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January 20, 2003
File No.: 23536

Mr. Warren Rosebraugh, PE
Flood Control District of Maricopa County
2801 West Durango
Phoenix, Arizona 85009

SUBJECT: Geotechnical Study Report
Hawes Road Channel Investigation
Assignment No. 5
Contract No. 2001C003
Emelita Avenue to Apache Trail
Mesa, Arizona

Dear Mr. Rosebraugh:

Included in this report are the results of our geotechnical study and recommendations for planned improvements to the Hawes Road Channel – Emelita Avenue to Apache Trail, in Mesa, Arizona. The project will include construction of approximately 3000 linear feet of trapezoidal channel and 2500 linear feet of 66-inch diameter pipe. Attached is a site plan showing the boring locations, logs of the test borings, and the results of laboratory testing. Geotechnical recommendations for design and construction are presented below. The conclusions and recommendations presented in this report are subject to the limitations presented in the limitations section.

General Site Conditions

Within the project limits, the proposed lined channel follows an unlined existing channel from Emelita north to Pueblo Avenue, and is populated with desert trees and brush along most of the channel. From Pueblo Avenue north, the existing unlined channel continues approximately 1000 feet and ends just south of boring location B-3, with small brush in the channel. Hawes Road, from Boring Location B-3 to Broadway Road, is an asphalt-paved two-lane road, with a small-unlined channel on the east boundary, and an unpaved shoulder on the west boundary. Continuing north from Broadway to Apache Trail, Hawes Road is bordered by an unpaved shoulder to the west, and the unlined channel with larger brush to the east.

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Geotechnical Profile

The generalized soil profile is composed of clayey sands and silty sands interbedded with laterally discontinuous sand and gravel lenses. The soils encountered in the borings were typically described as moist. No free groundwater was observed at the test boring locations. Caving of the borings ranged from 8.6 feet to 4.6 feet from the surface.

Pavement Section

Within the project limits, existing Hawes Road asphaltic pavement ranged in thickness from three and one-quarter inches to four and one-half inches. Asphalt thickness was measured on borings B-5 through B-8. The pavement throughout the project is in good condition, with only slight cracking within the length of Hawes Road.

Based on information provided by the City of Mesa, Hawes Road is designated as a major collector. Pavement replacement on Hawes Road should therefore conform to City of Mesa standard specifications detail No. M-19.1 for a Major Collector Street, as noted below:

Hawes Road Replacement Pavement Section
2 ½ inches M.A.G. A-19 surface course
3 inches M.A.G. A-19 base course
10 inches A.B.C (Aggregate Base Course)

Placement requirements for the pavement section should be in accordance with the M.A.G. Section 321 (Specifications for Asphalt Concrete Pavement) and M.A.G. Section 310 (Specifications for Untreated Base). Observation and testing should be performed to verify conformance with these recommended specifications.

Engineered Structural Fill

Engineered fill required to bring the site to grade, support structural elements such as boxes, or for granular bedding below the bottom of pipes, should be free of vegetation and debris, and contain no rocks or lumps larger than three inches nominal diameter. Soils from areas of on-site excavation may be re-used in engineered fills. Imported soils for use in engineered fill should meet the following gradation requirements when tested in accordance with American Society of Testing Materials (ASTM) Test Method C 136:

Screen Size (Square Opening)	Percent Passing By Weight
3-inch (1 ½-inch below pipes)	100
No. 4	40 – 100
No. 200	15 – 50

The soils should possess a plasticity index of no greater than 20 when tested in accordance with ASTM Test Method D 4318.

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Engineered fill should be uniformly moisture-conditioned to between one percent below and two percent above the optimum moisture content, placed in horizontal lifts of thickness compatible with the equipment being used, and compacted by mechanical means only to at least 95 percent of maximum dry density. Optimum moisture content and maximum dry density should be determined in accordance with ASTM Test Method D698.

In all areas to receive engineered fill, we recommend the exposed cut surface be scarified in the upper eight inches, brought to within one percent below and two percent above optimum moisture content, and compacted to at least 95 percent of maximum dry density as determined by ASTM Test Method D698.

Trench Backfill and Pipe Bedding

Pipe bedding backfill (i.e., material from the bottom of the pipe to the springline of the pipe) should consist of ½ Sack or 1 Sack Controlled Low Strength Material (CLSM) slurry backfill in accordance with M.A.G. Section 728 and placement per M.A.G. Section 604.

Trench zone backfill (i.e., material placed between the pipe springline and finished subgrade) may consist of native soil from areas of on-site excavation. If import material is used for pipe or trench zone backfill, we recommend it consist of material that meets the gradation requirements of engineered structural fill as tabulated in the previous section. In general, poorly graded clean coarse-grained sand or poorly-graded clean gravel or sandy gravel should not be used for pipe or trench zone backfill due to the potential for soil migration into the relatively large void spaces present in this type of material and water seepage along trenches backfilled with coarse-grained sand and/or gravel.

Compaction of trench backfill above the CLSM pipe bedding material shall be in accordance with the requirements of Section 601.4.4 of the M.A.G. Specifications. Within pavement areas, trench backfill should be compacted to at least 100 percent relative compaction within two feet of finished subgrade. Mechanical compaction is recommended; ponding or jetting should not be allowed, especially in areas supporting structural loads or beneath concrete slabs supported-on-grade, pavements, or other improvements.

Recommendations provided above for pipe zone backfill are minimum requirements only. More stringent material specifications may be required to fulfill local codes and/or bedding requirements for specific types of pipes. We recommend the project Civil Engineer develop these material specifications based on planned pipe types, bedding conditions, and other factors beyond the scope of this study.

Channel Stability

A concrete-lined trapezoidal channel with slopes no steeper than 1.5H:1V is recommended. For the extension of the channel from Emelita Avenue to Broadway Road, it is recommended that the

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existing slope be cut back beyond the erosion features to provide a smooth working surface for placement of concrete or any required earthwork.

Shrink and Swell Considerations

Soils in the project area will experience an estimated earthwork shrinkage factor of 10 to 15 percent, when graded and compacted in accordance with project requirements. The shrinkage factor is the reduction in volume when comparing the compacted volume to the volume of the natural soil before compaction.

Allowable Bearing Pressure

Providing that the site is developed as outlined above, an allowable bearing pressure of 2000 pounds per square foot is recommended for pipe or box structures at a depth of five feet or more below finished grade.

Estimated Settlements

Vertical movements of the channel and pipe designed as recommended above are estimated not to exceed one-quarter inch for the native soils at the moisture contents encountered during test excavations or for fills at compaction moisture contents introduced during construction. Differential settlement between similarly loaded segments is expected to be less than one-quarter inch.

Resistance to Lateral Loads

The passive soil resistance of properly completed backfill against edges of pipes or structural elements should be considered as being equal to forces exerted by a fluid of 350 pounds per cubic foot unit weight. A coefficient of friction of 0.35 is recommended for computing lateral resistance between the bases of concrete structures and the soils in analyzing lateral loads.

Lateral pressure and resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied to these values for design purposes. The appropriate factor of safety will depend on the design condition, and should be determined by the project Structural Engineer. Depending on the application, typical factors of safety could range from 1.0 to 1.5.

Prior to placing steel or concrete, footing excavations should be cleaned of all debris, loose or soft soil, and water. All footing excavations should be observed by the project Geotechnical Engineer just prior to placing steel or concrete to verify the recommendations contained herein are implemented during construction.

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Corrosivity

One factor for evaluating soil corrosivity is electrical resistivity. The electrical resistivity for a soil is a measure of resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. As soil's resistivity decreases, its corrosivity increases.

A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals is provided below:

Resistivity in ohm-centimeters	Corrosivity Category
0 to1,000	severely corrosive
1,000 to 2,000	corrosive
2,000 to 10,000	moderately corrosive
Over 10,000	mildly corrosive

Laboratory resistivity test results on composite soil samples ranged from 966 to 1064 ohm-cm, which represent the minimum resistivity of saturated site soils. Therefore, on-site soils would be categorized as severely corrosive to corrosive towards ferrous metals. Arizona Department of Transportation has established design criteria based on resistivity and pH for determining life of corrugated galvanized steel culvert pipe. Based on an averaged resistivity of 1015 ohms-cm, and an averaged pH of 8.25, a life of 50 years is estimated for dry soil conditions. As there is some potential for increase in soil moisture, it is recommended that no buried galvanized piping be utilized, unless it is coated with asphalt or polymer resin.

