identifying the level of service needed at an airport and in setting priorities in funding airport improvements.

There are two types of operations, local and itinerant. Local operation are arrivals or departures of aircraft which operate in the local traffic pattern and are known to be arriving or departing from within a 20-mile radius of the airport. Also, simulated instrument approaches or low passes by any aircraft are considered to be a local operation. Itinerant operations are those arrivals or departures other than local operations.

Since there is no daily log of operational activity at the Greenfield airport, there is no historical data for extrapolating any kind of projections. However, in 1987 and 1988 the I.D.O.T. conducted counting operations at the airport using the sound-actuated counters as mentioned earlier in this report. The D.O.T. methodology involves counting actual operations for several weeks during each season of the year. From this data, total annual operations are estimated. As a result of this count, the D.O.T. estimated there to be approximately 1,502 annual operations at the Greenfield airport.

FORECAST OF ANNUAL OPERATIONS

The forecasted total operations at the Greenfield airport have been estimated by using the number of based aircraft, and factors of the anticipated number of operations per year of based aircraft per local and itinerant activities. According to the 1985 Iowa Aviation System Plan, "Itinerant operations account for approximately 58 percent of total aviation operations. This figure is based on data from FAA control towers." The following Table I-13 presents total, itinerant and local annual operation forecasts for the Greenfield airport.

TABLE I-13 - ANNUAL OPERATIONS FORECAST, GREENFIELD AIRPORT

Year	Based Aircraft	Annual Operations	Itinerant Operations	Local Operations
1989	19	1,502	871	631
1990	21	1,659	962	697
1995	24	1,896	1,100	796
2000	28	2,212	1,283	929
2010	35	2,765	1,604	1,161

AIR PASSENGERS AND AIR FREIGHT

Based on previously completed studies, a projection for passenger data can be determined by using a factor of 1.5, times the number of itinerant operations at the Greenfield airport. The respective projections are listed in the following Table I-14.

TABLE I-14 - AIR PASSENGERS, GREENFIELD AIRPORT

Year	Itinerant Operations	Air Passengers
1989	871	1,307
1990	962	1,443
1995	1,100	1,650
2000	1,283	1,925
2010	1,604	2,406

The anticipated tonnage of air freight can be estimated using a factor of eight pounds of freight per air passenger as estimated in the previous table.

TABLE I-15 - AIR FREIGHT, GREENFIELD AIRPORT

Year	Air Passengers	(tons) Air Freight
1989	1,307	5.2
1990	1,443	5.7
1995	1,650	6.6
2000	1,925	7.7
2010	2,406	9.6

AIRPLANE DESIGN GROUP

Future airport facilities at Greenfield need to be planned in such a manner that they will safely accommodate anticipated aircraft operations in order to accomplish transportation and economic development goals.

In order to accommodate aircraft anticipated to operate at a particular airport, the I.D.O.T. maintains a policy that 500 annual operations of the existing or proposed critical aircraft are necessary to implement further development or construction of improved facilities at that airport. At the Greenfield airport, the aircraft that would be considered to be critical would be of the twin-engine, six place aircraft that is used by the medium to high travel tendency occupational sector. Greenfield is currently actively pursuing major manufacturing and corporate businesses to locate in the Adair County area that would need to utilize jet aircraft. This type of operation would require a major improvement of airport facilities, however it is difficult to project the future of this need given the existing conditions in Adair County. Therefore, the larger twin-engine aircraft will be considered the critical aircraft for the scope of this study.

The type of airport facilities to plan for are based on the design aircraft approach category and airplane design group. These can be characterized as follows.

1. Aircraft Approach Categories

    A. Category A: Approach speed less that 91 knots.

    B. Category B: Approach speed 91 knots or more, but less than 121 knots.

    C. Category C: Approach speeds 121 knots or more, but less than 141 knots.

2. Airplane Design Group

    A. Airplane Design Group I: Wingspan up to, but not

exceeding 49 feet.

B. Airplane Design Group II: Wingspan 49 feet up to, but not exceeding 79 feet.

C. Airplane Design Group III: Wingspan 79 feet up to , but not exceeding 118 feet.

As can be anticipated from the forecasts and user contacts, the majority of aircraft operations will be made by single and light twin engine aircraft. A typical larger aircraft in this group would include a Beech King Air. The King Air has a wingspan of 50.3 feet and an approach speed of 100 knots. The gross takeoff weight is 9,650 pounds. On this basis, the ultimate facilities at the Greenfield Airport should be considered to meet Airplane Design Group II, Approach Category B - Utility standards. However, short term development should be planned with respect to the design guidelines for a Basic Utility II airport.

II. FACILITY REQUIREMENTS

--INTRODUCTION--

This portion of the study describes those facility and equipment requirements needed to accommodate the aviation demand forecast in the previous portion of the study. It is intended that this information be presented in a form that can be readily used in preparing the Airport Layout Plan for the existing airport site.

The following specific items of development and requirements are addressed:

Runway and Taxiway - length, width, clearances, visibility, orientation and grades.

Terminal Area - apron, hangars, administration building, and auto parking.

Obstructions - navigable airspace.

Drainage

Paving - rigid pavement and flexible pavement.

Marking, Lighting, and Visual Aids.

Navigational Aids.

Information contained herein is drawn primarily from applicable FAA Advisory Circulars. As indicated in the Forecast of Aviation Demand section of this study, development should be planned to utility airport standards for Basic Utility II with long range goals respective of Airplane Design Group II standards.

Basic Utility II Design Guidelines:

As previously mentioned, the immediate needs of the Greenfield Airport are to meet the standards of the Basic Utility II classification. According to the 1985 D.O.T. Iowa Aviation System Plan, this class of airport is designed to provide access to regional service areas with restrictions to jet aircraft and large, twin-engine aircraft.

The following table lists types of services recommended for the Basic Utility II classification of airport.

Primary Runway:	Length	- 3,400 feet
	Width	- 60 feet
	Surface	- hard
	Taxiway	- turnaround
Secondary Runway:	Length	- 2,720 feet
	Width	- 120 feet
	Surface	- turf
	Taxiway	- none
Primary Runway Lights:	Edge Intensity	- MIRL
	End Identifier	- Varies
	VASI	- Varies
	Approach	- No
Navaids:	Beacon	- Yes
	Seg. Circle	- Yes
Lighted Wind	Indicator	- Yes
	NDB	- Yes
Land:	Title	- 120 acres

Although a 3,400' runway would appear to be adequate at the present, allowances should be made in the configuration of future airport facilities to accommodate a longer runway should the need arise. The following section will deal with the consideration given to a long term goal of planning for the Airplane Design Group II standards as adapted from applicable FAA Advisory Circulars. Tables II-1 and II-2 present dimensional standards for the ultimate Greenfield Airport. These standards were determined by a computer program provided by the FAA as a supplement to Advisory Circular 150/5300-13, Airport Design.

TABLE II-1 - AIRPORT AND RUNWAY DATA

Airport Elevation	1,360 feet
Mean daily maximum temperature of the hottest month	89.00 F
Maximum difference in runway centerline elevation	10.00 feet
Length of haul for airplanes of more than 60,000 pounds	0 miles

RUNWAY LENGTHS RECOMMENDED FOR AIRPORT DESIGN

Small airplanes with approach speeds of less than 30 knots	340 feet
Small airplanes with approach speeds of less than 50 knots	910 feet
Small airplanes with less than 10 passenger seats	
75 percent of these small airplanes	3,000 feet
95 percent of these small airplanes	3,500 feet
100 percent of these small airplanes	4,200 feet
Small airplanes with 10 or more passenger seats	4,500 feet
Large airplanes of 60,000 pounds or less	
75 percent of these large airplanes at 60% useful load	5,500 feet
75 percent of these large airplanes at 90% useful load	7,000 feet
100 percent of these large airplanes at 60% useful load	5,900 feet
100 percent of these larage airplanes at 90% useful load	8,800 feet

Small airplane is an airplane of 12,500 pounds or less maximum takeoff weight. Large airplane is an airplane of more than 12,500 pounds maximum takeoff weight.

REFERENCE: AC 150/5300-13, AIRPORT DESIGN, dated September 29, 1989.

TABLE II-2 - AIRPORT DESIGN AIRPLANE AND AIRPORT DATA

Aircraft approach category B		
Airplane design group II		
Airplane wingspan		78.99 feet
Primary runway end is nonprecision instrument more than 3/4-statute mile)		
Other runway end is nonprecision instrument more than 3/4-statute mile)		
Airplane maximum certificated takeoff weight is 12,500 lbs. or less		
Airplane undercarriage width		14.00 feet

RUNWAY AND TAXIWAY WIDTH AND CLEARANCE DESIGN STANDARDS

Runway centerline to parallel runway centerline		700 feet
wider runway separation may be required for capacity (See AC 150/5060-5)		
Runway centerline to hold line	125.0	200 feet
Runway centerline to parallel taxiway or taxilane centerline	164.5	240 feet
Runway centerline to edge of aircraft parking	250.0	250 feet
Taxiway centerline to parallel taxiway or taxilane centerline	104.8	105 feet
Taxiway centerline to fixed or movable object	65.3	65.5 feet
Taxilane centerline to parallel taxilane centerline	96.9	97 feet
Taxilane centerline to fixed or movable object	57.4	57.5 feet
Runway protection zone at the primary end:		
Length		1000 feet
Width 200 feet from runway end		500 feet
Width 1200 feet from runway end		800 feet
Runway protection zone at other runway end:		
Length		1000 feet
Width 200 feet from runway end		500 feet
Width 1200 feet from runway end		800 feet
Runway obstacle free zone (OFZ) width		250 feet
Runway obstacle free zone length beyond each runway end		200 feet
Approach obstacle free zone width		250 feet
Approach obstacle free zone length beyond approach light system		200 feet
Approach obstacle free zone slope from 200 feet beyond threshold		50:1
Inner-transitional surface obstacle free zone slope		0:1
Runway width		75 feet
Runway shoulder width		10 feet
Runway blast pad width		95 feet
Runway blast pad length		150 feet
Runway safety area width		150 feet
Runway safety area length beyond each runway end		
or stopway end, whichever is greater		300 feet
Runway object free area width		500 feet
Runway object free area length beyond each runway end		
or stopway end, whichever is greater		600 feet
Clearway width		500 feet
Stopway width		75 feet
Taxiway width	29.1	35 feet

TABLE II-2 (Continued)

Taxiway edge safety margin		7.5 feet
Taxiway shoulder width		10 feet
Taxiway safety area width	79.0	79 feet
Taxiway object free area width	130.6	131 feet
Taxilane object free area width	114.8	115 feet
Taxiway wingtip clearance	25.8	26 feet
Taxilane wingtip clearance	17.9	18 feet
Threshold surface at primary runway end:		
Distance out from threshold to start of surface		0 feet
Width of surface at start of trapezoidal section		250 feet
Width of surface at end of trapezoidal section		700 feet
Length of trapezoidal section		2250 feet
Length of rectangular section		2750 feet
Slope of surface		20:1
Threshold surface at other runway end:		
Distance out from threshold to start of surface		0 feet
Width of surface at start of trapezoidal section		250 feet
Width of surface at end of trapezoidal section		700 feet
Length of trapezoidal section		2250 feet
Length of rectangular section		2750 feet
Slope of surface		20:1

REFERENCE: AC 150/5300-13, AIRPORT DESIGN, dated September 29, 1989.

RUNWAY AND TAXIWAY

Length - Runway length requirements are a function of the aircraft type using the facility and certain conditions at the airport, including temperature, surface wind, runway gradient, pavement condition, and altitude of the airport. The following paragraphs describe these factors and their effect on the runway length at the Greenfield Airport.

Temperature - The higher the temperature, the longer the runway length requirements. This is due to the fact that higher temperatures reflect lower air densities. Therefore, increased airspeed is required to obtain or maintain proper lift. These faster speeds require longer runway lengths for accceleration and deceleration. This study assumes a mean daily maximum temperature during the hottest month of the year to be 89 degrees Fahrenheit.

Surface Wind - The greater the head wind the shorter the runway length requirements and conversely, tailwinds require longer runway lengths. The following table approximates the effect of wind:

ACTUAL WIND (KNOTS)	% INCREASE OR DECREASE OF LENGTH WITH NO WIND
+ 5	- 3
+ 10	- 5
- 5	+ 7

SOURCE: Planning and Design of Airports, Robert Horonjeff

For the purpose of this study, a no wind situation will be assumed. This is a worst case situation since if there is any wind, a landing direction can be selected where there is at least some head wind component.

Runway Gradient - Runway gradient, or slope of the runway, requires additional runway length for takeoff of an uphill gradient as opposed to a level or downhill gradient. However, for general aviation aircraft operating on runways with gradients less than 2%, this effect is considered to be negligible.

Altitude of the Airport - The higher the altitude of the airport, the longer the runway length requirements. Higher altitudes reflect lower air densities. Therefore, higher operating speeds are required to maintain sufficient lift. In general, an

additional 7% of runway length is required for each additional 1,000 feet of altitude. For the purpose of this study, an altitude of 1,360 feet above mean sealevel is assumed for the airport. The runway length requirement at the Greenfield Airport is based on the above criteria in Table II-1 and determined to be 4,500 as shown in Table II-1. This assumes zero headwind, maximum certified takeoff and land weights, and optimum flap setting for the shortest runway length (normal operation).

If the wind analysis determines that a crosswind runway is necessary, it is recommended that its length be at least 80% of the length of the primary runway.

Parallel Taxiway

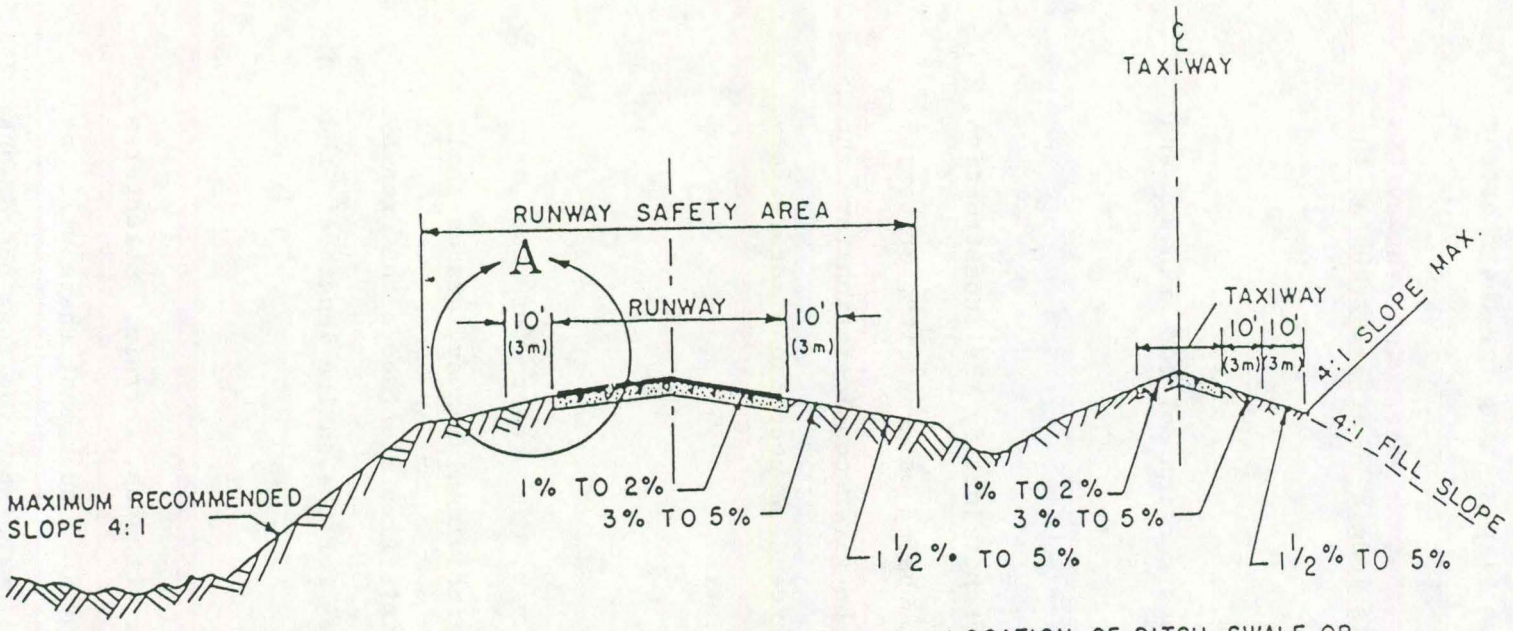
Figure II-1 depicts a typical cross section of the runway and taxiway configuration.

The forecast of aviation demand does not justify the construction of a full parallel taxiway system based on capacity criteria. However, it is recommended that it be given consideration for the long range plan should activity exceed expectations or safety reasons should justify its development.

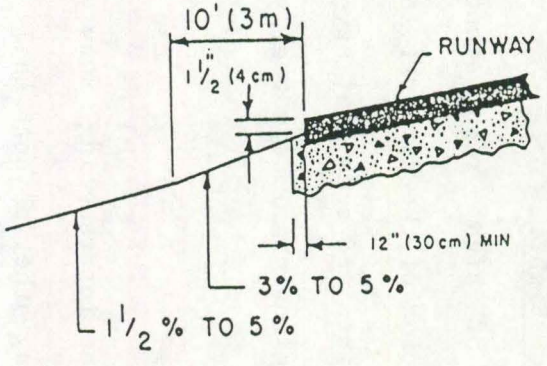
Line of Sight:

Line of sight requirements are very important for the safe operation of the airport. Along an individual runway, grades shall be maintained such that any two points five feet above the runway centerline shall be mutually visible for the entire length of the runway.

Between intersecting runways, grade changes, terrain, structures and any other objects shall be maintained such that there will be an unobstructed line of sight from any point five feet above the



LOCATION OF DITCH, SWALE OR HEADWALL DEPENDS ON SITE CONDITION BUT IN NO CASE WITHIN LIMITS OF RUNWAY SAFETY AREA.



DETAIL A

TRANSVERSE SLOPES SHOULD BE ADEQUATE TO PREVENT THE ACCUMULATION OF WATER ON THE SURFACE. SLOPES SHOULD FALL WITHIN THE RANGES SHOWN ABOVE. THE RECOMMENDED $1\frac{1}{2}$" (4 cm) PAVEMENT EDGE DROP IS INTENDED TO BE USED BETWEEN PAVED AND UNPAVED SURFACES. IT IS DESIRABLE TO MAINTAIN A 5% SLOPE FOR THE FIRST 10' (3m) OF UNPAVED SURFACE IMMEDIATELY ADJACENT TO THE PAVED SURFACE.

TYPICAL CROSS SECTION
FIGURE II-1

runway centerline to any point five feet above the centerline of the intersecting runway within the runway visibility zone. The runway visibility zone is graphically depicted in Figure II-2.

