

EASTERN ARAPAHOE COUNTY VERTICAL CONTROL

PHASE 1 Revision

PHASE 1- WATKINS ROAD / I-70 TO QUINCY
PHASE 3- QUINCY AVENUE / WATKINS TO BRICKCENTER

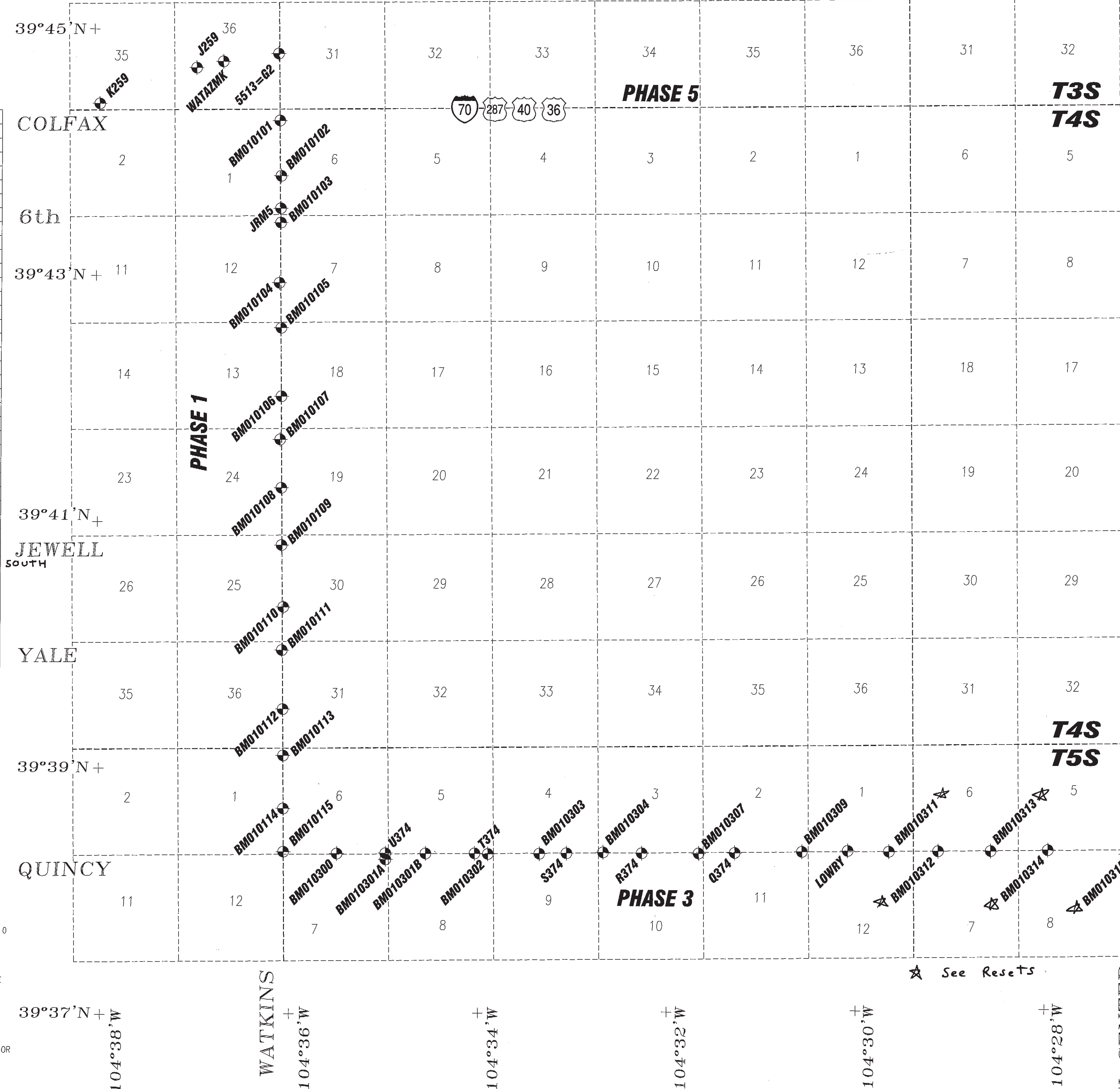
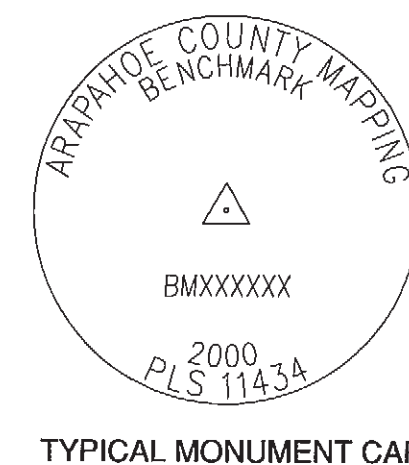
MARK ID	LATITUDE	LONGITUDE	ELEV (m)	ELEV (ft)	GRAVITY (kgal)	GEOPOTENTIAL (gpu)	LOCATION
K259	39°44'24" N	104°38'01" W	1695.554	5562.83	0.9796153	1661.11277	1.6 MILES WEST ALONG THE UPRR FROM THE TRAIN STATION
J259	39°44'41" N	104°37'00" W	1682.047	5518.52	0.9796180	1647.88348	0.6 MILES WEST ALONG THE UPRR FROM THE TRAIN STATION
WATAZMK	39°44'44" N	104°36'43" W	1681.228	5515.83	0.9796182	1647.08137	0.3 MILES WEST ALONG THE UPRR FROM THE TRAIN STATION
5513=62	39°44'47" N	104°36'11" W	1682.027	5518.45	0.9796184	1647.86473	250' NORTH OF THE INT OF THE UPRR & WATKINS ROAD
BM010101	39°44'15" N	104°36'11" W	1688.093	5538.35	0.9796166	1653.80510	300' SOUTH OF I-70 & WATKINS, EAST SIDE OF ROAD
BM010102	39°43'49" N	104°36'12" W	1690.881	5547.50	0.9796150	1656.53410	0.5 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
JRM5	39°43'32" N	104°36'12" W	1691.811	5550.55	0.9796138	1657.44297	0.9 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010103	39°43'25" N	104°36'12" W	1692.312	5552.19	0.9796134	1657.93312	1.0 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010104	39°42'56" N	104°36'12" W	1702.971	5587.16	0.9796114	1668.37268	1.5 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010105	39°42'34" N	104°36'11" W	1715.143	5627.10	0.9796100	1680.29558	2.0 MILES SOUTH OF I-70 & WATKINS, EAST SIDE OF ROAD
BM010106	39°42'01" N	104°36'12" W	1721.100	5646.64	0.9796077	1686.12870	2.5 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010107	39°41'40" N	104°36'13" W	1734.227	5689.71	0.9796063	1698.98678	3.0 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010108	39°41'16" N	104°36'12" W	1746.973	5731.53	0.9796047	1711.47266	3.5 MILES SOUTH OF I-70 & WATKINS, EAST SIDE OF ROAD
BM010109	39°40'48" N	104°36'13" W	1749.728	5740.57	0.9796028	1714.16813	4.0 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010110	39°40'18" N	104°36'13" W	1765.599	5792.64	0.9796008	1729.71469	4.5 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010111	39°39'57" N	104°36'14" W	1772.707	5815.96	0.9795994	1736.67631	5.0 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010112	39°39'28" N	104°36'14" W	1797.490	5897.27	0.9795974	1760.95401	5.5 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010113	39°39'06" N	104°36'15" W	1792.153	5879.75	0.9795959	1755.72169	5.9 MILES SOUTH OF I-70 & WATKINS, WEST SIDE OF ROAD