Soluble sulfates contents for the native soil samples tested ranged from 9.5 to 24 ppm, indicating a negligible potential for concrete degradation due to exposure to sulfates. Therefore, Type II cement may be used for concrete in contact with soil.

Pipe Alternatives

The site is suitable for the following pipe applications:

- Reinforced Concrete Pipe (RCP)
- Treated Corregated Metal Pipe (CMP)
- High Density Polyethylene Pipe (HDPE)
- Cast-In-Place Concrete Pipe (CIP)

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Permanent Slopes

We recommend unprotected cut and fill slopes be constructed at a gradient no steeper than 2H:1V (horizontal to vertical). For slopes with slope paving, we recommend they be constructed at a gradient no steeper that 1.5H:1V. Tops of channel slopes should be graded to route water away from channel lining and unprotected slopes.

Turn-downs are recommended at the crest of all concrete channel linings to minimize the potential of surface water erosion from undercutting behind the channel walls. Such undercutting could cause erosion and loss of support as well as increased hydrostatic pressures. In areas where flows may enter the channel from the top, the depth of the recommended turn-down should be at least 1.5 to 2.0 feet.

Temporary Excavations

Materials encountered at our widely spaced test borings consisted predominately of clayey to silty sands. In our opinion, at the locations explored, these soils would primarily be considered Type B soil when applying the OSHA regulations. For this soil type, OSHA recommends a maximum slope inclination of 1H:1V, or flatter, for excavations 20 feet or less in depth. Steeper cut slopes may be utilized for excavations less than five feet deep depending on the strength, moisture content, and homogeneity of the soils as observed in the field. Slopes may need to be flattened locally if zones of relatively clean sands and/or gravels (OSHA Type C soils) are encountered during construction.

The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Such regulations are strictly enforced and, if they are not followed, the Owner, Contractor, and/or earthwork and utility subcontractors could be liable for substantial penalties.

Construction Considerations

Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within one-third the slope height from the top of any excavation. Where the stability of adjoining walls or other structures is endangered by excavation operations, support systems such as shoring, bracing, or underpinning may be required to provide structural stability, and to protect personnel working within the excavation. A professional engineer registered in the State of Arizona should design shoring, bracing, or underpinning required for the project (if any).

Earthen berms or other methods should be used to prevent runoff water from entering all excavations. All runoff water should be collected and disposed of outside the construction limits.

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Limitations

The recommendations contained in this report are based on our field explorations, laboratory tests, and our understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the three borings drilled during the field investigation. It is anticipated that some variations in the soil conditions will exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site, which are different from those described in this report, Kleinfelder should be immediately notified so that we may make any necessary revisions to the recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, Kleinfelder should be notified. This report was prepared in accordance with the generally accepted standard of practice in Arizona at the time the report was written. No warranty, expressed or implied, is made. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

This report may be used only by the client and only for the purposes stated, within a reasonable time from its issuance. Land use, site conditions (both on and offsite), or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client who wishes to use this report shall notify Kleinfelder of such intended use. Based on the intended use of the report, Kleinfelder may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release Kleinfelder from any liability resulting from the use of this report by any unauthorized party.

Please give me a call if I can be of further assistance.

Respectfully submitted,

KLEINFELDER, INC.

Reviewed by:

Marcos J. Cartagena
Staff Professional

Steven A. Haire, P.E.
Senior Geotechnical Engineer

Attachments: Boring Logs, Laboratory Testing, and Site Plan

Copies to: Addressee (3)
F.C.D.M.C. / Michael Lopez, PE (1)

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ATTACHMENT 1

Boring Logs

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LESS THAN 5% PASSING NO. 200 SIEVE	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% PASSING NO. 200 SIEVE	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LESS THAN 5% PASSING NO. 200 SIEVE	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% PASSING NO. 200 SIEVE	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

Note: Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing No. 200 sieve require dual USCS symbols. (See KEY A-3 if provided)

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UNIFIED SOIL CLASSIFICATION SYSTEM
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MCFCD
Hawes Road
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KEY
A-1

GEO-KEY_A1_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

LOG SYMBOLS

BULK / GRAB SAMPLE

MODIFIED CALIFORNIA SAMPLER
(2 inch inside diameter)

RING (PORTER) SAMPLER
(2-1/2 inch inside diameter)

STANDARD PENETRATION
SPLIT SPOON SAMPLER
(2.0-inch O.D. X 1.4-inch I.D.)

SHELBY TUBE
(3 inch outside diameter)

NON-STANDARD PENETRATION
SPLIT SPOON SAMPLER
(1.5-inch O.D. X 0.9-inch I.D.)

BDBGM SIZE CORE BARREL
(1.65-inch I.D.)

BW44 SIZE CORE BARREL
(1.75-inch I.D.)

HQ-3 SIZE CORE BARREL
(2.4-inch I.D.)

WATER LEVEL
(level after completion)

WATER LEVEL
(level where first encountered)

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.

2. No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.

3. Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.

4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

5. NA = Not Analyzed

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LOG KEY
Hawes Road Channel Improvements
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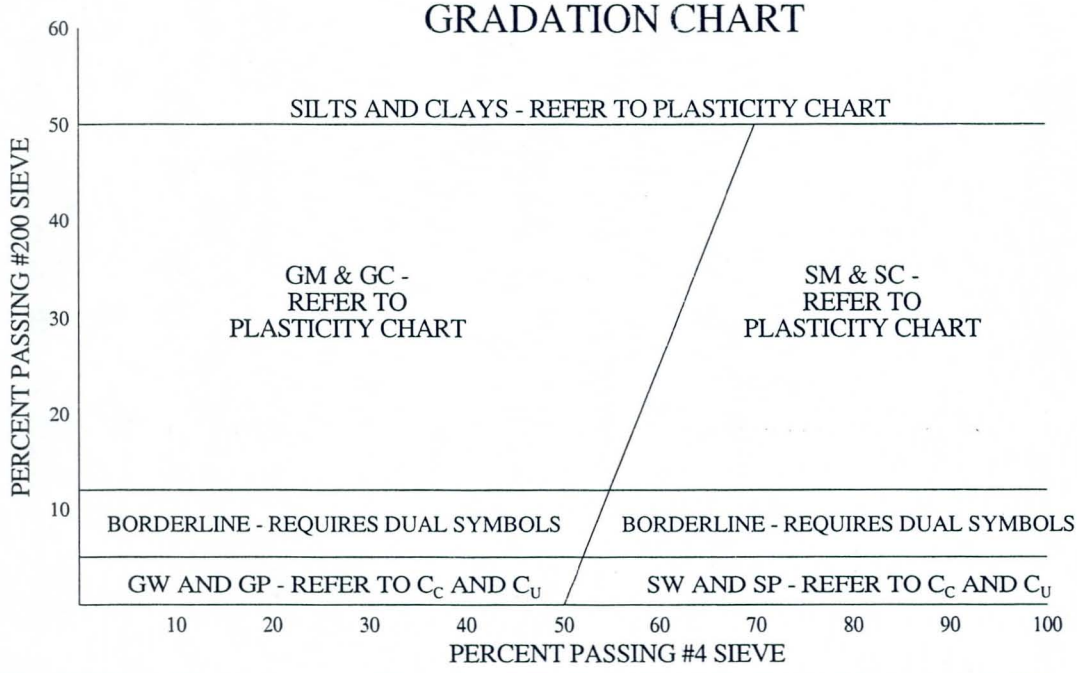
KEY