Obstacle Free Zone:

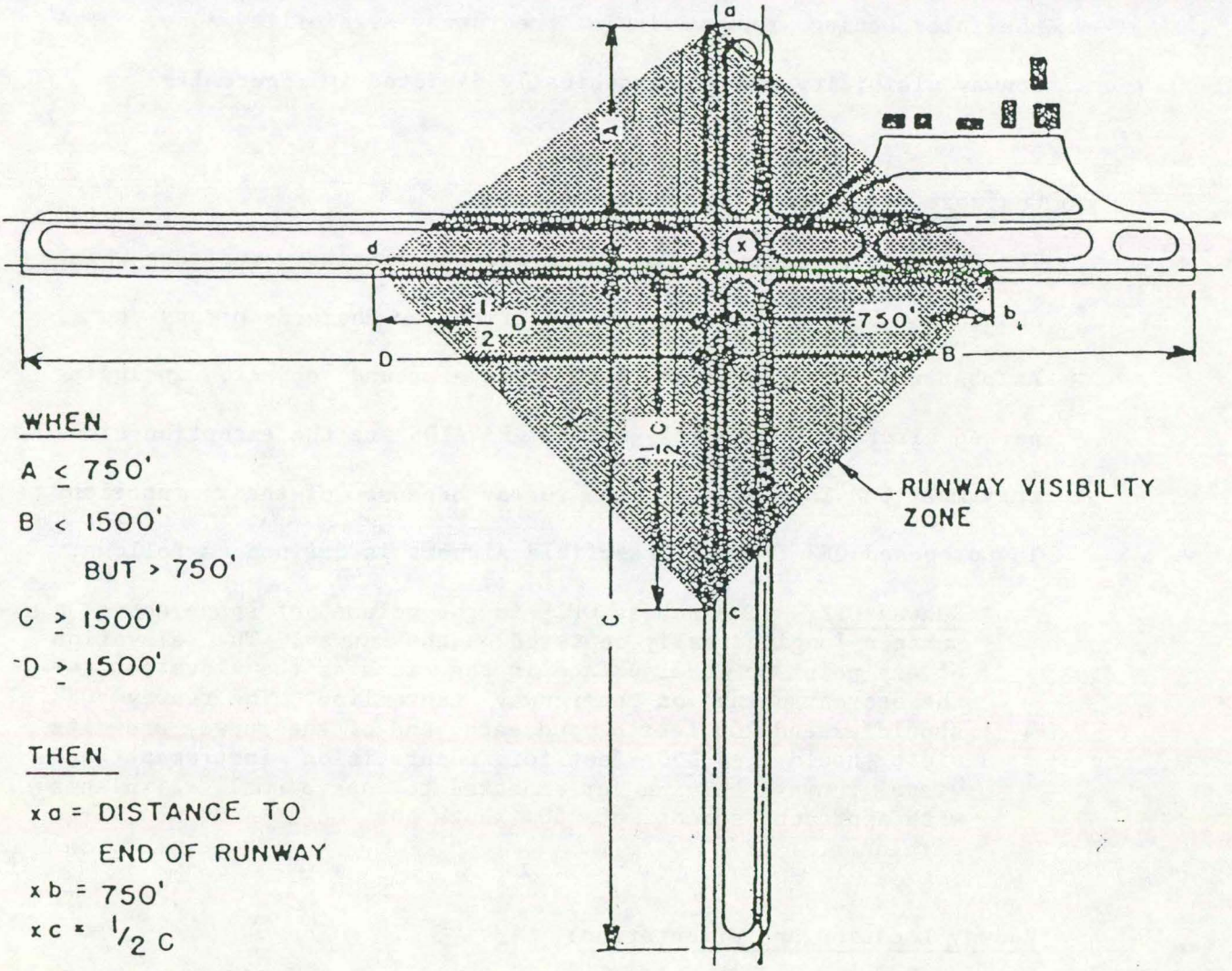
The Obstacle Free Zone (OFZ) is an area of imaginary surfaces which should not be penetrated by obstructions or hazards of any sort. An obstruction or hazard is any above ground object, including parked aircraft. Frangibly-mounted NAVAIDS are the exception since they must be located near the runway because of their function. The proposed OFZ for the Greenfield Airport is defined as follows:

> Runway OFZ - The runway OFZ is the volume of space above a surface longitudinally centered on the runway. The elevation of any point on the surface is the same as the elevation of the nearest point on the runway centerline. The runway OFZ should extend 200 feet beyond each end of the runway and its width should be 250 feet for nonprecision instrument and visual runways serving or expected to serve small airplanes with approach speeds of 50 knots or more and no large airplanes.

Runway Location and Orientation:

Runway location and orientation are important from a safety, environmental, efficiency, and economic point of view. The following paragraphs discuss the considerations to be made in runway location and orientation.

Wind coverage is of paramount importance in orienting a runway. Runway orientation should be such that the airport can be utilized 95% of the time without excessive cross-wind components. For "utility" class of airports, such as Greenfield, FAA standards



WHEN

A ≤ 750'

B < 1500'

BUT > 750'

C ≥ 1500'

D ≥ 1500'

THEN

xa = DISTANCE TO END OF RUNWAY

xb = 750'

xc = 1/2 C

xd = 1/2 D

RUNWAY VISIBILITY ZONE
FIGURE II-2

require that the crosswind component not exceed 10.5 knots (12 miles per hour) 95% of the time.

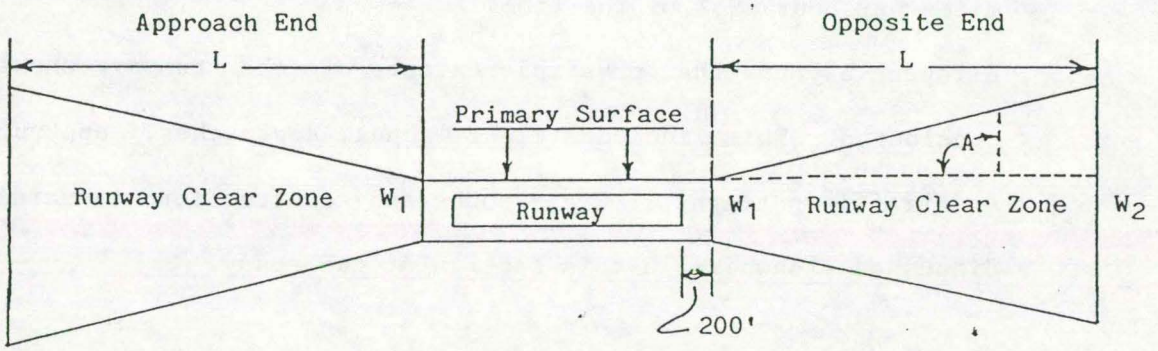
Airspace beyond the physical extents of the runway should be considered. This includes clear zones, approaches, obstructions and traffic patterns. Clear zones and obstruction standards are discussed elsewhere in this section of the study.

Topography plays an important role in selecting the orientation of the runway. Considerations must be made on the effect of the grading on surface and subsurface drainage, and soil types to be encountered along with the total cost of construction.

Clear Zones:

It is required that the airport owner have an "adequate property interest" in the clear zone area. "Adequate property interest" in order of preference may be in the form of fee ownership; a clear zone easement restricting the existence of any growths, structures, or objects except normal crops; or an avigation easement restricting the height of obstructions. Examples of the dimensions and location of the clear zone are depicted in Figure II-3.

With respect to safety requirements for the airport, the City of Greenfield has provided a "tall structure ordinance" which falls into the avigation easement category of restrictions for the clear zone areas.



Facilities Expected To Serve	Set No.	Runway End		Dimensions				
		Approach End	Opposite End	Length L (feet)	Inner Width W_1 (feet)	Outer Width W_2 (feet)	Runway Clear Zones (acres)	Flare Ratio A (rise/run)
Only Small Airplanes	1	V		1,000	250	450	8.035	.1:1
			V	1,000	250	450	8.035	.1:1
	2	V		1,000	500	650	13.200	.075:1
			NP	1,000	500	800	14.922	.15:1
	3	NP		1,000	500	800	14.922	.15:1
			NP	1,000	500	800	14.922	.15:1
Large Airplanes	4	V		1,000	500	700	13.770	.1:1
			V	1,000	500	700	13.770	.1:1
	5	V		1,000	500	700	13.770	.1:1
			NP 3/4 +	1,700	500	1,010	29.465	.15:1
	6	V		1,000	1,000	1,100	24.105	.05:1
			NP 3/4	1,700	1,000	1,510	48.978	.15:1
	7	V		1,000	1,000	1,100	24.105	.05:1
			P	2,500	1,000	1,750	78.914	.15:1
	8	NP 3/4 +		1,700	500	1,010	29.465	.15:1
			NP 3/4 +	1,700	500	1,010	29.465	.15:1
	9	NP 3/4 +		1,700	1,000	1,425	47.320	.125:1
			NP 3/4	1,700	1,000	1,510	48.978	.15:1
	10	NP 3/4 +		1,700	1,000	1,425	47.320	.125:1
			P	2,500	1,000	1,750	78.914	.15:1
	11	NP 3/4		1,700	1,000	1,510	48.978	.15:1
			NP 3/4	1,700	1,000	1,510	48.978	.15:1
	12	NP 3/4		1,700	1,000	1,510	48.978	.15:1
			P	2,500	1,000	1,750	78.914	.15:1
	13	P		2,500	1,000	1,750	78.914	.15:1
			P	2,500	1,000	1,750	78.914	.15:1

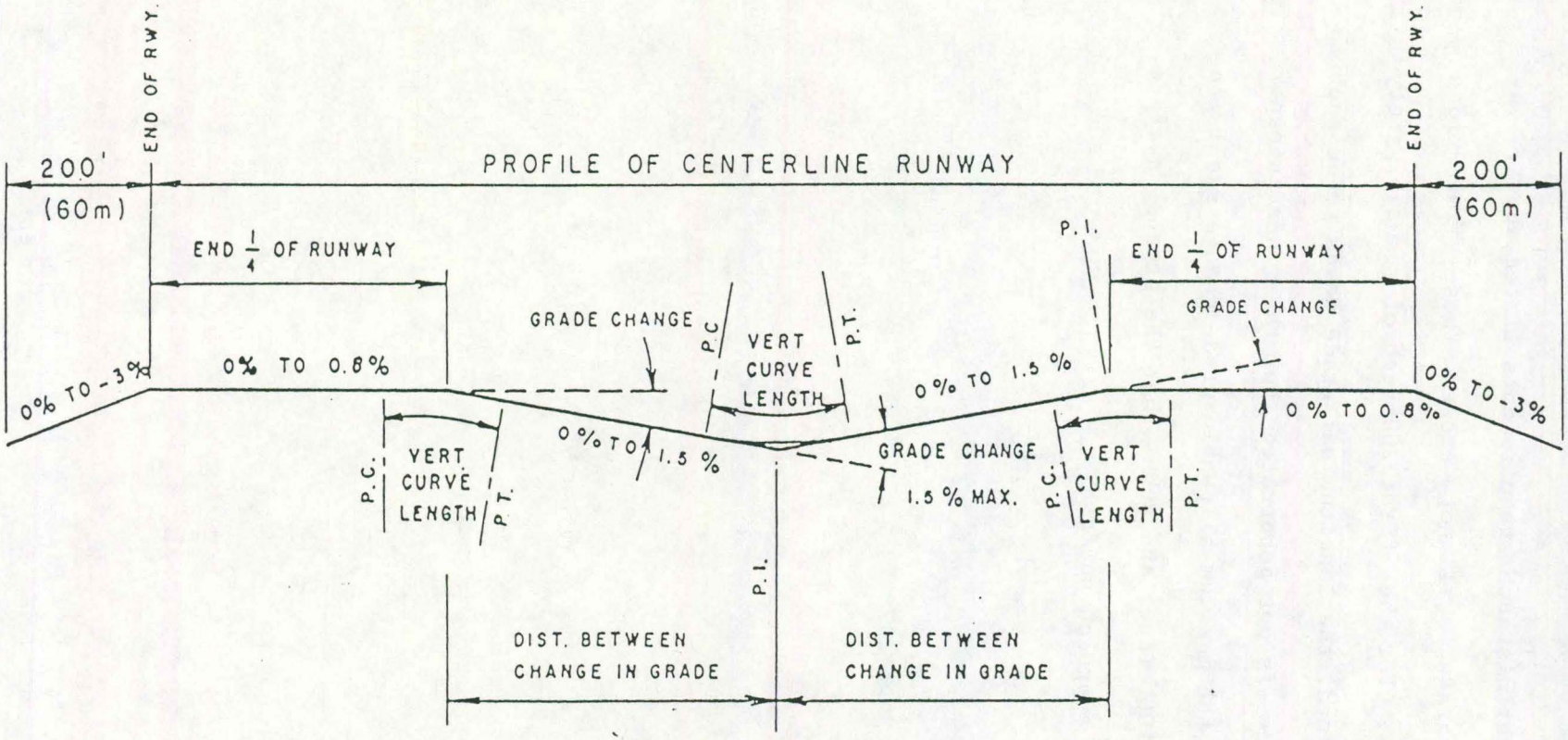
V = Visual approach
NP = Nonprecision approach
P = Precision instrument approach

NP 3/4 + = Visibility minimums more than 3/4-statute mile
NP 3/4 = Visibility minimums as low as 3/4-statute mile

RUNWAY CLEAR ZONE DIMENSIONS
FIGURE II-3

Surface Gradient:

In addition to the sight distance requirements listed above, the runway's longitudinal grade shall not exceed those limitations depicted in Figure II-4. For the first 200 feet of runway safety area beyond the runway end, the longitudinal grade needs to be such that the primary surface is not penetrated nor the grade steeper that 3%. Beyond that, the maximum allowable grade change shall be plus or minus 2% per 100 feet, and such that the ground surface does not penetrate the approach surface.



MINIMUM DISTANCE BETWEEN CHANGE IN GRADE = 1000' (300m) x SUM OF GRADE CHANGES (IN PERCENT).

MINIMUM LENGTH OF VERTICAL CURVES = 1000' (300m) x GRADE CHANGE (IN PERCENT).

LONGITUDINAL GRADE LIMITATIONS
FIGURE II-4

Itinerant Apron:

The area for parking itinerant aircraft can be projected based on the forecasted itinerant operations. The methodology used in this projection is described as follows:

a. Calculate the total annual itinerant operations. This was done in the forecast of aviation demand of this report.

b. Calculate the average daily itinerant operations for the most active month. Assume the most active month is 10% busier than the average month.

c. Assume the busiest itinerant day is 10% more active than the average day. This is based on data from FAA surveys.

d. Assume that each aircraft represents two operations, a landing and a takeoff.

e. Assume that a certain portion of the itinerant airplanes will be on the apron during the busiest day. Fifty percent is used here.

Based on the above analysis, the itinerant apron requirements have been calculated and are presented in the following table.

TABLE II-3 - REQUIRED ITINERANT TIE-DOWNS

YEAR	ANNUAL ITINERANT OPERATIONS	ITINERANT TIE-DOWNS REQUIRED
1990	962	2
1995	1,100	2
2000	1,283	2
2010	1,604	3

Present facilities for tie-downs can handle up to four aircraft, which exceeds the forecasted requirement. Therefore, the available

space that has been allocated for this purpose is sufficient, but the location may have to change if another runway is constructed.

Based Aircraft Apron:

In addition to itinerant apron requirements, a certain area will be required for the tie-down of based aircraft. This depends on a number of variables and is difficult to project. Some of the factors affecting an aircraft owner's decision to tie-down an airplane are: quality of the available hangars; cost of hangar space; value of the aircraft; and personal preference. For Greenfield it is estimated that a maximum of 15% of the based aircraft owners will choose to tie-down their aircraft. The calculated based aircraft tie-down spaces are determined as follows.

TABLE II-4 - REQUIRED BASED AIRCRAFT TIE-DOWNS

YEAR	BASED AIRCRAFT	BASED AIRCRAFT TIE-DOWNS REQUIRED
1990	21	3
1995	24	4
2000	28	4
2010	35	5

These projections combined with the tie-down projections for itinerant aircraft justify the need for additional tie-down facilities at the Greenfield Airport.

Apron Requirements:

Total apron area requirements should provide adequate space for the following.

a. Tie-down of based aircraft
b. Tie-down of itinerant aircraft
c. Temporary parking of transient aircraft
d. Short term loading and unloading
e. Fueling

With proper planning, the apron area will accommodate the maximum number of aircraft while maintaining ease of ingress and egress. The apron area should also be planned with a certain amount of flexibility and expandability.

Hangars:

Hangar space requirements are in two forms, T-hangars and conventional hangars. The majority of aircraft owners will prefer to store their aircraft in T-hangars. This is the most economical form of aircraft storage for individual owners. Some aircraft owners, more specifically corporate aircraft owners, may prefer to hangar their aircraft in an individual conventional hangar. However, aircraft projections for the Greenfield Airport do not include planning considerations for this type of aircraft activity. Conventional hangar space should be provided for fixed base operator facilities if such a service is to be implemented at Greenfield.

The criteria for the number of hangar spaces that should be planned for is as follows:

a. T-hangar space should be provided for the number of based aircraft at the airport (use projected numbers for planning purposes). In addition, provide two to three spaces for itinerant aircraft which may need a space and as an attraction to new based aircraft.

b. The number of conventional hangar spaces to be allowed for is difficult to estimate. It is highly dependent on the personal preferences of the local users. In cases where opportunities exist for corporate aircraft to be based, two to three corporate hangars are adequate for the 20-year development of a utility category airport.

c. Conventional hangar space should also be provided for the fixed base operator facilities, as mentioned previously. Initially, one such hangar will be adequate with the potential for a second hangar in the long range development of the airport.

Based on the above criteria, the hangar requirements at the Greenfield Airport are determined as follows:

TABLE II-5 - HANGAR REQUIREMENTS

YEAR	T-HANGAR SPACE	CONVENTIONAL HANGAR SPACE
1990	24	1
1995	27	1
2000	31	2
2010	38	2

Typical configurations of T-hangars and taxiways are depicted in Figure II-5.

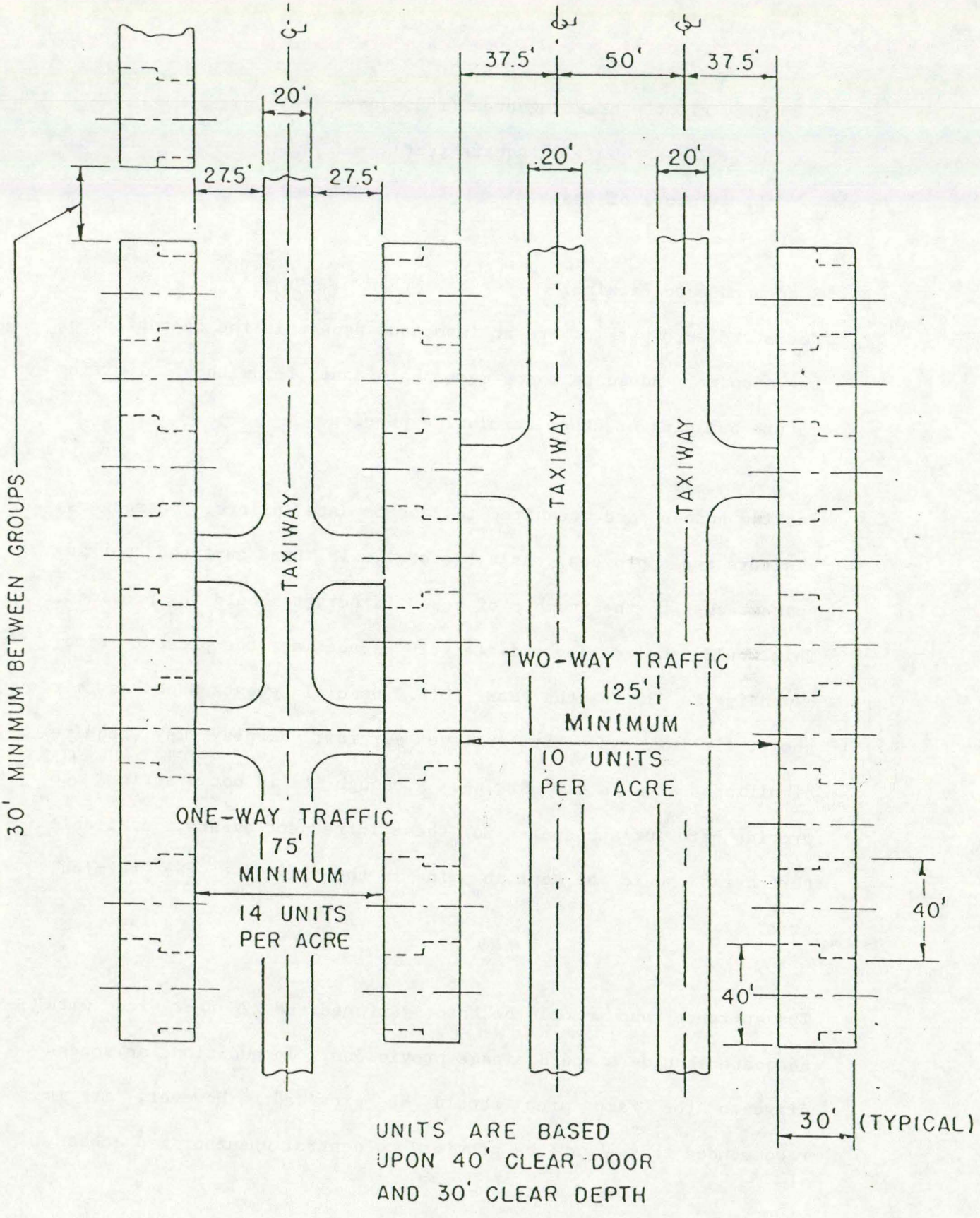
Administration Building:

An administration building provides accommodations for the general public along with those responsible for administration of the airport. Standards for building requirements should be included in consideration for the long range planning goals of the Greenfield Airport. The minimum requirements for a facility of this nature include the following:

a. Waiting room (500 square feet)

b. Administrator's office (180 square feet)

c. Public restrooms



T-HANGAR LAYOUT
FIGURE II-5

d. Pilot's briefing area (180 square feet)

e. Class room (200 square feet)

f. Future offices

Roads and Auto Parking:

Roads and auto parking are an important aspect in the operation of the airport. Adequate space must be planned for without limiting future building or other terminal expansion.

