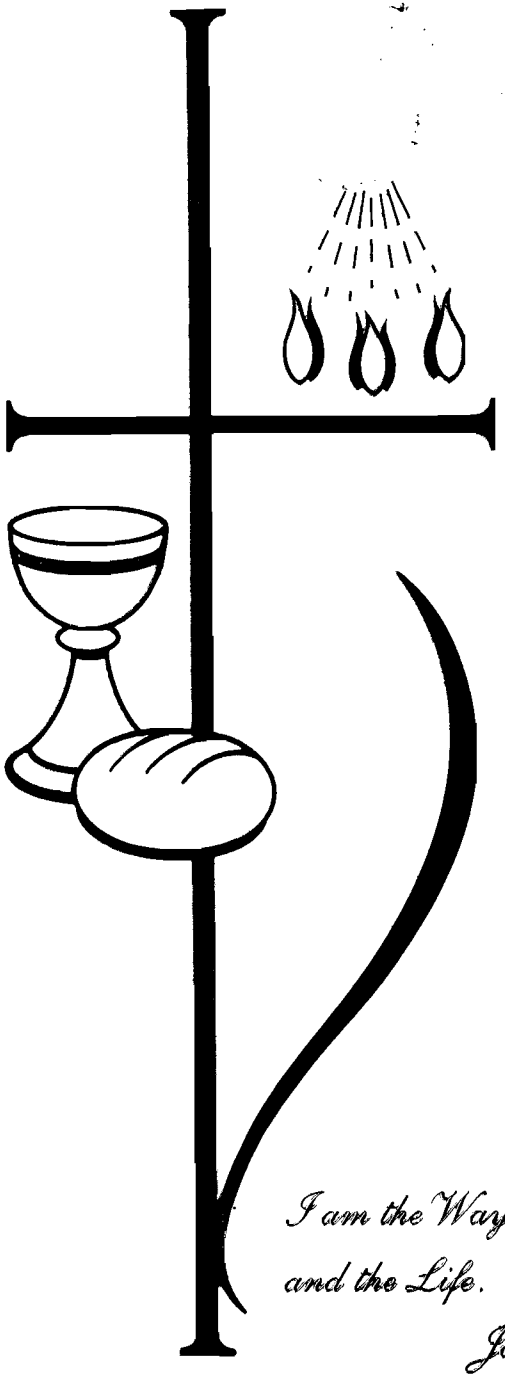


I am the Way, the Truth, and the Life.

John 14:6

Rite of Christian Initiation

This is to certify that

Douglas Albert Boyd

born on the 22 *day of* March, 1933

in Conroe (*City*) Texas (*State*)

Baptized May 7, 1944 *at* First Baptist Church (*Church*)

in Crane (*City*) Texas (*State*)

was received into full communion with the Roman Catholic Church after making a solemn Profession of Faith, celebrating the sacrament of Confirmation, and sharing in the Holy Eucharist

on the 17 *day of* March, 2010

at St. Thomas the Apostle

Pastor Rev. William P. Saucier

Sponsor Leo Denton

THE NAME OF THE AGRICULTURAL & MECHANICAL COLLEGE OF TEXAS WAS OFFICIALLY CHANGED TO TEXAS A&M UNIVERSITY ON AUGUST 23, 1963

AGRICULTURAL AND MECHANICAL COLLEGE OF TEXAS

COLLEGE STATION, TEXAS

BOYD, DOUGLAS ALBERT

Box 214, McCamey, Texas

COURSE NUMBER	DESCRIPTIVE TITLE	HOURS TH-PR	GRADE	CR. HRS	GR. PTS.	COURSE NUMBER	DESCRIPTIVE TITLE	HOURS TH-PR	GRADE	CR. HRS	GR. PTS.	COURSE NUMBER	DESCRIPTIVE TITLE	HOURS TH-PR	GRADE	CR. HRS	GR. PTS.	COURSE NUMBER	DESCRIPTIVE TITLE	HOURS TH-PR	GRADE	CR. HRS	GR. PTS.
	ARCHITECTURE							18		11	21	Trans., Arlington State College											
	FALL SEMESTER 1951						SPRING SEMESTER 1953					Hist	105	3		3	3						
Arch 101	Architecture I	1-9	B	4	8	Arch 202	Architecture II	1-15	B	6	12		FALL SEMESTER 1956										
Basic101	Orientation	0-2	C	1	1	C.E. 206	Plane Surveying	1-3	D	2	0	Arch 327	Construction I	3-0	B	3	6						
Engl 103	Comp. & Rhet.	3-0	C	3	3	M.E. 102	Eng. Problems	1-2	F	0	0	Arch 401	Architecture IV	0-18	C	6	6						
Math 101	Algebra	3-0	C	3	3	Phys 201	College Physics	3-3	D	4	0	Arch 429	History of Arch.	3-0	C	3	3						
M.E. 101	Eng. Problems	1-2	F	0	0	M.S. 212	Engineer Corps	1-2	C	1	1	Engl 371	Great Books	3-0	C	3	3						
M.E. 105	BenchWork in Wood	1-6	B	3	6	P.E. 202	Required Phy. Ed.	0-3	C	0	1	Land 411	Land.for Arch&Eng.	2-2	C	3	3						
M.S. 121	Mil. Sc. (General)	1-2	C	1	1	H.S. 205	Prin. of Sociology	3-0	C	3	3	Psy. 303	Psy. for Tech. Stu.	3-0	C	3	3						
P.E. 101	Required Phy. Ed.	0-3	B	0	2			18		16	17			21		21	24						
		17		15	24		(Design)						SPRING SEMESTER 1957										
	SPRING SEMESTER 1952						FALL SEMESTER 1953					Arch 328	Construction I	3-0	WP	0	0						
Arch 102	Architecture I	1-9	B	4	8	Arch 301	Architecture III	0-18	C	6	6	Arch 402	Architecture IV	0-18	WP	0	0						
Basic102	Remedial Reading	0-2	C	1	1	Arch 305	Freehand Drawing	0-3	B	1	2	Arch 430	History of Arch.	3-0	WP	0	0						
Engl 104	Comp. & Rhet.	3-0	D	3	0	Arch 329	Art & Civilization	2-0	C	2	2	Arch 556	City Planning	2-3	WP	0	0						
Math 102	Algebra	3-0	D	3	0	Arch 353	Technol. of Mat'ls	2-0	B	2	4	Hist 106	History of the U.S.	3-0	WP	0	0						
M.E. 101	Eng. Problems	1-2	C	2	2	Engl 210	Writing&Discussion	2-0	F	0	0	P.E. 301	Physical Education	0-3	WP	0	0						
M.E. 106	Cabinet Making	1-6	A	3	9	Math 223	Diff.&IntegralCalc	4-0	D	4	0			19									
M.S. 122	Mil. Sc. (General)	1-2	C	1	1	M.E. 102	EngineeringProblems	1-2	C	2	2												
P.E. 102	Required Phy. Ed.	0-3	B	0	2			19		17	16												
		17		17	23		SPRING SEMESTER 1956																
	FALL SEMESTER 1952					Arch 228	Elem. of Mechanics	3-0		3	6												
Arch 201	Architecture II	1-15	A	6	18	Arch 302	Architecture III	0-18	A	6	18												
Engl 210	Writ. & Discussion	2-0	F	0	0	Arch 330	Art & Civilization	2-0	A	2	4												
Math 116	Plane Trig&Anal.	4-0	D	4	0	Arch 354	Technol. of Mat'ls	2-0	A	2	6												
M.E. 102	Engr. Problems	1-2	F	0	0	Engl 210	Writing& Discussion	2-0	C	2	2												
Phys 201	College Physics	3-3	F	0	0	Phys 202	College Physics	3-3	D	4	0												
M.S. 211	Engineer Corps	1-2	C	1	1			19		19	36												
P.E. 201	Required Phy. Ed.	0-3	B	0	2																		