BM010114	39°38'40" N	104°36'13" W	1799.484	5903.81	0.9795941	1762.90078	6.5 MILES SOUTH OF I-70 & WATKINS, EAST SIDE OF ROAD
BM010115	39°38'19" N	104°36'13" W	1801.368	5909.99	0.9795927	1764.74419	NE CORNER INTERSECTION WATKINS & QUINCY
BM010300	39°38'18" N	104°35'39" W	1816.564	5959.84	0.9795932	1779.63349	0.5 EAST OF INTERSECTION WATKINS & QUINCY, NORTH SIDE OF ROAD
U374	39°38'18" N	104°34'58" W	1823.441	5982.41	0.9795939	1786.37248	1.1 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
BM010301A	39°38'15" N	104°34'58" W	1826.450	5992.28	0.9795937	1789.32048	1.1 MILES EAST OF INT WATKINS & QUINCY, SOUTH SIDE OF ROAD
BM010301B	39°38'18" N	104°34'33" W	1803.918	5918.35	0.9795944	1767.24568	1.5 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
T374	39°38'15" N	104°33'57" W	1801.332	5909.87	0.9795949	1764.71354	1.9 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
BM010302	39°38'17" N	104°33'54" W	1788.278	5867.04	0.9795951	1751.92438	2.0 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
BM010303	39°38'15" N	104°33'20" W	1764.686	5789.64	0.9795958	1728.81074	2.5 MILES EAST OF INT WATKINS & QUINCY, SOUTH SIDE OF ROAD
S374	39°38'14" N	104°33'03" W	1761.176	5778.13	0.9795961	1725.37289	2.8 MILES EAST OF INT WATKINS & QUINCY, NW COR OF BRIDGE
BM010304	39°38'17" N	104°32'40" W	1767.066	5797.45	0.9795969	1731.14458	3.1 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
R374	39°38'13" N	104°32'15" W	1779.024	5836.68	0.9795973	1742.86108	3.5 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
BM010307	39°38'16" N	104°31'39" W	1795.513	5890.78	0.9795985	1759.01828	4.0 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
Q374	39°38'12" N	104°31'16" W	1795.518	5890.80	0.9795989	1759.02407	4.5 MILES EAST OF INT WATKINS & QUINCY, WEST SIDE OF ROAD
BM010309	39°38'14" N	104°30'33" W	1816.511	5959.67	0.9796004	1779.59502	5.0 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
LOWRY	39°38'13" N	104°30'04" W	1839.271	6034.34	0.9796013	1801.89570	5.6 MILES EAST OF INT WATKINS & QUINCY, NORTH SIDE OF ROAD
BM010311	39°38'12" N	104°29'38" W	1806.889	5928.10	0.9796018	1770.17051	6.0 MILES EAST OF INT WATKINS & QUINCY, SOUTH SIDE OF ROAD
BM010312	39°38'12" N	104°29'07" W	1790.757	5875.17	0.9796029	1754.36650	6.5 MILES EAST OF INT WATKINS & QUINCY, SOUTH SIDE OF ROAD
BM010313	39°38'11" N	104°28'33" W	1778.658	5835.48	0.9796041	1742.51460	6.9 MILES EAST OF INT WATKINS & QUINCY, SOUTH SIDE OF ROAD
BM010314	39°38'12" N	104°27'57" W	1770.278	5807.99	0.9796055	1734.30743	7.5 MILES EAST OF INT WATKINS & QUINCY, SOUTH SIDE OF ROAD
BM010315	39°38'11" N	104°27'14" W	1756.008	5761.17	0.9796070	1720.32882	SE CORNER OF INTERSECTION BRICK CENTER & QUINCY

