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GEOTECHNICAL INVESTIGATION REPORT

**ZONIA MINE
KIRKLAND JUNCTION
YAVAPAI COUNTY
ARIZONA**

PREPARED FOR:

**ARIMETCO, INC.
6245 E. BROADWAY, SUITE 350432
TUCSON, ARIZONA 85008**

PREPARED BY:

**DEVELOPMENT ENGINEERING, INC.
5110 NORTH 40TH STREET, SUITE 210
PHOENIX, ARIZONA 85018**

OCTOBER 1993

DEI NO. 2718

October 8, 1993

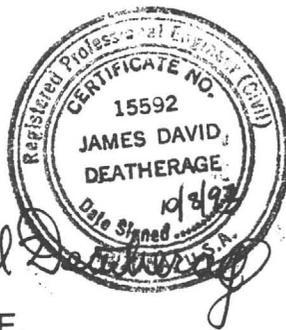
Mr. Leonard Heuberger
Arimetco, Inc.
6245 E. Broadway
Suite 350
Tucson, Arizona 85711

Subject: **GEOTECHNICAL INVESTIGATION REPORT
ZONIA MINE
Kirkland Junction, Arizona
DEI Job No. 2718**

Dear Mr. Heuberger:

DEVELOPMENT ENGINEERING, INC., (DEI), herewith submits our report summarizing the geotechnical investigation conducted for the above referenced project. The report includes the results of test drilling and laboratory analysis along with our discussion and recommendations for the project. With consideration for the recommendations for site preparation, the sites can be suitable for the proposed construction. The review of the retaining wall at the proposed EW building site reveals that the wall sections will not be stable if the vat leach cells are removed from the north side of the retaining wall.

Respectfully Submitted,



J. David Deatherage, P.E.
Geotechnical Services Manager

Copies: Addressee (2)

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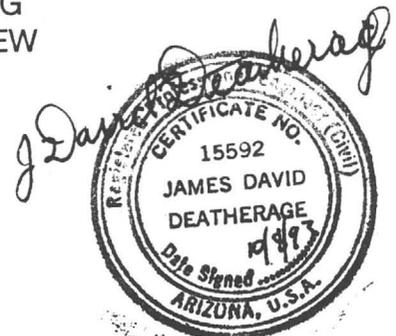
FIGURES (Figures follow Text)

- FIGURE 1 SITE LOCATION MAP
- FIGURE 2 SITE VICINITY MAP
- FIGURE 3 SX-EW SITE BORING LOCATIONS
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DEI FIELD EXPLORATION AND LABORATORY TESTING
SUMMARY OF RETAINING WALL STRUCTURAL REVIEW

Project No. 2718



GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

1.0 INTRODUCTION

DEVELOPMENT ENGINEERING, INC. (DEI) was retained by Arimetco, Inc. (Arimetco) on September 10, 1993 to perform a geotechnical investigation of the proposed new SX-EW plant and truck maintenance areas at the Zonia Mine, near Kirkland Junction. DEI understands that the Zonia Mine operated as a copper mine with heap leaching during the 1970's, and that it is Arimetco's intention to reopen the mine and conduct additional heap leaching.

This report presents the results of a soils investigation at the site of the proposed new SX-EW plant and truck maintenance facility for the mine. The new SX-EW plant is to be located in a portion of the NW/4 of the SW/4 of Section 12, and the truck maintenance facility is to be located in portions of the SE/4 of the SE/4 of Section 11, and portions of the SW/4 of the SW/4 of Section 12, Township 11 North, Range 4 West, Gila and Salt River Base and Meridian, Yavapai County, Arizona.

The Zonia Mine is approximately six miles by unpaved road from State Route 89. The site is shown on the site location map presented as Figure 1. The turn off to the mine leads southeast from State Route 89, starting approximately 1,500 feet south of Kirkland Junction. The mine office building is the first structure encountered after entering the locked gate at the entrance of the mine.

2.0 PURPOSE AND SCOPE OF SERVICES

The purpose of this geotechnical investigation is to generally characterize the subsurface conditions at the two sites, and to develop recommendations for foundation design criteria. The scope of services included:

1. Recovery and testing of concrete cores from the existing retaining wall in the area of the proposed new SX-EW plant. An assessment of the retaining wall capacity was performed.
2. Exploration of subsurface conditions by drilling five borings and excavating nine backhoe testpits.
3. Visual classification and continuous logging of soils encountered during the subsurface work.

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

4. Laboratory testing of selected soil samples.
5. Evaluation of pertinent engineering characteristics of the soils encountered based on visual observation and laboratory testing.
6. Preparation of this report presenting physical data acquired and geotechnical design recommendations.

3.0 PROPOSED CONSTRUCTION

DEI was shown the proposed new SX-EW plant location by Mr. Larry Ayres of Western States Engineering and Construction, Inc. (Western States) during our initial site visit on August 27th, 1993. Mr. Joe Smith of Arimetco showed DEI the truck maintenance facility location on September 21, 1993. A site vicinity map is presented as Figure 2.

The proposed SX-EW plant is to be located approximately 400 feet southeast of the mine office building, in the original Zonia Mine plant area. The new plant will include a EW building 40 feet wide, 260 feet long, and 25 to 30 feet high. The EW building will be located in the fill area above and to the south of an existing retaining wall. Maximum column loads for the EW building were estimated by Western States to be 26 kips dead load, 34 kips dead load and live load, and 54 kips dead load, live load, and crane load. Foundation loading estimates for the tank farm and SX plant were not available at the time of the investigation. The SX-EW plant area is shown on Figure 3.

The truck maintenance facility will be located approximately 2,000 feet to the southwest of the SX-EW plant, between Leach Basin 1 and Leach Basin 2 as shown on Figure 2. The facility is to be situated on the east side of a hill in an elevated saddle between the two leach basins.

The truck facility will consist of a square three bay building 90 feet on a side with an adjacent 60 foot by 35 foot truck wash pad. The building will be 32 to 46 feet high, with maximum column loads estimated by Western States to be 71.5 kips dead load, 111.5 kips dead load and live load, and 162 kips dead load, live load, and crane load. A site map of the approximate truck maintenance area is presented on Figure 4.

4.0 SITE CONDITIONS

DEI's field work for the project was performed on September 21 and 22, 1993. The EW building site consists of a relatively level upper pad area bounded on the south by

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENENCE SITES

the unpaved mine access road and on the north by a retaining wall approximately 12 feet high. The upper pad area above the retaining wall is paved with a concrete slab. The upper pad area contained five reinforced concrete vat leach vaults on the west side, and a large above ground diesel fuel storage tank on the east side. A crane was parked immediately east of the fuel tank. Beneath and north of the retaining wall is the proposed new Tank Farm area. This area contains a series of reinforced concrete vat leach cells that are connected to the retaining wall. North of the vat leach cells is a concrete lined pad area with short separation walls. A large ground mounted transformer is located in the east side of this pad area, and pole mounted power lines run southeast from the mine office building through the site to this transformer and continue southeast. Beyond the pad area is the proposed SX facility area which currently contains an access road that separates the pad area from two concrete lined reservoirs and a equipment and supply building.

The truck maintenance area is in a rock hillside and extends out over an area of fill that was originally part of the leach pile in the old mine leaching area. Little vegetation is present in the SX area, and vegetation in the truck maintenance area is limited to the undisturbed hillside in the western area of the site.

5.0 INVESTIGATION

The field explorations were planned to obtain soils and geologic information for the proposed construction. The work was coordinated by J. David Deatherage, P.E. of this firm. Field work was performed by Dustin Watson, who maintained a continuous detailed log of materials and conditions encountered in each boring, assisted in extracting relatively undisturbed and SPT samples at frequent depth intervals and recorded various other pertinent site data. The relative density of the materials was evaluated by the driving resistance of the samplers. Relatively undisturbed soil samples were extracted with a 2.5 inch diameter (I.D.) ring sampler. The Unified Soil Classification System was used in classifying the soils encountered. All borings were backfilled at the completion of the drilling. Logs of the borings are presented in the Appendix. The subsurface exploration was completed on September 22, 1993.

Laboratory tests were performed on samples obtained from the borings to aid in classifying the soils and to evaluate their physical and engineering characteristics. Due to the coarse grain texture of the recovered soils, the testing was limited to moisture content, density, and pH determinations. The results of the laboratory testing are presented on the boring logs in the Appendix.

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

5.1 SX-EW Plant

The subsurface conditions at the SX-EW site were explored by drilling three 8-inch diameter, hollow-stem auger borings at the locations shown on Figure 3. The borings were drilled with a CME-75 drill rig and extended to depths ranging from 11 to 39.5 feet below the existing site grades.

The three borings in the SX plant were all placed through 12 inch diameter holes that had been cored out from the concrete slabs. The borings revealed the following subsurface conditions:

From the surface to a depth of between 1 to 7 feet, the soils underlying the site were fill soils consisting of clays with silt, sand, gravel and cobbles. The soils were slightly moist, medium in plasticity, and hard in consistency.