Parking spaces are required to accommodate pilots, passengers, visitors and employees. As a general rule, hard surfaced parking spaces equal to the number of based aircraft should be provided. This would require approximately 20 spaces at the present time, expanding to 35 in the year 2010. Special events such as air shows, fly-ins, and the antique aircraft display may require significant amounts of parking. Although it is not practical to provide hard surface space for these infrequent events, available turf areas should be kept in mind in the layout of the terminal area.

The entrance road should be hard surfaced and 22 feet wide with adequate shoulders and drainage provisions. In addition, an access drive to the ramp area should be provided. However, it is recommended that a gate be provided to control unauthorized access.

--OBSTRUCTIONS--

This section sets forth the standards for determining obstructions in the navigable air space around the airport. This information has been incorporated into a tall structure zoning ordinance by the City of Greenfield for future protection of air space. Enforcement of this ordinance is the key to successful and continued operation of an airport facility. This information should also be provided to the FAA for use in analyzing notices of proposed construction in the area of the airport.

The following sections of this report will be quoting Federal Aviation Regulation Part 77 - Objects Affecting Navigable Air Space as it pertains to the Greenfield Airport.

Obstruction Standards:

An obstruction is considered to be any object of natural growth, terrain, or structures of permanent or temporary construction if it is higher than any of the following heights or surfaces:

a. A height of 500 feet above ground level at the site of the object.

b. A height that is 200 feet above ground level or above the established airport elevation, whichever is higher, within three nautical miles of the established reference point of an airport. That height increases in the proportion of 100 feet for each nautical mile of distance from the airport up to a maximum of 500 feet.

c. The surface of a takeoff and landing area of an airport or any imaginary surface established under paragraphs 77.25, 77.28, or 77.29 (FAR Part 77). However, no part of the takeoff or landing area itself will be considered an obstruction.

The height of traverse ways to be used for the passage of mobile objects are increased as follows:

a. 17 feet for an Interstate highway.

b. 15 feet for any other public roadway.

c. 10 feet above the height of the highest mobile object that would normally traverse the road, whichever is greater, for a private road.

d. 23 feet for a railroad.

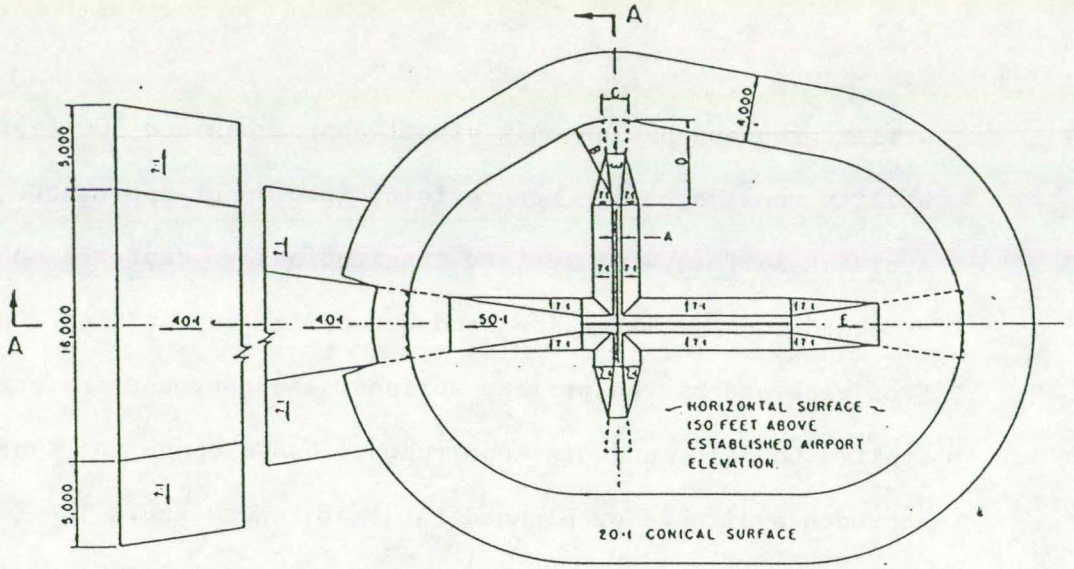
e. For a waterway or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse the way.

The following paragraphs describe the imaginary surfaces as they would apply to the Greenfield Airport. Refer to Figure II-6 for a graphic depiction of these surfaces.

Horizontal Surface - A horizontal plane 150 feet above the established airport elevation, the perimeter of which is constructed by swinging arcs of 5,000 feet radii from the center of each end of the primary surface of each runway and connecting the adjacent arcs by lines tangent to those arcs.

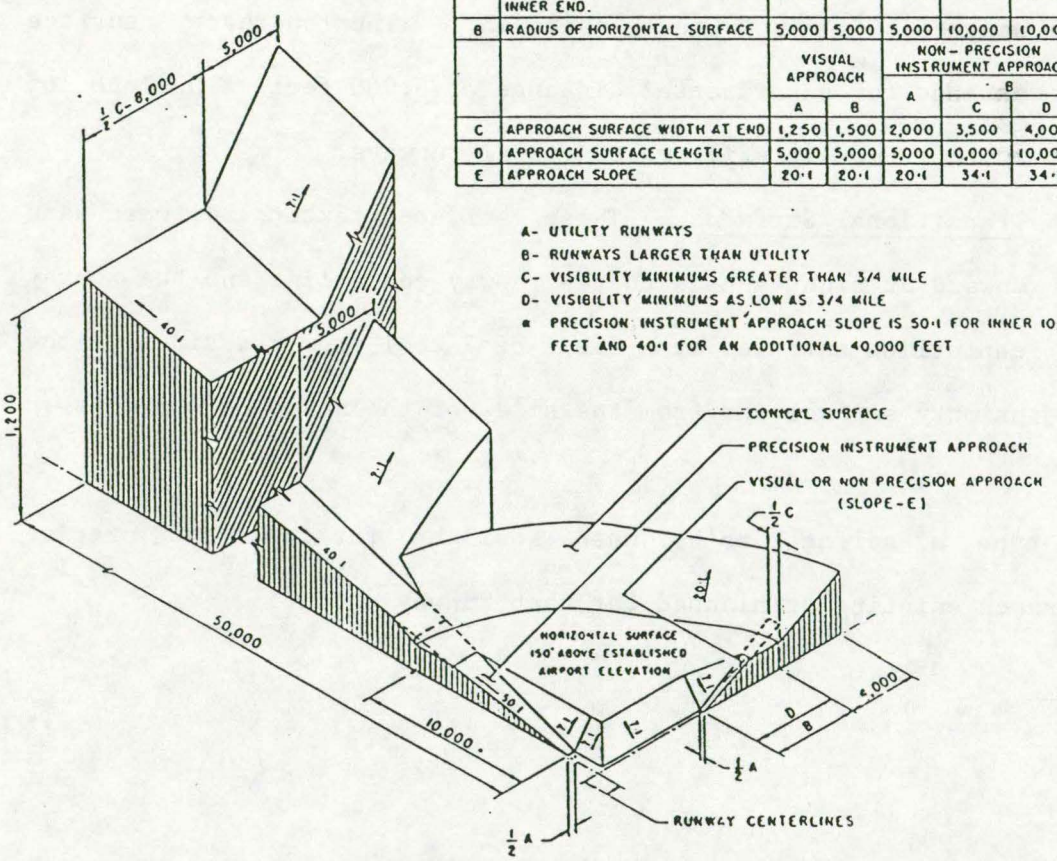
Conical Surface - A horizontal surface extending outward and upward from the periphery of the horizontal surface at a slope of 20 to 1 for a horizontal distance of 4,000 feet.

Primary Surface - A surface longitudinally centered on a runway and extending 200 feet beyond the end of that runway. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width of a primary surface is 250 feet for



DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		A	B	A	B		
					C	D	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END.	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
		A	B	A	B		
					C	D	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A- UTILITY RUNWAYS
B- RUNWAYS LARGER THAN UTILITY
C- VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D- VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



ISOMETRIC VIEW OF SECTION A-A

IMAGINARY SURFACES
FIGURE II-6

utility runways having only visual approaches and 500 feet for utility runways having nonprecision instrument approaches.

Approach Surface - A surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. An approach surface is applied to each end of each runway based upon the type of approach available or planned for that runway end. The inner edge of the approach surface is the same width as the primary surface and it expands uniformly to a width of 1,250 feet for that end of a utility runway with only visual approaches; 2,000 feet for that end of a utility runway with a nonprecision instrument approach. The approach surface extends for a horizontal distance of 5,000 feet at a slope of 20 to 1 for all utility and visual runways.

Transitional Surface - These surfaces extend outward and upward at right angles to the runway centerline and the runway centerline extended at a slope of 7 to 1 from the sides of the primary surface and from the sides of the approach surfaces.

The type of surface to be used shall be for the most precise approach existing or planned for that runway end.

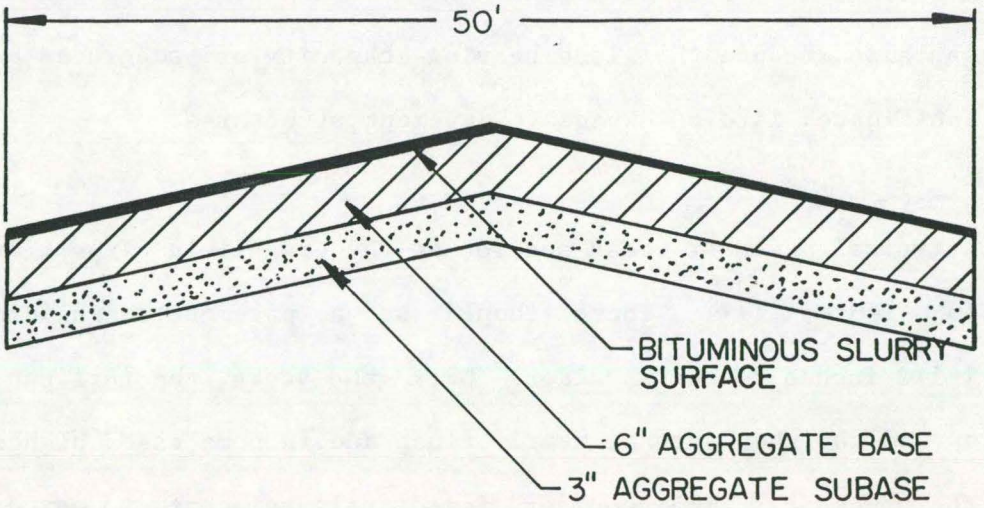
--DRAINAGE--

An adequate drainage system is important for the safety of aircraft operations and for the longevity of the pavements. Improper drainage can result in the formation of puddles on pavements which are hazardous to aircraft landing or taking off. Improper drainage can also reduce the load bearing capacity of subgrades and the anticipated life of expensive pavement structures.

A typical pavement cross section at the Greenfield Airport is shown in Figure II-7. There should be a pavement edge drop of 1 1/2 inches to the shoulder. Over the years, the turf can build up and the shoulders be nearly flush and in some cases higher than the pavement. The shoulder immediately adjacent to paved areas should be maintained at a 5% slope for the first ten feet from the pavement edge to assure positive surface runoff. Beyond ten feet, turf areas should be maintained at 2% slope.

Surface drainage systems should be designed on a five-year frequency of storm. Methods of computation are contained in FAA Advisory Circular 150/5300-5B Airport Drainage.

Subsurface drainage systems are desirable where water may rise to within one foot of the pavement section or where there are capillary susceptible soils. Water in the subgrade contributes directly to frost boil and heaving action. Also, saturated



EXISTING TYPICAL PAVEMENT SECTIONS
FIGURE II-7

subgrades exhibit a greatly reduced load bearing capacity. For these reasons, soil conditions and subsurface water conditions play important roles in airport design.

Airport pavement is intended to provide a smooth and safe all-weather surface free from particles and other debris that may be picked up by propeller wash. The pavement should be of sufficient thickness and strength to accommodate the anticipated loads without undue pavement distress. For the utility category of airport, this would include aircraft with a maximum gross weight of 12,500 pounds and a single wheel landing gear.

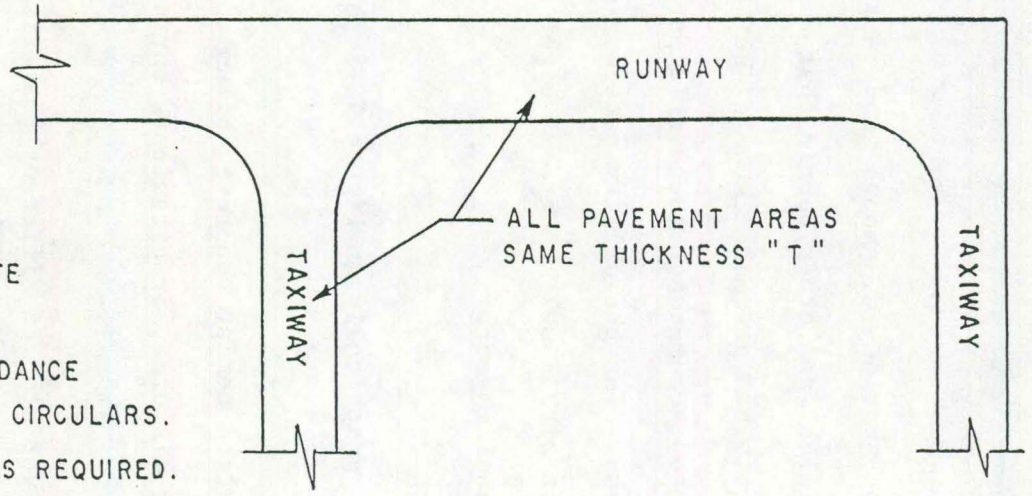
Various pavement courses are shown graphically in Figure II-8 and described as follows.

Surface Course - includes Portland cement concrete, bituminous concrete, aggregate bituminous mixtures, or bituminous surface treatments.

Base Course - consists of a variety of different materials which generally fall into two main classes, treated and untreated. The untreated bases consist of stone, gravel, lime rock, sand-clay, or a variety of other materials. The treated bases normally consist of a crushed or uncrushed aggregate that has been mixed with cement or bitumen.

Subbase Course - consists of a granular material or a stabilized soil.

The existing pavement section at the Greenfield Airport consists of a bituminous surface with a six inch aggregate base course. This

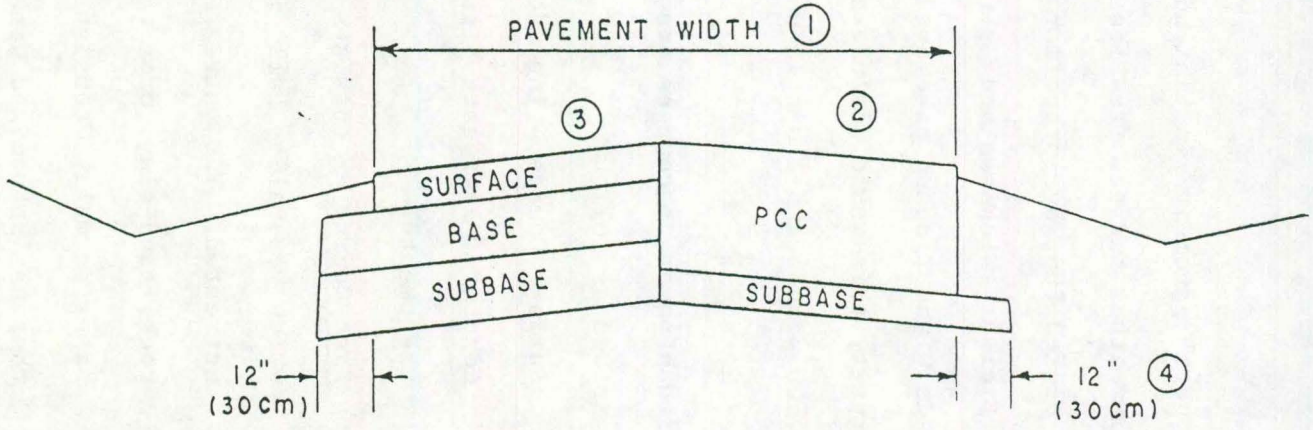


(1) RUNWAY AND TAXIWAY WIDTHS IN ACCORDANCE WITH APPROPRIATE ADVISORY CIRCULARS

(2) TRANSVERSE SLOPES IN ACCORDANCE WITH APPROPRIATE ADVISORY CIRCULARS.

(3) SURFACING, BASE, PCC, ETC., AS REQUIRED.

(4) MINIMUM 12" (30 cm) TYPICAL [UP TO 30" (76 cm) ALLOWABLE FOR SLIP-FORMED PCC]



TYPICAL PAVEMENT SECTIONS
FIGURE II-8

lies on a three inch subbase course and a six inch sub grade. This pavement strength permits a single wheel load of 7,000 pounds.

Marking:

Pavement markings are an important aid in safely guiding aircraft on runways and taxiways. The specific details of marking layout are addressed on FAA Advisory Circular 150/5340-1E, Marking of Paved Areas on Airports. The following describes some of the requirements as they would apply to the Greenfield Airport. Refer to Figures II-9 and II-10 for details.

Visual Runway-

a. Centerline markings consist of a line of uniformly spaced stripes 120 feet in length and gaps of 80 feet. The minimum width is 12 inches.

b. Designation marking indicates the magnetic bearing of the runway centerline to the nearest ten degree increment. For example, a magnetic bearing of 127 degrees would be represented by a "13". The numbers are normally 60 feet high with a width dependent on the runway width.

c. Fixed distance markings are required when there is jet activity. Two solid longitudinal bars located either side of the runway centerline 1,000 feet from the runway threshold.

d. Holding position markings (taxiways and intersecting runways) consist of a painted hold line and a sign indicating the runway designation numbers.

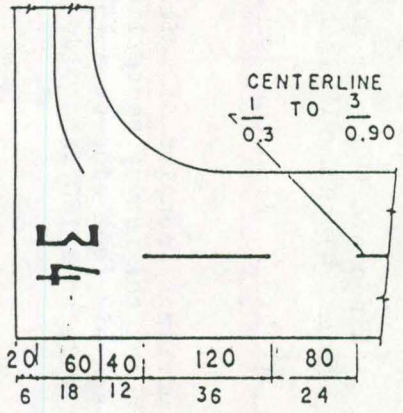
Nonprecision Instrument Runway:

a. Centerline markings are the same as for the visual runway except the minimum width is 18 inches.

b. Designation markings are the same as for the visual runway.

c. Threshold markings consist of eight longitudinal lines symmetric about the runway centerline. The lines are 150 feet long and six feet wide on a 75 foot wide runway and eight feet wide on a 100 foot wide runway.

