DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING – P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO ATTENTION OF:

March 22, 1995

Planning Division

SEE DOCUMENT DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers has enclosed for your review a copy of the Feature Design Memorandum (FDM) with Environmental Assessment (EA), and a draft Finding of No Significant Impact (FONSI), for the Des Moines Recreational River and Greenbelt, Red Rock Multi-Purpose Trail, Segment 4.

This document addresses proposed construction of a segment of multi-purpose trail along the north side of Lake Red Rock, Marion County, Iowa.

The FDM is being circulated for a 30-day public review period, commencing from the date of this letter. If at the end of the 30 days, no comments are received that alter the determination that no significant environmental impact will result, the FONSI will be signed and kept on file at the office of the Rock Island District, U.S. Army Corps of Engineers.

Please send any comments to the address listed below:

District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Planning Division
Clock Tower Building
P.O. Box 2004
Rock Island, Illinois 61204-2004

Sincerely,

Charles S. Cox
Colonel, U.S. Army
District Engineer

Enclosure

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM #10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

MARCH 1995

U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT
CLOCK TOWER BUILDING
ROCK ISLAND, ILLINOIS 61204-2004

ACKNOWLEDGMENTS

U.S. Army Corps of Engineers, Rock Island District

Technical Manager	Timothy Hess, P.E.
Civil Design	Timothy Hess, P.E.
Geotechnical Exploration and Design	Nicholas Davila, P.E. George Millar
Hydrologic and Hydraulic Design	John Schliekelman, P.E.
Structural Design	Keith Wilson, P.E.
Cost Estimate	Michael Cummings
Technicians	Ronald Cover
Surveying and Mapping	William Riebe, L.S. John Gall James Long
Economic and Social Analysis	Sharron Jackson
Real Estate	Denise Tyler
Cover Design	Loren Carey
Environmental Assessment	Kevin Griggs
Recreational Planning	Dorene Bollman
Cultural Resources	James Ross
Lake Red Rock Manager	Gerald Dowell

Hanson Engineers, Inc.

Project Manager	James Moll, P.E., S.E.
Civil Design	Nancy Heil
Hydrologic and Hydraulic Design	Nancy Heil
Structural Design	John Harmes, P.E., S.E.
Surveying	Gary Rogers, L.S.

DES MOINES RECREATIONAL RIVER AND GREENBELT
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WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
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FEATURE DESIGN MEMORANDUM #10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

1. INTRODUCTION

a. Purpose, Scope and Organization of Report

(1) Purpose: The purpose of this report is to establish the project requirements and to evaluate the project on the basis of engineering, economic, and environmental viability.

(2) Scope: This report includes a project description, alignment alternatives, real estate considerations, operation and maintenance considerations, a detailed cost estimate, a plan for project implementation, an economic analysis, design analyses, a consultant's report and an environmental assessment.

(3) Organization: This report was prepared by the U.S. Army Corps of Engineers, Rock Island District, and Hanson Engineers, Incorporated. The planning and design study completed by Hanson Engineers, Inc. is located in the section "Consultant's Report". The environmental assessment completed by the Rock Island District is located in the section "Environmental Assessment". Appendices for all sections to include the appendices to the Environmental Assessment and the Consultant's Report are grouped together at the end of this document.

b. Project Authority

The Des Moines Recreational River and Greenbelt (hereinafter referred to as the Greenbelt) was authorized on August 15, 1985 by Public Law 99-88, the 1985 Supplemental Appropriations Act. The Greenbelt calls for the development, operation, and maintenance of a recreational area on, and along, the Des Moines and Boone Rivers from Fort Dodge and Webster City, Iowa, downstream to relocated U.S. Highway 92 in the vicinity of Red Rock Dam. A Greenbelt location and vicinity map can be found on Plate 1 of the Consultant's Report. Red Rock Multi-Purpose Trail, Segment 4 is one of many Greenbelt Projects.

c. General Design Memorandum

The General Design Memorandum (GDM) for Greenbelt covers the administration, comprehensive plan, plan for initial development and coordination of this project, and discusses the conditions for Federal participation. The comprehensive plan addresses the entire Greenbelt. The Red Rock Multi-Purpose Trail, Segment 4 project is one of the projects included in the comprehensive plan.

d. Other Reports

A list of Feature Design Memorandums (FDM) prepared for other Greenbelt projects follows:

FDM #1 : Bennington Bridge Access, May 1986
FDM #2: Jester Park Campground Improvements, August 1989
FDM #3: Red Rock Multi-Purpose, Segment 1, May 1989
FDM #4: Lutheran Hospital Bike Trail, March 1990
FDM #5: Dragoon Trail Scenic Road Route, October 1991
FDM #6: Red Rock Multi-Purpose Trail, Segment 2, March 1991
FDM #7: Hamilton County Scenic Overlooks, Canceled
FDM #8: Downtown River front Plaza/Amphitheater, August 1992
FDM #9: Red Rock Multi-Purpose Trail, Segment 3, March 1993

e. Advisory Committee

A Greenbelt Advisory Committee was established in accordance with the Conference Report on H.R. 2577, dated July 29, 1985. This committee is composed of local officials from the cities, counties, and state governments in the Greenbelt project areas as well as from the Corps of Engineers. At the September 4, 1987 meeting, the advisory committee recommended nine separable projects, including the Red Rock Multi-Purpose Trail, Segment 4 project, to the Corps of Engineers for construction.