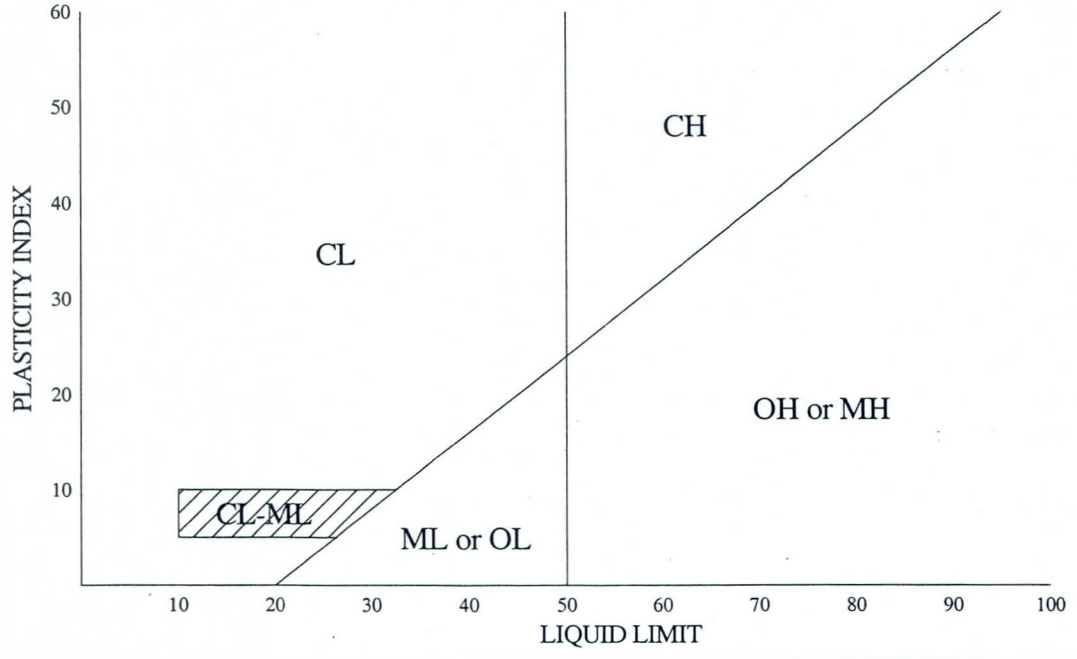
A-2

GEO-KEY_A2_LOG 23536.GPJ cnewman@kleinfelder.com 01/20/2003

GRADATION CHART



PLASTICITY CHART



DEFINITIONS OF SOIL FRACTIONS

SOIL FRACTION	PARTICLE SIZE RANGE
Boulders	Greater than 300mm (12in.)
Cobbles	300mm to 75mm (12in. to 3in.)
Coarse Gravel	75mm to 19mm (3in. to 3/4in.)
Fine Gravel	19mm (3/4in.) to No. 4 sieve
Coarse Sand	No. 4 sieve to No. 10 sieve
Medium Sand	No. 10 sieve to No. 40 sieve
Fine Sand	No. 40 sieve to No. 200 sieve
Fines	less than No. 200 sieve

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CHARTS & DEFINITIONS
Hawes Road Channel Improvements
MCFCD
Hawes Road
Mesa, Arizona

KEY

A-3

GEO-KEY_A3_CHART 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 23.993', W 111 deg. 39.008'			Date Started:	11/20/2002
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	11/20/2002
Drilling Company:	GSI	Equipment:	CME-75	Logged By:	MC
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic			Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 10.0 feet)
			8							SC	**Clayey Sand**, trace gravel, fine to medium grained, light brown, slightly moist, very firm, low plasticity
			18								Surface Condition: Gravelly Surface
			28								
	5		7				93 / 46				Note: moderately firm, slight cementation
			5								
			4								
	10		20								Note: very firm
			20								
			19								Boring terminated at 10.0 feet Sampling stopped at 11.5 feet Caved to 5.0 feet
	15										
	20										

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LOG OF BORING B-1
Hawes Road Channel Improvements
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BORING
B-1
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LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 24.084', W 111 deg. 39.020'			Date Started:	11/20/2002
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	11/20/2002
Drilling Company:	GSI	Equipment:	CME-75	Logged By:	MC
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic			Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION
											0.0 to 10.0 feet
											Surface Condition: Gravelly Surface
			16 16 16				92 / 36			SC-SM	**Clayey Sand to Silty Sand**, fine to medium grained, light brown, slightly moist, very firm, low plasticity, slight cementation
	5		13 12 14				92 / 34				Note: firm, light brown to brown
	10		12 13 9								
											Boring terminated at 10.0 feet Sampling stopped at 11.5 feet Caved to 5.0 feet
	15										
	20										

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LOG OF BORING B-2
Hawes Road Channel Improvements
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BORING
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LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 24.207', W 111 deg. 39.017'		
Groundwater (ft):	No Free Groundwater Encountered		
Drilling Company:	GSI	Equipment:	CME-75
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic		

Date Started:	11/20/2002
Date Completed:	11/20/2002
Logged By:	MC
Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 10.0 feet)
											Surface Condition: Gravelly Surface
			8 16 15							SM	**Silty Sand**, fine to medium grained, brown, slightly moist, very firm, low plasticity, slight cementation
	5		9 6 7				92 / 35				Note: moderately firm
	10		3 4 5					Chloride = 66 ppm Sulfate = 9.5 ppm			Note: trace gravel
											Boring terminated at 10.0 feet Sampling stopped at 11.5 feet Caved to 4.5 feet
	15										
	20										

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LOG OF BORING B-3
Hawes Road Channel Improvements
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BORING
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Latitude & Longitude:	N 33 deg. 24.317', W 111 deg. 39.018'			Date Started:	11/20/2002
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	11/20/2002
Drilling Company:	GSI	Equipment:	CME-75	Logged By:	MC
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic			Total Depth (ft):	10.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 10.0 feet)
											Surface Condition: Gravelly Surface
			8 12 7				95 / 40			SC	**Clayey Sand**, fine to medium grained, brown, slightly moist, firm, low plasticity, slight cementation
	5		10 10 14				86 / 19			SC-SM	**Clayey Sand to Silty Sand**, medium grained, red-brown, slightly moist, firm, low plasticity
	10		16 20 22							SC	**Clayey Sand**, fine to medium grained, brown, slightly moist, very firm, low plasticity
											Boring terminated at 10.0 feet Sampling stopped at 11.5 feet Caved to 6.0 feet
	15										
	20										

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LOG OF BORING B-4
Hawes Road Channel Improvements
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BORING
B-4
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LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 24.436', W 111 deg. 39.003'			Date Started:	11/20/2002
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	11/20/2002
Drilling Company:	GSI	Equipment:	CME-75	Logged By:	MC
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic			Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 15.0 feet)
											Surface Condition: Asphaltic Concrete
			9				79 / 12				4" AC
			9								4" AB
			7							SW-SC	**Clean Sand - Clayey Sand**, trace gravel, fine to medium grained, brown, slightly moist, firm, low plasticity, slight cementation
	5		5					Chloride = 29 ppm Sulfate = 11 ppm			
			9								
			13								
	10		14				74 / 12			SC	**Clayey Sand**, fine to medium grained, light brown, slightly moist, very firm, medium plasticity, slight cementation
			17								
			16								
	15		6								Note: trace gravel, firm
			7								
			10								Boring terminated at 15.0 feet Sampling stopped at 16.5 feet Caved to 7.0 feet
	20										

KLEINFELDER

Drafted By:	MC
Date:	January, 2003
Project Number:	23536

LOG OF BORING B-5
Hawes Road Channel Improvements
MCFCD
Hawes Road
Mesa, Arizona

BORING B-5

LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 24.650', W 111 deg. 39.007'		
Groundwater (ft):	No Free Groundwater Encountered		
Drilling Company:	GSI	Equipment:	CME-75
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger
Hammer Type:	Automatic		

Date Started:	11/20/2002
Date Completed:	11/20/2002
Logged By:	MC
Total Depth (ft):	15.0

ELEVATION (ft) / DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) — Moisture Content (%)	LABORATORY: Liquid Limit — Plasticity Index	LABORATORY: Passing #4 Sieve (%) — Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 15.0 feet)
										Surface Condition: Asphaltic Concrete
		8 7 7							SC	3" AC **Clayey Sand**, fine to medium grained, light brown, slighlty moist, moderately firm, low to medium plasticity
5		8 12 20					Chloride = 102 ppm Sulfate = 20 ppm			Note: very firm, slight cementation
10		6 8 9			40 — 18	87 — 35				Note: firm, medium plasticity
15		10 14 11								Note: brown, very firm
20										Boring terminated at 15.0 feet Sampling stopped at 16.5 feet Caved to 8.5 feet