ADMISSION

Graduate, Crane High School 1951

ENTRANCE CREDITS

English 4	Spanish	Gen. Sci. 1	Stenog.		
W. Hist.	Algebra 2	Physics	Typ.		
M. Hist.	Pl. Geom. 1	Phys. Geog.	C. Law		
Tex. Hist.	S. Geom.	Physiology	F. Spk.		
Am. Hist. 1	Trig.	Voc. Agr.	Music 1		
Civics ½	Adv. Arith.	Bkg.	M.D. 1		
Econ ½	Biology 1	Draw.			
Latin	Chem.	Shop Work 2			

Date of Birth: 3-22-33 Date of Entrance: 9-17-51

2-4-53. Arch 500, Summer Practice, 12 Weeks, Satisfactorily Completed This Date.

Resigned; 2-28-57

Cum: Hrs: Grds: Avg.

TESTING PROGRAM

American Council On Education 1949 Gross 84 Local Percentile 24

Quantitative Gross Decile

Linguistic Gross Decile

English Gross Decile

Mathematics Gross Decile

Grading System: A, excellent (92-100); B, good (84-91); C, fair (76-83); D, lowest passing grade (70-75); F, (below 70) failure; WP, withdrew passing, WF, withdrew failing.

Grade Points: Grade A, 3 points per credit hour; Grade B, 2 points per credit hour; Grade C, 1 point per credit hour; Grades D, F, no points.

Semester: The regular semester is 18 weeks of class work.

Summer Term: Each summer term is 6 weeks.

ODESSA COLLEGE

Douglas A. Boyd
PO Box 534
Mobile AL 36601-0534

04/03/98 0188086

PERMANENT RECORD CARD

ODESSA COLLEGE
201 W. UNIVERSITY
ODESSA, TEXAS 79764

COURSE ABBREV. & NUMBER	COURSE DESCRIPTION	HOURS EARNED	GRADE	GRADE POINTS
	SPRING 73			
BA 241A	PRIN OF ACCOUNTING	4	B	12
EDP 133	INTO COMP PROGRAM	3	A	12
READ 132	ADV COL READ-STDY S	0	W	0
ECO 232	ECONOMIC PROBLEMS	3	B	9
GOVT 231	STATE AND FEDERAL GOVT	3	B	9
SPCH 131	FUND OF SPEECH	0	W	0
PHED 4000	PE-REQUIRED MILITARY SERV	4	S	0
	SEMESTER GPA 3.231	17		42
	SUMMER I 73			
ECO 231	PRINC OF ECONOMICS	3	B	9
HIST 232	US HISTORY FROM 1865	3	A	12
	SEMESTER GPA 3.500	6		21
	SUMMER II 73			
BA 242A	PRIN OF ACCOUNTING	0	W	0
GOVT 232	STATE AND FEDERAL GOVERNM	0	W	0
	SEMESTER GPA 0.000	0		0
	INSTITUTIONAL GPA 3.316	23		63
	GRADUATION GPA 3.316	23		63
	** END OF TRANSCRIPT **			

COURSE ABBREV. & NUMBER	COURSE DESCRIPTION	HOURS EARNED	GRADE	GRADE POINTS

METHOD OF ADMISSION : ORIG= CUR = 4
DATE OF BIRTH : 03/22/33

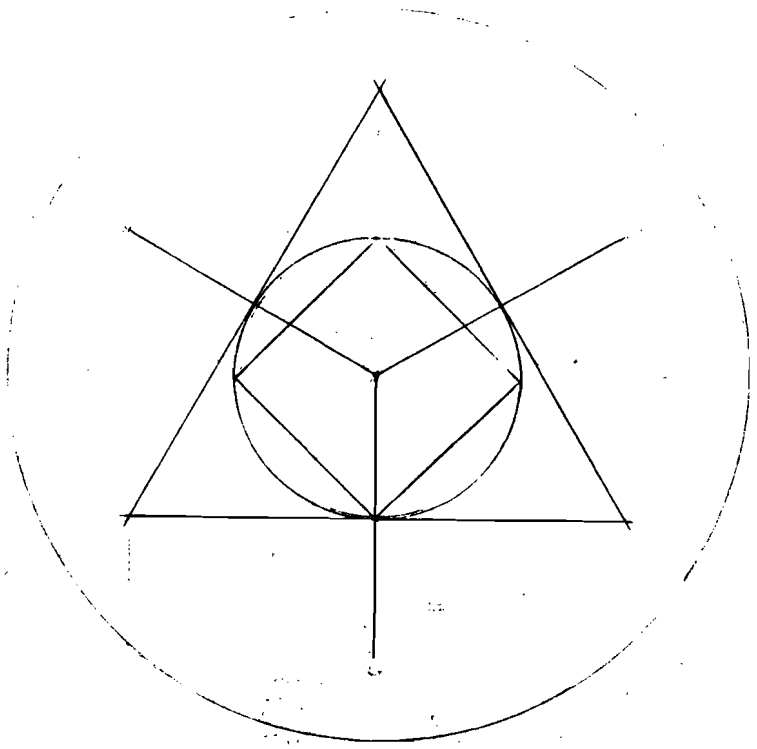
TASP READ : - 0
TASP MATH : - 0
TASP ENGL : - 0