LEGEND

- DENOTES THAT THIS POINT WAS NOT USED AS PROJECT CONTROL. MOVEMENT HAS BEEN DETECTED AT THESE NGS POINTS. THE ELEVATION REPORTED HEREON IS BASED UPON THIS SURVEY, AN UPDATED ELEVATION.
- DENOTES THAT THIS POINT WAS USED AS PROJECT CONTROL CHECK. THE ELEVATIONS REPORTED HEREON ARE BASED UPON THIS SURVEY, AN UPDATED ELEVATION.
- DENOTES LOCATION OF BENCHMARK
- DENOTES AREA OF REVISION
- DENOTES THE "KILO GAL" UNIT OF GRAVITATIONAL ACCELERATION
- DENOTES THE "GEOPOTENTIAL UNIT" UNIT OF GRAVITY POTENTIAL
- DENOTES THE "METER" LINEAR UNIT OF MEASURE
- DENOTES THE "US SURVEY FOOT" LINEAR UNIT OF MEASURE. BEING DEFINED AS (3937/1200)(VALUE IN METERS)
- DENOTES INTERSECTION
- DENOTES NORTH
- DENOTES WEST
- DENOTES NORTHEAST
- DENOTES NORTHWEST
- DENOTES SOUTHEAST
- DENOTES SOUTHWEST
- DENOTES THE UNION PACIFIC RAILROAD
- DENOTES NATIONAL GEODETIC SURVEY