KLEINFELDER

Drafted By:	MC
Date:	January, 2003
Project Number:	23536

LOG OF BORING B-6
Hawes Road Channel Improvements
MCFCD
Hawes Road
Mesa, Arizona

BORING
B-6
Page 1 of 1

LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 24.773', W 111 deg. 39.006'			Date Started:	11/20/2002
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	11/20/2002
Drilling Company:	GSI	Equipment:	CME-75	Logged By:	MC
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic			Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 15.0 feet)
											Surface Condition: Asphaltic Concrete
			5								4-1/2" AC
			3							SC	**Clayey Sand**, fine to medium grained, brown, slightly moist, soft, low to medium plasticity
			4								
	5		16					Chloride = 15 ppm Sulfate = 15 ppm			Note: light brown, very firm, slight cementation
			28								
			50/5								
	10		5			43 / 21	94 / 42				Note: brown, soft, medium plasticity
			2								
			4								
	15		31								Note: light brown, hard, slight cementation
			41								
			41								Boring terminated at 15.0 feet Sampling stopped at 16.5 feet Caved to 8.0 feet
	20										

KLEINFELDER

Drafted By:	MC
Date:	January, 2003
Project Number:	23536

LOG OF BORING B-7
Hawes Road Channel Improvements
MCFCD
Hawes Road
Mesa, Arizona

BORING
B-7
Page 1 of 1

LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

Latitude & Longitude:	N 33 deg. 24.855', W 111 deg. 39.006'			Date Started:	11/20/2002
Groundwater (ft):	No Free Groundwater Encountered			Date Completed:	11/20/2002
Drilling Company:	GSI	Equipment:	CME-75	Logged By:	MC
Hole Diameter (in):	6 5/8	Drilling Method:	Hollow Stem Auger		
Hammer Type:	Automatic			Total Depth (ft):	15.0

ELEVATION (ft)	DEPTH (ft)	FIELD: Sample Interval	FIELD: Blow Counts per 6" Interval	FIELD: Continuous Pen. Resistance (bpf)	LABORATORY: Dry Density (pcf) / Moisture Content (%)	LABORATORY: Liquid Limit / Plasticity Index	LABORATORY: Passing #4 Sieve (%) / Passing #200 Sieve (%)	LABORATORY: Other Tests	Graphical Log	USCS Classification	DESCRIPTION (0.0 to 15.0 feet)
											Surface Condition: Asphaltic Concrete
			6								4-1/2" AC
			3							SC	**Clayey Sand**, fine to medium grained, brown, moist, soft, low plasticity
			2								
	5		7					Chloride = 157 ppm Sulfate = 24 ppm			Note: trace gravel, firm, slight cementation
			9								
			10								
	10		40			41 / 10	93 / 36			SM	**Silty Sand**, fine to medium grained, light brown, slightly moist, hard, low plasticity, slight cementation
			27								
			50/3								
	15		13								Note: light brown to brown, firm, slight cementation
			20								
			22							GP-SP	**Sandy Gravel with clay**, medium grained, brown, moist, firm, non-plastic, slight cementation
	20										Boring terminated at 15.0 feet Sampling stopped at 16.5 feet Caved to 8.6 feet

KLEINFELDER

Drafted By:	MC
Date:	January, 2003
Project Number:	23536

LOG OF BORING B-8
Hawes Road Channel Improvements
MCFCD
Hawes Road
Mesa, Arizona

BORING
B-8
Page 1 of 1

LAT&LONGITUDE_MARCOS_SOIL 23536.GPJ cnewman@kleinfelder.com 01/20/2003

ATTACHMENT 2

Laboratory Testing

KLEINFELDER

PROJECT: HAWES ROAD CHANNEL
LOCATION: MESA, ARIZONA
REVIEWED BY: M. CONNOLLY

PROJECT NO: 23536
WORK ORDER NO: 02230
DATE SAMPLED: 11/20/2002

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

					COBBLES		GRAVEL								SAND								Silt or	
							Coarse				Fine				Coarse		Medium			Fine			Clay	
Location & Depth	USCS	LL	PL	PI	6"	4"	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#8	#10	#16	#30	#40	#50	#100	#200	Lab #
B-6 @ 10.0' - 11.5'	SC	40	22	18	100	100	100	100	100	100	100	98	98	92	87	73	70	62	52	49	46	41	35	4
B-7 @ 10.0' - 11.5'	SC	43	22	21	100	100	100	100	100	100	100	100	99	97	94	85	82	74	66	62	59	52	42	8
B-8 @ 10.0' - 11.5'	SM	41	31	10	100	100	100	100	100	100	100	100	100	96	93	82	79	69	59	55	52	45	36	12

PERCENT PASSING BY WEIGHT

1335 WEST AUTO DRIVE, TEMPE, ARIZONA PHONE: (480) 763-1200 FAX: (480) 763-1212
ISSUED: 1/15/2003

KLEINFELDER

PROJECT: HAWES ROAD CHANNEL
LOCATION: MESA, ARIZONA
REVIEWED BY: M. CONNOLLY

PROJECT NO: 23536
WORK ORDER NO: 02229
DATE SAMPLED: 11/20/2002

MECHANICAL SIEVE ANALYSIS
GROUP SYMBOL, USCS (ASTM D-2487)

SIEVE SIZES

					COBBLES		GRAVEL								SAND								Silt or Clay	
							Coarse				Fine				Coarse		Medium			Fine				
Location & Depth	USCS	LL	PL	PI	6"	4"	3"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#8	#10	#16	#30	#40	#50	#100	#200	Lab #

PERCENT PASSING BY WEIGHT

B-1 @ 5.0' - 6.5'	SC	28	16	12	100	100	100	100	100	100	100	97	95	95	93	88	86	79	70	66	62	56	46	2
B-2 @ 0.0' - 1.5'	SC-SM	23	17	6	100	100	100	100	100	100	100	100	97	95	92	83	80	71	61	56	53	46	36	4
B-2 @ 5.0' - 6.5'	SC-SM	23	16	7	100	100	100	100	100	100	100	100	97	94	92	81	79	69	58	54	50	44	34	5
B-3 @ 5.0' - 6.5'	SM	20	17	3	100	100	100	100	100	100	100	100	100	96	92	79	75	66	57	53	50	44	35	8
B-4 @ 0.0' - 1.5'	SC	30	18	12	100	100	100	100	100	100	100	100	100	98	95	85	82	74	65	62	58	51	40	10
B-4 @ 5.0' - 6.5'	SC-SM	21	16	5	100	100	100	100	100	100	100	97	94	91	86	65	61	48	37	33	29	25	19	11
B-5 @ 0.0' - 1.5'	SW-SC	20	15	5	100	100	100	100	100	100	100	99	97	86	79	60	55	42	29	24	20	15	12	13
B-5 @ 10.0' - 11.5'	SC	36	19	17	100	100	100	100	100	100	100	99	96	88	74	55	51	41	31	27	24	19	12	15

1335 WEST AUTO DRIVE, TEMPE, ARIZONA PHONE: (480) 763-1200 FAX: (480) 763-1212
ISSUED: 1/15/2003

KLEINFELDER

PROJECT:	HAWES ROAD CHANNEL	**PROJECT NO:**	23536
LOCATION:	MESA, ARIZONA	**WORK ORDER NO:**	02229
MATERIAL:	SEE BELOW	**LAB NO:**	SEE BELOW
SAMPLE SOURCE:	SEE BELOW	**DATE SAMPLED:**	11/20/2002
		REVIEWED BY:	M. CONNOLLY

PH & RESISTIVITY (AZ 236)

LAB NO	SAMPLE SOURCE	MATERIAL	RESISTIVITY (Ohm-cm)	pH
14	B-1 & B-3 @ 0.0' - 1.5', B-1, B-2, & B-4 @ 10.0' - 11.5', & B-5 @ 5.0' - 6.5'	SOIL SAMPLES	1,604	8.4

KLEINFELDER

PROJECT:	HAWES ROAD CHANNEL	**PROJECT NO:**	23536
LOCATION:	MESA, ARIZONA	**WORK ORDER NO:**	02230
MATERIAL:	SEE BELOW	**LAB NO:**	SEE BELOW
SAMPLE SOURCE:	SEE BELOW	**DATE SAMPLED:**	11/20/2002
		REVIEWED BY:	M. CONNOLLY

PH & RESISTIVITY (AZ 236)