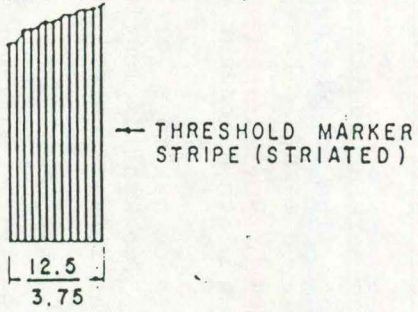
NOTE: UNITS ARE EXPRESSED AS $\frac{\text{FEET}}{\text{METERS}}$ e.g. $\frac{10}{3}$.



VISUAL RUNWAY

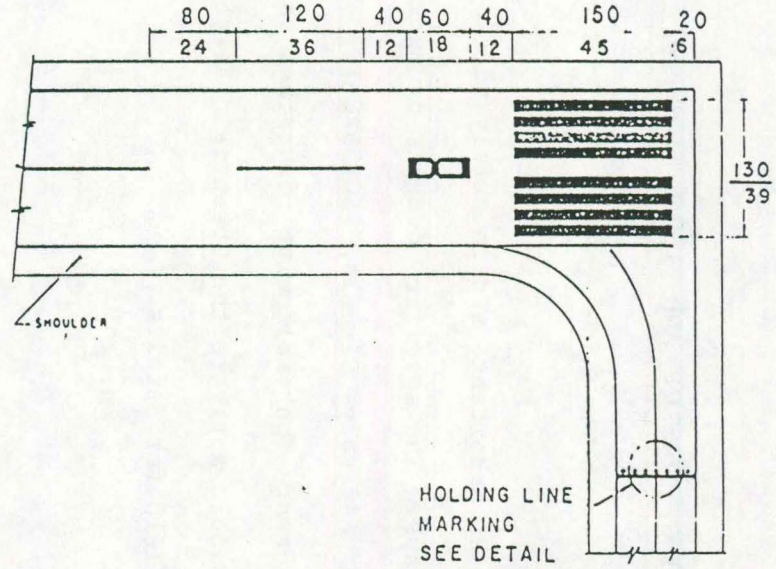
NOTES:

1. ALL STRIPES AND SPACES TO BE EQUAL WIDTH.
2. MAXIMUM WIDTH 6 INCHES (15cm) MINIMUM WIDTH 4 INCHES (10cm).



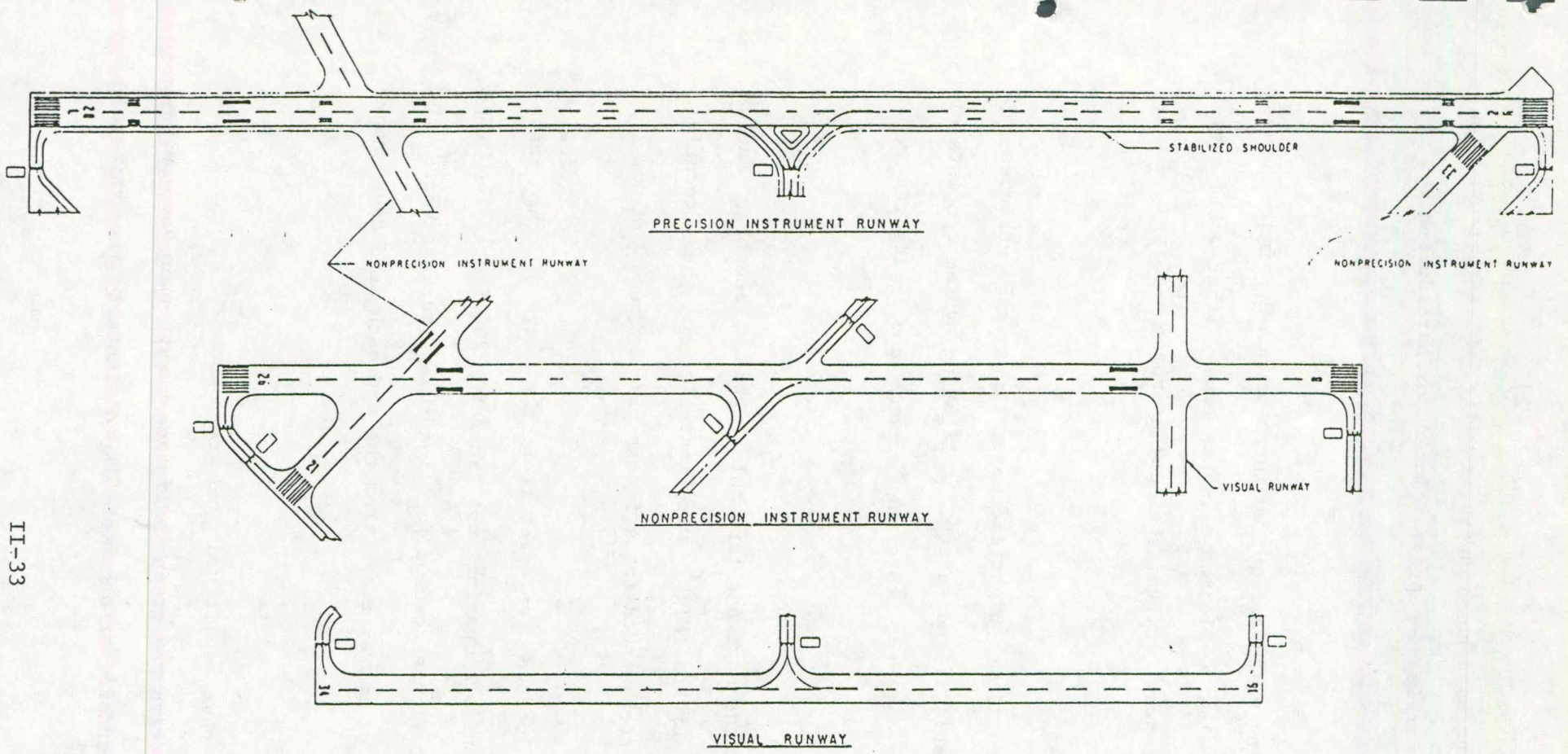
FROST AREA MARKING

(TYPICAL)



NONPRECISION INSTRUMENT RUNWAY

VISUAL AND NONPRECISION MARKING
FIGURE II-9



RUNWAY MARKINGS
FIGURE II-10

The color of marking used on runways is white, while that used on taxiways and for marking deceptive, closed or hazardous areas is yellow.

Nonprecision marking will be required for a proposed primary runway in the long range plan, while the existing runway (that would serve as the crosswind runway) maintains visual approach markings.

Lighting:

Airport lighting allows nighttime operations and enhances an airport's serviceability and safety. A lighting system consists of runway and taxiway lights, rotating beacon, and a lighted wind indicator.

Runway lights include edge and threshold lights. Recently, Medium Intensity Runway Lights (MIRL) were installed at the Greenfield airport, and are recommended for a future primary runway also.

Edge lights are located ten feet from the edge of the runway pavement with a uniform spacing not exceeding 200 feet. The edge lights have clear lenses except for instrument runways where the last 2,000 feet of runway away from the approach end have amber lenses.

Threshold lights have split red and green lenses. The red half faces the runway and the green half faces away from the runway. Although the standard arrangement is to install six threshold

lights on a visual runway and eight threshold lights on an instrument runway, it is recommended that an eight light system be included in the plan for a future primary runway in case an instrument approach should be developed at that time. The threshold lights are installed in two groups of four and a ten foot spacing with the outside light in line with the edge lights.

Blue taxiway lights are similar to runway lights as far as intensity and location are concerned. Specific details of runway and taxiway edge lighting systems can be found in FAA Advisory Circular 150/5340-24, Runway and Taxiway Edge Lighting System.

An airport rotaing beacon has two rotating beams of light. One light is green and the other white.

The wind indicator or wind sock should be installed at the center of a segmented circle and lighted for enhanced visibility. The lighting should also illuminate any traffic pattern indicators associated with the installation. Specific information on wind indicators and rotatng beacons can be obtained from FAA Advisory Circular 150/5340-21.

Airport Visual Aids:

A number of visual aids are available to assist a pilot in locating and navigating about an airport. Those recommended for the Greenfield Airport for immediate and long range implementation are described in the following paragraphs.

Runway End Identifier Lights (REIL) consist of two flashing lights located at the runway threshold. The lights provide positive identification of the end of the runway and are of particular use in featureless terrain or confusing surrounding lights.

Visual Approach Slope Indicators (VASI) or Precision Approach Path Indicators (PAPI) provide visual guidance for landing approaches. The light units are normally located on the left side of the runway as viewed on approach and emit red and white beams of light which enables a pilot to determine whether the approach is being made above, on, or below the recommended approach. A pilot is "on path" if the indicator shows red/white, "below path" if red/red is shown, or "above path" if white/white is shown.

For the future facilities at the Greenfield Airport, it is recommended that a proposed primary runway implement the REIL and VASI systems for improved navigation and to meet standards set for a General Utility Airport classification.

--NAVIGATIONAL AIDS--

Navigational aids currently found at the Greenfield Airport include a rotating beacon and a Unicom. A Unicom is a radio frequency assigned to individual airports that is used as an aeronautical advisory tool for pilots concerned with airport services and airport utilization.

Other navigational aids recommended for the Greenfield Airport include a Nondirectional Beacon (NDB) and a Terminal Very High Frequency Omnirange (TVOR) should instrument operations become a reality.

The NDB radiates a signal which can be used by pilots to provide electronic guidance to the airport. A symmetrical T-antenna is recommended for this. The antenna consists of two 65 foot poles spaced at approximately 350 feet with two wires strung between them. The NDB should be located on airport property but at least 100 feet away from any metal buildings, power lines or metal fences. The ground should be smooth, level and well-drained. The location should take into account the obstruction standards described in this report.

The TVOR provides azimuth information to the pilot. The TVOR should be near the runway intersection but at least 500 feet from a runway centerline and 250 feet away from a taxiway centerline. The

signal can be distorted or reflected by fences, structures, power lines or trees. The following clearances should be maintained.

Structures - No structure within 750 feet. Beyond that, metal buildings should be cleared by a vertical angle of 1.2 degrees and other buildings by 2.5 degrees.

Fences - Metal fences should be at least 500 feet away.

Power and Telephone Lines - Overhead power and telephone lines should have a clearance of at least 1,200 feet.

Trees - Trees within 1,000 feet of the antenna should be removed. Beyond 1,000 feet, trees should be cleared by a vertical angle of 2 degrees.

The ground surface around a TVOR should be relatively flat and free from ravines, ditches, rocks, or embankments. The ground may slope gently away from the TVOR but not towards it.

III. SITE EVALUATION

--INTRODUCTION--

The Site Evaluation Phase will identify and discuss alternatives for development of future facilities as detailed in the previous portions of this study. The alternatives will be confined to utilization or expansion of the existing Greenfield Airport site. Due to the investment in the existing airport facilities, it is not feasible or prudent to consider any alternate sites at this time.

The major improvements being considered are the development of a primary runway, development of a crosswind runway and the various terminal area improvements. Of these features the most significant consideration in the future development of the airport is the primary runway. This study has identified the need to plan for the ultimate development of a 4,200' by 75' primary runway. Referring to Figures III-1 and III-2, significant features to be considered in evaluating the development of this runway are as follows:

1. State Highway 25 is a north-south highway located east of the existing airport property. It is assumed that no realignment of the highway is feasible. In addition, the Part 77 surfaces described in the previous phase, must maintain a clearance of 15 feet over the highway.

2. A county road provides access to the airport and farmsteads in the vicinity. The road connects with Highway 25 and then runs

easterly along the south side of the airport, then curves north along the east side of the airport.

3. The terrain around the airport is rolling. Numerous drainageways limit alternatives for development.

4. Various homes and farmsteads are scattered around the vicinity of the airport. These features limit development alternatives.

Taking the above factors into consideration, only two alternatives are feasible and warrant detailed evaluation for development of a 4,200' runway at the existing site. These alternatives are for the expansion of the existing runway to the southeast and development of a new east-west alignment. The following sections discuss the two alternatives in detail.

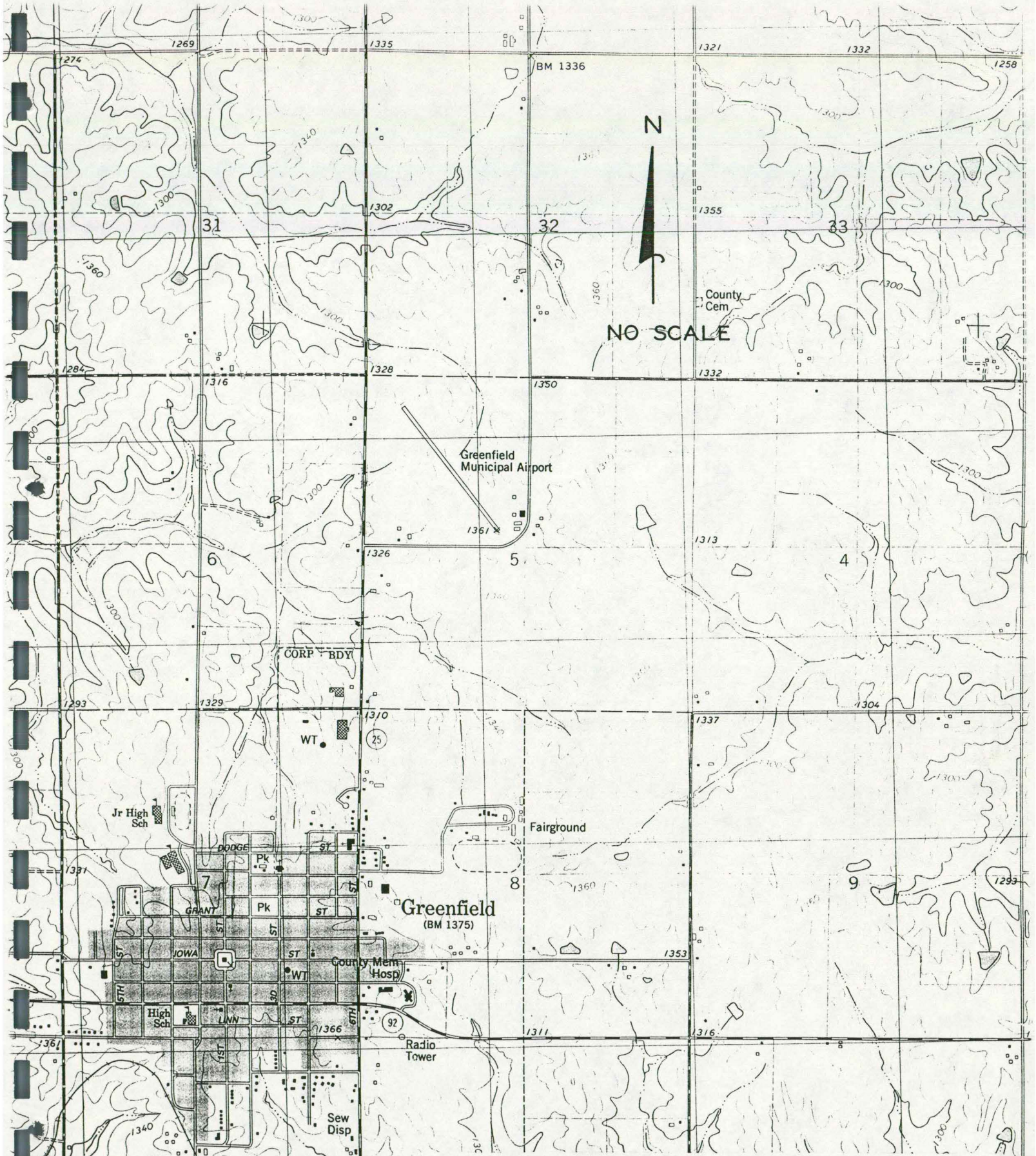


FIGURE III-1
VICINITY MAP
GREENFIELD MUNICIPAL AIRPORT

P.N. 4093.03

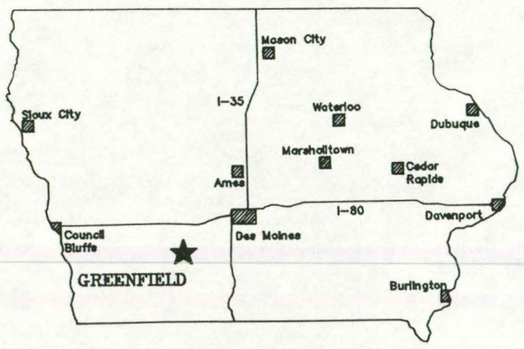
LEGEND

- Property or Right-of-Way Lines
- Railroad Tracks
- Building
- Power Pole w/Guy
- Telephone Pole
- Intakes
- Fences
- Manhole
- Hydrant
- Trees
- Bushes
- Stump
- Curb Stop
- Valve
- Street Light
- Street Signs
- Culvert
- Water Line
- Sanitary Sewer Line
- Storm Sewer Line
- Gas line
- Electric Cable
- Telephone Cable

AIRPORT LAYOUT PLAN
GREENFIELD MUNICIPAL AIRPORT
GREENFIELD, IOWA
~1990~

REVISIONS	
DATE	SHEETS

SHEET INDEX



CGA
CONSULTING ENGINEERS
MARSHALLTOWN AMES

APPROVED:

SIGNED, DATE

_____ _____ ,1990

I HEREBY CERTIFY THAT THESE PLANS WERE PREPARED BY ME OR UNDER MY DIRECT PERSONAL SUPERVISION AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF IOWA.