f. Principles and Guidelines

Principles and Guidelines activities were accomplished by a combination of activities documented in the September 1987 General Design Memorandum (GDM) and Programmatic Environmental Impact Statement (PEIS), in the workings of the Advisory Committee, and in this report. A number of alternatives for the overall project were addressed in the PEIS and the plans were formulated in the GDM for each separable element in coordination with the local sponsors and the Advisory Committee. Extensive public involvement activities and public meetings have been conducted on a continuing basis under the guidance of the Greenbelt Advisory Committee.

g. Local Sponsor

The Red Rock Multi-Purpose Trail System, as described in the Greenbelt General Design Memorandum, is authorized to be funded entirely by the Federal government. Segment 4, like Segments 1, 2 and 3, is not cost-shared with a local sponsor and does not require a local cooperation agreement. The project is funded entirely by the Federal government and will be built entirely on land owned by the Federal government. The Corps of Engineers is the project sponsor.

2. DESCRIPTION OF PROJECT

a. Project Purpose

The purpose of Segment 4 is to provide a recreational facility for use by the public. The project makes areas of publicly owned land which are presently accessible only to hikers, accessible to pedestrians, bicyclists, and cross country skiers. Segment 4 will connect to a previously constructed trail at Wallashuck Recreation Area and run northwest alongside Lake Red Rock terminating at Cordova Park near State Highway 14. Segment 4 is the last in a series of trail segments which will provide a continuous multi-purpose trail between the Red Rock Dam Tailwater Area and State Highway 14.

b. Project Location

The project is located along the northeast shore of Lake Red Rock in Township 77 North, Range 19 West, Sections 33, 32 and 31 , and Township 76 North, Range 19 West, Section 12, 11, 1, 2, 3, 4, and 5 (U.S.G.S. , Pella and Otley, 15' quadrangle), Marion County, Iowa. The project begins at Wallashuck Recreation Area and runs northwest alongside Lake Red Rock for approximately 8.6 miles.

c. Project Description:

(1) The project involves the construction of 43,360 feet of asphalt surfaced trail and 2,050 feet of concrete surfaced trail. The trail will have a paved width of 10 feet with a 2-foot or 3-foot earth shoulder on each side depending on right-of-way availability. The trail crosses several small drainage channels. All drainage channels are crossed via culvert and embankment except for two locations which are crossed via a bridge. The terrain the trail passes through is generally very hilly with both forested and grassland areas.

(2) Segment 4 is only one segment of the Red Rock Multi-Purpose Trail system authorized by the Greenbelt General Design Memorandum (see Figures 2-1 and 2-2). Segment 1, described in FDM #3, involved the construction of approximately 1000 feet of trail and a 500-foot-long-bridge over the Des Moines River. Segment 2, described in FDM #6, involved the construction of approximately 10,700 feet of trail to include an underpass below Marion County Highway T-15 and a 400-foot-long bridge over a portion of Lake Red Rock. Segment 3 as described in FDM #9, involved the construction of approximately 10,000 feet of trail to include a 150-foot-long timber bridge and 1,250-foot long embankment through Lake Red Rock.