LAB NO	SAMPLE SOURCE	MATERIAL	RESISTIVITY (Ohm-cm)	pH
3, 7, & 11	B-6, B-7, & B-8 @ 5.0' - 6.5'	SOIL SAMPLES	966	8.1

KLEINFELDER

PROJECT:	HAWES ROAD CHANNEL			**JOB NO:**	23536
LOCATION:	MESA, ARIZONA			**WORK ORDER NO:**	02229
MATERIAL:	SOIL SAMPLE			**LAB NO:**	9
SAMPLE SOURCE:	B-3	**DEPTH:**	10.0' - 11.5'	**TESTED BY:**	IAS LABORATORIES

ANALYSES RESULTS

ANALYSIS	RESULTS	UNITS
CHLORIDE	66	ppm
SULFATE	9.5	ppm

KLEINFELDER

PROJECT:	HAWES ROAD CHANNEL	**JOB NO:**	23536
LOCATION:	MESA, ARIZONA	**WORK ORDER NO:**	02229
MATERIAL:	SOIL SAMPLE	**LAB NO:**	14
SAMPLE SOURCE:	B-5 **DEPTH:** 5.0' - 6.5'	**TESTED BY:**	IAS LABORATORIES

ANALYSES RESULTS

ANALYSIS	RESULTS	UNITS
CHLORIDE	29	ppm
SULFATE	11	ppm

KLEINFELDER

PROJECT:	HAWES ROAD CHANNEL			**JOB NO:**	23536
LOCATION:	MESA, ARIZONA			**WORK ORDER NO:**	02230
MATERIAL:	SOIL SAMPLE			**LAB NO:**	3
SAMPLE SOURCE:	B-6	**DEPTH:**	5.0' - 6.5'	**TESTED BY:**	IAS LABORATORIES

ANALYSES RESULTS

ANALYSIS	RESULTS	UNITS
CHLORIDE	102	ppm
SULFATE	20	ppm

KLEINFELDER

PROJECT:	HAWES ROAD CHANNEL			**JOB NO:**	23536
LOCATION:	MESA, ARIZONA			**WORK ORDER NO:**	02230
MATERIAL:	SOIL SAMPLE			**LAB NO:**	7
SAMPLE SOURCE:	B-7	**DEPTH:**	5.0' - 6.5'	**TESTED BY:**	IAS LABORATORIES

ANALYSES RESULTS

ANALYSIS	RESULTS	UNITS
CHLORIDE	15	ppm
SULFATE	15	ppm

KLEINFELDER

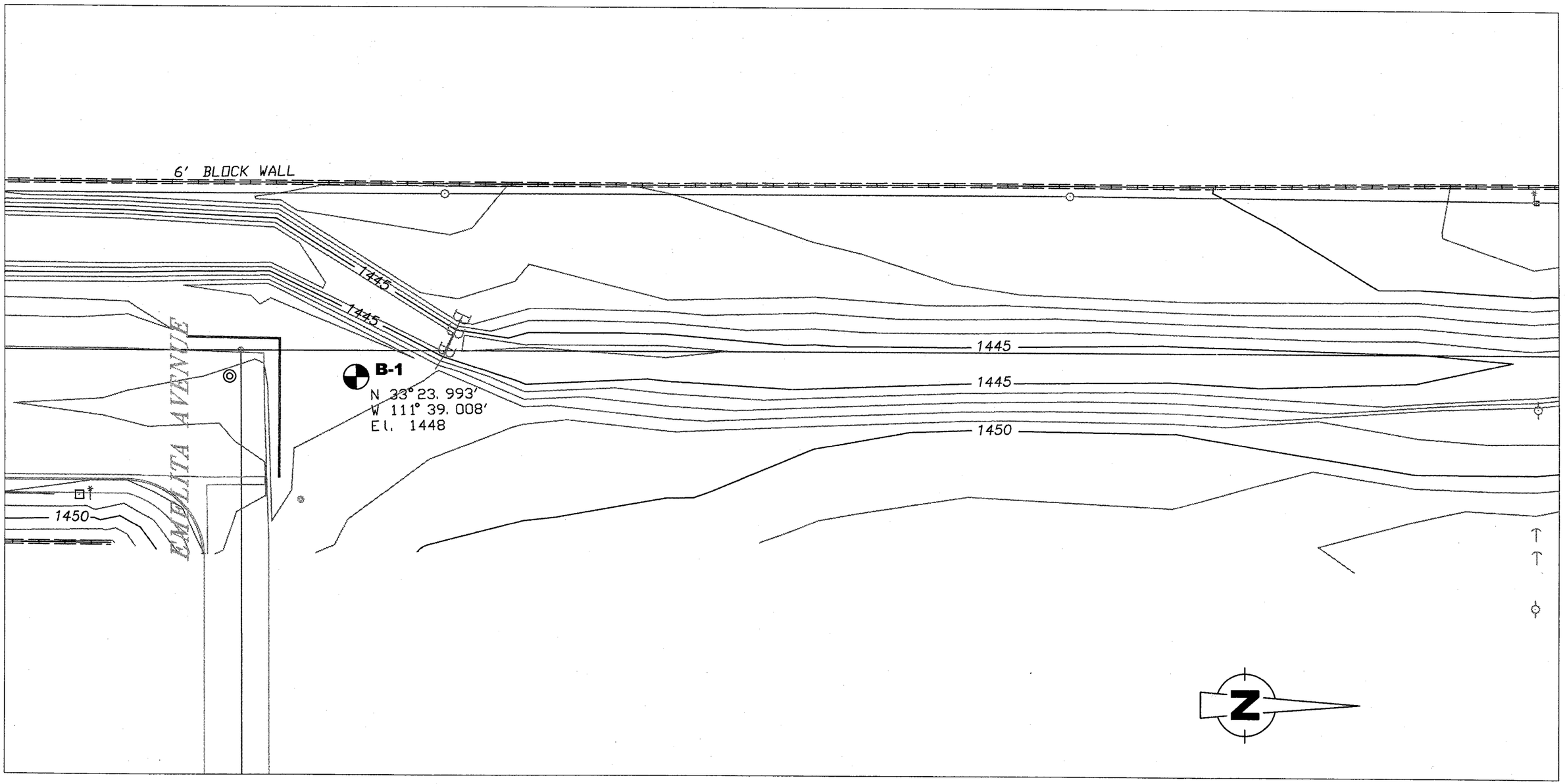
PROJECT:	HAWES ROAD CHANNEL			**JOB NO:**	23536
LOCATION:	MESA, ARIZONA			**WORK ORDER NO:**	02230
MATERIAL:	SOIL SAMPLE			**LAB NO:**	11
SAMPLE SOURCE:	B-8	**DEPTH:**	5.0' - 6.5'	**TESTED BY:**	IAS LABORATORIES