SIGNED, DATE

5-23 ,1990

WILLIAM R. GRABE, P.E.
IOWA REG. NO. 9221

P.N. 4093.03 SHEET 1

0 300' 600' 900'

N

MAGNETIC DECLINATION
7° 38' E (1979)

APPROACH SURFACE
5000' x 500' x 2000'
20:1 SLOPE

CLEAR ZONE ELEV.= 1405.3'
ROAD ELEV.= 1315.8'
CLEARANCE= 89.5'

CLEAR ZONE ELEV.= 1392.5'
ROAD ELEV.= 1313.4'
CLEARANCE= 72.3'

CLEAR ZONE
1000' x 500' x 800'
20:1 SLOPE

FUTURE
RELOCATED
COUNTY ROAD

CLEAR ZONE ELEV.= 1381.3'
ROAD ELEV.= 1330.6'
CLEARANCE= 40.7'

ELEV.= 1355.5'

BRL

50'

200'

CLOSE ROAD

CLEAR ZONE ELEV.= 1377.6'
ROAD ELEV.= 1326.2'
CLEARANCE= 50.8'

RUNWAY END
ELEV.= 1358
LAT. 41°19'34"
LONG. 94°25'01"

ULTIMATE
ARP

N 78° 11' E (TRUE)

ULTIMATE 4240' x 75' RUNWAY

END OF 3,440' RUNWAY

RUNWAY END
ELEV.= 1361.0'
LAT. 41°19'23"
LONG. 94°26'08"

APPROACH SURFACE
5000' x 500' x 2000'
20:1 SLOPE

CLEAR ZONE
1000' x 500' x 800'
20:1 SLOPE

CLEAR ZONE ELEV.= 1390.0'
ROAD ELEV.= 1327.5'
CLEARANCE= 53.0'

CLEAR ZONE
1000' x 500' x 800'
20:1 SLOPE

ELEV.= 1360.0'

35'

240'

125'

LOS

CLEAR ZONE ELEV.= 1384.0'
ROAD ELEV.= 1324.6'
CLEARANCE= 59.4'

APPROACH SURFACE
5000' x 500' x 2000'
20:1 SLOPE

STATE HIGHWAY 25

CLEAR ZONE ELEV.= 1361.0'
ROAD ELEV.= 1353.7'
CLEARANCE= 7.3'

CLEAR ZONE ELEV.= 1366.0'
ROAD ELEV.= 1357.5'
CLEARANCE= 8.6'

CLEAR ZONE ELEV.= 1367.0'
ROAD ELEV.= 1360.8'
CLEARANCE= 6.2'

CLEAR ZONE
1000' x 500' x 800'
20:1 SLOPE

APPROACH SURFACE
5000' x 500' x 2000'
20:1 SLOPE

AIRPORT DATA

ITEM		EXISTING	ULTIMATE
AIRPORT ELEVATION		1,361 MSL	1,361 MSL
NORMAL MAX. TEMP.		89° F	89° F
TAXIWAY MARKING		BASIC	N.P.I.R.
NAVIGATIONAL AIDS		NDB	NDB
AIRPORT COORDINATES	LAT.	41°19'37"	41°19'38"
	LONG.	94°26'51"	94°26'40"
AIRPLANE DESIGN GROUP		I	II
COMBINED WIND COVERAGE		85.5	93.6

RUNWAY DATA

ITEM	RUNWAY 13-31		RUNWAY 7-25	
	EXISTING	ULTIMATE	EXISTING	ULTIMATE
EFFECTIVE GRADIENT, %	0.23	0.23		0.07
% WIND COVERAGE	85.5	85.5		74.7
SAFETY AREA	2300'x150'	2300'x150'		4600'x150'
PAVEMENT STRENGTH	6000	12,500		12,500
APPROACH SLOPES	20:1	20:1		20:1
LIGHTING	MIRL, MITL	MIRL, MITL		MIRL, MITL, REIL
MARKING	NONPRECISION	NONPRECISION		NPIR
APPROACH AIDS	NONE	VASI		PAPI
LENGTH	2,500'	2,500'		4,200'
WIDTH	50'	50'		75'

ABBREVIATIONS

BRL	BUILDING RESTRICTION LINE
FBO	FIXED BASE OPERATOR
MIRL	MEDIUM INTENSITY RUNWAY LIGHTS
REIL	RUNWAY END IDENTIFIER LIGHTS
VASI	VISUAL APPROACH SLOPE INDICATOR
NDB	NON-DIRECTIONAL RADIO BEACON
ARP	AIRPORT REFERENCE POINT
LOS	LINE OF SIGHT
ILS	INSTRUMENT LANDING SYSTEM
VOR	VERY HIGH FREQUENCY OMNIRANGE
TVOR	TERMINAL VOR

LEGEND

EXISTING	ULTIMATE	ITEM
NOT SHOWN	BRL	BUILDING RESTRICTION LINE
1218	NOT SHOWN	GROUND CONTOURS
		AIRPORT PROPERTY LINE
●●● ●●●	○○○ ○○○	THRESHOLD LIGHTS
		FACILITIES
▲	△	RUNWAY IDENTIFIER LIGHTS
●	○	RUNWAY LIGHTS
		BUILDING CONSTRUCTION
TL	TL	TILE LINE & INTAKE
P	NOT SHOWN	POWER LINE
xxxxxxxx		EASEMENTS
NOT SHOWN	LOS	LINE OF SIGHT
		AIRPORT PROPERTY LINE
		CLEAR ZONE
		AIRPORT FENCING
T	NOT SHOWN	TELEPHONE LINE
		PRECISION APPROACH PATH INDICATOR

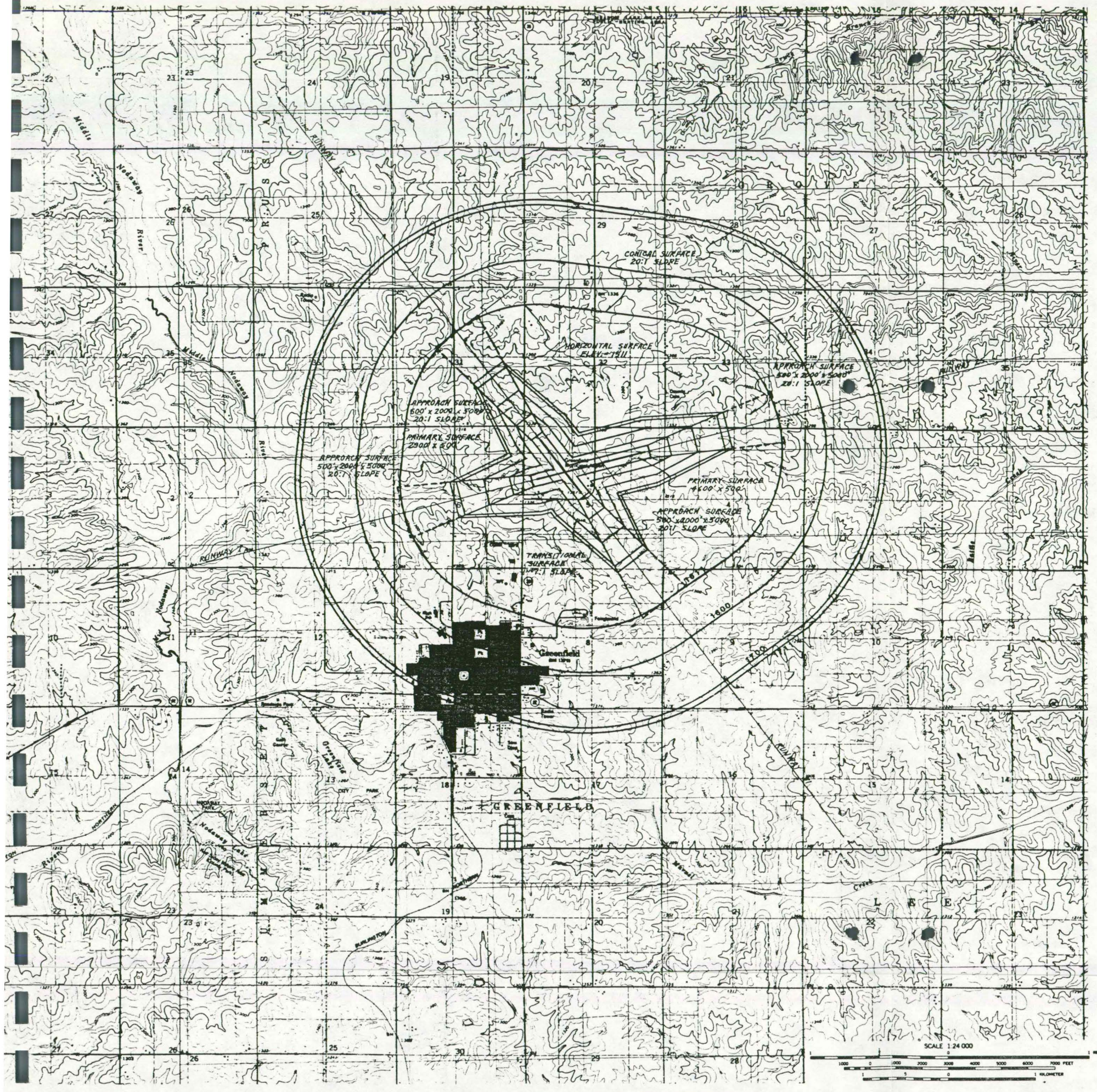
REVISION	DATE

AIRPORT LAYOUT PLAN

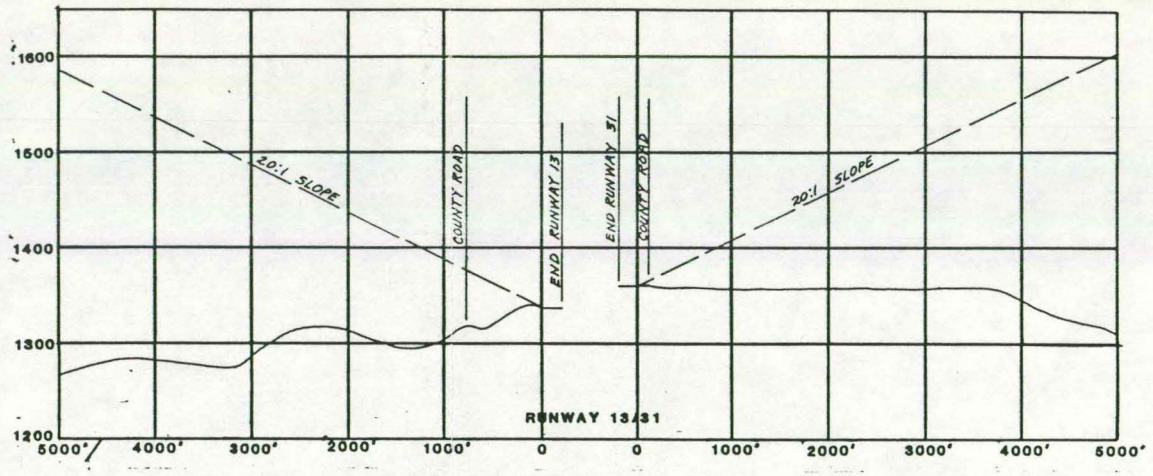
GREENFIELD MUNICIPAL AIRPORT
GREENFIELD IOWA

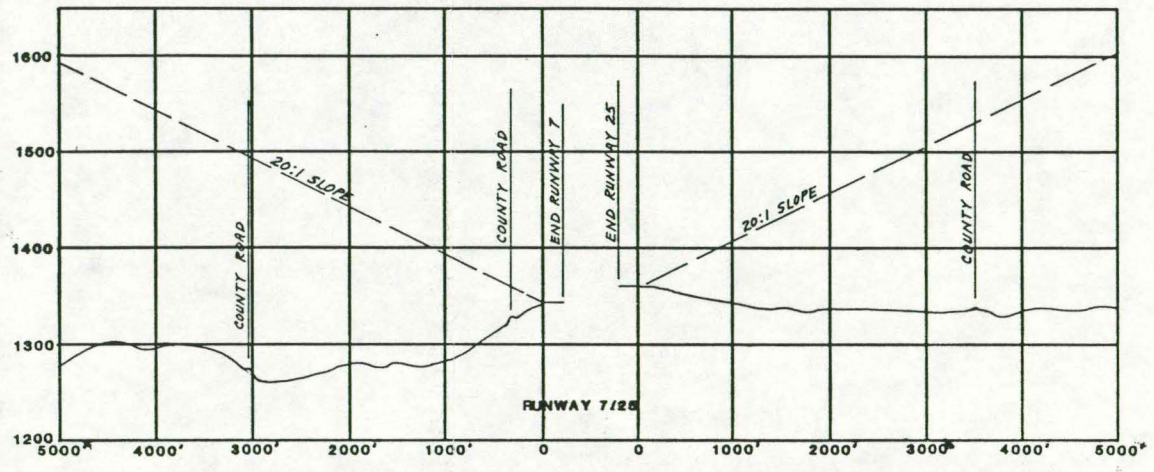
CGA CONSULTING ENGINEERS
MARSHALLTOWN AMES

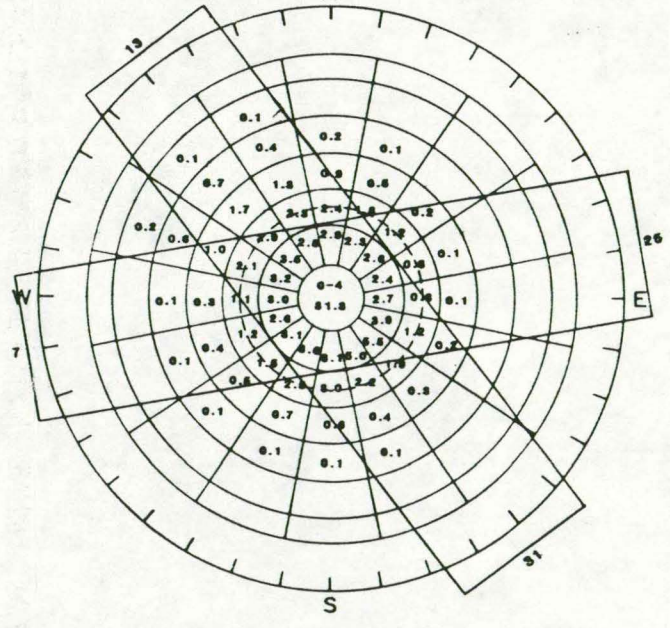
DATE 4-90
P.N. 4093
SHEET 2 OF 6



APPROACH PROFILES







WIND COVERAGE

13/31	86.6%
7/25	74.7%
COMBINED	93.6%

WIND ROSE
LOCATION: DES MOINES MUNICIPAL AIRPORT
RECORD OF PERIOD 1951-1960

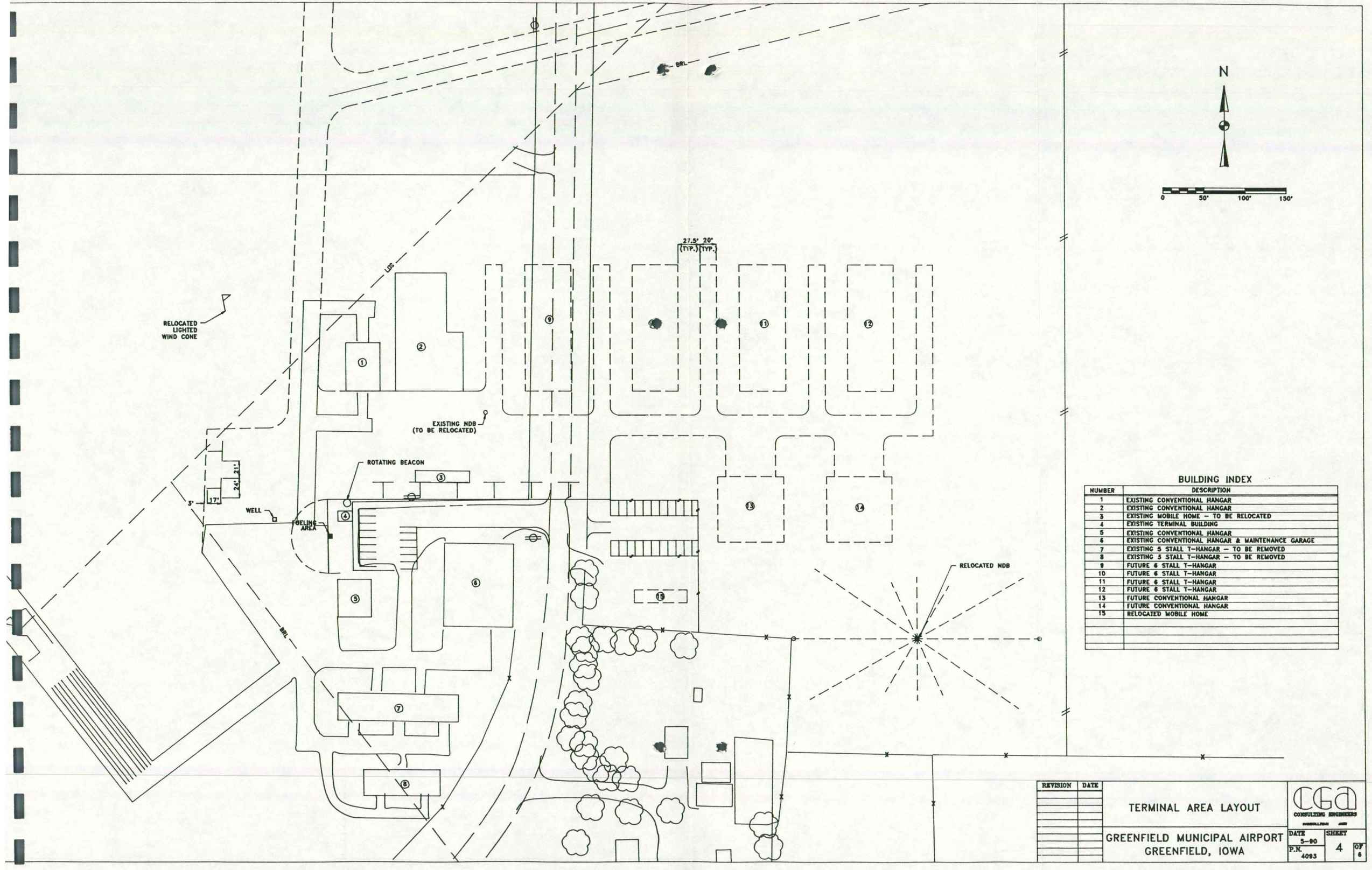
REVISION	DATE

F.A.R. PART 77 SURFACES

GREENFIELD MUNICIPAL AIRPORT
GREENFIELD, IOWA

CGA CONSULTING ENGINEERS
MARSHALLTOWN IOWA AMES IOWA

DATE 4-90
P.N. 4093
SHEET 3 OF 6



BUILDING INDEX

NUMBER	DESCRIPTION
1	EXISTING CONVENTIONAL HANGAR
2	EXISTING CONVENTIONAL HANGAR
3	EXISTING MOBILE HOME – TO BE RELOCATED
4	EXISTING TERMINAL BUILDING
5	EXISTING CONVENTIONAL HANGAR
6	EXISTING CONVENTIONAL HANGAR & MAINTENANCE GARAGE
7	EXISTING 5 STALL T-HANGAR – TO BE REMOVED
8	EXISTING 3 STALL T-HANGAR – TO BE REMOVED
9	FUTURE 6 STALL T-HANGAR
10	FUTURE 6 STALL T-HANGAR
11	FUTURE 6 STALL T-HANGAR
12	FUTURE 6 STALL T-HANGAR
13	FUTURE CONVENTIONAL HANGAR
14	FUTURE CONVENTIONAL HANGAR
15	RELOCATED MOBILE HOME

REVISION	DATE

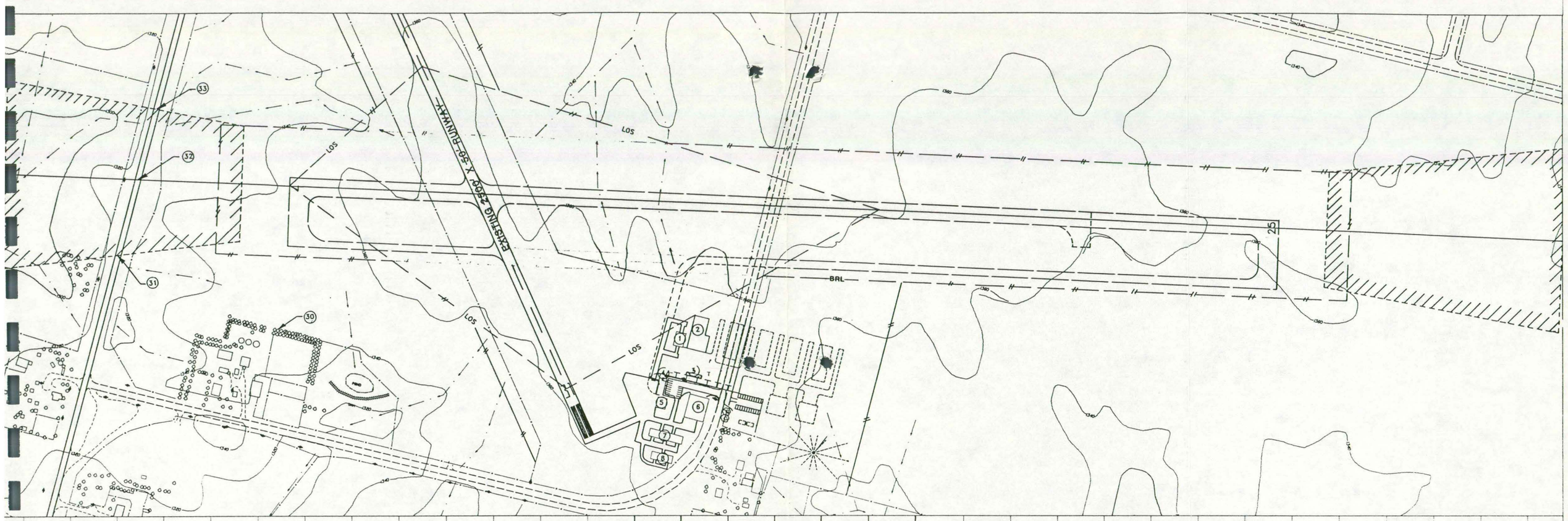
TERMINAL AREA LAYOUT

GREENFIELD MUNICIPAL AIRPORT
GREENFIELD, IOWA

CGA CONSULTING ENGINEERS

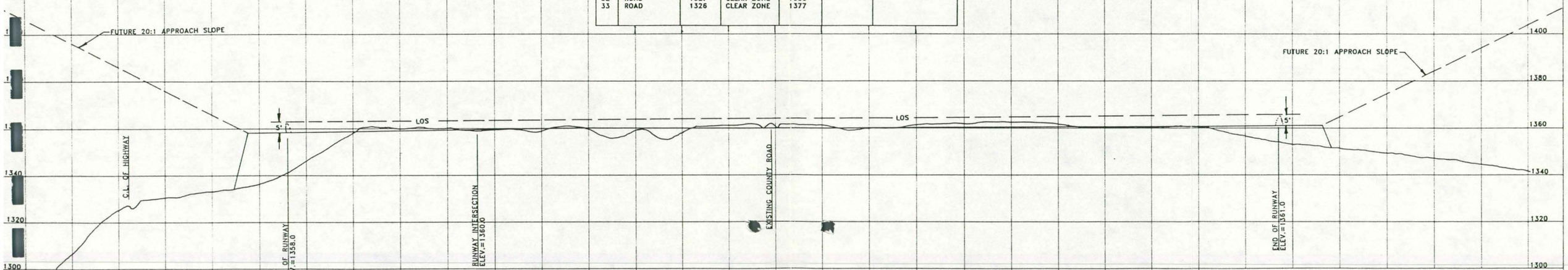
DATE 5-90
P.N. 4093
SHEET 4 OF 6

3-22-90



OBJECTS TABLE – RUNWAY 7/25

ITEM NO.	DESCRIPTION	TOP ELEVATION	PART 77 SURFACE	PART 77 ELEVATION	OBSTRUCTED BY (FT.)	DISPOSITION
1	HANGAR	1381	TRANSITIONAL	1396		
2	HANGAR	1387	TRANSITIONAL	1404		
3	MOBILE HOME	–				RELOCATE
30	TALLEST TREE	1410	TRANSITIONAL	1411		
31	ROAD	1325	CLEAR ZONE	1384		
32	ROAD	1327	CLEAR ZONE	1380		
33	ROAD	1326	CLEAR ZONE	1377		