#-DENOTES HONORS COURSE

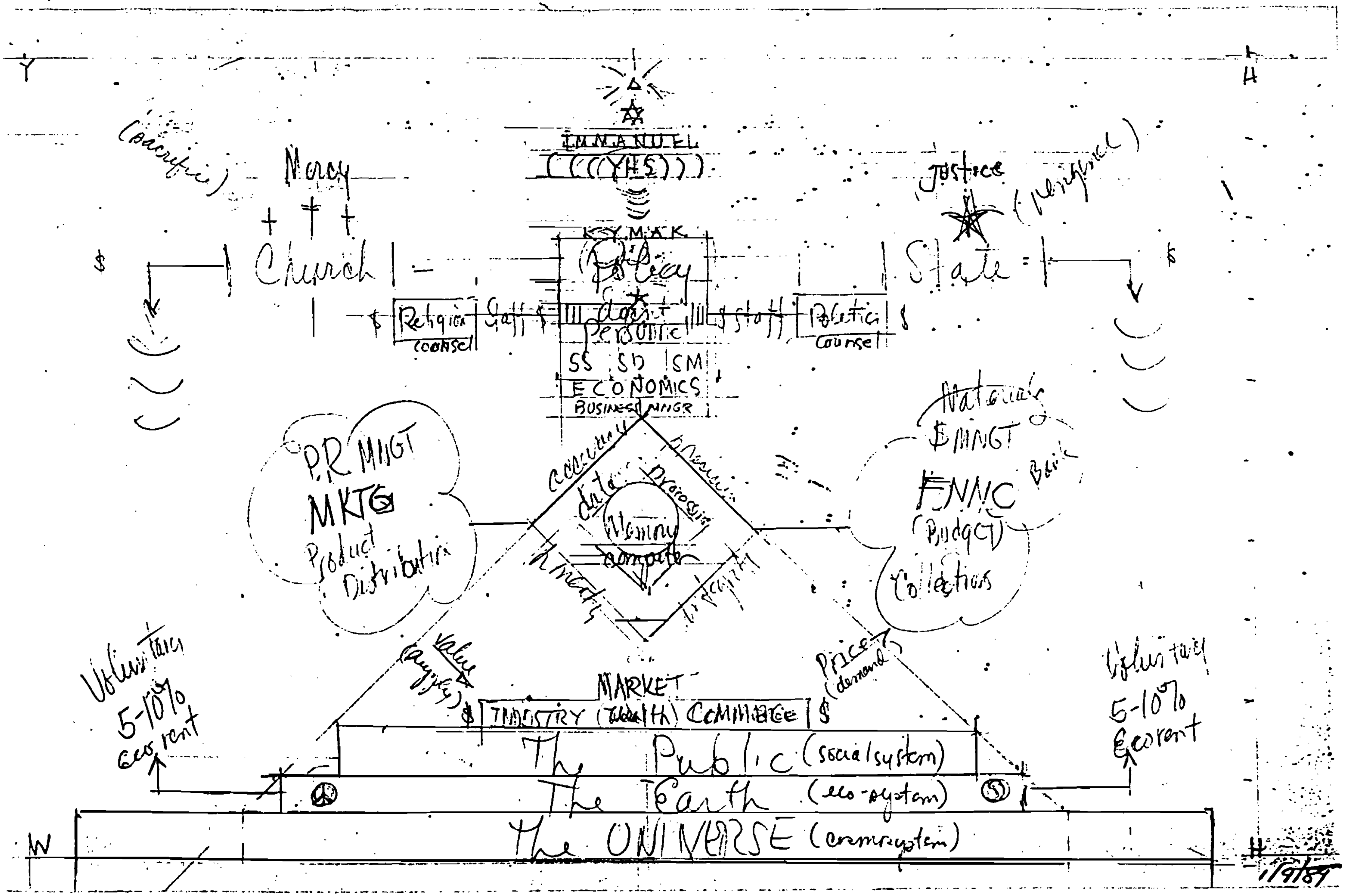
HIGH SCHOOL : GRADUATE: DATE:

COLLEGES ATTENDED	DEGREES	YR. GRAD.	HRS. EARNED
TEXAS A&M UNIVERSITY			

OFFICIAL TRANSCRIPTS BEAR SIGNATURE STAMP EMBOSSED WITH COLLEGE SEAL

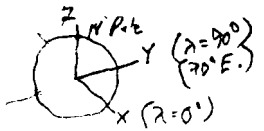


KUMAR


IMMANUEL
(((YHS)))
Mercy
(sacrifice)
Church
Justice
(vengeance)
State
Religion counsel
Politics counsel
staff
Policy
SS SD SM
ECONOMICS
BUSINESS MNGR
P.R. MNGT
MKTG
Product Distribution
FNNC
(Budget)
Collections
Bank
Value (supply)
Price (demand)
MARKET
INDUSTRY (Wealth) COMMERCE
The Public (social system)
The Earth (eco-system)
The UNIVERSE (cosmosystem)
Voluntary 5-10% eco rent
Voluntary 5-10% Ecorent
Y
H
W
H
1/9/89

5/13/87

Formulas to convert: $\phi, \lambda, H \leftrightarrow X, Y, Z$



Forward:

$$X = (N+H)\cos\phi\cos\lambda \quad (20) \quad (1)$$

$$Y = (N+H)\cos\phi\sin\lambda \quad (20) \quad (2)$$

$$Z = [N(1-e^2)+H]\sin\phi \quad (20) \quad (3)$$

$$N = a/(1-e^2\sin^2\phi)^{1/2} \quad (30) \quad (4)$$

Inverse (general):

$$\lambda = \arctan_2(Y/X) \quad (5)$$

$$\phi = \arcsin\{Z/[a(1-e^2)/(1-e^2\sin^2\phi)^{1/2}+H]\} \quad (6)$$

iterative using $\phi = \arcsin(Z/a)$ as 1st approx. for ϕ and $H = 0$ as 1st approx. for H. Get new ϕ from above equation, new H from next equation, then reiterate to convergence.

[Note: "Exact" formulas in Surveying & Mapping, June 1985, p. 145 are not exact.]

$$H = (X^2+Y^2)^{1/2}/\cos\phi - a/(1-e^2\sin^2\phi)^{1/2} \quad (7)$$

Inverse (if $H=0$):

$$\lambda = \arctan_2(Y/X) \quad (5)$$

$$\phi = \arcsin\{Z/[a^2(1-e^2)^2+e^2Z^2]^{1/2}\} \quad (8)$$

To shift from one datum to another, the above can be used by applying (1)-(4) to old lat./long. adding $\Delta X, \Delta Y, \Delta Z$ to values obtained, then using (5)-(7) to get new lat/long. Even if old H is inside zero, the new H must be calculated to get the proper lat.

▷ It is much faster, however, to use Molodensky equations:

$$\Delta\phi(\text{degrees}) = (180°/\pi)\{-\Delta X\sin\phi\cos\lambda - \Delta Y\sin\phi\sin\lambda + \Delta Z\cos\phi + \Delta a(Ne^2\sin\phi\cos\phi)/a + \Delta f[M/(1-e^2)^{1/2} + N(1-e^2)^{1/2}]\sin\phi\cos\phi\}/(M+H)$$

$$\Delta\lambda(\text{degrees}) = (180°/\pi)\{-\Delta X\sin\lambda + \Delta Y\cos\lambda\}/[(N+H)\cos\phi]$$

$$\Delta H = \Delta X\cos\phi\cos\lambda + \Delta Y\cos\phi\sin\lambda + \Delta Z\sin\phi - \Delta a(a/N) + \Delta f(1-e^2)^{1/2}N\sin^2\phi$$

where N is above, $M = a(1-e^2)/(1-e^2\sin^2\phi)^{3/2}$

$\Delta f = (1-e_2^2)^{1/2} - (1-e_1^2)^{1/2}$

$\Delta a = a_2 - a_1$

$\Delta X, \Delta Y, \Delta Z$ = change (new − old)

(a_1, e_1^2) old ellipsoid; (a_2, e_2^2) new ellipsoid

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA 22092

In Reply Refer To:
WGS-Mail Stop 521

January 5, 1989

Rec'd 1/17/89

Mr. Douglas Boyd
Box 534
Mobile, Alabama 36601

Dear Mr. Boyd:

I have recalculated your two revised points using the Molodensky equations and have marked them on your sheet. I'm afraid that I am not in a position to unscramble your program. I am only partially familiar with HP logic, and even if it were in TI logic, it would take time which I cannot devote to this project. As I indicated in my last letter of March 3, 1988, I cannot justify further material effort on your requests, which have extended over the past 4½ years.