Underlying the surface fill soils are 7 to 17 feet of clays with silt, sand, gravel and cobbles. These soils were slightly moist to dry, low to medium in plasticity, and hard in consistency. One boring encountered auger refusal due to cobbles within this strata at a depth of 11 feet below the surface.

Underlying the clays in two of borings was a phyllite metamorphic rock that extended through the depth of the investigations. The rock was typically moderately weak, highly to completely weathered, and thinly foliated.

Ground water was not encountered in any of the borings.

5.2 Truck Maintenance Building

The subsurface conditions at the Truck Maintenance Building site were explored by drilling two 8-inch diameter, hollow-stem auger borings and excavating nine backhoe test pits at the locations shown on Figure 4. The borings were drilled with a CME-75 drill rig and extended to depths ranging from 4 to 22.5 feet below the existing site grades. The test pits were excavated with a Ford 555A backhoe to depths ranging from 1 to 12 feet below the existing grades.

The two borings and test pits revealed the following subsurface conditions:

On the eastern portion of the site, the upper soils consist of sand, silt, gravel and cobble fill. From the surface to a depth of between 1 to 7 feet, the fill soils were dry, low in plasticity, and medium dense. The fill soils were acidic

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

as indicated by a pH of 4.0 encountered from one tested sample. Portions of this fill may have been leached in the past. The fill soil thickness increases to the east and decreases to the west, feathering into the undisturbed hillside that makes up the western portion of the site.

Underlying the surface fill soils are 1 to 4 feet of soils consisting of clay and silt with sand, gravel and cobbles. These soils were slightly moist, medium in plasticity, and hard in consistency. These soils were buried under the mining activity fill work during the earlier mining activity at the site, and represent the original surficial alluvium soils.

Underlying the clay and silt strata was a phyllite metamorphic rock that extended through the depth of the investigations. The rock was typically moderately weak, highly to completely weathered, and thinly to very thinly foliated. On the hillside in the western portion of the site the rock is overlain with thin to no thickness of alluvium. Backhoe and auger refusal was encountered in numerous locations within the phyllite rock.

Ground water was not encountered in any of the borings or test pits. A shallow pond of collected surface water was present immediately east of the investigated area.

5.3 EW Building Retaining Wall Review

As part of the proposed construction, Western States plans to locate the new EW building on the raised pad above the proposed tank farm area. An existing retaining wall is present that separates the upper EW pad area from the lower tank farm area. The retaining wall is as high as 12 feet, and consists of three different sections. The east portion of the retaining wall is approximately 75 feet long, the center portion is approximately 20 feet long, and the west portion is approximately 52 feet long. The western portion of the retaining wall is staggered north of the center and eastern portions of the wall. The center and eastern portions of the retaining wall exhibits evidence of deterioration. The field investigation by DEI developed the information relative to the existing conditions of the retaining wall to assist in a review of the structural capacity of the retaining wall.

Numerous reinforced concrete cells are attached to the side of the retaining wall, starting on the west side of the center section and continuing across the wall to the east side of the eastern section. The cells were apparently used in the vat leaching operations during the earlier copper processing operations at the mine. The acidic solutions used in that process have deteriorated the concrete in the cells and also into

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

the wall of the retaining wall. Reinforcing bars are exposed in several locations in the cells and in the retaining wall. The exposed reinforcing in the retaining wall is confined to the top of the wall.

DEI mobilized a concrete coring company to the site on September 21, 1993 and cored a total of 20 concrete cores ranging in diameter from 2 to 12 inches. Nine different areas were cored, including two locations in the concrete slab above the retaining wall, four locations in the retaining wall, two locations in the tank farm area north and below the retaining wall, and one area in the center of the proposed SX facility. Twelve inch cores were placed in three of the areas to allow soil drilling through the concrete slabs.

Soils backfill adjacent to the retaining wall were observed through the core holes in the wall at two locations. In each location the backfill against the wall consisted of fill soils consisting of clays with silt, sand, gravel and cobbles. The soils were slightly moist, medium in plasticity, and hard in consistency.

Measurement of slab and wall thickness based on the lengths of the recovered cores were as follows:

Upper Slab	4.0 to 5.0 inches thick, reinforced with wire mesh
Retaining Wall	
East Section	8.75 to 9.6 inches thick, reinforced with vertical No. 5 bars 10 inch on center. Horizontal No. 3 bar 10 inch on center.
Center Section	8.0 inches thick, reinforced with horizontal and vertical No. 4 bars 10 inch on center.
West Section	Assumed similar to east section.
Slab in Tank Farm	5.5 to 5.75 inches thick
Slab in SX plant	8.0 inches thick

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

Compression testing was performed on seven selected cores. Results were as follows:

LOCATION	COMPRESSIVE STRENGTH (PSI)
Upper Slab	4610 to 6500
East Retaining wall-Top	4980
East Retaining Wall-Bottom	5710
Center Retaining Wall-Top	3950
Slab in Tank Farm	5600
Slab in SX Plant	3750

Given the concrete dimensions measured in the field and the observed reinforcing patterns, the structural capacities of the retaining wall sections were analyzed by a DEI structural engineer using measured and assumed data. The analysis was performed with the Cantilevered Retaining Wall computer program Retain Pro 3. The center and the eastern portions of the wall were modelled separately, without the benefit of the lateral restraint provided by the attached reinforced concrete vat leaching cells. A summary of the analysis and assumed details of the wall sections are presented in the Appendix. The analysis reveals that the walls are not stable for even the existing loading conditions if the vat leach cells are removed. The computed moments in the base of the retaining walls exceed the allowable moments by a considerable margin. DEI observed that there were no drainage holes in the base of the retaining wall.

6.0 DISCUSSION AND RECOMMENDATIONS

Retaining Wall:

The existing retaining wall in the proposed new SX-EW plant area will require additional structural support if the reinforced concrete leaching vats are removed. Several alternatives are possible to allow the EW building construction above the retaining wall. One alternative considers removing only portions of the vat leach cells, leaving sections attached to the retaining wall to act as buttresses. Another possible alternative would be construction of new reinforced concrete buttresses tied to the wall. A third alternative would involve the installation of drilled soil tiebacks. DEI also suggests that weep holes be installed in the base of the retaining wall to reduce any possible fluid pressure that may develop behind the retaining wall.

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENENCE SITES

Geotechnical Conditions:

Based on the result of field and laboratory testing, the upper fill and surficial soils at the SW-EW site are medium dense to hard, and would be expected to provide firm support for spread footing loadings, but be somewhat sensitive to increases in moisture. Recommended design criteria for foundations bearing on these soils are presented in the following sections. It is possible that areas of the SX-EW site will have subsurface profiles different from those observed in the three borings. Areas of loose fill may be present in areas of the site not investigated during DEI's field work, particularly in the SX area which had not been defined at the time of the investigation. If critical structures are to be located in areas of the site not in the vicinity of the borings, DEI recommends that additional investigations be performed to assess the subsurface conditions at the sites.

Based on the results of field and laboratory testing, the fill soils at the truck maintenance area are loose to medium dense, and would be expected to provide inadequate support for spread footing loadings. These soils are also acidic, and would be expected to be aggressive to concrete structures. DEI recommends that the truck building be situated on the hillside such that the portion of the building and associated structures that extends over the fill is minimized. The fill areas that remain under the proposed building should be excavated and removed. New import fill that is not acidic should be placed as engineered compacted fill in the place of the removed fill according to the following recommendations.

Settlements of foundations constructed according to DEI recommendations and bearing on site soils at existing moisture contents are estimated to be less than 1 inch. An additional 1 to 2 inches of vertical movement is estimated for foundations bearing on the site fill soils that become wetted. Much of this movement would be differential in nature, with the maximum movement corresponding to thicker areas of the underlying fill that become wetted. Settlements of spread footings founded on the phyllite rock would be less than 1/2 inch for the suggested bearing pressures.

Structural design for the footings and interior and exterior concrete slabs should consider potential settlement movements. Particular attention should be directed to the site grading and drainage requirements discussed in the following sections, in order to reduce the possible future foundation movements.

Construction criteria for foundations and pavement bearing on site soils are presented in the following sections. Site grading and drainage measures are recommended to reduce the possibility of foundations movements induced by wetting of moisture sensitive soils. These recommendations are presented in lieu of alternative foundation

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

construction involving over excavation of the subgrade soils or supporting the structure on drilled foundations with grade beams and a suspended floor system. Details on these more positive alternatives can be developed if desired.

Foundations:

The following recommendations are presented for footings bearing on prepared alluvium and structural fill, and footings bearing on undisturbed native subgrade soils:

<u>Foundation Loading</u>	<u>Bearing Pressures</u>
Dead plus live loads	3,000 psf

The following recommendations are presented for footings bearing on undisturbed native phyllite rock:

<u>Foundation Loading</u>	<u>Bearing Pressures</u>
Dead plus live loads	14,000 psf

Square footings should have a minimum width of 2 feet, and continuous footings should be a minimum of 1.33 feet wide. Footings should have a minimum depth below lowest adjacent finished grade of 2.0 feet. Bearing pressures can be increased by one-third when considering wind or seismic forces.