REVISION	DATE

PLAN AND PROFILE RUNWAY 7/25

GREENFIELD MUNICIPAL AIRPORT
GREENFIELD, IOWA

CGA CONSULTING ENGINEERS
MARSHALLTOWN AMES

DATE 5-90 | SHEET 5 OF 6
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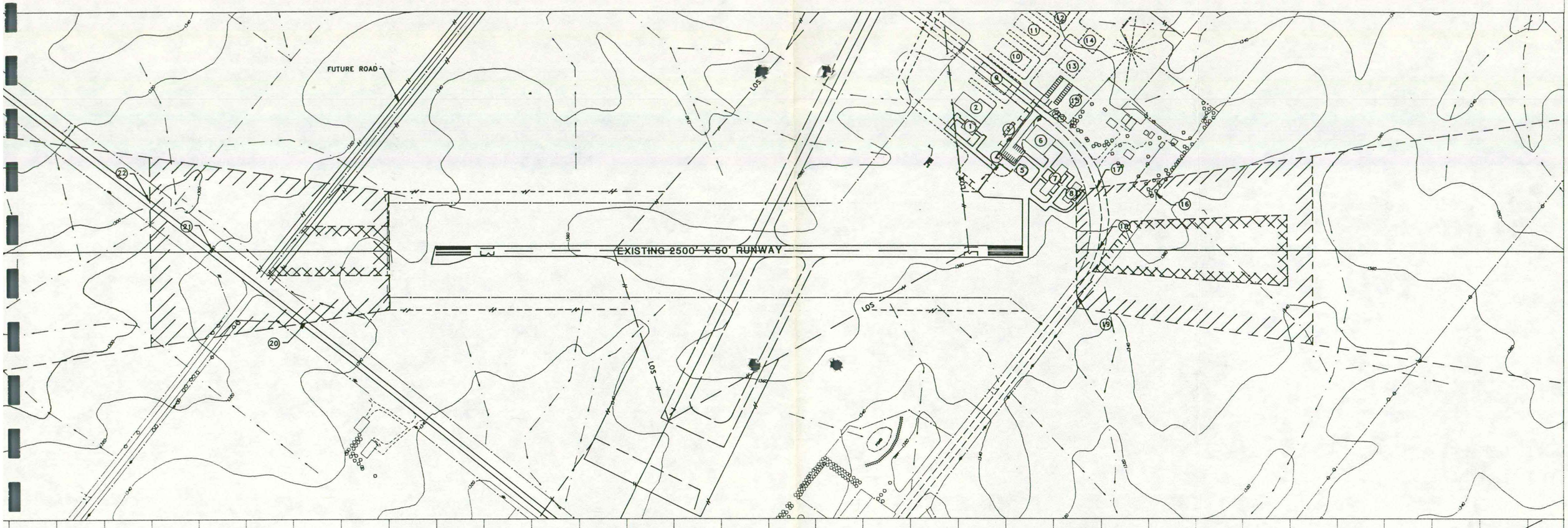
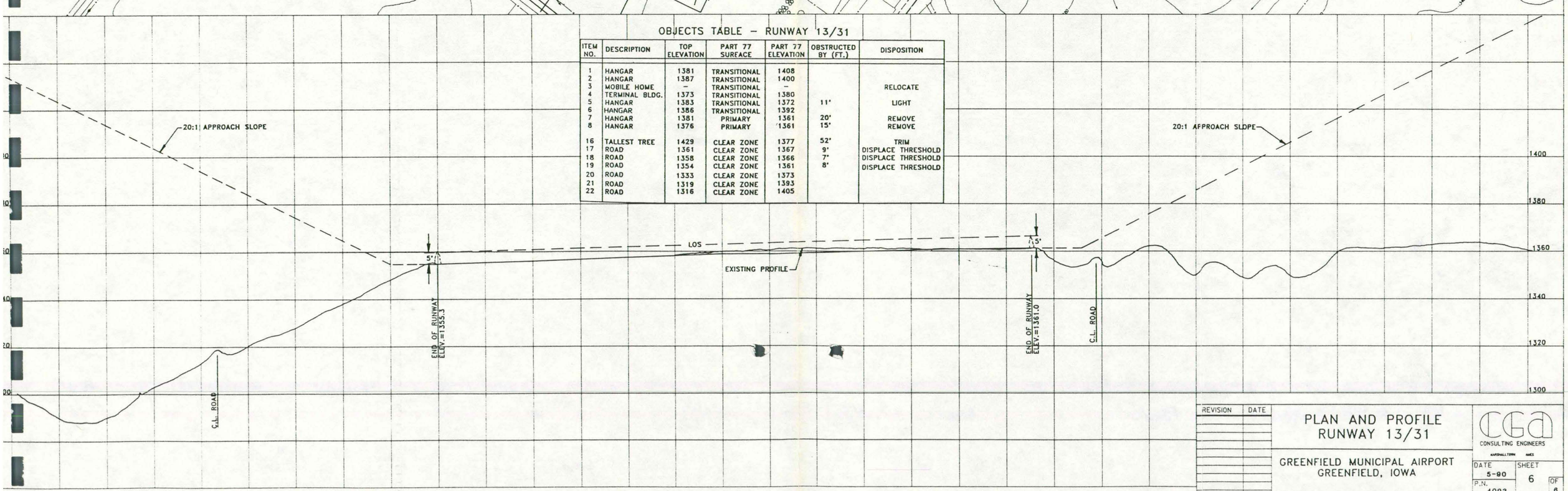


OBJECTS TABLE – RUNWAY 13/31

ITEM NO.	DESCRIPTION	TOP ELEVATION	PART 77 SURFACE	PART 77 ELEVATION	OBSTRUCTED BY (FT.)	DISPOSITION
1	HANGAR	1381	TRANSITIONAL	1408		
2	HANGAR	1387	TRANSITIONAL	1400		
3	MOBILE HOME	–	TRANSITIONAL	–		RELOCATE
4	TERMINAL BLDG.	1373	TRANSITIONAL	1380		
5	HANGAR	1383	TRANSITIONAL	1372	11'	LIGHT
6	HANGAR	1386	TRANSITIONAL	1392		
7	HANGAR	1381	PRIMARY	1361	20'	REMOVE
8	HANGAR	1376	PRIMARY	1361	15'	REMOVE
16	TALLEST TREE	1429	CLEAR ZONE	1377	52'	TRIM
17	ROAD	1361	CLEAR ZONE	1367	9'	DISPLACE THRESHOLD
18	ROAD	1358	CLEAR ZONE	1366	7'	DISPLACE THRESHOLD
19	ROAD	1354	CLEAR ZONE	1361	8'	DISPLACE THRESHOLD
20	ROAD	1333	CLEAR ZONE	1373		
21	ROAD	1319	CLEAR ZONE	1393		
22	ROAD	1316	CLEAR ZONE	1405		



REVISION	DATE

PLAN AND PROFILE
RUNWAY 13/31

GREENFIELD MUNICIPAL AIRPORT
GREENFIELD, IOWA

CGA CONSULTING ENGINEERS
MARSHALLTOWN IOWA

DATE 5-90 | SHEET 6 OF 6
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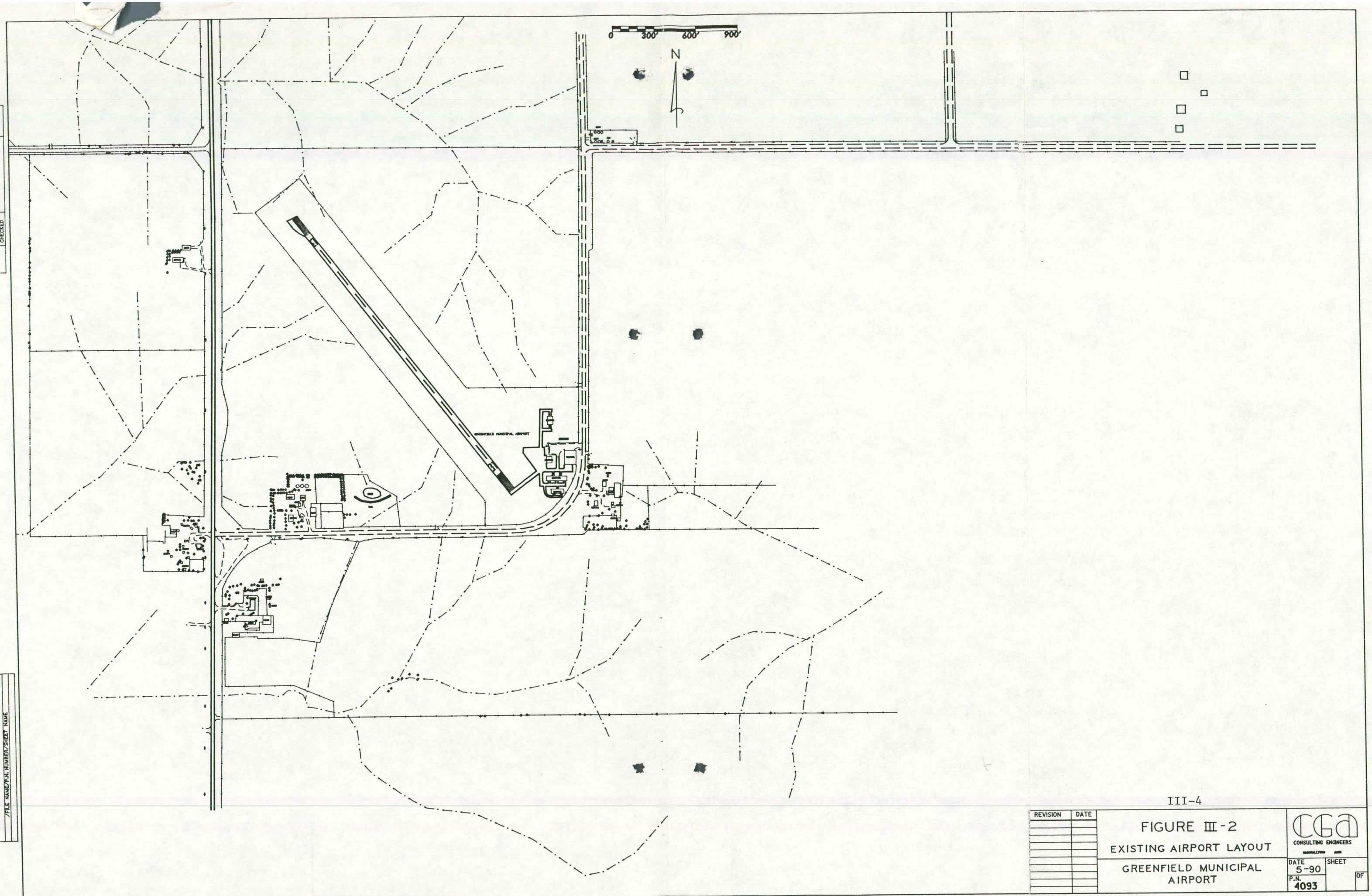

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FIGURE III-2

EXISTING AIRPORT LAYOUT

GREENFIELD MUNICIPAL AIRPORT

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DATE 5-90
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This alternative involves expansion on the existing runway alignment as depicted in Figure III-3. The terrain and Highway 25 will not allow expansion of the runway to the northwest. Therefore, any expansion would need to be to the southeast.

Obstructions:

Approaches to runway 13/31 would be relatively free from obstructions. However, assuming a non-precision runway were developed, the two existing T-hangars would penetrate the primary surface. In addition, several of the other terminal area buildings along with portions of the farmstead across the road would penetrate the transitional zone. Final disposition of those obstructions would be dependent on an FAA airspace review. The alternatives would be obstruction lighting or potentially removal of the obstruction.

Wind Coverage:

FAA standards recommend that an airport provide a runway orientation that an aircraft can utilize with a crosswind component of 12 mph or less 95% of the time. If this cannot be achieved with a single runway, a crosswind runway must be planned. An analysis of the wind coverage for existing runway 13/31 is depicted in Figure III-4. The analysis indicates the wind coverage for this 13/31 orientation is 85.5%. Although a northwest/southeast orientation of the primary runway achieves the maximum

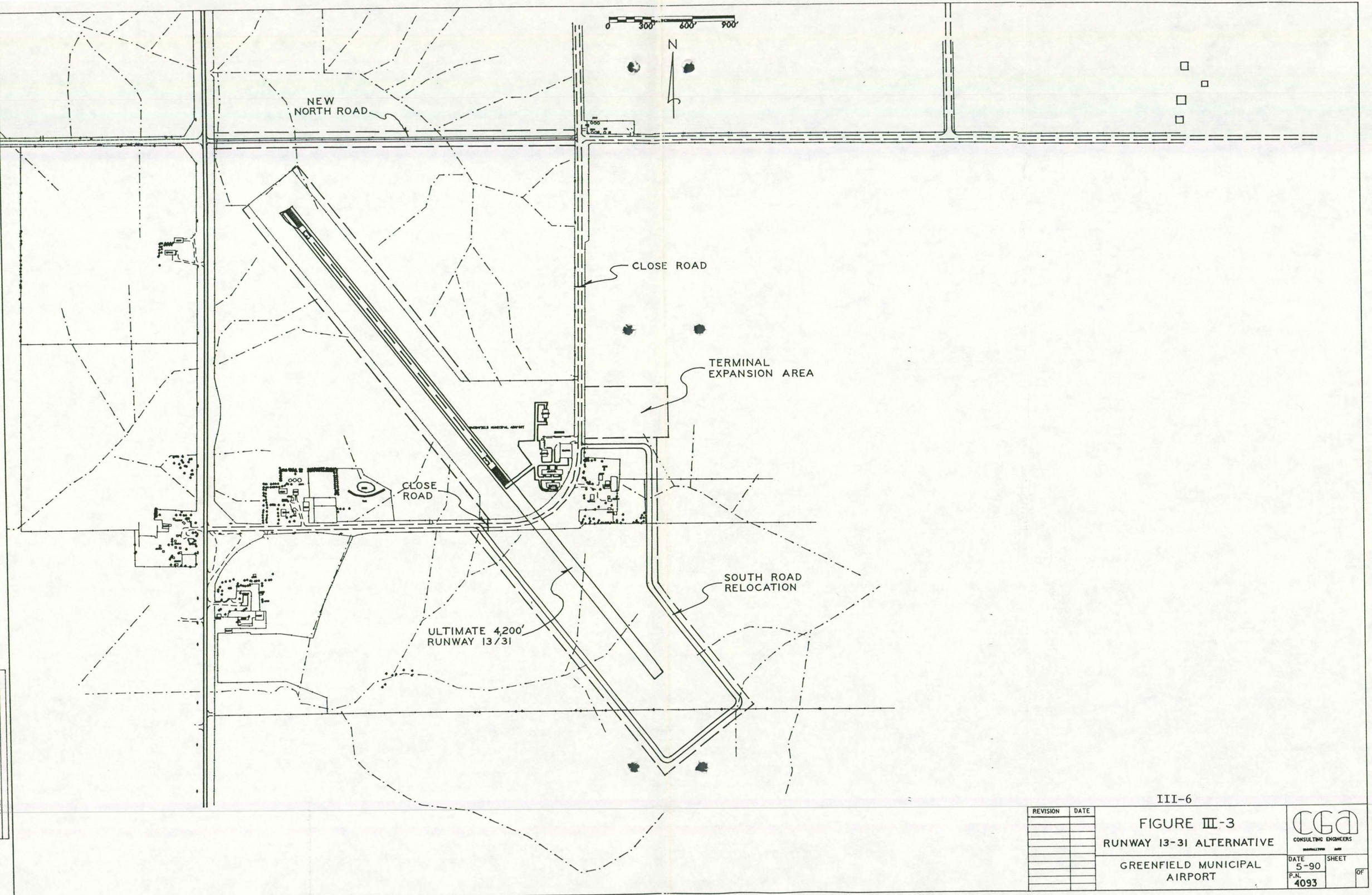

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FIGURE III-3
RUNWAY 13-31 ALTERNATIVE
GREENFIELD MUNICIPAL AIRPORT

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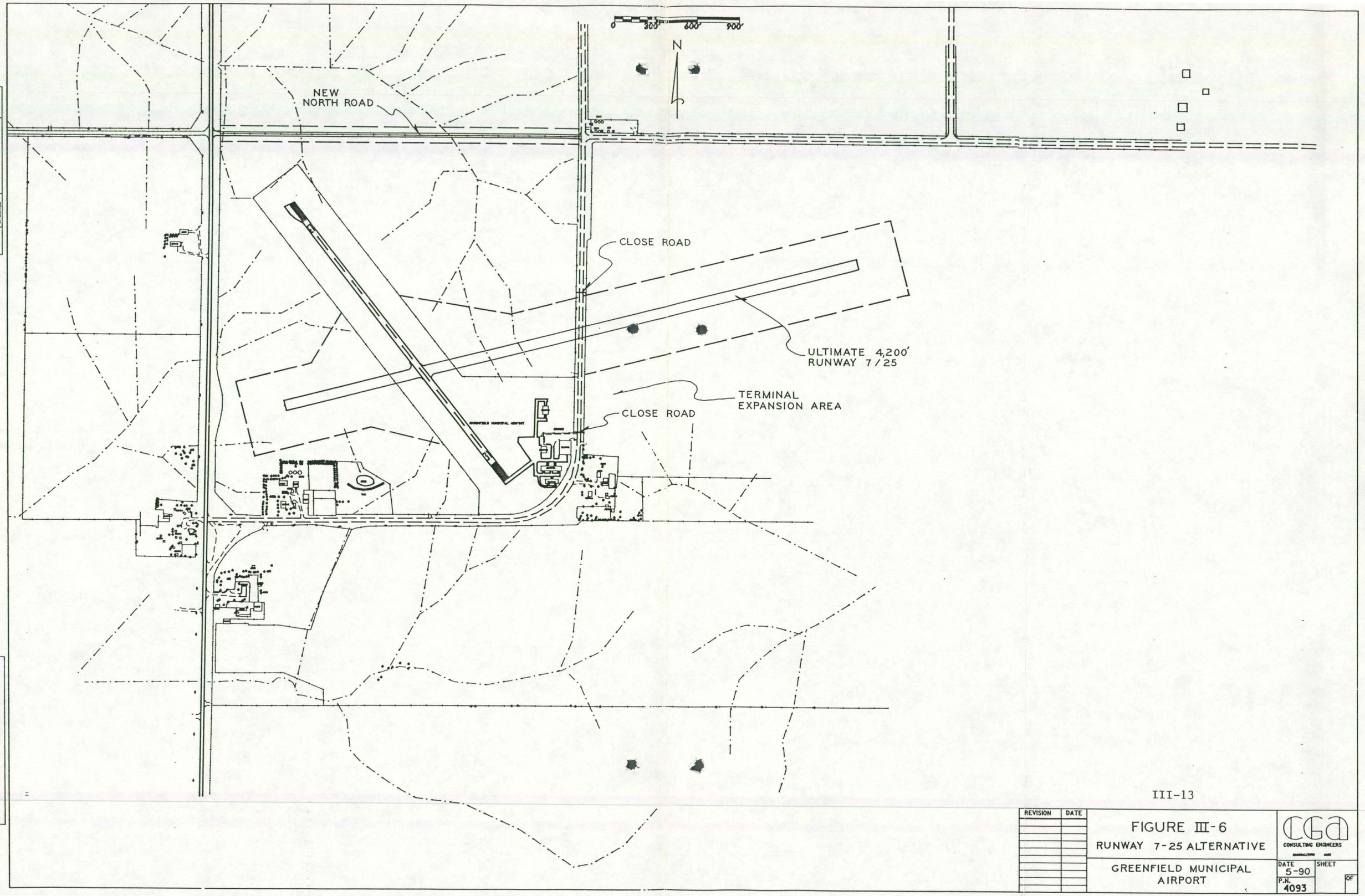