Sincerely,

John P. Snyder

John P. Snyder

sheet # 1

P.S. Would you please compute and Return to me. Deb.

Please compute: (MOLODENSKY)

$\phi_1 = 30°.64044349 \rightarrow 0$

$\lambda_1 = -87°.98000094 \rightarrow M$; $h = \emptyset = H$

$\phi_2 = 30°.66470165$

$\lambda_2 = -88°.06008835$

Revised Molodensky: ϕ = 39.0718169, λ = 94.36984502

Using revised Molodensky: I get:
30°.66540635
-88°.06008835

5 M	
0.0 M	

Note: using KYMAK Transformation formula. I have obtained:

$\phi_2 = 30°.66582535$ (~~665166~~24)

$\lambda_2 = 88°.05975035$ (0.0596916)

	pe.	ae
$\Delta\phi$	6 M	50 M
$\Delta\lambda$	14 M	28.9 M
		91/M = 298 FT

H = 1657.736931 meters

$\Delta\phi$ = 0.1598

= 30.66512184

= -88.05975035

H = 1654.81835

(CORRECTED) * KYMAK $\phi_1 = 39°.0712335$ N
$\lambda_1 = 94°.36986086$ W

Preliminary 1st datum (use +X+Y+Z):
$\phi_2 = 39°.09079644$
$\lambda_2 = 94°.42783696$
= NAD 1927 @ starting point; h = 1020 FEET.

(APPRX.) $\Delta\phi$ = 68.125 ~~71.8~~ METERS (cp. MOLODENSKY to KYMAK); $\Delta\lambda$ = 24.5375 ~~25.377~~ METERS = 0°0'1".0675/W

PROBABLE ERROR:

	ϕ	λ
MOLODENSKY	3M/N	20M/E
KYMAK	71.8	25.
'27 To '83, KYMAK	1.33	32.676

Reverse +ΔX = -6823.304 ✓
+ΔY = -23432.768 ✓
+ΔZ = -5108.765 ✓

Please recompute starting point

1st datum sphere (KYMAK DATUM): R = 6356908.8 (~~6356752.314~~) m
$e^2 = 0$ ✓

2nd " ellipsoid a = 6378206.4 m ✓
$e^2 = .006768658$ ✓

use +XYZ 1.18.89

(1st datum Lat = 39.09079644° * 39.0732335 → 0
Long = -94.36985943° → M (94.42783696)

2nd datum Lat = 39.10945125° → $\Delta\phi$ = 0°.01863481 (39.0716163 SLIGHT CORRECTION) *
Long = -94.4281355° recompute * $\Delta\lambda$ = 0°.05827407

Note: ... 5 m
I have obtained (KYMAK) & by iteration:
ϕ = 39.11006953 → (39.0752335)
λ = 94.36986085 = $\lambda_N - \Delta\lambda$

Molodensky ϕ_1 = 39°.07213163

Using (+XYZ):
ϕ_2 = 39.0328070 8
λ_2 = -94.37038224
$\Delta\lambda$ = -0.057989763 1.18.89

* changes to
lat. = 39.10840669° → 0
long. = -94.4858289° → M.

$\Delta\phi$ = 0.0186101, ϕ = 39.0721861 9 in equation.
I GOT: 1/18/89: $\Delta\phi$ = 0°.29062024, ϕ_2 = 39°.38141668

($\Delta\lambda$ = 0.0579919428 (I GOT) 1.18.89
∴ λ_0 = -94.36984502 \ H = 2519.9...)

United States Department of the Interior

GEOLOGICAL SURVEY
RESTON, VA. 22092

In Reply Refer To:
WGS-Mail Stop 521

February 19, 1986

Mr. Douglas Boyd
PO Box 638
Mobile, Alabama 36601

Dear Mr. Boyd:

I have spent some time studying your letter of February 2 as time permits. So far the formulas look accurate and simple. I plan to evaluate them further and to see whether they would be suitable to use in place of Molodensky or other formulas in shifting from one ellipsoidal datum to another. If this appears to be the case, I shall pursue this further with appropriate individuals in NOAA.

Thank you for assembling these formulas. I assure you that I will make every effort to see that you get proper credit and are posted on developments.

Sincerely,

John P. Snyder

John P. Snyder

Dr. Colvo Correspondence

Dear Mr. Boyd: 7-13-84

The delay in reply to your letters of June 20 and June 24 has resulted in part from vacation. I'm afraid that I cannot answer you as directly as I would like. One problem is the fact that the elevation is measured perpendicular to the geoid, but this is not quite the same direction as the center of the Earth. The latitude and longitude are measured with respect to the ellipsoid, but if the reference ellipsoid is not mass-centered, these measurements are in turn not directed toward the center of the Earth.

For practical purposes, I think you can treat the elevation of 1020' given in your letter of June 20 as a geocentric elevation, and the discrepancy would not be as great as the inaccuracy of measuring the elevation. The geoid is about 30 meters below the WGS-72 ellipsoid, which is mass-centered because it is determined using satellites. The latitude and longitude are with reference to the NAD 1927 datum using the Clarke 1866 ellipsoid. Therefore, an adjustment must be made to convert the latitude and longitude to the WGS-72 reference system. This is rather involved, using Molodensky equations. One can then obtain X, Y, and Z coordinates using ellipsoidal geometry. These coordinates can be related to a sphere of proper radius to give you the length of 1' arc which you desire.

This would all require considerable computation, but I am not sure that this would be useful information which would produce the results you want. No sphere can intersect the Earth along a given contour except at certain local points, because contours are measured relative to the geoid (mean sea level at a given point) rather than relative to a sphere or even an ellipsoid.

I know this is frustrating when you have tried to be so specific in your letters, but discussing a geometric problem in a letter is difficult.

Sincerely,

Dear Mr. Boyd: 9-18-84

I have enclosed the formula for the distance to the center of the ellipsoid from the surface. Unfortunately, deflection from perpendicular between geoid and ellipsoid is not straightforward. It depends on the undulation of the geoid at the particular point desired. While the vertical effect can be ignored, as I stated in my letter of July 13, the horizontal effect, although small, would take rather complicated use of the spherical harmonics defining the geoid. Dr. Colvocoresses did not mean to give the impression that this was fairly easy. We do not have adequate information here, but I have sent copies of your and my correspondence to:

Elizabeth Wade
Chief, Horizontal Network Branch
N/CG12, National Geodetic Survey
6001 Executive Boulevard
Rockville, Maryland 20852

and you should be hearing from them soon.