The footing excavations should be observed by a representative of the geotechnical engineer. Excessively moist or unstable soils or rock should be removed from the excavation and replaced with aggregate base material compacted to a minimum of 95 percent of the ASTM D698 maximum density, within two percent of the optimum moisture content.

Site Grading:

Site grading should include the removal of vegetation and loose soil from under the proposed structures and from all areas receiving fill. Subgrade preparation is necessary in areas not already covered with structures or concrete slabs. In the truck maintenance area all fill soils should be removed from under the planned structures and replaced with engineered fill. The upper foot of remaining subgrade soils should be scarified, moisture conditioned, and compacted to a minimum of 95 percent of the ASTM D-698 maximum density, within two percent of the optimum moisture content.

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENANCE SITES

All other fill should be moisture conditioned and compacted to a minimum of 95 percent of the ASTM D-698 maximum density, within two percent of the optimum moisture content. Plasticity index of fill soils should be limited to less than 15.

Surface Drainage:

Building roof and surface drainage should be diverted away from the foundation and retaining wall areas. Site grading should be constructed so that water will not pond adjacent to the buildings or structures, and drainage is not impeded. Where foundations are not protected by directly adjoining concrete slabs or pavement, a positive grade must be maintained away from the buildings or structures.

Lateral Loads:

Passive soil resistance against edges of footings, stem walls, etc., with properly compacted backfill, should be considered as being equal to forces exerted by a fluid of 250 pounds per cubic foot. For computing the lateral resistance offered between the bases of footings and slabs bearing on structural fill or rock, a coefficient of friction of 0.45 is recommended. For native subgrade soils a coefficient of 0.30 is recommended.

Slopes:

It is recommended that slopes constructed of compacted fill using the site clay soils be designed at 2:1 (horz. to vert.) or flatter. Slopes constructed of excavated subgrade clay soils be designed at 2.5:1 (horz. to vert.) or flatter. Slopes excavated into the weathered phyllite rock should be designed at 1:1 (horz. to vert.) or flatter. Considerable sloughing is anticipated in the more weathered phyllite, and DEI suggests leaving an accessible bench area at the toe of each slope to catch ravelling rock and debris. Surface water runoff should be directed away from the top of slopes to reduce ravelling and possible slope saturation.

7.0 LIMITATIONS AND CONCLUDING REMARKS

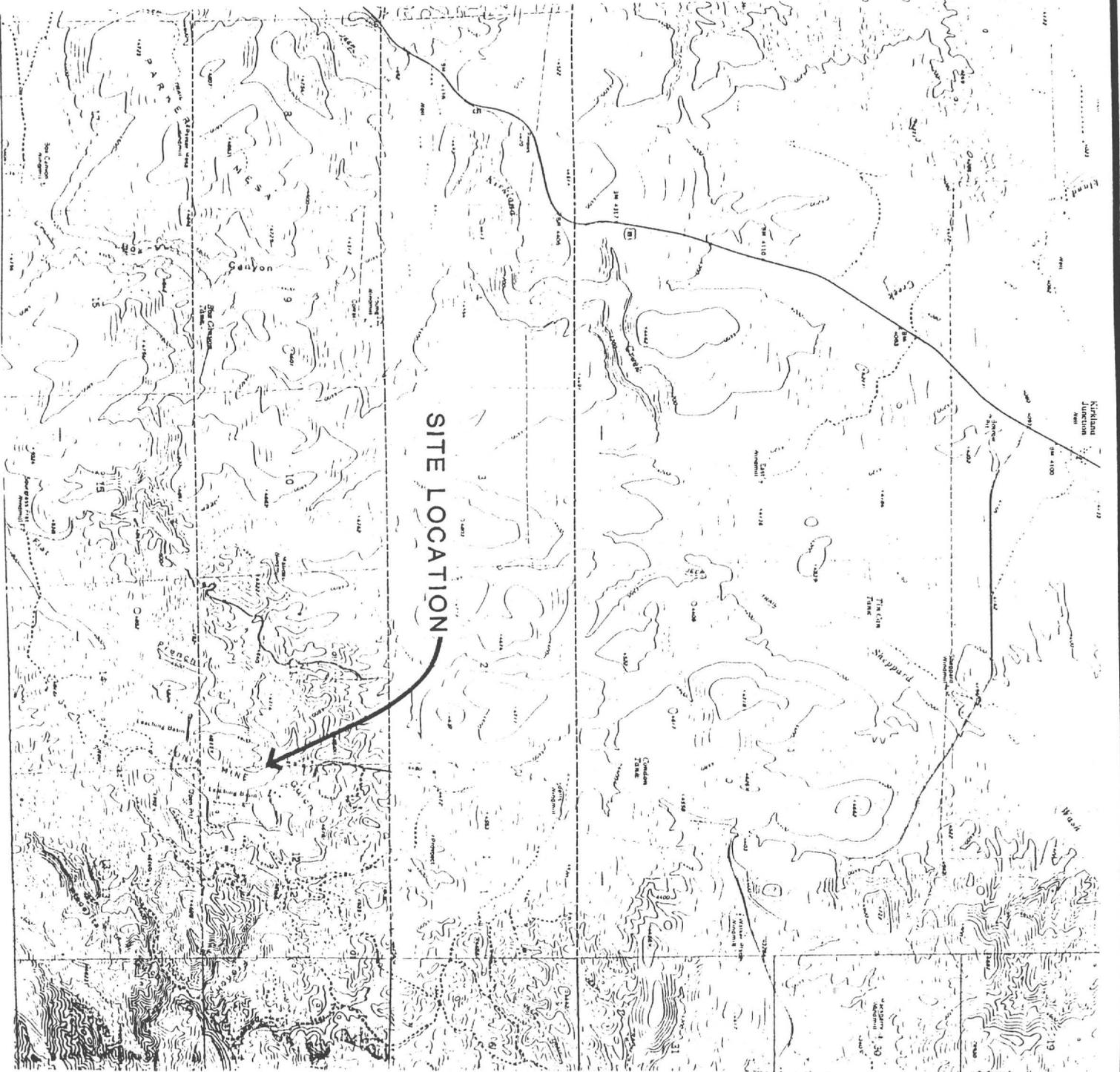
The recommendations made in this report are based on the assumption that the soil conditions do not vary appreciably between the testing locations. The subsurface information presented in this report does not constitute a direct or implied warranty that the soil conditions between testing locations can be directly interpolated or extrapolated, or that soil conditions and/or variations different from those disclosed will not be revealed.

GEOTECHNICAL INVESTIGATION REPORT ZONIA MINE SX-EW AND TRUCK MAINTENENCE SITES

Development Engineering, Inc. prepared this report to aid in the evaluation of the site and to assist in foundation design for this project. We have developed our recommendations in accordance with generally accepted professional engineering principles and practices. We make no warranty either expressed or implied. Our conclusions are based on the results of the field explorations and on our interpretations of subsurface conditions between and beyond these explorations. If the contractor encounters conditions that appear different from those described in this report, we should be notified so that we may review and verify or modify our recommendations.

8.0 REFERENCES

Bowles, Joseph E., 1977, "Foundation Analysis and Design", McGraw Hill, New York.