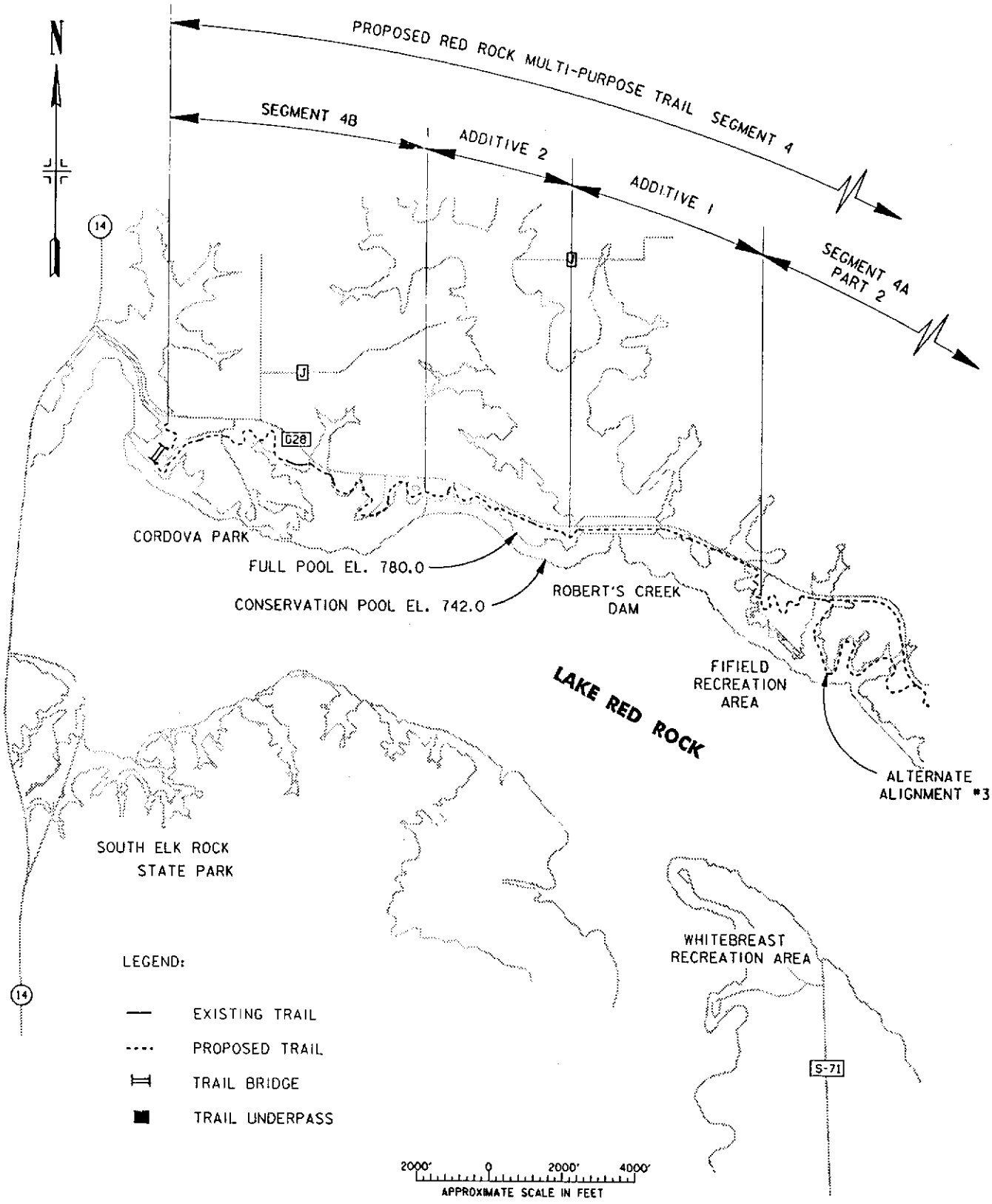


Figure 2-1: Project Location Plan

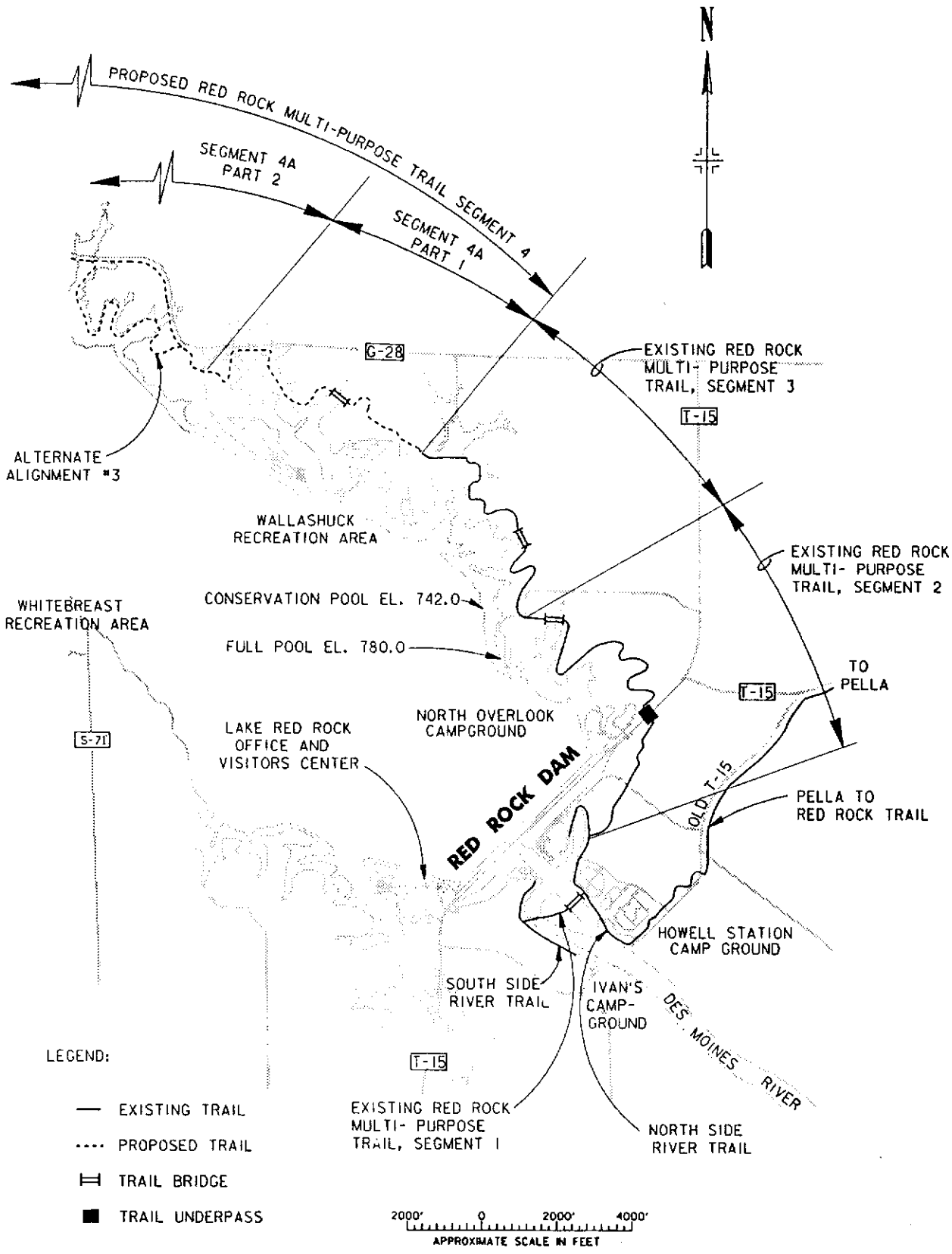


Figure 2-2: Project Location Plan

3. ALIGNMENT ALTERNATIVES

a. Construction Within Lake Red Rock Flood Control Pool

(1) Description: The proposed trail will be constructed in the Lake Red Rock flood control pool between Stations 429+00 and 448+00 as shown in Plates 26 and 27 of the Consultant's Report. The elevation of the maximum flood control pool at Lake Red Rock is 780 feet above sea level. Conservation pool at Lake Red Rock is at elevation 742, except during autumn (Sept. 15 to Dec. 15) when the pool is raised to elevation 744 for the benefit of migrating water fowl. A duration curve and frequency curve for Lake Red Rock is shown in Figures 3-1 and 3-2 respectively. A tabulation of elevation and duration is shown in Table 3-1. It should be noted that the duration curve and tabular data is for the period between 15 April and 15 October which is when the trail will receive most of its use.

(2) Inundation: Constructing the trail below elevation 780 will result in the trail being periodically inundated. Approximately 1,900 feet of trail will be constructed below elevation 780. Approximately 300 feet of trail will be constructed as low as elevation 765. Allowing for one-foot of wave run-up the trail will be able to be used by the public until the lake reaches elevation 764. Trail closure gates will be installed at elevation 783 at both ends of the inundated portion of trail. The closure gates will be shut for a high water event of elevation 764 or greater which will result in approximately a 2,000-foot section of trail between the closure gates being closed to the public. As shown in Figure 3-2, an elevation of 764 results in a percent exceedence probability of 16 percent which roughly translates to a 6-year-flood-event. As shown in Table 3-1, the average length of duration for elevation 764 is about five weeks. Therefore, approximately a 2,000-foot portion of the proposed trail will be closed to the public, statistically, every 6 years for a period of approximately five weeks.