III-13

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FIGURE III-6
RUNWAY 7-25 ALTERNATIVE

GREENFIELD MUNICIPAL AIRPORT

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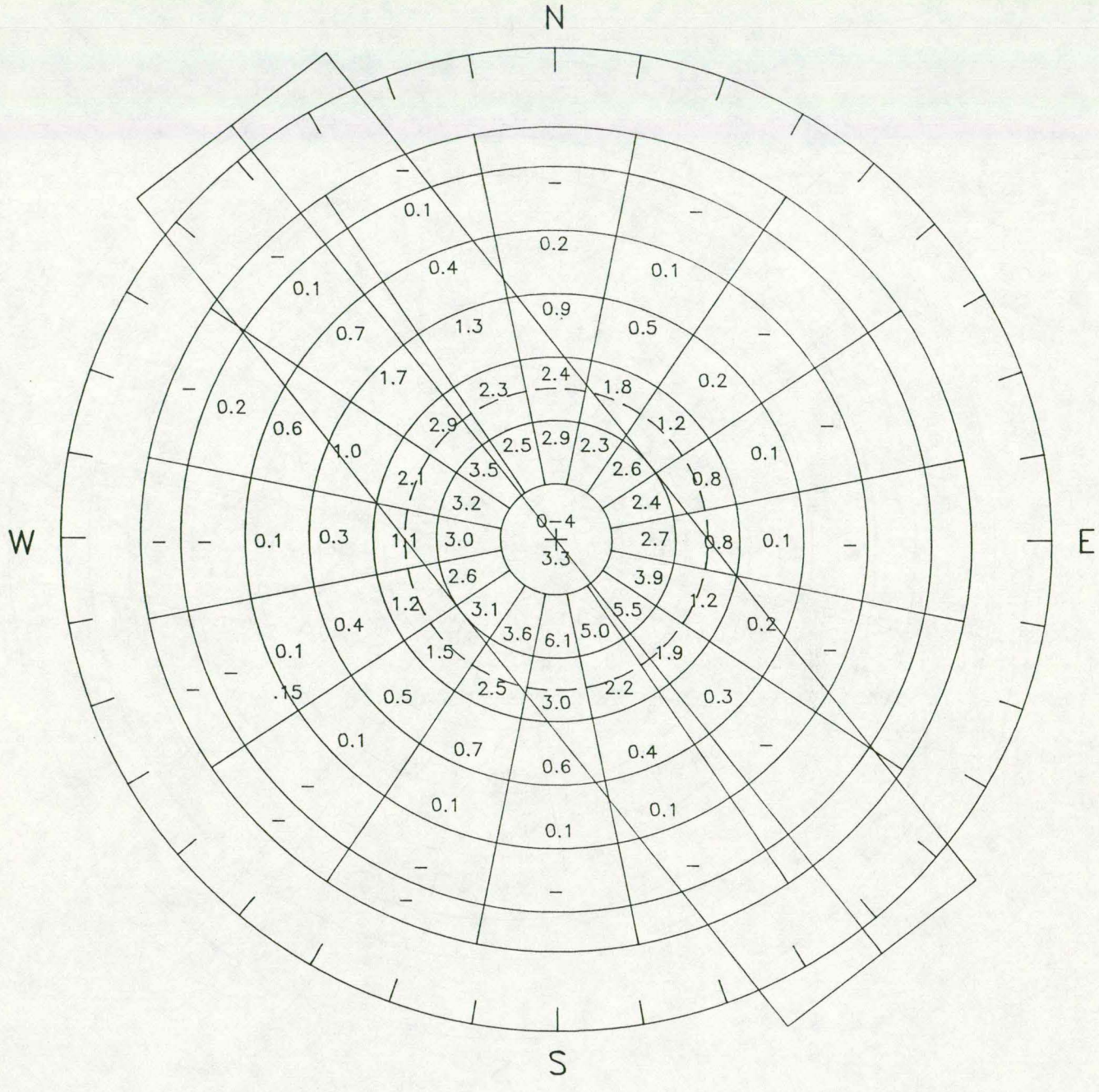

WIND ROSE

FIGURE III – 4
RUNWAY 13/31 WIND COVERAGE
GREENFIELD MUNICIPAL AIRPORT

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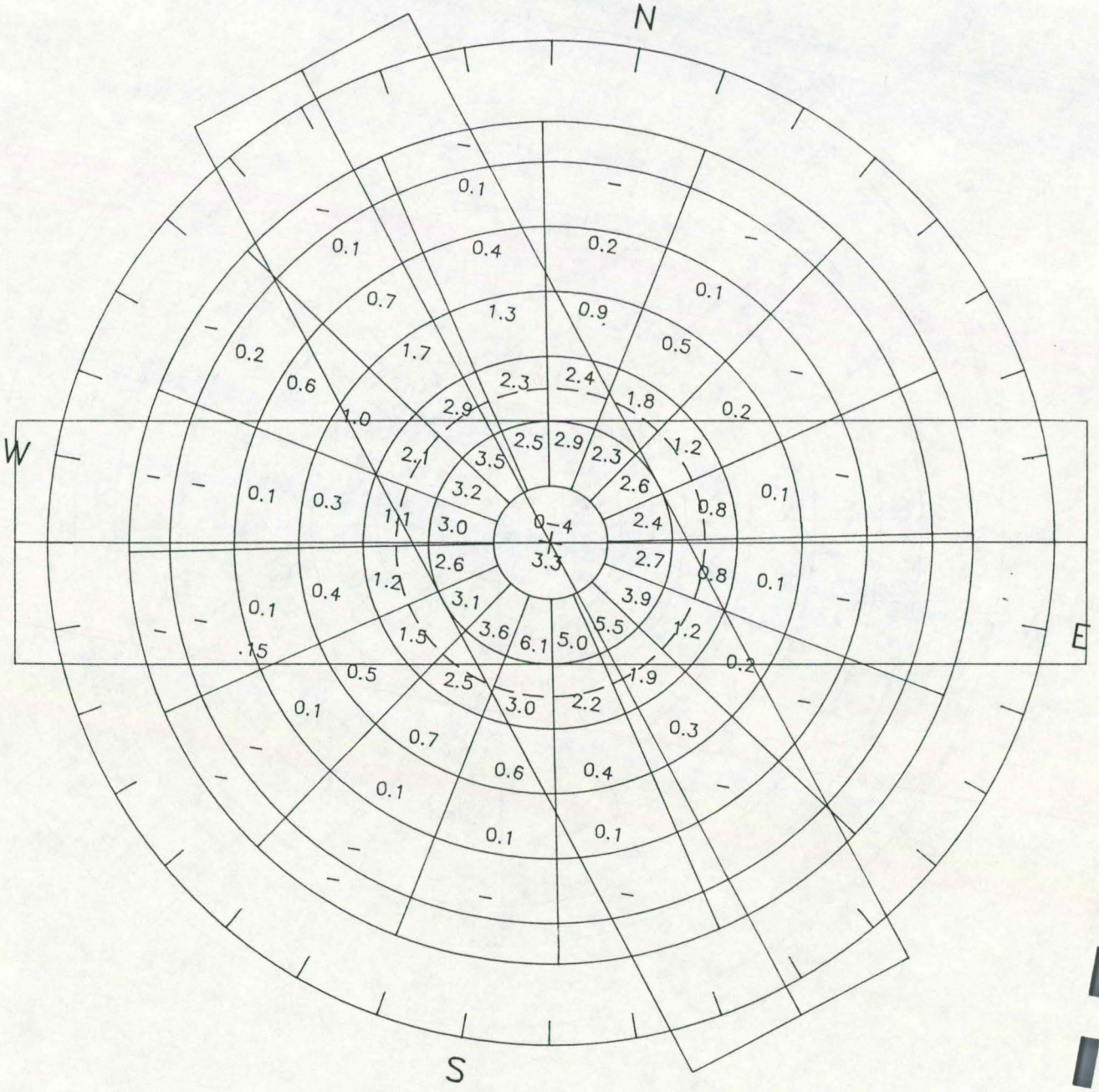


WIND ROSE

FIGURE III – 5
COMBINED WIND COVERAGE
GREENFIELD MUNICIPAL AIRPORT

wind coverage attainable by a single runway, a crosswind runway would be required to meet the wind coverage standards.

Cross Wind Runway:

The site constraints discussed in the Introduction above would limit the potential for a crosswind runway to a few variations of a generally east/west orientation. A ridge runs from near the middle of the existing airport site in an easterly direction providing the opportunity for development of a runway with an approximate 7/25 orientation. Any other orientations are precluded by significant drainageways and terrains limitations which make construction impractical. Combined wind coverage for runway 13/31 and runway 7/25 is 93.6% and is depicted in Figure III-5.

The maximum length of crosswind runway that can be obtained without crossing the county road east of the airport is limited to 1,600 feet. Therefore, the county road would need to be closed in order to obtain a useable crosswind runway length.

Road System:

Modifications to the County road system around the airport would be required. The extended runway would require closure of the road south of the terminal area and any crosswind runway would require closure of the road at a point north of the terminal area. Therefore, over a mile of new roadway would be necessary to maintain access to the terminal area and the farmstead across the road from the terminal area. This roadway is depicted in Figure III-3. In addition, it would be necessary to extend a new roadway from the T-intersection northeast of the airport westerly one half

mile to Highway 25 in order to maintain access to areas north and east of the airport.

Terminal Area Development:

Terminal area requirements are described in the previous section of this study. There is adequate space to provide expanded terminal facilities east of the existing terminal area. This would require that the county road east of the airport be closed and the alternate access around the south side of the airport be developed.

Development Cost:

The following itemizes the estimated development cost for runway 13/31 and recommended road improvements. This estimate is for the purpose of comparing the two alternatives. A more comprehensive and complete estimate will be prepared for the selected alternative as part of the final phase of this study.

RUNWAY 13/31 ALTERNATIVE

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
	LAND ACQUISITION				
1.	Land in Fee for Runway 13/31	29	Acres	$2,000.00	$ 58,000
2.	Easements for Runway 13/31	21	Acres	750.00	15,750
3.	Land in Fee for North Road	6	Acres	2,000.00	12,000
4.	Land in Fee for South Road	13	Acres	2,000.00	26,000
5.	Tree Removal & Damages		L.S.		25,000
6.	Fencing	25,200	L.F.	2.50	63,000
7.	Appraisals, Negotiations, Legal and Abstracting		L.S.		20,000
8.	Miscellaneous & Contingencies		10%		18,250
					$ 238,000
	CONSTRUCT RUNWAY 13/31				
1.	Excavation & Grading	30,000	C.Y.	2.00	60,000
2.	Culverts	400	L.F.	25.00	10,000
3.	4" Aggregate Base Course	5,300	Ton	12.00	63,600
4.	5" P.C.C. Paving	36,800	S.Y.	13.00	478,400
5.	Subdrains	9,200	L.F.	6.00	55,200
6.	Runway Marking	25,000	S.F.	0.40	10,000
7.	Seeding & Fertilizing	4	Acres	650.00	2,600
8.	M.I.R.L. System		L.S.		60,000
9.	Miscellaneous Construction		L.S.		25,000
10.	Contingencies		10%		76,480
11.	Legal, Administration & Engineering		20%		153,720
					$ 995,000
	CONSTRUCT SOUTH ROAD RELOCATION				
1.	Excavation & Grading	40,000	C.Y.	2.00	80,000
2.	Rock Surfacing	4,300	Ton	10.00	43,000
3.	Seeding & Fertilizing	6	Acres	650.00	3,900
4.	Culverts		L.S.		8,000
5.	Miscellaneous Construction		L.S.		10,000
6.	Contingencies		10%		14,490
7.	Legal, Administration & Engineering		30%		48,610
					$ 208,000
	CONSTRUCT NORTH ROAD				
1.	Excavation & Grading	30,000	C.Y.	2.00	60,000
2.	Rock Surfacing	2,000	Ton	10.00	20,000
3.	Seeding & Fertilizing	3	Acres	650.00	1,950
4.	Culverts		L.S.		50,000
5.	Miscellaneous Construction		L.S.		10,000
6.	Contingencies		10%		14,195
7.	Legal, Administration & Engineering		30%		46,855
					$ 203,000
	TOTAL ALTERNATIVE 13/31				$1,644,000

--RUNWAY 7/25--

The second alternative for a 4,200 foot primary runway is an approximately east-west alignment with a magnetic designation of 7/25. This alternative is depicted in Figure III-6. The west end of this runway would be located as far west as would be allowed by terrain constraints. The west end location should also be situated to maintain clearances and minimize impacts on Highway 25 and the farmstead southwest of the airport.

Obstructions:

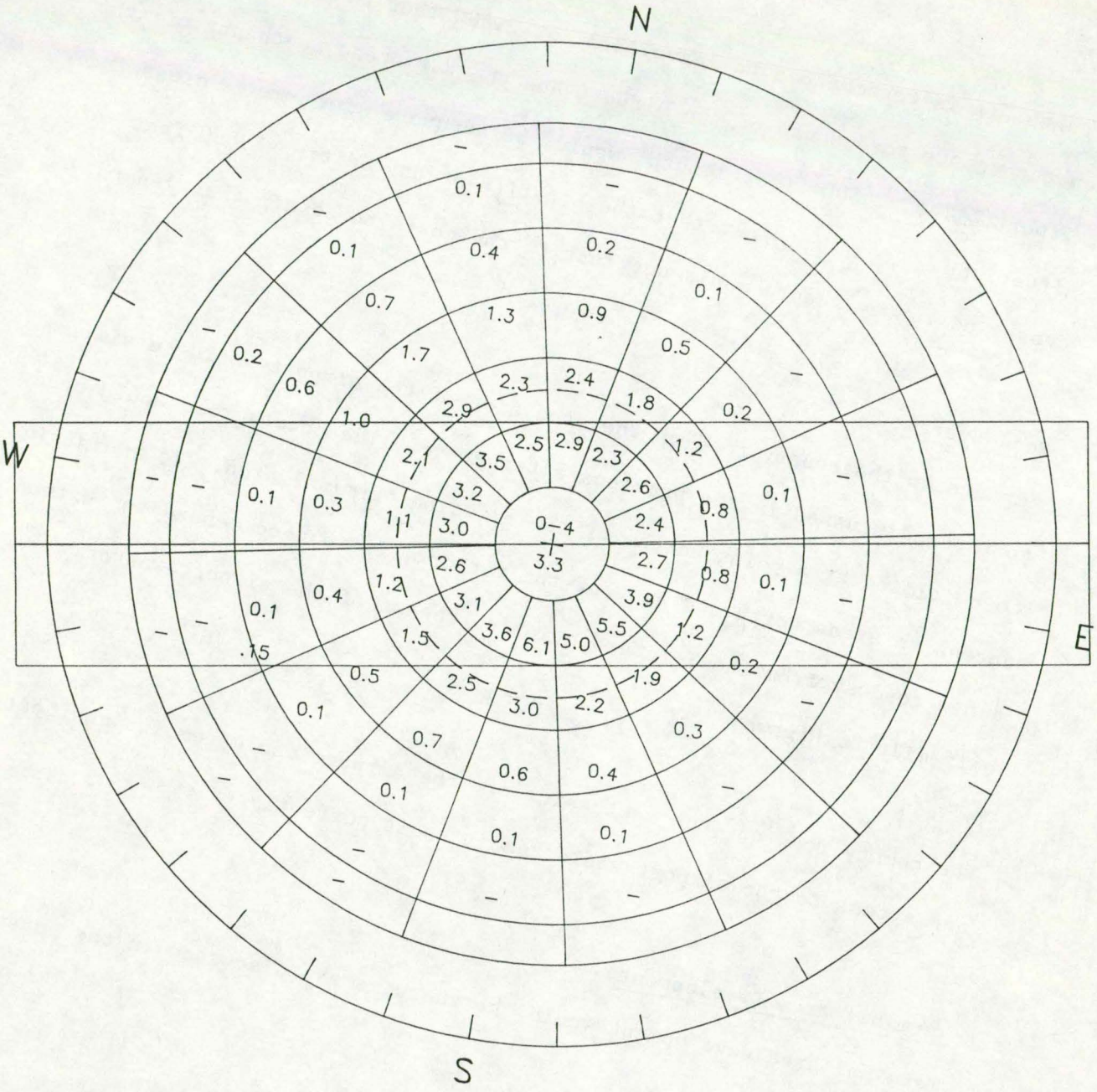
The approaches to runway 7/25 would be relatively free from obstructions. In addition, the runway could be situated so that there would be no obstructions to the other Part 77 surfaces.

Wind Coverage:

A wind rose analysis is shown in Figure III-7 for runway 7/25. The analysis indicates that the single runway would provide 74.7% coverage. This is relatively low coverage and higher percentages would be possible with other orientations. The combined coverage for a new runway 7/25 and the existing runway 13/31 would be the same as discussed in the previous alternative - 93.6%.

Crosswind Runway:

If runway 7/25 were developed as the primary runway, existing runway 13/31 would be designated as the crosswind runway. Although 80% of the primary runway length or 3,360 feet would be desirable for the crosswind runway



WIND ROSE

FIGURE III – 7
RUNWAY 7/25 WIND COVERAGE
GREENFIELD MUNICIPAL AIRPORT

length, it is recommended to leave 13/31 at 2,500 feet to minimize impacts on the county road south of the airport and the farmstead southeast of the airport. The 2,500 foot length would be adequate for many crosswind situations. It is not felt that the benefits of an additional 860 feet of crosswind runway length would not justify the costs to attain that length.

Road System:

Impacts on the county road on the east side of the airport would be similar to those discussed in the previous alternative. The county road would need to be closed at a point north of the existing terminal area. To maintain access to areas north and east of the airport, it is recommended to extend a new roadway from the T-intersection northeast of the airport westerly one half mile to Highway 25.

The county road on the south side of the airport would remain unaffected and access to the airport would remain as it currently exists.

Terminal Area Development:

Terminal area development would be the same as discussed in the previous alternative.

Development Cost:

The following estimates the development costs for the purpose of comparison with the other alternative.