SITE LOCATION

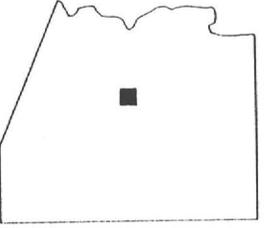
FIGURE 1
 SITE LOCATION MAP
 ZONIA COPPER MINE
 KIRKLAND JUNCTION, ARIZONA



SCALE 1:48000



■ QUADRANGLE
 LOCATION



PROJECT NO. 2718	PREPARED BY: DDW
DATE: 09/13/93	REVIEWED BY: <i>gld</i>

5110 N. 40th STREET, STE. 201
 PHOENIX AZ. 85018 PH: (602) 954-9035

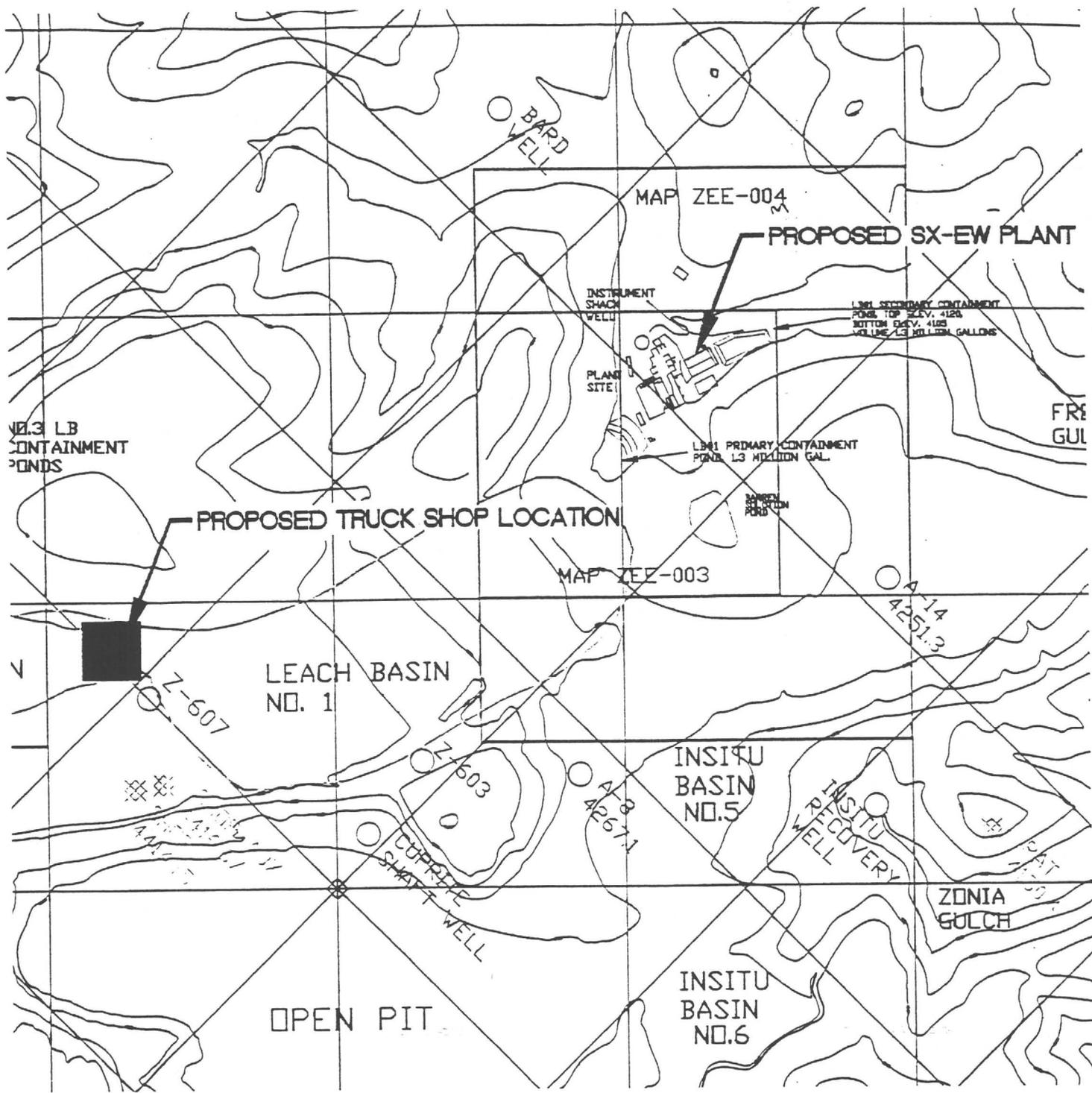
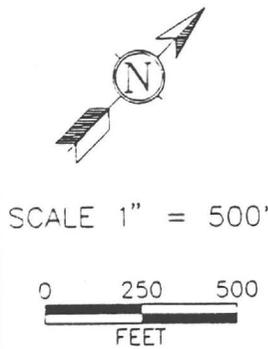


FIGURE 2

SITE VICINITY MAP
ZONIA COPPER MINE



PROJECT NO.

2718

DATE:

10/06/93

PREPARED BY:

DDW

REVIEWED BY:

Jed

Development Engineering

5110 N. 40th STREET, STE. 201
PHOENIX AZ. 85018 PH: (602) 954-0032



● = BORING LOCATION



SCALE 1" = 50'

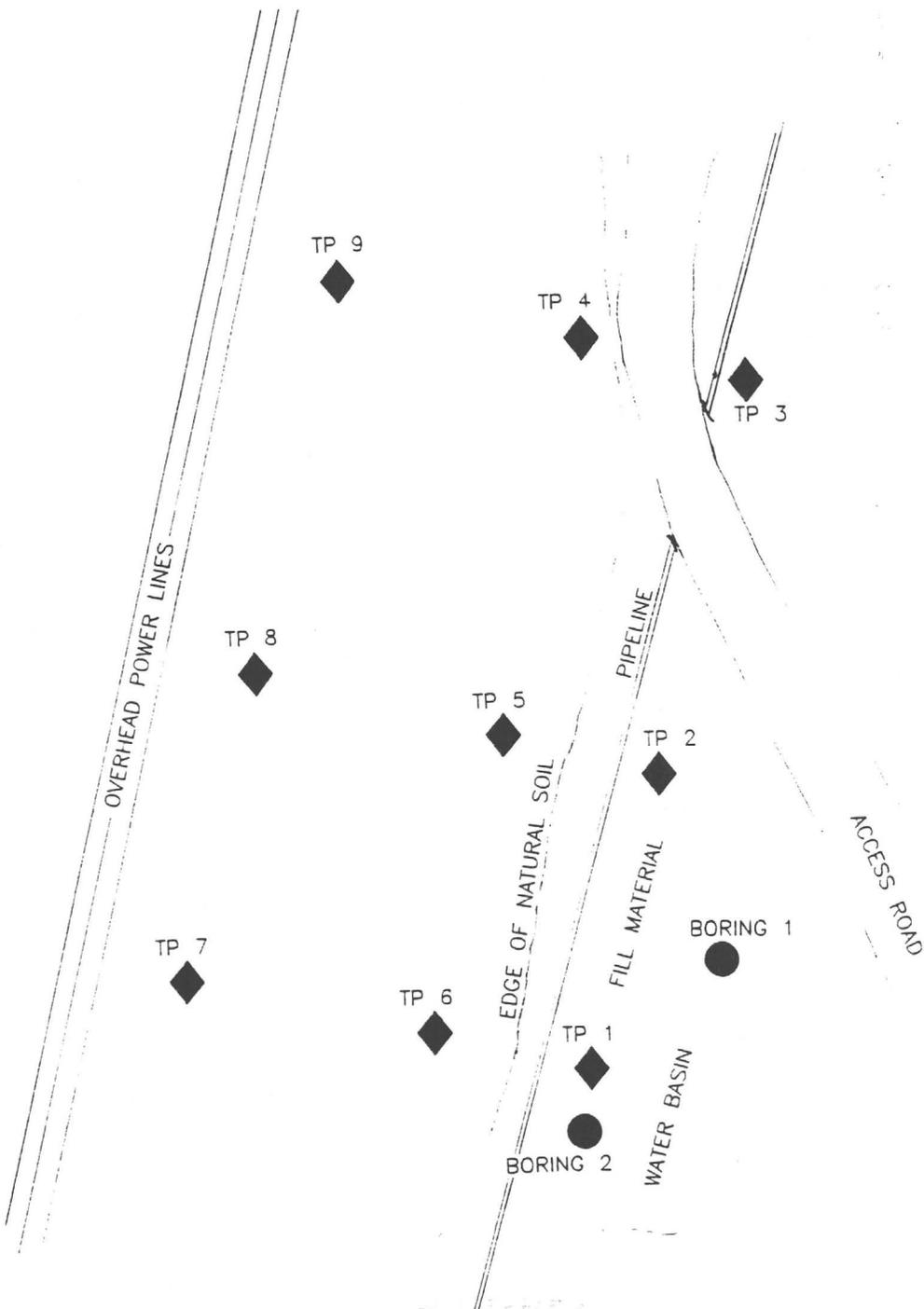


FIGURE 3

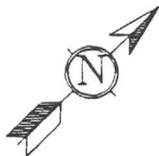
BORING LOCATIONS
SX-EW PLANT AREA

PROJECT NO. 2718	PREPARED BY: DDW	
DATE: 10/06/93	REVIEWED BY: <i>Jed</i>	

5110 N. 40th STREET, STE. 201
PHOENIX AZ. 85018 PH: (602) 954-0033



- = BORING LOCATION
- ◆ = TEST PIT LOCATION



SCALE 1" = 50'

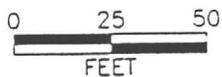


FIGURE 4
BORING LOCATIONS
TRUCK SHOP AREA

PROJECT NO.

2718

PREPARED BY:

DDW

DATE:

10/06/93

REVIEWED BY:

Jdd

Development Engineering
5110 N. 40th STREET, STE. 201
PHOENIX AZ. 85018 PH: (602) 954-0038

APPENDIX

BORING LOG NO. DEI 1

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: East portion of proposed truck maintenance area.

Date: September 22, 1993

Drilling Method: CME 75

Driller: Geomechanics Southwest, Inc.

Elevation: 4733.0

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
SPT	-	-	10	0	SM	Brownish Yellow Sand, Silt, Gravel and Cobbles, loose to medium dense, subangular to angular, dry to slightly moist, low plasticity. NOTE: Fill Material. NOTE: pH is 4.0 at 4.0 feet.
				1		
				2		
RING	11	-	64	3		
				4		

Terminated Boring at 4.0 feet on 09/22/93. Ground water not encountered. Backfilled with cuttings on 09/22/93.