Sincerely,

John P. Snyder

John P. Snyder

Enclosure

Dear Mr. Boyd: 9-26-84

In response to a request by Mr. John P. Snyder of the U.S. Geological Survey for assistance in answering your letter regarding calculations of the deflection of the vertical, I am enclosing information from the National Geodetic Information Center on ordering such data from this agency.

As Mr. Snyder pointed out in his letters to you, deflections of the vertical have physical meaning only in a localized reference frame. Since the geoid is an irregular surface, owing to the uneven distribution of mass throughout the planet, the direction of the gravity vector changes from point to point.

The National Geodetic Survey currently has an operational deflection database containing nearly 6000 observed astrogeodetic deflections, several hundred satellite-derived deflections, and tens-of-thousands of gravimetrically-determined deflections.

This database can be accessed via appropriate computer programs to obtain interpolated deflections of the vertical for any point, given a geographic latitude and longitude, and an elevation (in meters) above (or below) mean sea level, for any place in the United States.

Similarly, a table of astrogeodetic deflections can be provided for any given state or area, from which a user can interpolate a deflection, although with less accuracy.

If you are interested in obtaining such data, please contact Mrs. Peggy Morrish (301-443-8623), or write:

National Geodetic Information Center (N/CG174)
NOAA/National Geodetic Survey
Rockville, Maryland 20852

Sincerely yours,

Michael D. Abell
Geodesist, Gravity, Astronomy,
and Space Geodesy Branch
National Geodetic Survey

Enclosure

cc:
John P. Snyder
U.S. Dept. of the Interior
Geological Survey
Reston, Va. 22092 (WGS-Mail Stop 521)

Mrs. Elizabeth Wade
N/CG12

Mrs. Peggy Morrish
N/CG174

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ROCKVILLE, MD 20852

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

NOS/National Geodetic Survey-N/CG142

SUFFIX-1: OLD DATUM eg. NAD1927
SUFFIX-2: NEW DATUM eg. NAD1983
GRS/180

WGS72
ΔX = -22
ΔY = 157
ΔZ = 176

1/14/86
D.Boyd

1) $\theta_1 = (\frac{b}{a}\tan\phi)\tan^{-1}$; $\frac{b}{a} = \sqrt{1-e^2}$
2) $r_1 = a_1 \cos\theta_1$; (ϕ_1 = ϕ each, ϕ_2 = ϕ new)
3) $z_1 = b_1 \sin\theta_1$
4) d = series ; see below (A)(B)(C)(D)
5) $\lambda = [\Delta x + (\Delta y/\tan\lambda)]\sin\lambda$,
6) $\Delta\lambda = [\ell/(r_1+d)]\sin^{-1}$
7) $\theta_1' = [(z_1 - \Delta z)/b_2]\sin^{-1}$
8) $\phi_2' = (\frac{a_2}{b_2}\tan\theta_1')\tan^{-1}$
9) $r_2' = a_2\cos\phi_2'$
10) $\Delta r = r_2'(n+d)$ (P_2 to P_1)
11) $L = \Delta r \sin\phi_2' \cong L = \ell\sin\alpha$ (B to R)
12) $\Delta z = L\cos\phi_2 \cong L'\cos\phi_2' = \Delta z'$
13) $z_2 = (z_1 - \Delta z) - \Delta z'$
14) $\theta_2 = (z_2/b_2)\sin^{-1}$
15) $\phi_2 = (\frac{a_2}{b_2}\tan\theta_2)\tan^{-1}$; $\frac{a}{c} = \frac{\tan\phi}{\tan\theta}$
16) $\Delta H = \Delta z \sin\phi_2$ (P_2 to P_1)
CHECKS: (12)(11)(15) Verify ϕ_2
17) $\Delta r = \Delta r' - r_2$ (10)(16)
(11) 18) $r_2' = \Delta z \tan\phi_2$ (12)(15) (P_2' to A)
19) $S \cong \Delta r' \tan\Delta\lambda$ (17)(6) arc r_2' (A to B)
20) (A) $\lambda = 90°W$; $d = \Delta y$; $\ell = \Delta x$
(B) $\lambda > 90°W$ and $\leq [\frac{\Delta y}{\Delta x}\tan^{-1}]$; $d = [\Delta y/\sin\lambda] + [\Delta x + (\Delta y/\tan\lambda)]\cos\lambda$
(C) $\lambda > 90°W$ but $\geq [\frac{\Delta y}{\Delta x}\tan^{-1}]$; $d = [\Delta x + (\Delta y/\tan\lambda)]\cos\lambda + [\Delta y/\sin\lambda]$
(D) $\lambda < 90°W$; $d = (\Delta y/\sin\lambda) - [\frac{\Delta x + (\Delta y/\tan\lambda)\cos\lambda}{\tan\lambda}]$
21) $\Delta\lambda = S/r_2'$ radian. (9)(9) central angle (α, A, B)
22) $\Delta S = r_2'\tan\Delta\lambda$ (18)(20)
23) $S = S'' \cos\Delta S$ (19)(21) arc r_2 ($P_2 \to P_2'$)

DOUGLAS BOYD
PO BOX 638
MOBILE, AL 36601

United States Department of the Interior
GEOLOGICAL SURVEY
RESTON, VA. 22092

In Reply Refer To:
WGS-Mail Stop 521

February 19, 1986

Mr. Douglas Boyd
PO Box 638
Mobile, Alabama 36601

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John P. Snyder

John P. Snyder

Dr. Colvocoresses

Dear Mr. Boyd: 7-13-84

The delay in reply to your letters of June 20 and June 24 has resulted in part from vacation. I'm afraid that I cannot answer you as directly as I would like. One problem is the fact that the elevation is measured perpendicular to the geoid, but this is not quite the same direction as the center of the Earth. The latitude and longitude are measured with respect to the ellipsoid, but if the reference ellipsoid is not mass-centered, these measurements are in turn not directed toward the center of the Earth.

For practical purposes, I think you can treat the elevation of 1020' given in your letter of June 20 as a geocentric elevation, and the discrepancy would not be as great as the inaccuracy of measuring the elevation. The geoid is about 30 meters below the WGS-72 ellipsoid, which is mass-centered because it is determined using satellites. The latitude and longitude are with reference to the NAD 1927 datum using the Clarke 1866 ellipsoid. Therefore, an adjustment must be made to convert the latitude and longitude to the WGS-72 reference system. This is rather involved, using Molodensky equations. One can then obtain X, Y, and Z coordinates using ellipsoidal geometry. These coordinates can be related to a sphere of proper radius to give you the length of 1' arc which you desire.

This would all require considerable computation, but I am not sure that this would be useful information which would produce the results you want. No sphere can intersect the Earth along a given contour except at certain local points, because contours are measured relative to the geoid (mean sea level at a given point) rather than relative to a sphere or even an ellipsoid.

I know this is frustrating when you have tried to be so specific in your letters, but discussing a geometric problem in a letter is difficult.