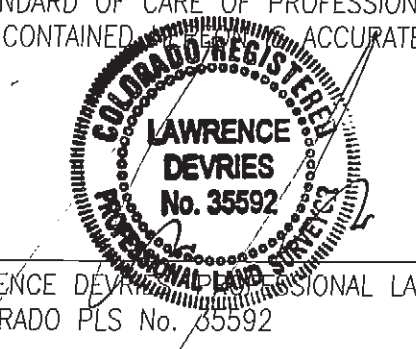
SURVEY NOTES

- THE ELEVATIONS REPORTED HEREON ARE REFERENCED TO THE NORTH AMERICAN VERTICAL DATUM OF 1988 (NAV88), THIS SURVEY BEING CLASSIFIED AS A SECOND ORDER CLASS 0 SURVEY AS DEFINED BY NGS.
- ALL MONUMENTS SET BY ZYLSTRA BAKER SURVEYING, INC ARE COLORADO DEPARTMENT OF TRANSPORTATION TYPE 2 CONTROL MONUMENTS, WHICH CONSIST OF BERNSTEN TOP SECURITY ROD MONUMENTS BEING 3 FOOT SMOOTH ALUMINUM ROD SECTIONS WITH A 3 FOOT FINNED ROD AT THE TOP SECTION CONNECTED BY FLOATING THREADS AND SELF LOCKING WASHERS, A SPIRAL DRIVE POINT ATTACHED TO THE BOTTOM AND A 3 1/4 INCH ALUMINUM CAP AFFIXED TO THE TOP. ADDITIONAL 3 FOOT SMOOTH ROD SECTIONS WERE ATTACHED TO THE BOTTOM SECTION UNTIL THE MONUMENT REACHED A STABLE DEPTH; MONUMENT DEPTHS RANGE FROM 6 TO 15 FEET.
- ALL GEODETIC POSITIONS LISTED HEREON ARE BASED UPON AUTONOMOUS GLOBAL POSITIONING SYSTEM (GPS) MEASUREMENTS AND HAVE A POSITIONAL TOLERANCE OF 50 FEET ±. POSITIONS ARE RELATIVE TO THE NORTH AMERICAN DATUM OF 1983, 1992 REALIZATION.
- THE EQUIPMENT USED IN THIS PROJECT CONSIST OF FIRST ORDER DIFFERENTIAL LEVELING EQUIPMENT AS OUTLINED BY NGS. A ZEISS DINI 11 AUTOMATIC PRECISE DIGITAL LEVEL (SERIAL No. 103281) WITH A SET OF (2) 3m PRECISE DIGITAL BAR CODE INVAR RODS (SERIAL No.'s 13512, 13513), CALIBRATED IN MUNICH GERMANY, WERE USED. STEEL TURNING PINS OR STEEL "TURTLES" WERE USED AS TURNING POINTS.
- THE ELEVATION DIFFERENCE DATA WAS CORRECTED FOR SYSTEMATIC ERRORS BY APPLYING CORRECTIONS THAT ACCOUNTED FOR ROD SCALE ERRORS, ROD INVAR TEMPERATURE, REFRACTION AND COLLIMATION ERROR. DUE TO THE SMALL EXTENTS OF THIS PROJECT IT WAS NOT NECESSARY TO APPLY CORRECTIONS THAT ACCOUNTED FOR EARTH TIDES AND CRUSTAL MOTION. THE MAGNETIC FIELD CORRECTION WAS NOT NECESSARY BECAUSE THE INSTRUMENTATION USED DURING OBSERVATIONS IS NOT SUSCEPTIBLE TO MAGNETIC EFFECTS. GRAVITY EFFECTS WERE ACCOUNTED FOR USING NAV88 MODELED GRAVITY AS PROVIDED BY NGS. AVAILABLE FOR DOWNLOAD AT WWW.NGS.NOAA.GOV. THE MODELED GRAVITY VALUES WERE USED TO COMPUTE NAV88 GEOPOTENTIAL NUMBERS AT EACH BENCHMARK. THE HELMERT ORTHOMETRIC REDUCTION EQUATION WAS USED TO REDUCE THE GEOPOTENTIAL VALUES TO NAV88 HELMERT ORTHOMETRIC HEIGHTS. THIS IS THE CURRENT METHOD IN USE BY NGS TO DATE. REFERENCE THE REPORT FOR PHASES 4 AND 5 FOR DETAILED CALCULATION METHODS.
- NOTICE: ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT, MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.
- NOTE ON REVISION: AT THE TIME THE ORIGINAL REPORT WAS ISSUED NAV88 MODELED GRAVITY WAS NOT AVAILABLE. THUS TRUE NAV88 GEOPOTENTIAL NUMBERS COULD NOT BE COMPUTED. NGS HAS SINCE RELEASED THE NAV88 GRAVITY MODEL. THE POSITIONS SHOWN HEREON ARE UPDATED BASED UPON MODELED GRAVITY, GEOPOTENTIAL NUMBERS AND DATA PROCESSED FROM PHASES 4 AND 5. THE DATA FROM PHASES 4 AND 5 PROVIDE APPROXIMATELY A 30 MILE CLOSED LEVEL CIRCUIT AND THE POSITIONS SHOWN ARE BASED UPON A SIMULTANEOUS LEAST SQUARES READJUSTMENT OF PHASES 1, 3, 4 AND 5. THE NGS BENCHMARKS USED AS PROJECT CONTROL DURING PHASES 1 AND 3 WERE HELD FIXED DURING THE READJUSTMENT. THE SIMULTANEOUS READJUSTMENT PROVIDES A STRONGER VERTICAL NETWORK. THE NETWORK READJUSTMENT YIELDED THE FOLLOWING STATISTICS (NEW-OLD VALUES): AVERAGE VERTICAL SHIFT OF +0.0043 METERS, A STANDARD DEVIATION OF 0.0033 METERS, A MINIMUM SHIFT OF -0.0008 METERS AND A MAXIMUM SHIFT OF 0.0119 METERS.
- NO GUARANTEE AS TO THE ACCURACY OF THE INFORMATION CONTAINED ON THE ATTACHED DRAWING IS EITHER STATED OR IMPLIED UNLESS THIS COPY BEARS AN ORIGINAL SIGNATURE OF THE PROFESSIONAL LAND SURVEYOR NAMED HEREON.