ANALYSES RESULTS

ANALYSIS	RESULTS	UNITS
CHLORIDE	157	ppm
SULFATE	24	ppm

ATTACHMENT 3

Site Plan



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

BORING LOCATIONS

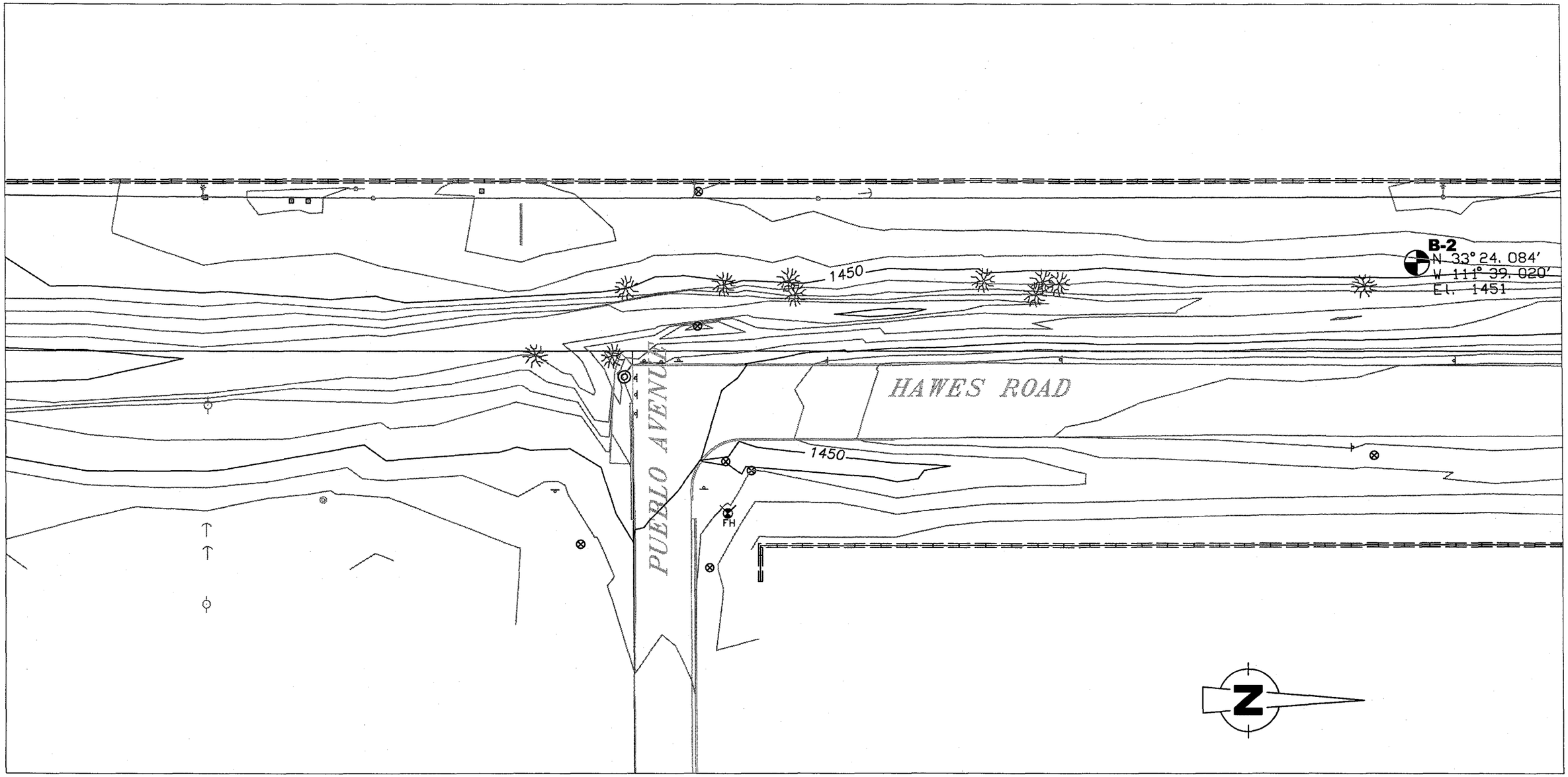
PLATE
1a

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002

g:\graphics\projects\####\####.dwg /dkc



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

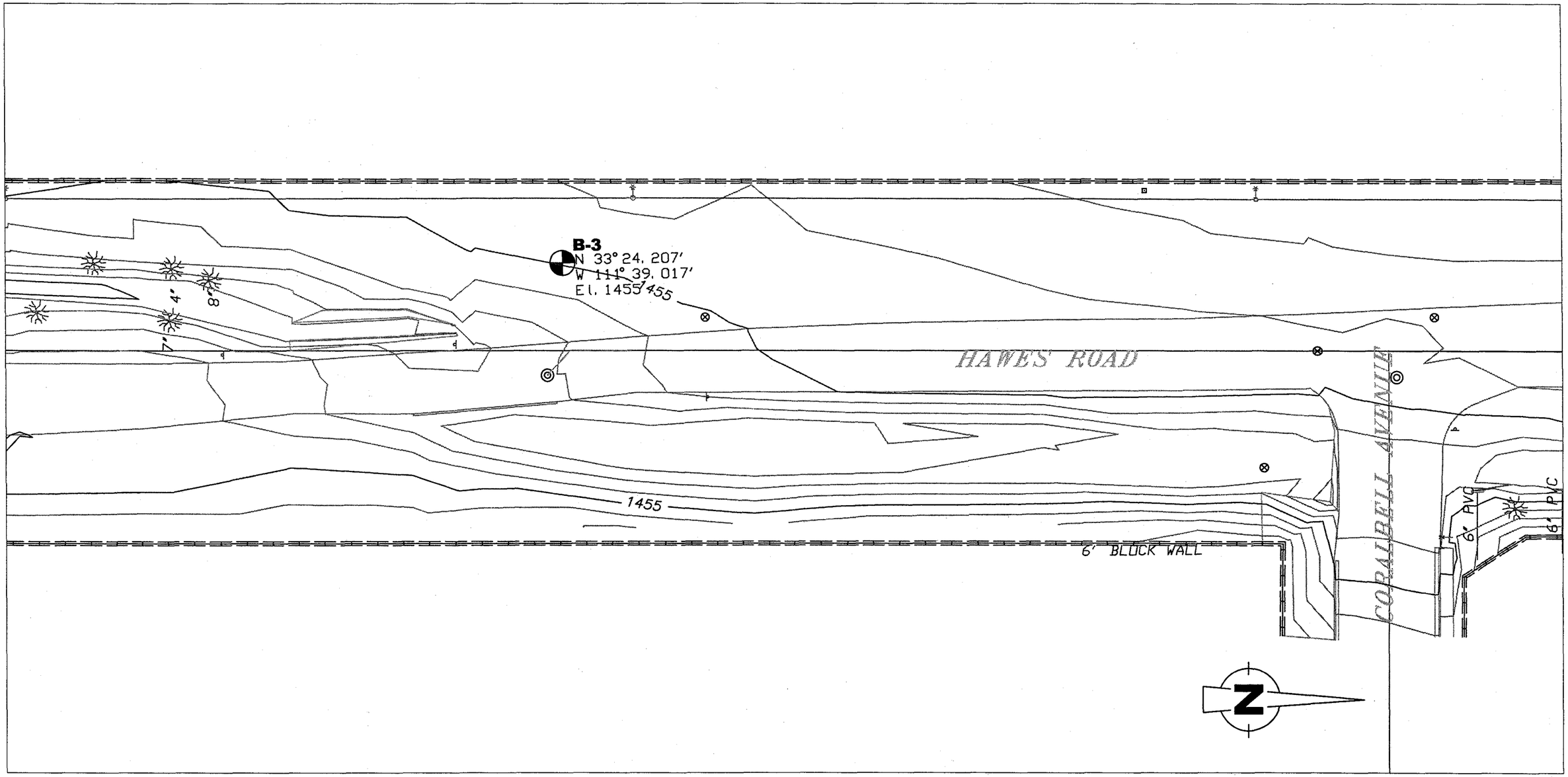