(3) Compensation for Lost Storage in the Flood Control Pool: Construction within the Lake Red Rock flood control pool will involve placing approximately 28,000 cubic yards of earth fill material within the flood control pool. The borrow area for the earth fill material is located within the flood control pool so placement of the earth fill will not decrease flood storage volume.

(4) Alternatives: Constructing the trail within the flood control pool can be avoided by purchasing privately owned lands. The authority for this project, Public Law 99-88 as approved on August 15, 1985, authorizes the United States to acquire privately owned lands by either purchase, donation, or exchange from willing sellers. Public Law 99-88 specifically states that the purchase of private property must be with the consent of the owner and that no condemnation authority is authorized. The Corps of Engineers has not been able to obtain permission from adjacent land owners to purchase the properties necessary to avoid construction within the flood control pool. Since the project authority does not allow for the condemnation of private property, construction outside of the flood control pool is not a viable alternative.

b. Purchase of Privately Owned Lands Near Dutchman's Landing Subdivision

(1) Description: The proposed trail alignment will require the purchase of privately owned lands between Stations 339+60 and 389+00 as shown on Plates 21-25 of the Consultant's Report. The private property which must be purchased for construction of the proposed alignment either lies within or is immediately adjacent to the existing right-of-way limits for Marion County Highway G-28.