BORING LOG NO. DEI 2

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Southeast portion of proposed truck maintenance area.

Date: September 22, 1993

Drilling Method: CME 75

Driller: Geomechanics Southwest, Inc.

Elevation: 4734.0

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
SPT	-	-	22	0	SM	Brownish Yellow Sand, Silt, Gravel and Cobbles, medium dense, angular to subangular, dry, low plasticity. NOTE: Fill Material.
BULK	-	-	-	1		
				2		
				3		
				4		
SPT	-	-	72	5		
				6		
				7	CL	Reddish Brown Clay and Silt with Sand, Gravel and Cobbles, hard, angular to subangular, slightly moist, medium plasticity.
				8		
				9		
SPT	-	-	57(6)	10		Olive Gray Phyllite, moderately strong, highly to completely weathered, very thinly foliated.
				11		
				12		
				13		
				14		
SPT	-	-	55	15		Reddish Brown to Olive Gray Phyllite, moderately weak, completely weathered, very thinly foliated.
				16		
				17		
				18		Olive Gray Phyllite, moderately strong, highly weathered, thinly to very thinly foliated.
				19		
				20		
				21		
				22		

Terminated Boring with auger refusal at 22.5 feet on 09/22/93. Ground water not encountered. Backfilled with cuttings on 09/22/93.

BORING LOG NO. DEI 3

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Concrete pad at top of retaining wall.

Date: September 22, 1993

Drilling Method: CME 75

Driller: Geomechanics Southwest, Inc.

Elevation: 4478.9

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
SPT	-	-	31	0	CL	Reddish Brown to Olive Gray Clay with Silt, Sand, Gravel and Cobbles, hard, slightly moist, medium plasticity. NOTE: Fill Material. NOTE: pH is 5.7 at 6.5 feet.
				1		
				2		
				3		
RING	9	107	33	4		
				5		
				6		
				7		
				8	CL	Brown to Yellowish Red Clay with Silt, Sand, Gravel and Cobbles, hard, dry, low to medium plasticity.
				9		
SPT	-	-	52(6)	10		
				11		
				12		
				13		
				14		
SPT	-	-	50(0)	15		
				16		
				17		
				18		
				19		
SPT	-	-	60(5)	20		
				21		
				22		
				23		
				24		
SPT	-	-	60(2)	25		Olive Gray Phyllite, moderately weak, completely weathered, very thinly foliated.
				26		
				27		
				28		
				29		
				30		

NOTE: Slow drilling below 29.0 feet.

BORING LOG NO. DEI 3 (cont.)

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Concrete pad at top of retaining wall.

Date: September 22, 1993

Drilling Method: CME 75

Driller: Geomechanics Southwest, Inc.

Elevation: 4478.9

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				31		Olive Gray Phyllite, moderately weak, completely weathered, very thinly foliated.
				32		
				33		
				34		
				35		
				36		
				37		
				38		
				39		

Terminated Boring with auger refusal at 39.5 feet on 09/22/93. Ground water not encountered. Backfilled with cuttings on 09/22/93.

BORING LOG NO. DEI 4

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Near base of retaining wall.

Date: September 22, 1993

Drilling Method: CME 75

Driller: Geomechanics Southwest, Inc.

Elevation: 4463.8

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0	CL	Reddish Brown to Olive Gray Clay with Silt, Sand, Gravel and Cobbles, hard, slightly moist, medium plasticity.
				1		
				2		
				3		
				4		
SPT	-	-	62	5		
				6		
				7		Reddish Brown to Olive Gray Phyllite, moderately weak, completely weathered, very thinly foliated.
				8		
				9		
SPT	-	-	70(3)	10		
				11		
				12		
				13		
				14		Olive Gray Phyllite, moderately weak, highly to completely weathered, very thinly foliated.
SPT	-	-	50(1)	15		
				16		
				17		
				18		
				19		
				20		
				21		
				22		

Terminated Boring with auger refusal at 22.0 feet on 09/22/93. Ground water not encountered. Backfilled with cuttings on 09/22/93.

BORING LOG NO. DEI 5

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Near water holding basins and shop building.

Date: September 22, 1993

Drilling Method: CME 75

Driller: Geomechanics Southwest, Inc.

Elevation: 4462.8

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
BULK	-	-	-	0	CL	Reddish Brown to Olive Gray Clay with Silt, Sand, Gravel and Cobbles, hard, slightly moist, medium plasticity.
				1		
				2		
				3		
				4		
SPT	-	-	43	5		
				6		
				7		
RING	4	118	109	8		NOTE: pH is 7.2 at 8.5 feet.
				9		
SPT	-	-	88(2)	10		
				11		

Terminated Boring with auger refusal at 11.0 feet on 09/22/93. Ground water not encountered. Backfilled with cuttings on 09/22/93.

BORING LOG NO. TEST PIT 1

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4733.1

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0	SM	Brownish Yellow Sand, Silt, Gravel, and Cobbles, loose, subangular to angular, dry.
GRAB	-	-	-	1		NOTE: Fill Material.
				2		
				3		
				4		
				5		
				6		
				7	CH	Brown to Reddish Brown Clay and Silt, with Sand, Gravel, and Cobbles, stiff to very stiff, angular to subangular, slightly moist, high plasticity.
				8		NOTE: Native Soil.
				9		
				10		
GRAB	-	-	-	11		Olive Gray Phyllite, moderately strong, highly weathered, thinly foliated.

Terminated digging at 11.0 feet on 09/21/93. No refusal. No ground water encountered. Backfilled test pit on 09/21/93.

BORING LOG NO. TEST PIT 2

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4735.1

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0	SM	Brownish Yellow Sand, Silt, Gravel, and Cobbles, loose, angular, dry.
				1		NOTE: Fill Material.
				2	CH	Brown to Reddish Brown Clay and Silt, with Sand, Gravel, and Cobbles, stiff to very stiff, angular to subangular, slightly moist to dry, high plasticity.
				3		Reddish Brown to Olive Gray Phyllite, moderately weak to weak, completely weathered, very thinly foliated.
				4		
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		

Terminated digging at 12.0 feet on 09/21/93. No refusal. No ground water encountered. Backfilled test pit on 09/21/93.

BORING LOG NO. TEST PIT 3

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4743.1

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0		Yellowish Red Phyllite, weak, completely weathered to residual soil, intensely foliated.
GRAB	-	-	-	1		Yellowish Red Phyllite, very strong, slightly weathered, very thinly foliated.

Terminated digging with refusal at 1.0 feet on 09/21/93. No ground water encountered. Test pit left open.

BORING LOG NO. TEST PIT 4

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4746.6

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0		Reddish Yellow to Olive Gray Phyllite, moderately strong, highly weathered, thinly to very thinly foliated.
				1		
				2		

Terminated digging with refusal at 2.5 feet on 09/21/93. No ground water encountered. Test pit left open.

BORING LOG NO. TEST PIT 5

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4741.5

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
GRAB	-	-	-	0	CL	Reddish Brown Clay and Silt with Sand and Gravel, soft, dry, medium plasticity.
				1		Reddish Brown to Yellowish Red Phyllite, moderately strong, highly weathered, thinly to very thinly foliated.
				2		

Terminated digging with refusal at 2.5 feet on 09/21/93. No ground water encountered. Test pit left open.

BORING LOG NO. TEST PIT 6

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4738.8

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0	CL	Reddish Brown Clay and Silt with Sand and Gravel, soft, dry, medium plasticity.
GRAB	-	-	-	1		Reddish Brown to Yellowish Red Phyllite, moderately strong, highly weathered, thin to very thin foliated.
				2		NOTE: Very strong, slightly weathered below 2.5 feet.

Terminated digging with refusal at 2.5 feet on 09/21/93. No ground water encountered. Test pit left open.

BORING LOG NO. TEST PIT 7

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4758.5

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0	CL	Reddish Brown Clay with Silt, Sand, Gravel, and Cobbles. <u>stiff, dry, medium plasticity.</u>
				1		Reddish Brown to Yellowish Red Phyllite, moderately strong, highly weathered, thinly to very thinly foliated.
				2		
				3		

Terminated digging with refusal at 3.0 feet on 09/21/93. No ground water encountered. Test pit left open.

BORING LOG NO. TEST PIT 8

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

Elevation: 4764.0

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
GRAB	-	-	-	0		Yellowish Red Phyllite, moderately weak, completely weathered, very thinly foliated.
GRAB	-	-	-	1		Reddish Brown Phyllite, moderately strong, highly weathered, thinly to very thinly foliated.

Terminated digging with refusal at 1.5 feet on 09/21/93. No ground water encountered. Test pit left open.