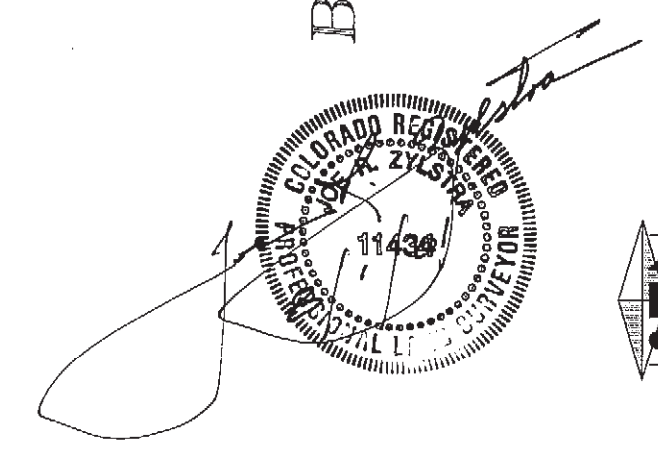
SURVEYOR'S CERTIFICATION

I, LAWRENCE DEVRIES, A PROFESSIONAL LAND SURVEYOR PRACTICING IN THE STATE OF COLORADO, BASED UPON MY PROFESSIONAL OPINION, DO HEREBY CERTIFY THAT THIS SURVEY WAS MADE TO THE STANDARD OF CARE OF PROFESSIONAL LAND SURVEYORS PRACTICING IN THE STATE OF COLORADO, I FIND THAT THE INFORMATION CONTAINED HEREON IS ACCURATE AND A REPRESENTATION OF SAID SURVEY.

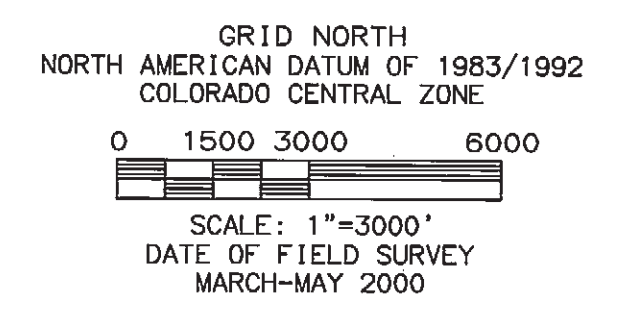


7-31-01
DATE ISSUED

LAWRENCE DEVRIES
PROFESSIONAL LAND SURVEYOR
COLORADO PLS No. 03592



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CLIENT: ARAPAHOE COUNTY ARAPAHOE COUNTY PROJECT No. CC98-028 ZBS PROJECT No. MM0102 DATE PREPARED JUNE 2000, REVISED JULY 2001