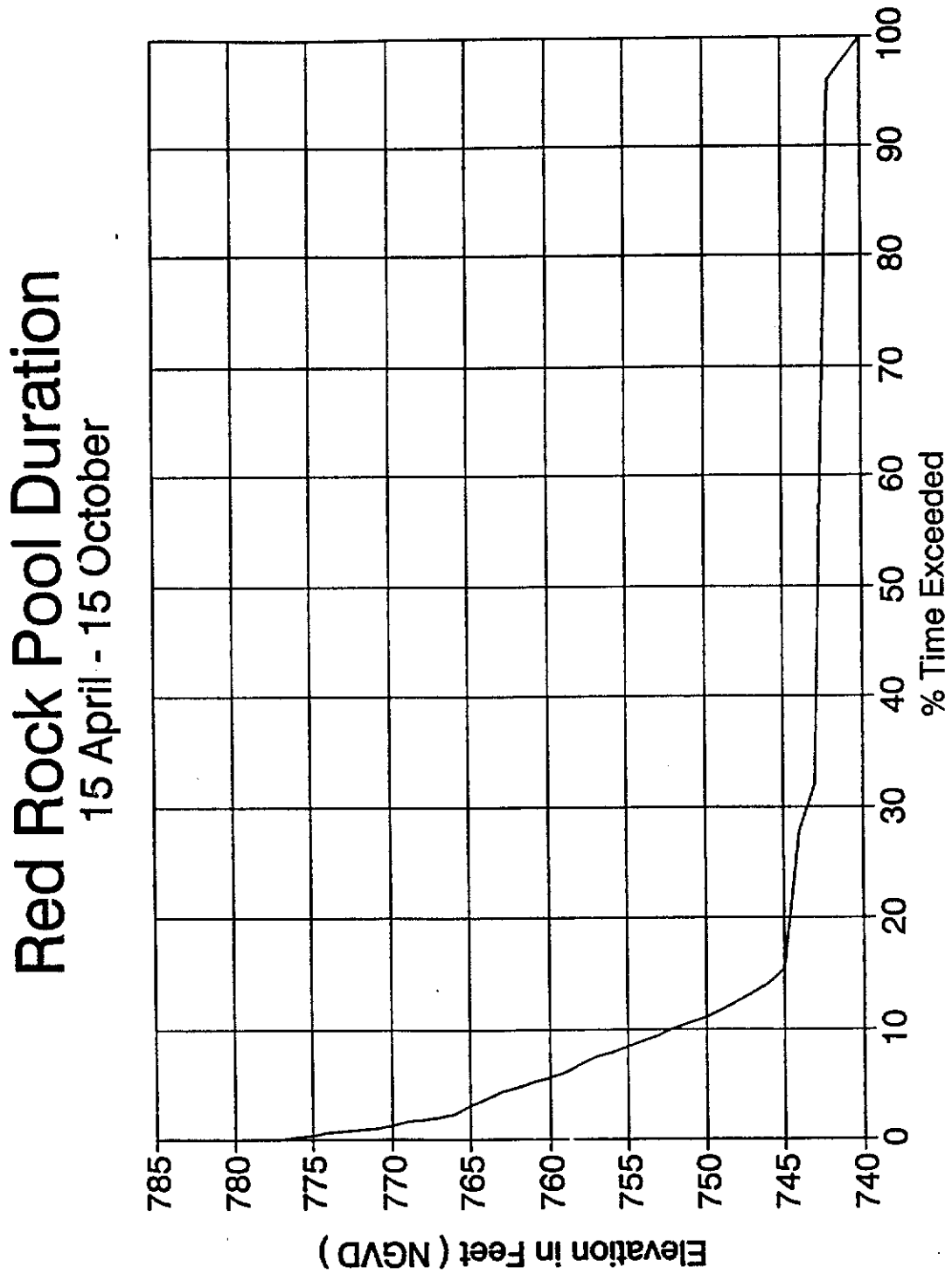


Figure 3-1: Red Rock Pool Duration

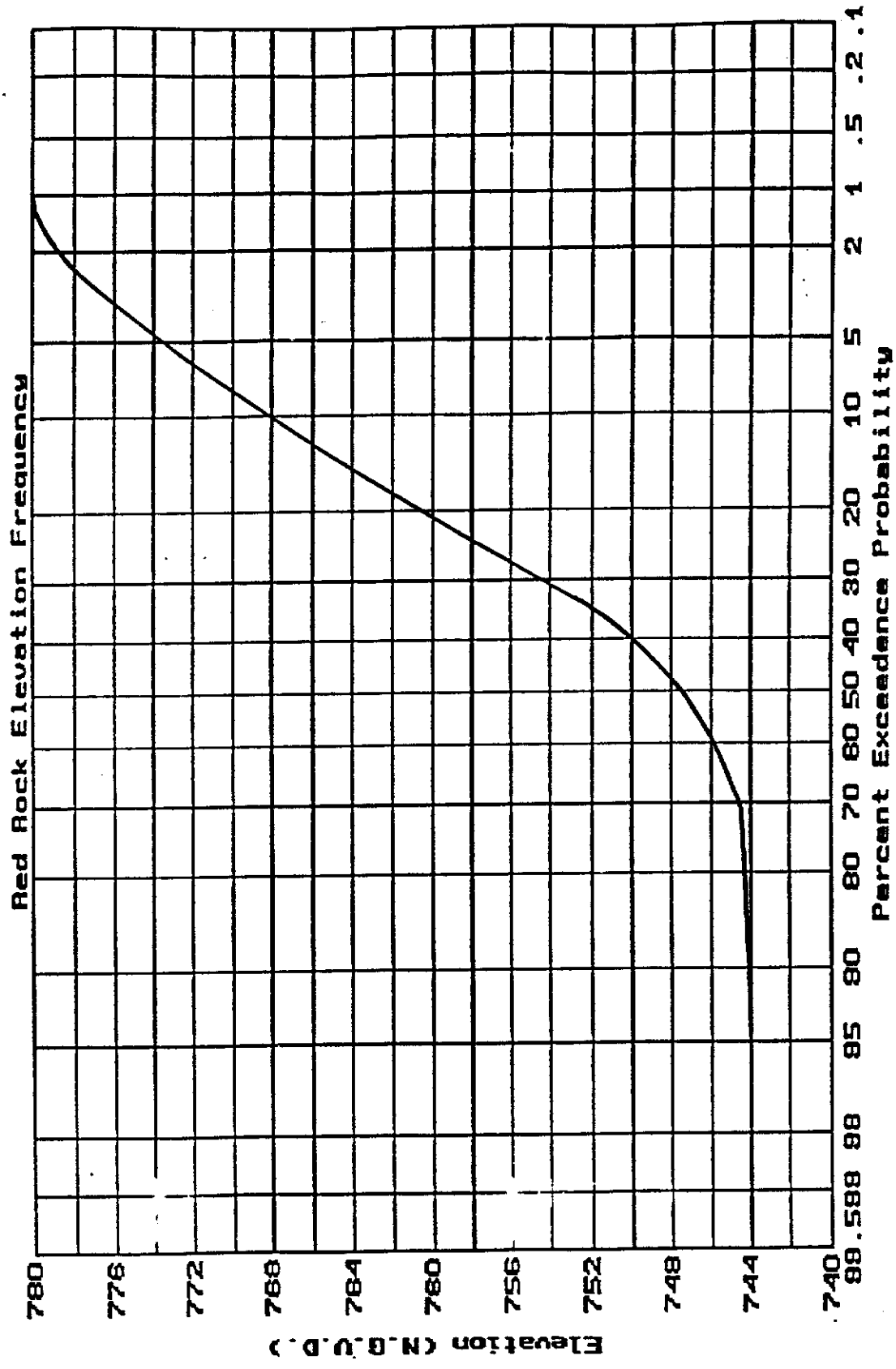


Figure 3-2: Red Rock Pool Elevation Frequency

Table 3-1: Red Rock Pool Duration

Red Rock Pool Duration
15 April - 15 October
1917 - 1991

Elevation	days	Percent	# Events	Ave Length
730	13800	100.0%	75	184.0
742	13240	95.9%	95	139.4
743	4427	32.1%	131	33.8
744	3843	27.8%	116	33.1
745	2133	15.5%	67	31.8
746	1967	14.3%	57	34.5
747	1842	13.3%	50	36.8
748	1728	12.5%	45	38.4
749	1627	11.8%	37	44.0
750	1541	11.2%	30	51.4
751	1468	10.6%	29	50.6
752	1393	10.1%	29	48.0
753	1314	9.5%	28	46.9
754	1246	9.0%	28	44.5
755	1172	8.5%	29	40.4
756	1105	8.0%	27	40.9
757	1038	7.5%	25	41.5
758	960	7.0%	26	36.9
759	859	6.2%	21	40.9
760	787	5.7%	19	41.4
761	722	5.2%	16	45.1
762	666	4.8%	13	51.2
763	599	4.3%	15	39.9
764	519	3.8%	15	34.6
765	427	3.1%	16	26.7
766	329	2.4%	11	29.9
767	283	2.1%	8	35.4
768	251	1.8%	7	35.9
769	230	1.7%	6	38.3
770	186	1.3%	6	31.0
771	155	1.1%	5	31.0
772	138	1.0%	5	27.6
773	115	.8%	5	23.0
774	89	.6%	3	29.7
775	59	.4%	6	9.8
776	38	.3%	4	9.5
777	16	.1%	2	8.0
778	4	.0%	2	2.0
779	0	.0%	0	.0
780	0	.0%	0	.0
781	0	.0%	0	.0
782	0	.0%	0	.0
783	0	.0%	0	.0
784	0	.0%	0	.0
785	0	.0%	0	.0

(2) Alternative Alignments #1 and #2: Alternative Alignment #1 is the segment of trail between Stations 378+90 and 391+34 as shown on Plate 23 of the Consultant's Report. This segment of trail will involve the purchase of private land as shown. Preliminary tract ownership research indicates that there are known title problems with the private land which must be purchased. Clearing the title problems may take six months to a year. A six month to one year delay will adversely affect the project schedule. To avoid a delay to the project schedule, Alternative Alignment #2 as shown on Plate 24 of the Consultant's Report was developed. Alternative Alignment #2 goes around the private property which Alternative #1 passes through, thus avoiding the purchase of private property between Stations 378+90 and 391+34. Alternative #1 is the desired alignment and will be constructed if the private land can be acquired in time to meet the project schedule. If the private land cannot be acquired in time to meet the project schedule then Alternative # 2 will be constructed between Stations 378+90 and 391+34.