RUNWAY 7/25 ALTERNATIVE

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
	LAND ACQUISITION				
1.	Land in Fee for Runway 7/25	56	Acres	$2,000.00	$ 112,000
2.	Easements for Runway 7/25	28	Acres	750.00	21,000
3.	Land in Fee for North Road	6	Acres	2,000.00	12,000
4.	Fencing	14,200	L.F.	2.50	35,500
5.	Appraisals, Negotiations, Legal and Abstracting		L.S.		18,000
6.	Miscellaneous & Contingencies		10%		20,500
					$ 219,000
	CONSTRUCT RUNWAY 7/25				
1.	Excavation & Grading	30,000	C.Y.	2.00	60,000
2.	Culverts	400	L.F.	25.00	10,000
3.	4" Aggregate Base Course	8,200	Ton	12.00	98,400
4.	5" P.C.C. Paving	36,800	S.Y.	13.00	478,400
5.	Subdrains	9,200	L.F.	6.00	55,200
6.	Runway Marking	25,000	S.F.	0.40	10,000
7.	Seeding & Fertilizing	6	Acres	650.00	3,900
8.	M.I.R.L. System		L.S.		60,000
9.	Miscellaneous Construction		L.S.		25,000
10.	Contingencies		10%		80,090
11.	Legal, Administration & Engineering		20%		161,010
					$1,042,000
	CONSTRUCT NORTH ROAD				
1.	Excavation & Grading	30,000	C.Y.	2.00	60,000
2.	Rock Surfacing	2,000	Ton	10.00	20,000
3.	Seeding & Fertilizing	3	Acres	650.00	1,950
4.	Culverts		L.S.		50,000
5.	Miscellaneous Construction		L.S.		10,000
6.	Contingencies		10%		14,195
7.	Legal, Administration & Engineering		30%		46,855
					$ 203,000
	TOTAL ALTERNATIVE 7/25				$1,464,000

SUMMARY

The following table presents a side by side comparison of the evaluation points discussed above along with a discussion of the comparisons.

	13/31	7/25
Obstructions	Impacts	No Impacts
Wind Coverage	Good	Fair
Cross Wind Runway	Develop New	Use Existing
Road System	1 1/2 Mile New Road	1/2 Mile New Road
Terminal Area Development	Expand East	Expand East
Development Cost	$1,644,000	$1,464,000

Development of primary runway 13/31 would have a greater immediate impact on the terminal area and the farmstead southeast of the airport than alternative 7/25 from an obstruction point of view. Lighting or removal of obstructions would be required under alternative 13/31 while there would appear to be no obstructions to runway 7/25 itself. Some obstructions to runway 13/31 as a crosswind runway would still exist even though runway 7/25 may be developed as the primary runway. The degree of these impacts would be dependent on the ultimate approach procedures that are maintained for runway 13/31.

For single runway wind coverage, alternative 13/31 has a distinct advantage over alternative 7/25. However, if alternative 7/25 were developed, existing runway 13/31 would immediately function as the crosswind runway without any additional development cost. The combined wind coverage would then be greater than development of runway 13/31 as the primary runway alone.

In further comparing the two alternatives for crosswind runway development, the only disadvantage with alternative 7/25 is the recommendation of maintaining the length at 2,500 feet for the crosswind runway which is slightly less than the ultimate optimum length. Alternative 13/31 on the other hand would require a greater impact on the road system and greater costs to develop a crosswind runway. Therefore, alternative 7/25 is felt to have the advantage in this category.

Both alternatives will have some impacts and costs associated with the road system around the airport. However, alternative 13/31 costs and impacts will be much greater than alternative 7/25. Under alternative 13/31, both the road relocation around the south side of the airport and the new east/west road on the north side of the airport will be immediately required upon expansion of runway 13/31. When runway 13/31 is extended, the road south of the terminal area must be closed to allow for the runway itself, while the road north of the terminal area will need to be closed to provide the area needed for relocation of the terminal area buildings. Under alternative 7/25 only the new east/west road north of the airport will be required.

Terminal area development requirements will be similar for both alternatives.

Construction cost for runway 13/31 and 7/25 would be very similar. Taking into account related road development costs, alternative 13/31 has an estimated 12% higher total development cost.

In conclusion, alternative 7/25 is preferred over 13/31 based on obstruction impacts, road system impacts and development costs.

IV. AIRPORT LAYOUT PLAN

V. DEVELOPMENT SCHEDULE AND COST ESTIMATES

PROPOSED IMPROVEMENTS

The improvements which will bring the airport to its ultimate development in the next 20 years are divided into three stages, for short, intermediate and long range periods. The stages can then be accomplished through phases, each designated as a project and usually lasting one construction season.

Stage One (1 to 5 Years): The projects planned for Stage One accomplishment are the development of the east/west primary runway to a length of 3,400 feet.

The first phased project would be acquisition of the land in fee and easement required for the runway. It is recommended that the total land required for the ultimate 4,200 foot runway be acquired. Although the runway will not be constructed immediately, the land would be protected for the future development. Easements could be used for acquisition of the approach areas. The easement should preferably be Clear Zone Easements, although Avigation Easements would be acceptable. A Clear Zone Easement would restrict the development of any type of object, whether man-made or natural growth. Normal farming operations would be allowed. An Avigation Easement would restrict the heights of objects in the easement area to the limitations defined in F.A.R. Part 77. The fee acquisition would include the land required for construction and operation of the runway plus protection of the line of sight between the runways. Acquisition of land in fee for terminal area expansion east of the existing terminal area is planned. In addition, the right of way for the new east-west county road

to be developed north of the airport is included in the land acquisition phase.

Two grading projects are planned for Stage One. The first is grading of the safety area for a 3,400' runway. The second is grading and rock surfacing of the new county road.

Lastly, the paving and lighting of a 3,400' x 60' primary runway is planned.

Stage Two (6 to 10 Years): The major development items anticipated during Stage Two included terminal area improvements and building restriction line and clear zone protection for runway 13/31.

Phase I ramp expansion would provide two additional tie-down spaces and a connecting taxiway to the mid-point of the primary runway. This connection to the mid-point would provide for the most efficient operation of the airport.

The existing 5-stall and 3-stall T-Hangars are located within the building restriction line for runway 13/31. It is recommended that these hangars be removed and replaced in the area east of the existing terminal area. It is also planned to acquire additional land in fee and easement around runway 13/31 to meet standard dimensional requirements.

It is anticipated that near the end of Stage Two, additional ramp area and tie-downs will be required to accommodate increasing activity. This ramp

expansion will require relocation of the existing NDB. Also, an additional T-hangar may be required to house increases in based aircraft.

Stage Three (11 to 20 Years): Stage Three improvements involve expansion of the primary runway, additional hangar development and various terminal area improvements.

Expansion of the primary runway from 3,400'x60' to 4,200'x75' would allow the airport to accommodate aircraft in Airplane Design Group II for utility standards. This generally includes twin engine aircraft used by business.

Additional hangar development would provide space to accommodate an anticipated increase in based aircraft. This would require an additional T-hangar and related taxiway. An area is also reserved for development of conventional hangars. It is anticipated that these would be developed privately for corporate aircraft.

Due to the concerns and more restrictive regulations governing fuel storage and handling, it is anticipated that new fuel handling facilities will be required.

An expanded parking lot will be necessary as activity increases.

A parallel taxiway to the primary runway will provide additional access points to and from the runway, thus improving its operational efficiency and safety.

STAGE DEVELOPMENT COSTS

Based on the previously described improvements, costs have been estimated for the stage development of the airport. The unit costs used represent an average for current pricing. Actual project costs may vary depending on several parameters such as construction conditions, specification requirements and time of construction.

Following are the estimated costs for the stage development.

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
	STAGE I DEVELOPMENT (1 TO 5 YEARS)				
	LAND ACQUISITION FOR RUNWAY 7/25, TERMINAL AREA AND COUNTY ROAD				
1.	Land in Fee for Runway 7/25	60	Acre	$2,000.00	$120,000
2.	Land in Fee for Terminal Area	12	Acre	2,000.00	24,000
3.	Land in Fee for County Road	6	Acre	2,000.00	12,000
4.	Easements for Runway 7/25	28	Acre	750.00	21,000
5.	Fencing	15,500	L.F.	2.50	38,750
6.	Appraisals, Negotiations, Legal and Abstracting		L.S.		18,000
7.	Miscellaneous & Contingencies		10%		23,250
					$257,000
	GRADING FOR 3,400' RUNWAY 7/25				
1.	Excavation & Grading	30,000	C.Y.	1.50	45,000
2.	Drainage Structure	400	L.F.	25.00	10,000
3.	Seeding & Fertilizing	28	Acre	650.00	18,200
4.	Miscellaneous & Contingencies		15%		10,980
5.	Legal, Administration & Engineering		30%		25,820
					$110,000
	CONSTRUCT COUNTY ROAD				
1.	Excavation & Grading	30,000	C.Y.	2.00	60,000
2.	Rock Surfacing	2,000	Ton	10.00	20,000
3.	Seeding & Fertilizing	3	Acre	650.00	1,950
4.	Culverts		L.S.		50,000
5.	Miscellaneous Construction		L.S.		10,000
6.	Contingencies		10%		14,195
7.	Legal, Administration & Engineering		30%		46,855
					$203,000
	PAVING & LIGHTING FOR 3,400' X 60' RUNWAY 7/25				
1.	Subgrade Preparation & Shoulder	25,500	S.Y.	0.50	12,750
2.	Crushed Stone Base	5,400	Ton	12.00	64,800
3.	P.C.C. Paving	24,500	S.Y.	13.00	318,500
4.	Seeding & Fertilizing	5	Acre	650.00	3,250
5.	Lighting System		L.S.		65,000
6.	Pavement Marking	25,000	S.F.	0.35	8,750
7.	Miscellaneous & Contingencies		10%		47,305
8.	Legal, Administration & Engineering		25%		130,645
					$651,000

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
	STAGE II DEVELOPMENT (6 TO 10 YEARS)				
	PHASE I RAMP EXPANSION & CONNECTING TAXIWAY				
1.	Excavation & Grading	5,000	C.Y.	$ 3.00	$ 15,000
2.	Subgrade Preparation	4,700	S.Y.	0.50	2,350
3.	Crushed Stone Base Course	1,000	Ton	12.00	12,000
4.	P.C.C. Paving	4,500	S.Y.	13.00	58,500
5.	Tie-Down Anchors	6	Each	50.00	300
6.	Seeding & Fertilizing	2	Acre	650.00	1,300
7.	Contingencies & Miscellaneous		10%		8,945
8.	Legal, Administration & Engineering		30%		29,605
					$128,000
	BUILDING RESTRICTION LINE AND CLEAR ZONE FOR RUNWAY 13/31				
1.	Land in Fee	3.5	Acre	2,000.00	7,000
2.	Land in Easement	23	Acre	750.00	17,250
3.	Fencing	3,200	L.F.	2.50	8,000
4.	Tree Removal		L.S.		5,000
5.	Appraisals, Negotiations, Legal & Abstracting		L.S.		10,000
6.	Miscellaneous & Contingencies		10%		4,750
					$52,000
	T-HANGAR (OBSTRUCTION) REMOVAL				
1.	Hangar Removal & Disposal		L.S.		8,000
	T-HANGAR CONSTRUCTION (INCLUDING TAXIWAY)				
1.	Site Preparation		L.S.		3,500
2.	T-Hangar	12	Stall	12,500.00	150,000
3.	Taxiway Grading	600	C.Y.	6.00	3,600
4.	Crushed Stone Base	320	Ton	12.00	3,840
5.	P.C.C. Paving	1,300	S.Y.	14.00	18,200
6.	Seeding & Fertilizing	2	Acre	650.00	1,300
7.	Contingencies & Miscellaneous		10%		18,044
8.	Legal, Administration & Engineering		25%		49,516
					$248,000
	PHASE II RAMP EXPANSION				
1.	Excavation & Grading	1,500	C.Y.	3.00	4,500
2.	Subgrade Preparation	4,600	S.Y.	0.50	2,300
3.	Crushed Stone Base Course	1,000	Ton	12.00	12,000
4.	P.C.C. Paving	4,500	S.Y.	13.00	58,500
5.	Tie-Down Anchors	18	Each	50.00	900
6.	Seeding & Fertilizing	2	Acre	650.00	1,300
7.	Contingencies & Miscellaneous		10%		7,950
8.	Legal, Administration & Engineering		30%		26,550
					$114,000

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
	STAGE II DEVELOPMENT (6 TO 10 YEARS) (CONTINUED)				
	T-HANGAR CONSTRUCTION (INCLUDING TAXIWAY)				
1.	Site Preparation		L.S.		$ 2,500
2.	T-Hangar	6	Stall	12,500.00	75,000
3.	Taxiway Grading	1,200	C.Y.	6.00	7,200
4.	Crushed Stone Base	250	Ton	12.00	3,000
5.	P.C.C. Paving	1,100	S.Y.	14.00	15,400
6.	Seeding & Fertilizing	1	Acre	650.00	650
7.	Contingencies & Miscellaneous		10%		10,375
8.	Legal, Administration & Engineering		25%		28,875
					$143,000
	RELOCATE NDB				
1.	Relocate NDB		L.S.		$ 18,000

ITEM NO.	DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	TOTAL PRICE
	STAGE III DEVELOPMENT (11 TO 20 YEARS)				
	WIDENING AND EXTENSION OF RUNWAY 7/25 FROM 3,400' X 60' TO 4,200' X 75'				
1.	Excavation, Grading & Shoulder	6,000	C.Y.	1.75	10,500
2.	Crushed Stone Base	3,000	Ton	12.00	36,000
3.	P.C.C. Paving	13,200	S.Y.	13.00	171,600
4.	Seeding & Fertilizing	6	Acre	650.00	3,900
5.	Extend Lighting System		L.S.		5,000
6.	Pavement Marking	30,000	S.F.	0.35	10,500
7.	Miscellaneous & Contingencies		10%		23,750
8.	Legal, Administration & Engineering		25%		65,750
					$327,000
	T-HANGAR CONSTRUCTION (INCLUDING TAXIWAY)				
1.	Site Preparation		L.S.		2,500
2.	T-Hangar	6	Stall	12,500.00	75,000
3.	Taxiway Grading	1,200	C.Y.	6.00	7,200
4.	Crushed Stone Base	250	Ton	12.00	3,000
5.	P.C.C. Paving	1,100	S.Y.	14.00	15,400
6.	Seeding & Fertilizing	1	Acre	650.00	650
7.	Contingencies & Miscellaneous		10%		10,375
8.	Legal, Administration & Engineering		25%		28,875
					$143,000
	PARALLEL TAXIWAY FOR RUNWAY 7/25				
1.	Excavation, Grading & Shoulder	20,000	C.Y.	1.50	30,000
2.	Crushed Stone Base	3,400	Ton	12.00	40,800
3.	P.C.C. Paving	15,000	S.Y.	13.00	195,000
4.	Seeding & Fertilizing	6	Acre	650.00	3,900
5.	Taxiway Lighting System		L.S.		45,000
6.	Pavement Marking	2,000	S.F.	0.35	700
7.	Miscellaneous & Contingencies		10%		31,540
8.	Legal, Administration & Engineering		25%		87,060
					$434,000
	BURIED FUEL TANKS				
1.	12,000 Gallon Buried Tank		L.S.		24,000
2.	Dispenser & Equipment		L.S.		7,500
3.	Miscellaneous & Contingencies		15%		4,725
4.	Legal, Administration & Engineering		25%		9,775
					$ 46,000
	PARKING LOT				
1.	Excavation & Grading	250	C.Y.	8.00	2,000
2.	Gravel Surfacing	300	Ton	8.00	2,400
3.	Miscellaneous & Contingencies		15%		660
4.	Legal, Administration & Engineering		30%		1,940
					$ 7,000

FINANCING

There are a number of sources of finances available to the City of Greenfield for airport improvement projects. The City should thoroughly investigate alternative sources in planning individual projects.

Government Grants: The Iowa Department of Transportation currently participates in eligible airport improvement projects through grants of 70% of the project cost with the remaining 30% to come from local sources. The D.O.T. in the past has had $1.5 to $2.5 million available per year for improvement projects. In general, eligible projects include any improvements serving public aviation. Projects not eligible for participation include hangars, aprons within 20 feet of a hangar, parking lots and driveways. Since demand for D.O.T. money exceeds the available funds, projects are funded in the following order or priority: safety projects, preservation of existing facilities, and construction of new facilities. The D.O.T. also maintains a reserve for airport facilities and equipment on a 50-50 matching basis. The facilities and equipment program has approximately $50,000 to $100,000 available annually.

The Federal Aviation Administration participates in similar general aviation airport improvement projects as the D.O.T. The current legislation provides for participation in projects at the rate of 90% of allowable project costs. The amount of money available for general aviation improvements is variable from year to year depending on the appropriation bill and the amount of discretionary funds. Current funding

levels for general aviation airports is approximately $2.5 million per year.

Other grants are sometimes available through other state and federal agencies. Such grants for airport improvements are not very common, however, their possibility should not be overlooked.

Private Financing: Private financing may be practical for construction of hangar facilities. Such facilities can be constructed with private capital on airport property with the hangar to be deeded to the City in trade for a long term lease for the facility. The advantage of such an arrangement is that it relieves the sponsor of the burden of financing private hangar facilities while retaining possession and control of all real property on the airport.

Private financing may also be available through donations. Some communities have had successful industrial fund drives soliciting private funds to help defray the local share of government participation grants.

Revenue Bonds: Revenue bond financing can be used for some airport improvements such as hangars. The advantage of revenue bonds is that it provides a method of financing necessary improvements without a direct burden to the taxpayer. The disadvantage is that the financing cost of revenue bonds is usually greater than general obligation bonds and it is very difficult to obtain sufficient rent on a hangar to retire revenue bonds.

General Obligation Bonds: General obligation bonds have historically been the most common method of financing the local share of government participation grants. The bonds are backed by the taxing power of the municipality. However, the amount a municipality can bond is limited and airport improvement costs must be budgeted along with all other essential public works.

Airport Generated Revenues: The airport itself generates some revenues through F.B.O. and operator fees, hangar rentals and income from airport farmland. These revenues, however, must first pay for normal operations and maintenance costs of the airport.

Implementation: Development of the proposed improvements will probably involve many of the above sources of funding. The following table presents one possible scenario for financing of the proposed development. It should be noted that while these cost estimates reflect anticipated needs, they may not be representative of the funds that may be available. Actual funding levels will be dependent on the priorities of the Greenfield City Council and the grant agencies.

PROJECT	TOTAL COST	FAA SHARE @ 90%	DOT SHARE @ 70% OR 50%	LOCAL SHARE
STAGE I IMPROVEMENTS				
Land Acquisition for Runway 7/25, Terminal Area & County Road	$ 257,000		$179,900	$ 77,100
Grading for 3,400' Runway 7/25	110,000		77,000	33,000
Construct County Road	203,000		142,100	60,900
Paving & Lighting for 3,400' x 60' Runway 7/25	651,000		455,700	195,300
	$1,221,000		$854,700	$366,300
STAGE II IMPROVEMENTS				
Phase I Ramp Expansion and Connecting Taxiway	$ 128,000		$ 89,600	$ 38,400
Building Restriction Line & Clear Zone for Runway 13/31	52,000		36,400	15,600
T-Hangar Removal	8,000			8,000
T-Hangar Construction	248,000			248,000
Phase II Ramp Expansion	114,000		79,800	34,200
T-Hangar Construction	143,000			143,000
Relocate NDB	18,000		9,000	9,000
	$ 711,000		$214,800	$496,200
STAGE III IMPROVEMENTS				
Widen and Extend Runway 7/25	$ 327,000	$294,300		$ 32,700
T-Hangar Construction	143,000			143,000
Parallel Taxiway	434,000	390,600		43,400
Buried Fuel Tanks	46,000			46,000
Parking Lot	7,000			7,000
	$ 957,000	$684,900		$272,100