Sincerely,

Dear Mr. Boyd: 9-18-84

I have enclosed the formula for the distance to the center of the ellipsoid from the surface. Unfortunately, deflection from perpendicular between geoid and ellipsoid is not straightforward. It depends on the undulation of the geoid at the particular point desired. While the vertical effect can be ignored, as I stated in my letter of July 13, the horizontal effect, although small, would take rather complicated use of the spherical harmonics defining the geoid. Dr. Colvocoresses did not mean to give the impression that this was fairly easy. We do not have adequate information here, but I have sent copies of your and my correspondence to:

Elizabeth Wade
Chief, Horizontal Network Branch
N/CG12, National Geodetic Survey
6001 Executive Boulevard
Rockville, Maryland 20852

and you should be hearing from them soon.

Sincerely,

John P. Snyder

John P. Snyder

Enclosure

Dear Mr. Boyd: 9-26-84

In response to a request by Mr. John P. Snyder of the U.S. Geological Survey for assistance in answering your letter regarding calculations of the deflection of the vertical, I am enclosing information from the National Geodetic Information Center on ordering such data from this agency.

As Mr. Snyder pointed out in his letters to you, deflections of the vertical have physical meaning only in a localized reference frame. Since the geoid is an irregular surface, owing to the uneven distribution of mass throughout the planet, the direction of the gravity vector changes from point to point.

The National Geodetic Survey currently has an operational deflection database containing nearly 6000 observed astrogeodetic deflections, several hundred satellite-derived deflections, and tens-of-thousands of gravimetrically-determined deflections.

This database can be accessed via appropriate computer programs to obtain interpolated deflections of the vertical for any point, given a geographic latitude and longitude, and an elevation (in meters) above (or below) mean sea level, for any place in the United States.

Similarly, a table of astrogeodetic deflections can be provided for any given state or area, from which a user can interpolate a deflection, although with less accuracy.

If you are interested in obtaining such data, please contact Mrs. Peggy Morrish (301-443-8623), or write:

National Geodetic Information Center (N/CG174)
NOAA/National Geodetic Survey
Rockville, Maryland 20852

Sincerely yours,

Michael G. Abell
Geodesist, Gravity, Astronomy, and Space Geodesy Branch
National Geodetic Survey

Enclosure

cc:
John P. Snyder
U.S. Dept. of the Interior
Geological Survey
Reston, Va. 22092 (WGS-Mail Stop 521)

Mrs. Elizabeth Wade
N/CG12

Mrs. Peggy Morrish
N/CG174

U. S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ROCKVILLE, MD 20852

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE, $300

NOS/National Geodetic Survey-N/CG142

Astronomic Information

Latitude, Longitude, Azimuth, and Deflection of Vertical

Astronomic information includes final results of astronomic latitude, longitude, azimuth, and deflection of the vertical determinations for more than 5,000 stations in the United States and the U. S. possessions. Astronomic information is listed by station and by 30' quadrangle locations. This information is required for the transformation between survey observations and mathematical models representing the Earth. In horizontal control surveys, the data often provide project orientation.

Exhibit 8 shows the printed data elements, including station identifiers (QID/QSN and name), both astronomic and geodetic positions (AST/GEOD, LAT and LONG), a measure of precision (SIG), the meridional component (M.C.) and prime vertical component (P.V.C.) of the deflection of the vertical, and the elevation. Also available, but not illustrated, are tables for the apparent place of Polaris and sidereal time of 0 hour Universal Time for each day of the year.

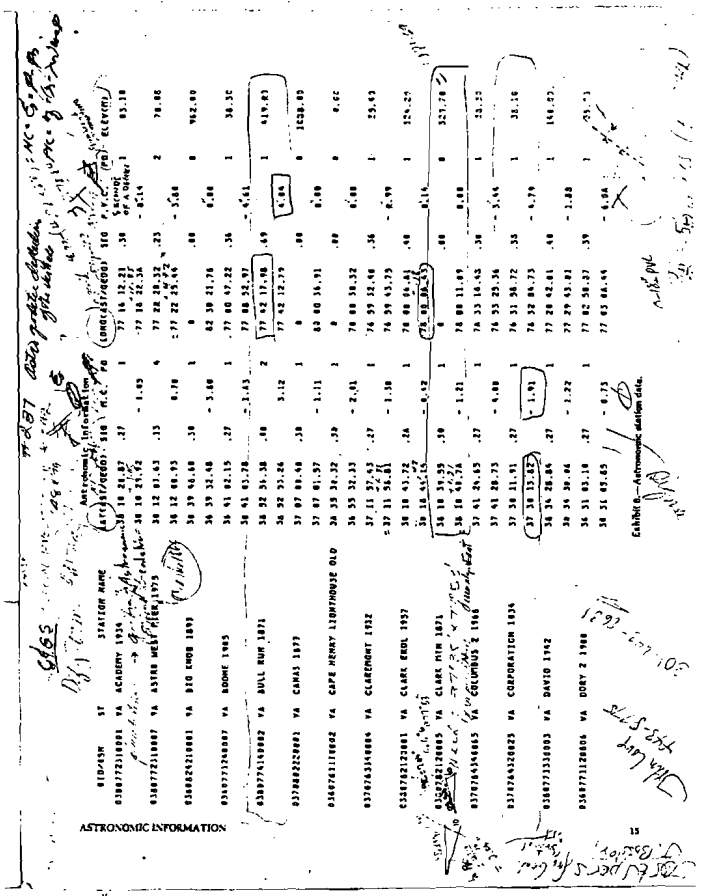
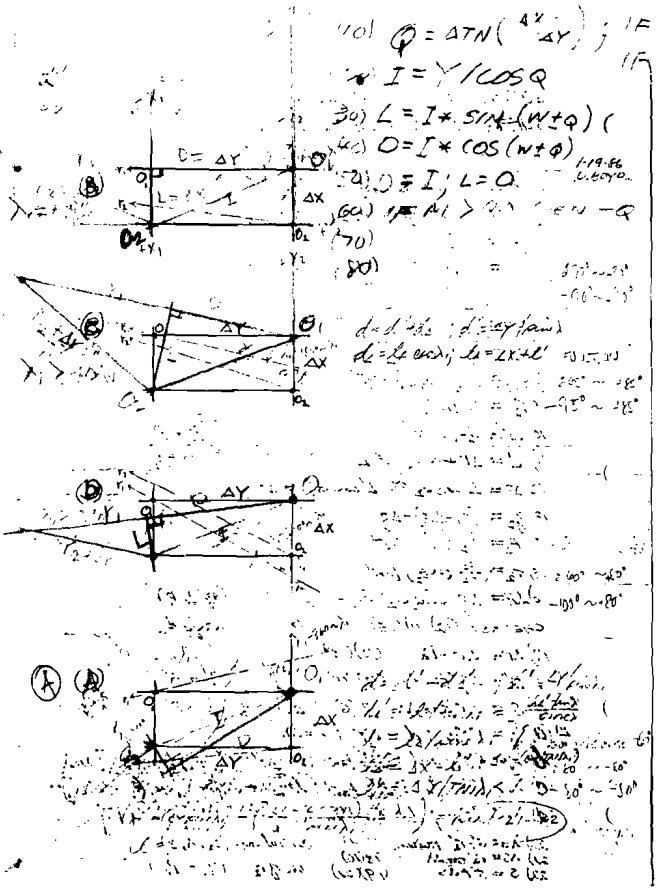


Exhibit 8.—Astronomic station data.