BORING LOG NO. TEST PIT 9

CLIENT: ARIMETCO

Project: DEI# 2718 - Zonia Mine, Kirkland Junction, Arizona

Location: Proposed Truck Service Area

Date: September 21, 1993

Drilling Method: Ford 555A Backhoe

Driller: ARIMETCO

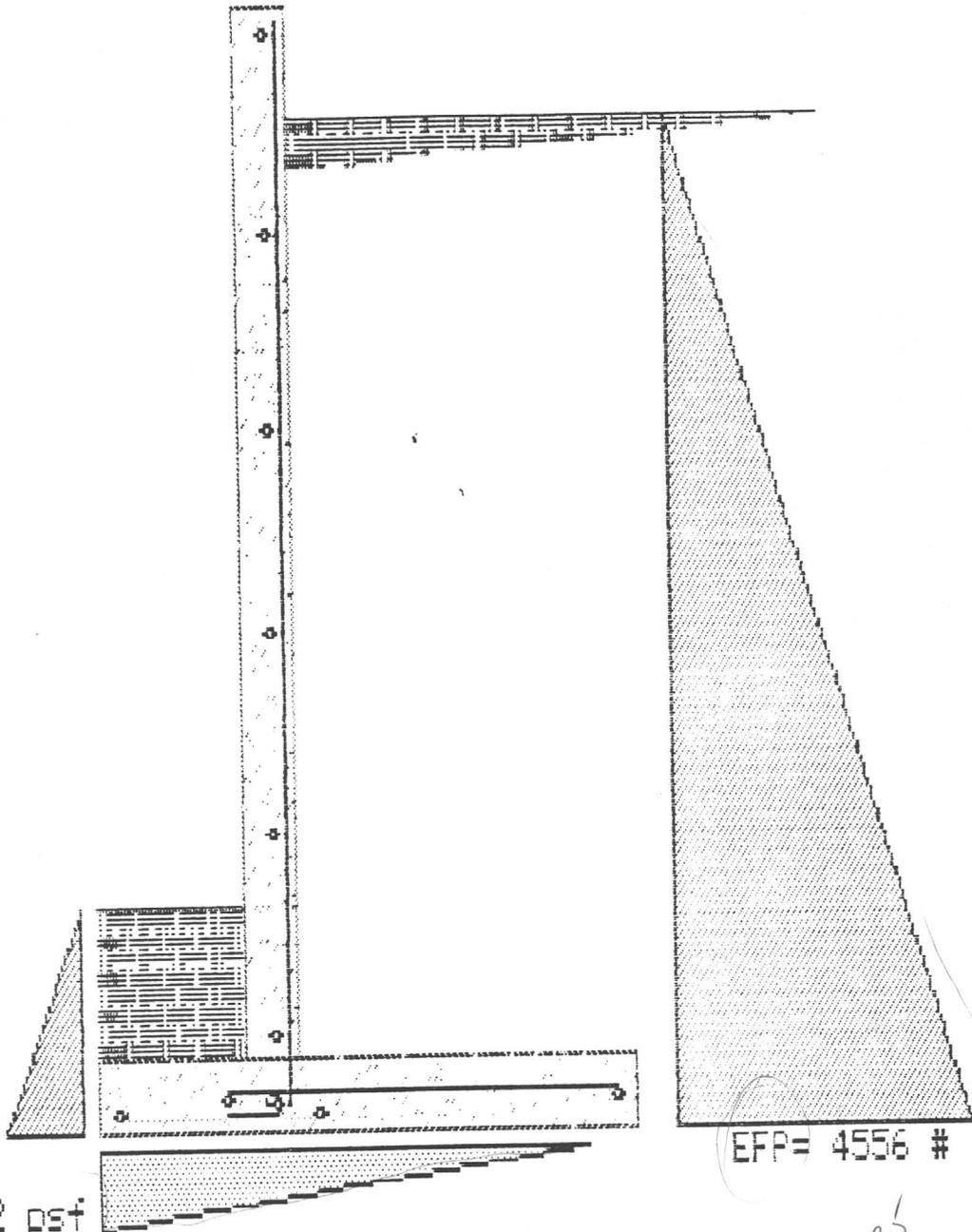
Elevation: 4761.6

Datum: ARIMETCO Surveying

DEI Rep.: Dustin D. Watson

Sample Type	Moisture (%)	Density (pcf)	Blows/ Ft.	Depth Ft.	USCS	Soil Description
				0		Reddish Yellow to Olive Gray Phyllite, moderately strong, highly weathered, thinly to very thinly foliated.
GRAB	-	-	-	1		
				2		
				3		

Terminated digging with refusal at 3.0 feet on 09/21/93. No ground water encountered. Test pit left open.



$\frac{1}{2}(250)(3)^2$

Pp= 1125 #

2972 dsf

EFP= 4556 #

Pracc [P] to Pwint

1462.5

DEVELOPMENT ENGINEERING, INC.
 5110 N. 40th Street Suite 201
 Phoenix, Arizona 85018
 Phone: (602) 954-0038
 Fax: (602) 955-9309

Title: RETAINING WALL
 Descr: 9" RETAIN

Job #: DEI 2718 By:DW
 Retain Pro3 (c)1989-93 File:RETAINPR.RPF

Page of
 Date:

CANTILEVERED RETAINING WALL DESIGN

Fig 1 of 2

----- SOIL DATA -----

Allowable Bearing	=	3,000	pcf
Active Lateral EFF	=	50.0	pcf
...Slope Active	=	0.0	pcf
..Active Press Limit	=	N/A	pcf
Bkfill Slope(0=level)	=	0.0:1	
Passive Lateral	=	250	pcf
Soil Density	=	117.0	pcf
Soil Ht over Toe	=	24.0	in

----- ADDED VERTICAL LOADS -----

Axial DL on Stem	=	0	plf
Axial LL on Stem	=	0	plf
..Ecc Left of Stem CL	=	0.00	in
Surcharge over Toe	=	0.0	pcf
Surcharge over Heel	=	0.0	pcf
Using Surcharge to resist overturning @ Heel	:	No	
@ Toe	:	No	

----- ADDED LATERAL LOADS -----

Lateral Load Acting On Stem Above Soil	=	0.00	pcf
Add'l Lateral Load	=	0.0	plf
...height to stop	=	0.00	ft
...height to start	=	0.00	ft

----- ADJACENT FOOTING -----

Vertical load	=	0	plf
...Ecc. (Toe side +)	=	0.00	in
Footing Width (perp)	=	0.00	ft
Face Top Stem to Ftg. CL	=	0.00	ft
Ftg. Base Above/Below Soil At Wall Face [+/-]	=	0.00	ft
Footing Type	:	Line	

----- WALL & FOOTING DATA -----

Retained Height	=	12.50	ft
Wall Ht. above soil	=	1.50	ft
Total Wall Height	=	14.00	ft
Key Depth	=	0.00	in
Key Width	=	0.00	in
Key Dist. to Toe	=	0.000	ft

Toe Width	=	2.00	ft
Heel Width	=	5.33	ft
Total Width	=	7.33	ft
Thickness	=	12.00	in

===== SUMMARY ===== Sliding Ratio < 1.5 !! =====

Pressure @ Toe	=	2,972	pcf	Factors of Safety:	
Pressure @ Heel	=	0	pcf	Overturning	= 2.07 :1
Allowable Press.	=	3,000	pcf	Sliding	= 0.99 :1
Eccentricity	=	17.50	in	Allowable Shear	= 120.21 psi
Resultant Outside Middle Third				1-Way Shear @ Toe	= 65.7 psi
Note: PV Not Used for Soil Pre				1-Way Shear @ Heel	= 143.6 psi

----- SLIDING CHECK ----- ^{4331 x 1.5}

Ftg/Soil Friction	=	0.320		Tot Lateral Force*1.5	=	6,496.9	#
Soil @ Toe Not Used	=	0.00	in	(-)Passive Pressure	=	1,125.0	#
Factor of Safety	=	0.99		(-)Friction	=	3,149.0	#
				Add'l Force Req'd	=	2,222.8	#

----- FOOTING DESIGN -----

(Using ACI Factors) --- Toe --- Heel ---			f'c	=	5,000	psi		
ACI 9.1 Pressure	=	4,161	0	Fy	=	40,000	psi	
Mu - Upward	=	7,463	0	ft-#				
Mu - Downward	=	1,075	27,677	ft-#				
Mu - Design	=	6,410	27,677	ft-#				
One-Way Shear:								
Vu	=	65.65	143.60	psi	#4 @	6.52	in	
Vu=2(f'c)1/2+.65	=	120.21	120.21	psi	#5 @	10.20	in	
Rebar CL To Edge	=	3.50	3.50	in	#6 @	14.47	in	
Depth to steel	=	3.00	3.00	in	#7 @	19.74	in	
Ru = Mu/bd^2	=	197.5	730.2		#8 @	25.99	in	
Min. Rebar Ratio	=	0.0018			#9 @	32.90	in	
					#10 @	41.78	in	
							10.49	in

----- Rebar Choices -----

DEVELOPMENT ENGINEERING, INC.
 1110 N. 40th Street Suite 201
 Phoenix, Arizona 85018
 Phone: (602) 954-0032
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Title: RETAINING WALL
 Descr: 9" RETAIN