(3) Alternative Alignment #3

(a) Alternative #3 is an alternative alignment for the segment of trail between Stations 337+00 and 391+35 as shown in Figure 2-1. The proposed trail alignment between Stations 339+60 and 389+00 will require the purchase of privately owned lands. The purchase of private lands for this segment of trail can be avoided by constructing Alternative Alignment #3. Alternative Alignment #3 will depart from the proposed trail alignment as shown on Plate 21 of the Consultant's Report at Station 337+00 and run south along the U.S. Government property boundary. Alternative Alignment #3 goes around the Dutchman's Landing Subdivision peninsula and ties into the proposed trail alignment at Station 391+35. Alternative Alignment #3 stays within the U.S. Government property boundary for its entire length of 7, 600 feet.

(b) Alternative Alignment #3 will require that approximately 5,740 feet of trail be constructed below elevation 780. Approximately 5,050 feet of trail will be constructed as low as elevation 765. Allowing for three feet of wave run-up, the trail will be able to be used by the public until the lake reaches elevation 762. Trail closure gates will be installed at elevation 783 at both ends of the inundated portion of trail. The closure gates will be shut for a high water event of elevation 762 or greater which will result in approximately a 5,800-foot section of trail between the closure gates being closed to the public. As shown in Figure 3-2, an elevation of 762 results in a percent exceedence probability of 18 percent which roughly translates into a 5-year-flood-event. As shown in Table 3-1, the average length of duration for elevation 762 is about seven weeks. Therefore, the construction of Alternative Alignment #3 will require that approximately a 7,800-foot portion of the proposed trail will be closed to the public, statistically, every 5 years for a period of approximately seven weeks. The proposed trail alignment between Stations 339+60 and 389+00 is above elevation 780 for its entire length and will never be closed due to inundation.