DEFENSE MAPPING AGENCY
WASHINGTON, D.C.

THE DEPARTMENT OF DEFENSE WORLD GEODETIC SYSTEM 1972

Prepared by the
World Geodetic System Committee
and presented by
Thomas O. Seppelin

May 1974

Presented at the International Symposium on Problems Related to the Redefinition of North American Geodetic Networks, Fredericton, New Brunswick, Canada 20-25 May 1974

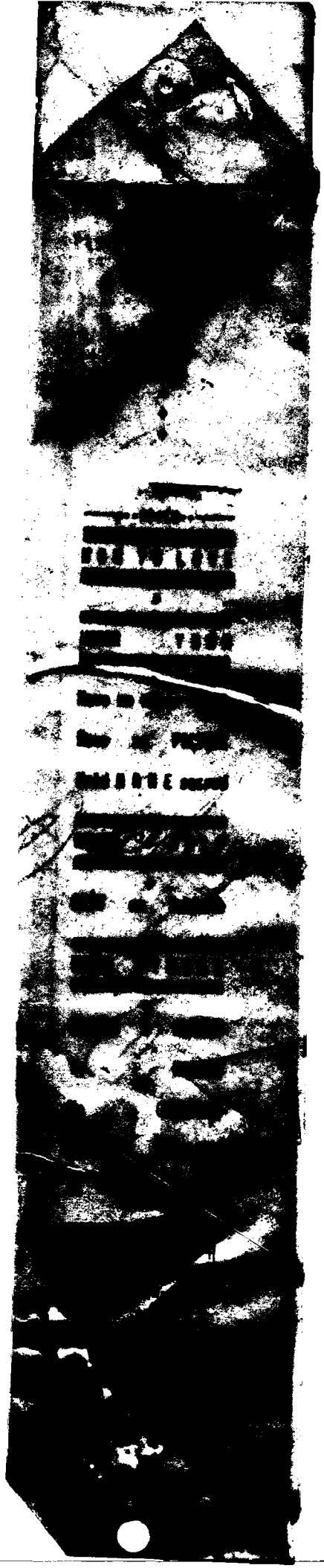
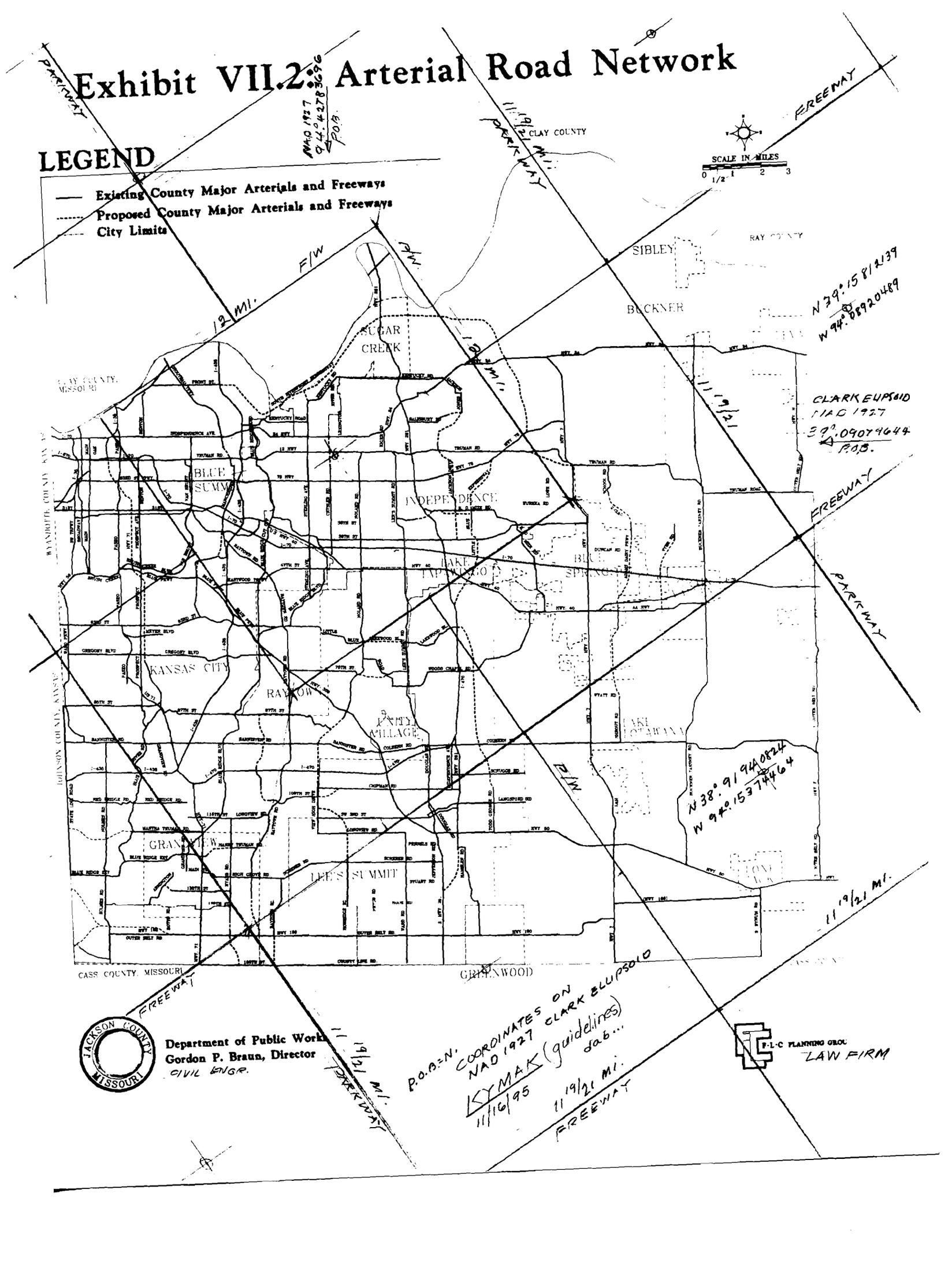
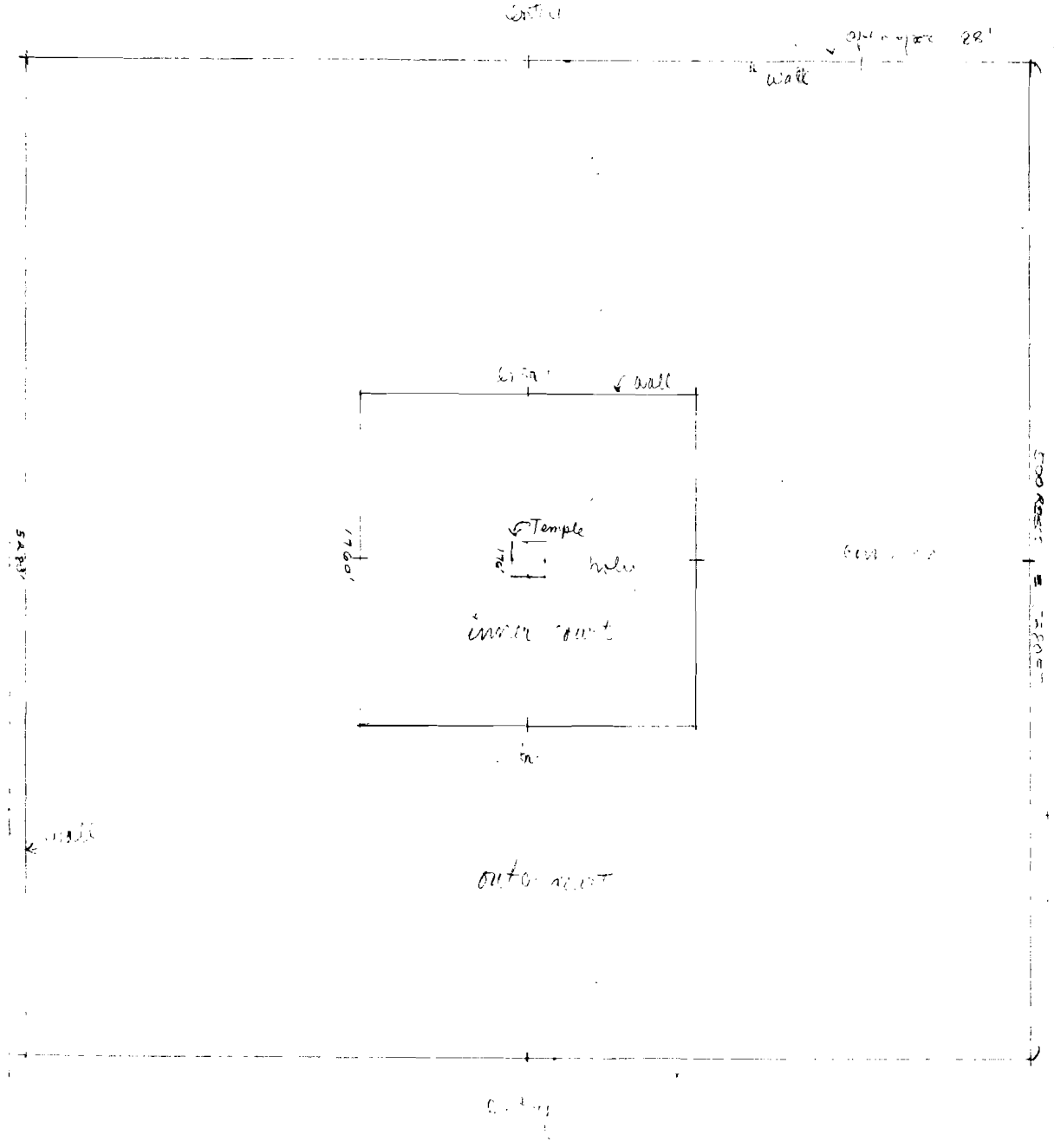