BORING LOCATIONS

PLATE
1b

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

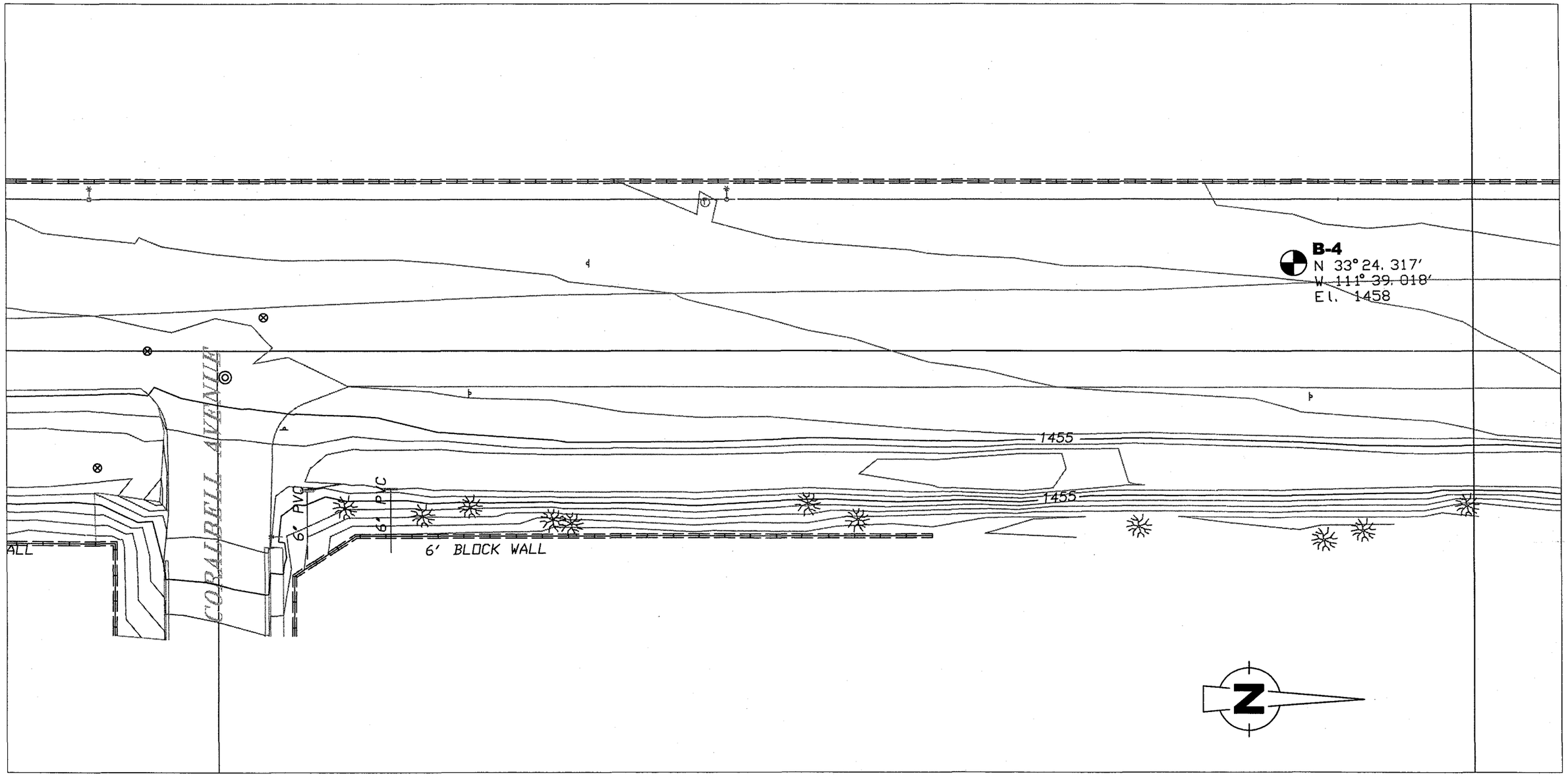
BORING LOCATIONS

PLATE
1C

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

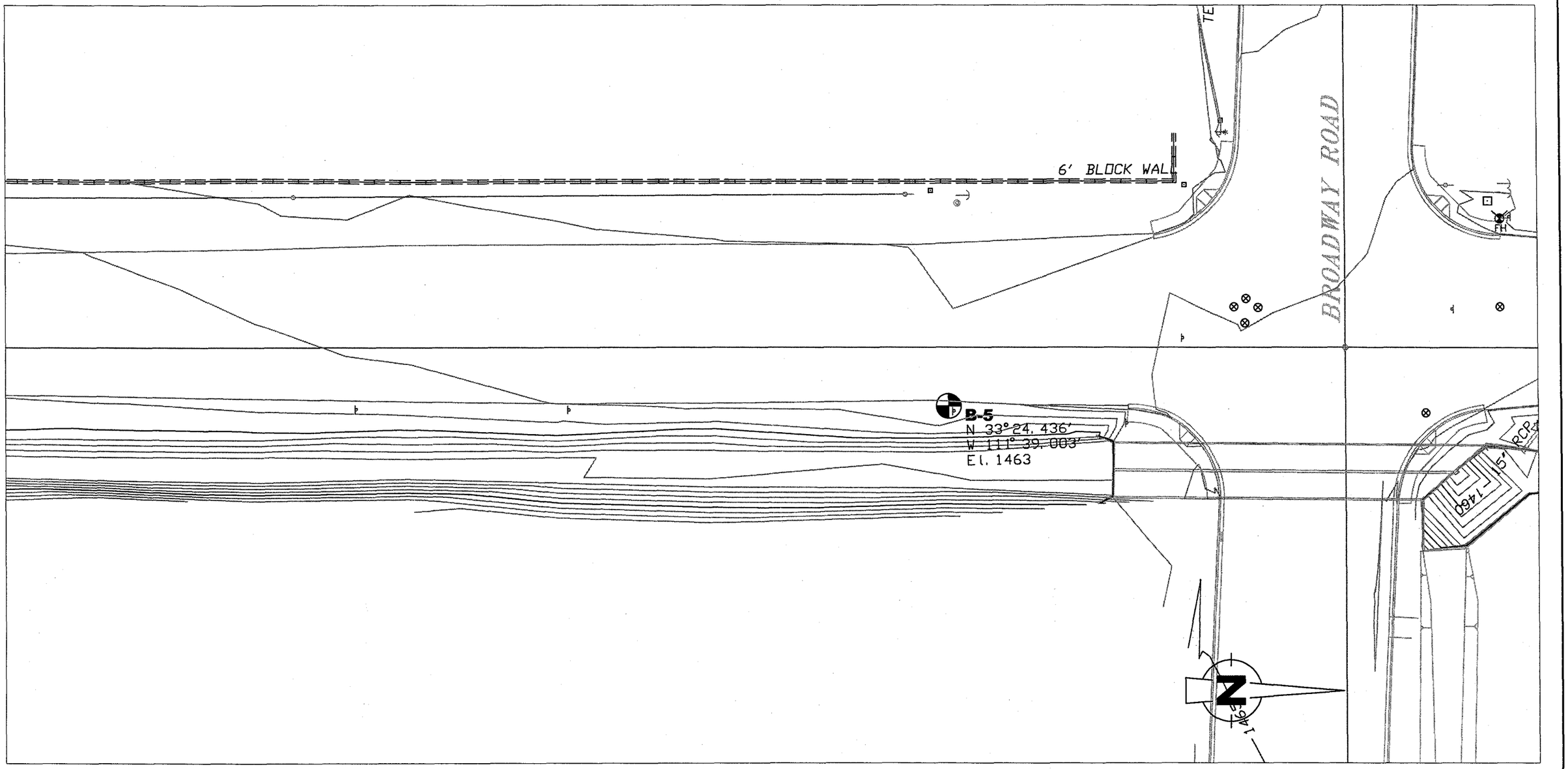
BORING LOCATIONS

PLATE
1d

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL, AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