(c) The estimated cost of Alternative Alignment #3 is $1,440,000. The estimated cost of the proposed trail between Stations 337+00 and 391+35 is $880,000. Alternative #3 will run along the shoreline of Lake Red Rock and through existing wooded areas. The proposed trail alignment between Stations 339+60 and 389+00 will run along Highway G-28 which is much less desirable in terms of aesthetics, traffic noise and traffic proximity to the trail users.

(d) After considering real estate concerns, time of inundation, aesthetics, traffic, and cost, the proposed trail alignment between Stations 339+60 and 389+00 was selected as the best alternative.

4. REAL ESTATE REQUIREMENTS. The majority of the proposed trail will be located on lands which were acquired by the United States as a part of the Red Rock Dam and Lake Red Rock Project. Portions of the trail will be located on U. S. lands which have been outgranted for use by others. Red Rock Trails Segment IV project requires 173.86 acres. Of this, 142.17 acres are owned by the U. S. Government and 31.69 acres are in private ownerships.

a. U. S. Government

The U. S. Government owns 142.17 acres that are affected by this project. Of that, 114.82 acres will be used for trail right-of-way and 27.35 acres are proposed for borrow areas. Portions of this government owned land are presently leased for public park and recreational purposes to Marion County Conservation Board. In addition, the County has obtained right-of-way easements to authorize the use of Federal land for public highway purposes. The existing leases for the lands managed by the County will be modified to allow the proposed development within the lease areas. The Corps of Engineers will obtain permission from the County to construct the trail within the proposed road easement areas.

b. Landowners

There are three known private landowners. From these landowners, 31.69 acres will be acquired in fee simple title. This acreage acquisition includes the possibility that Marion County will have to maintain highway rights-of-way easements, plus the acreage acquisition includes uneconomic use areas from the landowners. Commencement of fee title and right-of-way acquisition is scheduled to begin in June 1995.

5. OPERATION AND MAINTENANCE CONSIDERATIONS

a. Operation

Operation of the project is the responsibility of the Corps of Engineers. Operation will include enforcing applicable load limits, vehicle restrictions, and closure devices required to maintain the safe operation of the facility.

b. Maintenance

Maintenance of the project is the responsibility of the Corps of Engineers. Maintenance activities will include shoulder and pavement inspection and repair, riprap inspection and repair, culvert and bridge inspection and repair, culvert clean out, pavement markings, traffic control, sign replacements, and mowing adjacent to grassed areas as required.

c. Operation and Maintenance Agreement With Marion County

The segment of trail from Station 43 +92.5 to Station 289+60 will be constructed on U.S. Government owned land currently leased to the Marion County Conservation Board for the operation and maintenance of Cordova Park and Robert's Creek Park. Marion County has expressed an interest in operating and maintaining the segment of trail that fall within their lease areas. An agreement between the Corps of Engineers and Marion County concerning operation and maintenance of the segment of trail constructed on land currently leased to Marion County will be finalized during the preparation of the Real Estate Design Memorandum. Since operation and maintenance of the Segment 4 project is the responsibility of the Corps of Engineers, construction of the trail is not dependent upon the operation and maintenance agreement with Marion County.

6. COST ESTIMATE

a. General

This section contains the detailed cost estimate which was prepared for the Red Rock Multi-Purpose Trail, Segment 4 Feature Design Memorandum. It includes construction, planning, engineering and design, and construction management costs. The current working estimate (CWE) prepared for this Feature Design Memorandum (FDM) was developed after review of project plans, discussions, with design team members, and review of costs for similar construction projects. The Micro Computer Aided Cost Estimating System (MCACES GOLD ver.5.30) incorporating local wage and equipment rates was utilized to assemble and calculate project element costs. These costs and appropriate contingencies, are presented in accordance with EC1110-2-536, Civil Works Project Cost Estimating - Code of Accounts.

b. Price Level

Project element costs are based on March 1995 prices. These costs are considered fair and reasonable to a well equipped and capable contractor and include overhead and profit. Calculation of the Fully Funded Estimate (FFE) was done in accordance with guidance from CECW-B Memorandum dated 23 Feb. 94, Subject: Factors for Updating Study/Project Cost Estimates for the FY 1996 Budget Submission. Table 5-1 shows the Project Cost Summary.

c. Presentation of Estimated Costs

(1) The Segment 4 project was broken down into several major items of construction. They are presented in the following order:

Segment 4A, Part 1: Station 397+90 to 498+27
Segment 4A, Part 2: Station 309+70 to 397+90
Additive 1: Station 236+00 to 309+79
Additive 2: Station 189+60 to 236+00
Segment 4B: Station 43+92 to 189+60

(2) Tables 5-3 to 5-7 show a summary of the Project Construction Cost Estimate.

d. Contingency Discussion

(1) After review of project documents and discussion with personnel involved in the project, cost contingencies were assigned which reflect the uncertainty associated with each cost item. Per EC1110-2-263, these contingencies are based on qualified cost engineering judgment of the available design data, type of work

TABLE 5-1: Project Cost Summary

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4
PROJECT COST SUMMARY, MARCH 1995