Job #: DEI 2718 By: DW
 Retain Pro3 (c)1989-93 File:RETAINPR.RPF

Page of
 Date:

----- STEM DESIGN -----

(Values shown for concrete stems have been factored) Pg 2 of 2
 1- Descending Stem Sections, Highest @ Left -1-
 Stem Construction Data Highest (use columns from left to right)

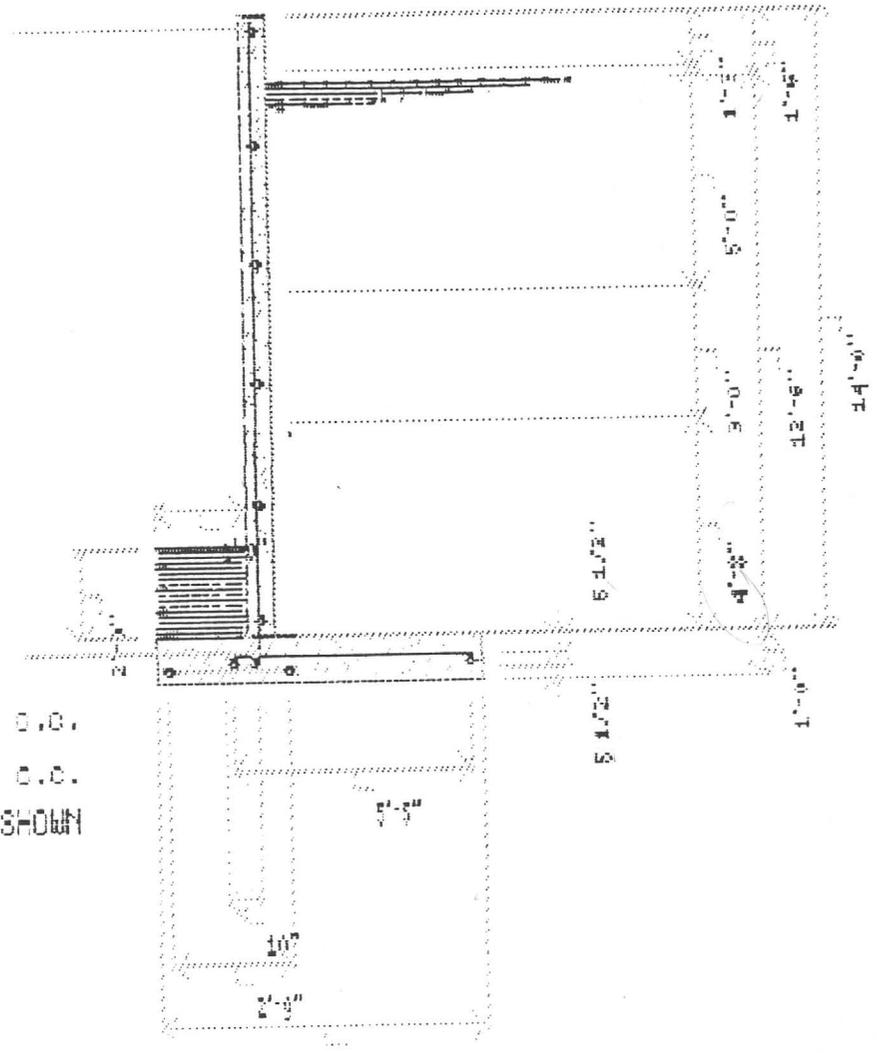
					ReCheck	ReCheck
DESIGN HT. ABOVE FTG.	=	14.00	9.00	6.00	3.00	0.00 ft
WALL TYPE ABOVE HT.	:	Concrete	Concrete	Concrete	Concrete	Concrete
Thickness (nominal)	=	9.00	9.00	9.00	9.00	in
Rebar Size	=	# 5	# 5	# 5	# 5	
Rebar Spacing	=	10.00	10.00	10.00	10.00	in
Rebar Placed at	:	Edge	Edge	Edge	Edge	
DESIGN DATA.....						
fb/Fb + fa/Fa	=	0.000	0.078	0.509	1.000	
Lateral Load @ Design Ht	=	0	521	1,796	3,836	#
MOMENT..... Actual	=	0	607	3,891	12,146	27,556 ft-#
Allowable	=	7,649	7,649	7,649	7,649	ft-#
SHEAR..... Actual	=	0.00	6.20	21.38	45.66	77.03 psi
Allowable	=	120.21	120.21	120.21	120.21	psi
Embedment Length Req'd	=	12.00	12.00	12.00	17.06	
Wall Weight	=	112.5	112.5	112.5	112.5	psf
Rebar Placed at Depth 'd'	=	7.00	7.00	7.00	7.00	in
MASONRY DATA.....						
f'm	=					psi
Fs	=					psi
Grouting	:					
Special Inspection	:					
n : Es / Em	=					
Short Term Increase	=					
CONCRETE DATA.....						
f'c	=	5,000	5,000	5,000	5,000	psi
Fy	=	40,000	40,000	40,000	40,000	psi

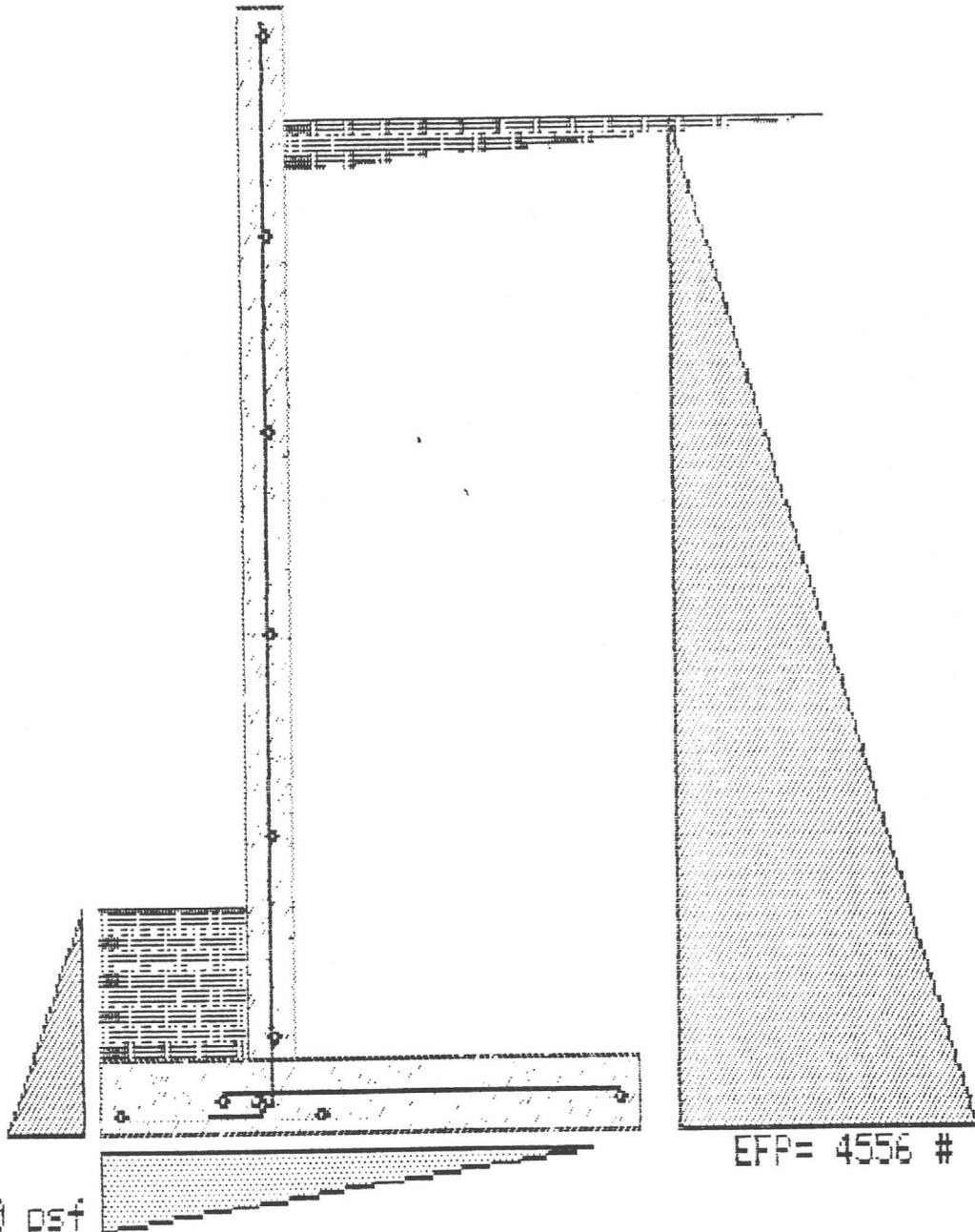
----- SUMMARY OF FORCES & MOMENTS -----

Origin of Force:	1- Overturning Moments			-1- Resisting Moments		
	#	ft	ft-#	#	ft	ft-#
Heel Active Press.	=	4,536	4.50	20,503		
Soil over Heel	=				6,698	5.04
Toe Active Press.	=	-225	1.00	-225		
Soil over Toe	=				468	1.00
Sloped Soil @ Heel	=				0	0.00
Adjacent Ftg. Load	=	0	0.00	0	0	0.00
Surcharge @ Heel	=				0	0.00
Surcharge @ Toe	=	0	0.00	0	0	0.00
Axial Load on Wall	=				0	0.00
Load @ Proj. Wall	=	0	0.00	0		
Averaged Stem Wts.	=				1,575	2.36
Earth Behind Stem	=				0	0.00
Added Lateral Load	=	0	0.00	0		
Footing Weight	=				1,099	3.67
Key Weight	=				0	0.00
Vert. Component of Active Press.	=				0	0.00
TOTALS	=	4,311		20,278	9,641	41,997