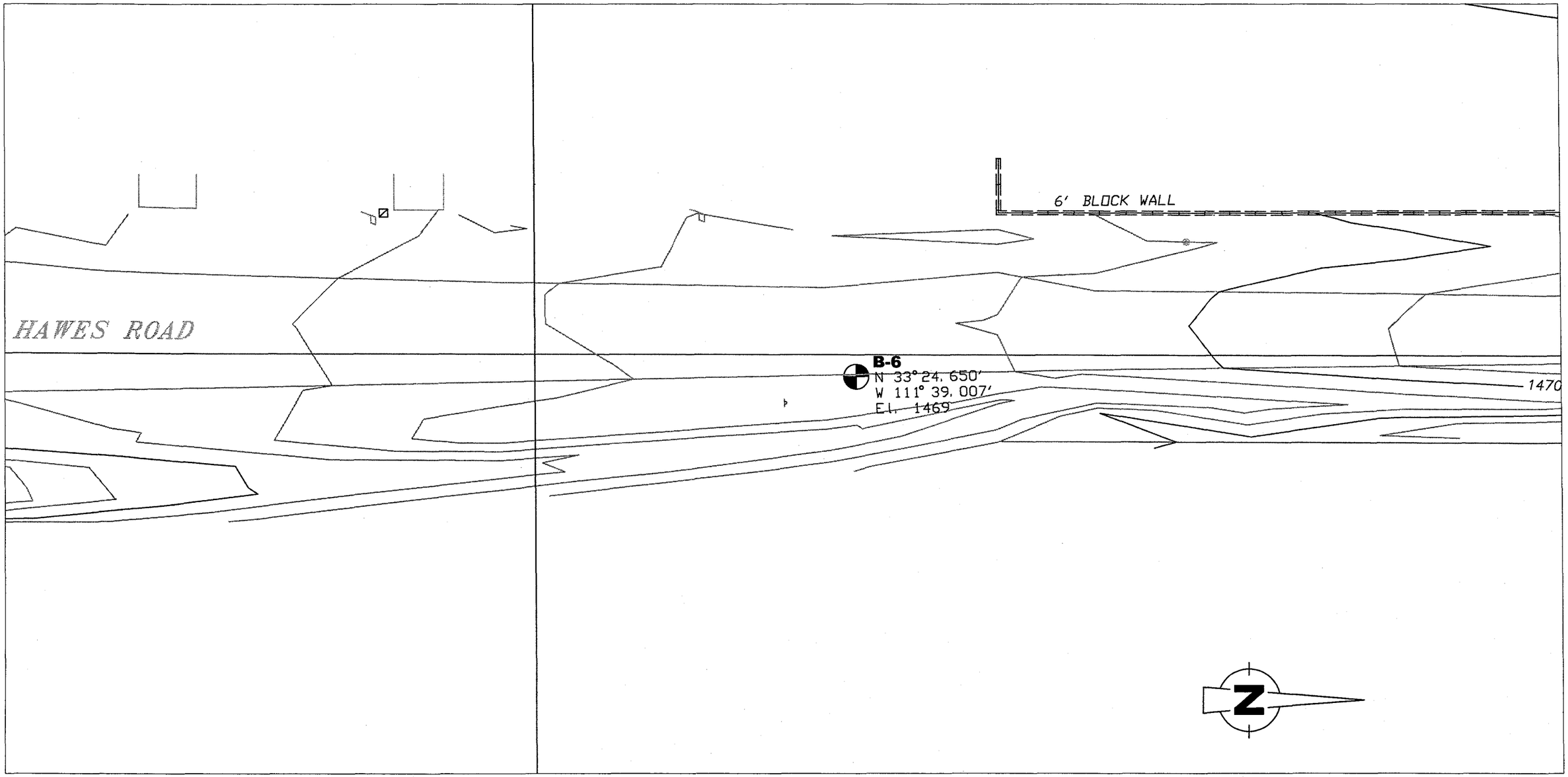
BORING LOCATIONS

PLATE
1e

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

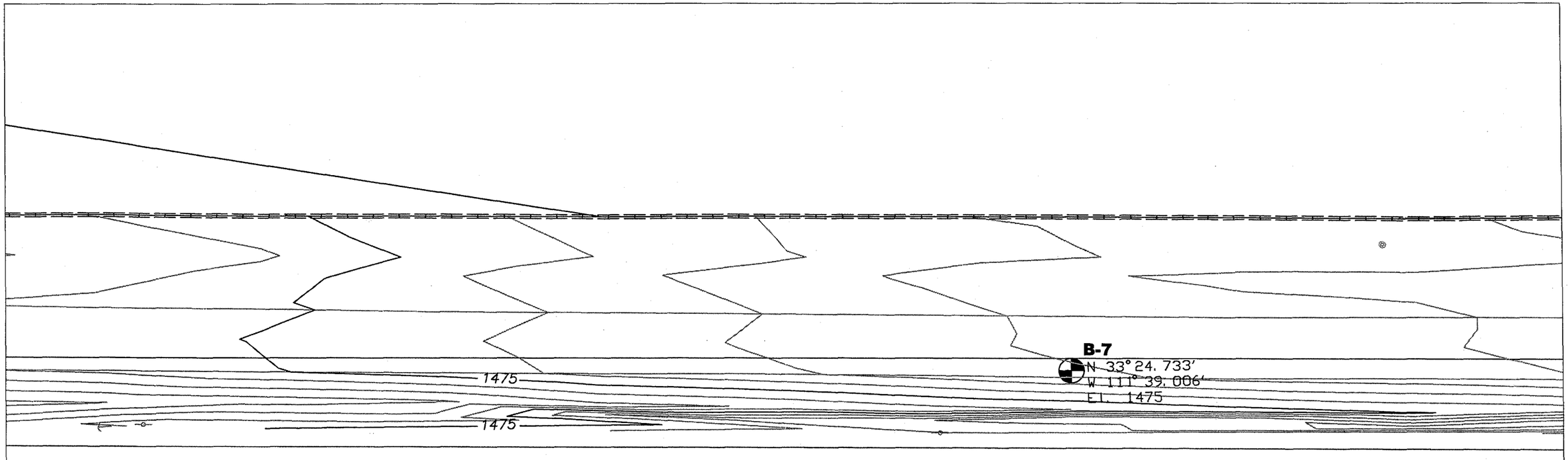
BORING LOCATIONS

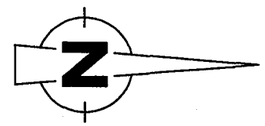
PLATE
1f

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002





0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

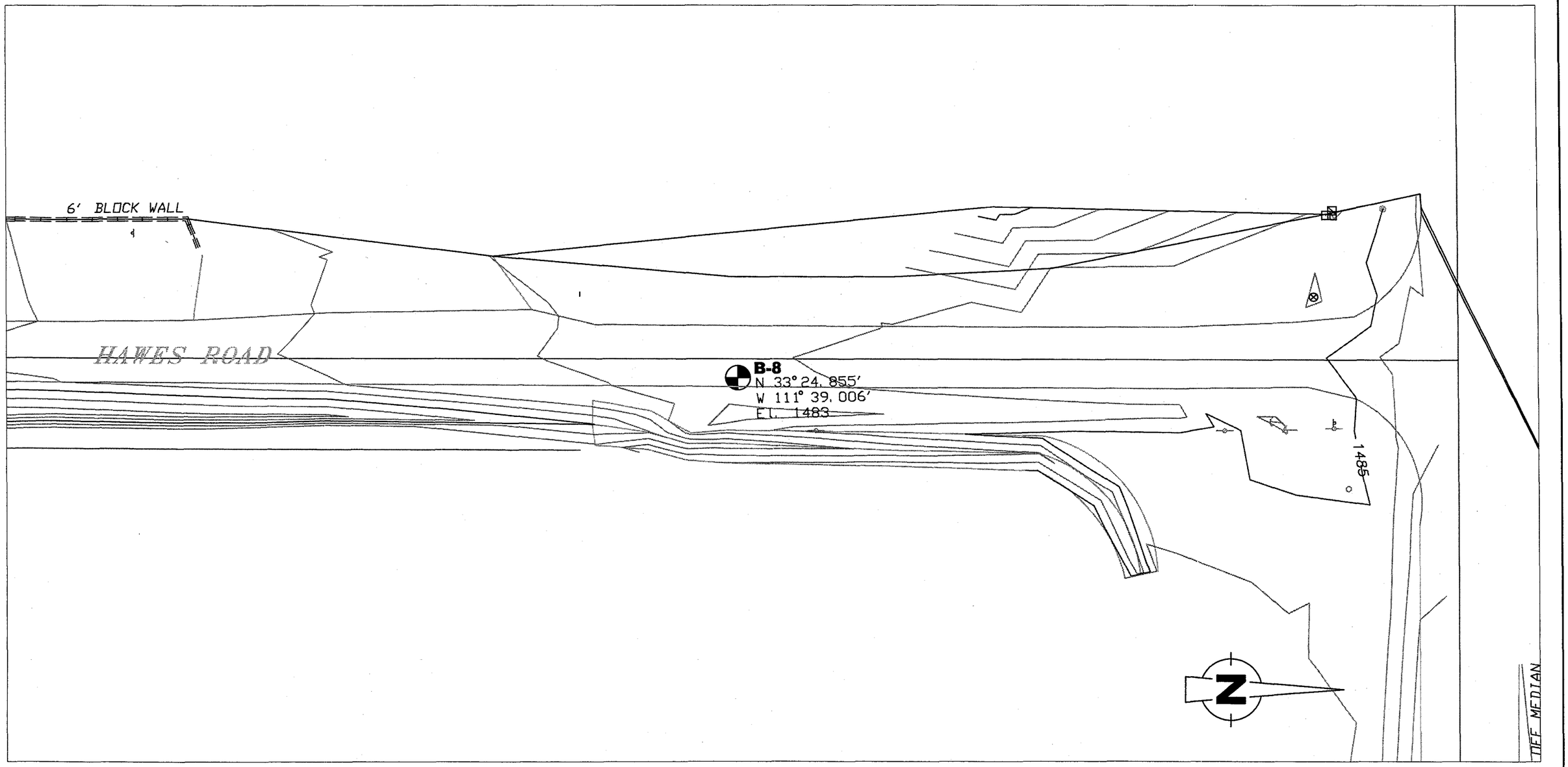
BORING LOCATIONS

PLATE
1g

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002



0 20' 40'

SCALE IN FEET
1"=20'

Hawes Road Channel Improvments
Emelita Avenue to Main Street
FCD Project Control No. 4420530

BORING LOCATIONS

PLATE
1h

KLEINFELDER
ENVIRONMENTAL, GEOTECHNICAL,
AND CONSTRUCTION SERVICES

PROJECT NUMBER 23536

December 2002