Exhibit VII.2: Arterial Road Network

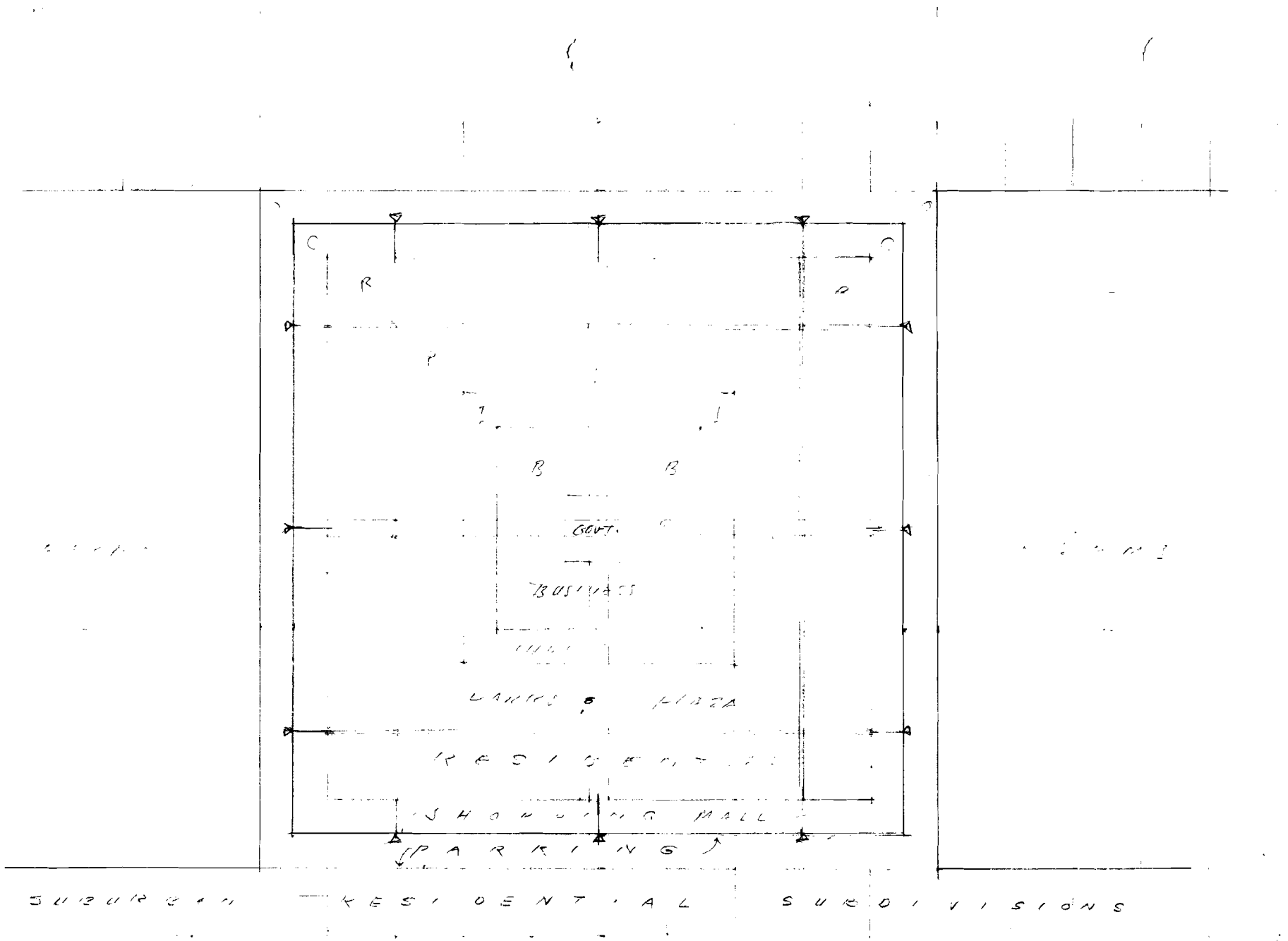




EZK. 40 ~ 48

1" = 880' = 500 cu

1/21/20



MODEL CITY
URBAN CORE (DETAIL)
KYMAK

440'
440'

3/31/9.
DAS..