6" CONC.
 #5 @ 10" Vert @ CL
 #4 @ 32" Horiz

#5 @ 10" Vert @ CL
 #4 @ 32" Horiz
 HEEL (top) : #5 @ " o.c.
 TOE (bot) : #5 @ " o.c.
 #4 HORIZ. AS SHOWN





Pp= 1125 #

2960 Dsf

EFP= 4556 #

Proc [P] to Print

DEVELOPMENT ENGINEERING, INC.
 5110 N. 40th Street Suite 201
 Phoenix, Arizona 85018
 Phone: (602) 954-0038
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Title: RETAINING WALL
 Descr: 9" RETAIN

Page of
 Date:
 Job #: DEI 2718 By:DW
 Retain Pro3 (c)1989-93 File:RETAINPR.RPF

CANTILEVERED RETAINING WALL DESIGN

Pg 1 of 2

----- SOIL DATA -----
 Allowable Bearing = 3,000 psf
 Active Lateral EFP = 50.0 psf
Slope Active = 0.0 psf
 ..Active Press Limit = N/A psf
 Bkfill Slope(0=level)= 0.0:1
 Passive Lateral = 250 pcf
 Soil Density = 117.0 pcf
 Soil Ht over Toe = 24.0 in

----- ADDED VERTICAL LOADS -----
 Axial DL on Stem = 0 plf
 Axial LL on Stem = 0 plf
 ..Ecc Left of Stem CL = 0.00 in
 Surcharge over Toe = 0.0 psf
 Surcharge over Heel = 0.0 psf
 Using Surcharge to resist
 overturning @ Heel : No
 @ Toe : No

----- ADDED LATERAL LOADS -----
 Lateral Load Acting
 On Stem Above Soil = 0.00 psf

 Add'l Lateral Load = 0.0 plf
 ...height to stop = 0.00 ft
 ...height to start = 0.00 ft

----- ADJACENT FOOTING -----
 Vertical load = 0 plf
 ...Ecc. (Toe side +) = 0.00 in
 Footing Width (perp) = 0.00 ft
 Face Top Stem to Ftg. CL = 0.00 ft
 Ftg. Base Above/Below Soil
 At wall Face [+/-1] = 0.00 ft
 Footing Type : Line

----- WALL & FOOTING DATA -----
 Retained Height = 12.50 ft
 Wall Ht. above soil = 1.50 ft
 Total Wall Height = 14.00 ft
 Key Depth = 0.00 in
 Key Width = 0.00 in
 Key Dist. to Toe = 0.000 ft

Toe Width = 2.00 ft
 Heel Width = 5.33 ft

 Total Width = 7.33 ft
 Thickness = 12.00 in

===== SUMMARY ===== Sliding Ratio < 1.5 !! =====
 Pressure @ Toe = 2,960 psf
 Pressure @ Heel = 0 psf
 Allowable Press. = 3,000 psf
 Eccentricity = 17.53 in
 Resultant Outside Middle Third
 Note: PV Not Used for Soil Pre

 Factors of Safety:
 Overturning = 2.06 :1
 Sliding = 0.98 :1
 Allowable Shear = 120.21 psi
 1-Way Shear @ Toe = 65.3 psi
 1-Way Shear @ Heel = 146.2 psi

----- SLIDING CHECK -----
 Ftg/Soil Friction = 0.320
 Soil @ Toe Not Used = 0.00 in
 Factor of Safety ✓ = 0.98

 Tot Lateral Force*1.5 = 6,496.9 #
 (-)Passive Pressure = 1,125.0 #
 (-)Friction = 3,132.0 #
 Add'l Force Req'd = 2,239.9 #

----- FOOTING DESIGN -----
 (Using ACI Factors) ---Toe--- --Heel--
 ACI 8.1 Pressure = 4,144 0 psf
 Mu - Upward = 7,453 0 ft-#
 Mu - Downward = 1,075 24,347 ft-#
 Mu - Design = 6,377 24,347 ft-#

 One-Way Shear:
 Vu = 45.34 146.21 psi
 Vn=Σ f'c d/Σ+ .33= 120.21 120.21 psi
 Rebar CL To Edge = 3.30 3.30 in
 Depth to steel = 6.00 6.00 in
 Ru = Mu/d² = 196.2 757.6
 Min. Rebar Ratio = 0.0018

 f'c = 3,000 psi
 Fy = 40,000 psi
 Upward soil pres. used on
 ----- Rebar Choices -----
 Toe (top) Heel (top)
 #4 @ 6.61 in 1.39 in
 #5 @ 10.23 in 2.46 in
 #6 @ 14.53 in 3.49 in
 #7 @ 19.24 in 4.76 in
 #8 @ 24.12 in 6.26 in
 #9 @ 30.07 in 7.87 in
 #10 @ 41.99 in 10.07 in

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 Phone: (602) 954-0038
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Title: RETAINING WALL
 Descr: 9" RETAIN

Job #: DEI 2718 By: DW
 Retain Proj (c)1989-93 File: RETAINPR.RPF

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 Date:

----- STEM DESIGN -----

(Values shown for concrete stems have been factored) Pg 2 of 2

!- Descending Stem Sections, Highest @ Left -!

Stem Construction Data Highest (use columns from left to right)
 -----ReCheck-----ReCheck-----

DESIGN HT. ABOVE FTG.	=	14.00	9.00	6.00	3.00	0.00	ft
WALL TYPE ABOVE HT.	:	Concrete	Concrete	Concrete	Concrete	Concrete	
Thickness (nominal)	=	8.00	8.00	8.00	8.00		in
Rebar Size	=	# 5	# 5	# 5	# 5		
Rebar Spacing	=	10.00	10.00	10.00	10.00		in
Rebar Placed at	:	Center	Center	Center	Center		
DESIGN DATA.....							
fb/Fb + fa/Fa	=	0.000	0.141	0.905	1.000		
Lateral Load @ Design Ht	=	0	521	1,796	3,836		#
MOMENT..... Actual	=	0	607	3,891	12,146	27,556	ft-#
Allowable	=	4,301	4,301	4,301	4,301		ft-#
SHEAR..... Actual	=	0.00	10.85	37.41	79.91	134.80	psi
Allowable	=	120.21	120.21	120.21	120.21		psi
Embedment Length Req'd	=	12.00	12.00	12.00	32.49		
Wall Weight	=	100.0	100.0	100.0	100.0		psf
Rebar Placed at Depth 'd'	=	4.00	4.00	4.00	4.00		in
MASONRY DATA.....							
f'm	=						psi
Fs	=						psi
Grouting	:						
Special Inspection	:						
n : Es / Em	=						
Short Term Increase	=						
CONCRETE DATA.....							
f'c	=	5,000	5,000	5,000	5,000		psi
Fy	=	40,000	40,000	40,000	40,000		psi

----- SUMMARY OF FORCES & MOMENTS -----

!- Overturning Moments -!- Resisting Moments -!

Origin of Forces:	!- Overturning Moments -!			!- Resisting Moments -!		
	#	ft	ft-#	#	ft	ft-#
Heel Active Press. =	4,536	4.50	20,503			
Soil over Heel =				6,820	5.00	34,089
Toe Active Press. =	-225	1.00	-225			
Soil over Toe =				468	1.00	468
Sloped Soil @ Heel =				0	0.00	0
Adjacent Ftg. Load =	0	0.00	0	0	0.00	0
Surcharge @ Heel =				0	0.00	0
Surcharge @ Toe =	0	0.00	0	0	0.00	0
Axial Load on Wall =				0	0.00	0
Load @ Proj. Wall =	0	0.00	0			
Averaged Stem Wts. =				1,400	2.33	3,267
Earth Behind Stem =				0	0.00	0
Added Lateral Load =	0	0.00	0			
Footing Weight =				1,099	3.67	4,030
Key Weight =				0	0.00	0
Vent. Component of =				0	0.00	0
Active Press.						
TOTALS =	4,311		20,278	9,788		41,854

Totals used for Soil Pressure, P_v Not Included = 9,788 41,854