ACCOUNT	FEATURE	CURRENT WORKING ESTIMATE (CWE)		FULLY FUNDED ESTIMATE (FFE)	
		FEDERAL	NON-FEDERAL	FEDERAL	NON-FEDERAL
01.	LANDS AND DAMAGES	$ 53,000.00		$ 53,000.00	
14.	RECREATION FACILITIES				
	SEGMENT 4A, PART 1	$ 1,470,000		$1,520,800	
	SEGMENT 4A, PART 2	$ 1,090,000		$1,125,900	
	ADDITIVE 1	$ 1,190,000		$1,300,000	
	ADDITIVE 2	$ 730,000		$795,500	
	SEGMENT 4B	$ 970,000		$1,504,100	
30.	PLANNING, ENGINEERING AND DESIGN	$835,000		$931,100	
	FEATURE DESIGN MEMO $485,000				
	PLANS & SPECS $330,000				
	ENGR DURING CONSTR $20,000				
31.	CONSTRUCTION MANAGEMENT	$490,000		$546,400	
	CONTRACT ADMIN $150,000				
	SHOP DWG REVIEW $30,000				
	QUALITY ASSURANCE $310,000				
	SUBTOTAL	$ 6,828,000	0	$ 7,777,100	0
	COMBINED TOTAL PROJECT COST	$ 6,828,000		$ 7,777,100	

NOTES:
1. TOTAL PROJECT COST IS 100% FEDERAL COST; PROJECT LANDS WILL BE GOVERNMENT OWNED.
2. CONSTRUCTION FOR SEGMENT 4A, Part 1 & SEGMENT 4A, Part 2 SCHEDULED FOR AUG 95 - OCT 96, GIVING INFLATION FACTOR OF 1.035. CONSTRUCTION FOR ADDITIVE 1, ADDITIVE 2, AND SEGMENT 4B SCHEDULED FOR MAR 96 - JULY 97 GIVING INFLATION FACTOR OF 1.093. CONSTRUCTION MANAGEMENT COSTS HAVE INFLATION FACTOR OF 1.115.

TABLE 5-2: Project Cost Estimate for Lands and Damages

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4
PROJECT COST ESTIMATE, MARCH 1995

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
01.	**LANDS AND DAMAGES**							
01.-	**BICYCLE TRAIL**							
01.A.-.-	PLANNING	1	JOB	SUM	$ 1,500	$ 150	10.0%	3
01.B.-.-	ACQUISITION	1	JOB	SUM	$ 20,000	$ 2,000	10.0%	3
01.E.-.-	APPRAISAL	1	JOB	SUM	$ 4,000	$ 400	10.0%	3
01.M.-.-	LANDS	1	JOB	SUM	$ 22,500	$ 2,250	10.0%	3
	SUBTOTAL				$ 48,000			
	CONTINGENCIES, Average of	10.00%				$ 4,800		
	TOTAL, SEGMENT 4				$ 52,800			

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

TABLE 5-3: Project Cost Estimate for Segment 4A, Part 1

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4, SEGMENT 4A, PART 1
PROJECT COST ESTIMATE, MARCH 1995

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
14.0.3.-	BICYCLE TRAIL							
14.0.3.B	MOBILIZATION & DEMOBILIZATION	1	JOB	SUM	$ 22,804	$ 2,280	10.0%	2,5
14.0.3.B	CLEARING AND GRUBBING	11.70	ACR	$ 4,780.00	$ 55,926	$ 5,593	10.0%	1
14.0.3.B	STRIPPING	5,576	CY	$ 2.00	$ 11,152	$ 2,230	20.0%	1,2,6
14.0.3.B	BIKE TRAIL EMBANKMENT	39,791	CY	$ 6.00	$ 238,746	$ 59,687	25.0%	1,6
14.0.3.B	AGGREGATE BASE COURSE	2,996	TON	$ 21.00	$ 62,916	$ 6,292	10.0%	2,3,5
14.0.3.B	PRIME COAT	3,300	GAL	$ 2.00	$ 6,600	$ 660	10.0%	3,6
14.0.3.B	BITUMINOUS CONCRETE PAVEMENT	1,482	TON	$ 50.00	$ 74,100	$ 7,410	10.0%	2,3,5
14.0.3.B	PAVEMENT PAINT STRIPING	10,037	LF	$ 0.15	$ 1,506	$ 151	10.0%	6
14.0.3.B	STABILIZED AGGREGATE SHOULDER	409	SY	$ 1.10	$ 450	$ 45	10.0%	2,3,5
14.0.3.B	STEEL BARRIER POSTS	4	EA	$ 640.00	$ 2,560	$ 256	10.0%	1,4,6
14.0.3.B	CULVERT, 18" DIA.	362	LF	$ 20.00	$ 7,240	$ 724	10.0%	1,4,6
14.0.3.B	CULVERT, 24" DIA.	236	LF	$ 29.00	$ 6,844	$ 684	10.0%	1,4,6
14.0.3.B	CULVERT, 30" DIA.	40	LF	$ 35.00	$ 1,400	$ 140	10.0%	1,4,6
14.0.3.B	CULVERT, 36" DIA.	386	LF	$ 51.00	$ 19,686	$ 1,969	10.0%	1,4,6
14.0.3.B	CULVERT APRONS	32	EA	$ 167.00	$ 5,344	$ 534	10.0%	1,4,6
14.0.3.B	CULVERT RIPRAP	186	TON	$ 30.00	$ 5,580	$ 558	10.0%	1,4,6
14.0.3.B	CULVERT BEDDING STONE	691	SY	$ 4.15	$ 2,868	$ 287	10.0%	1,4,6
14.0.3.B	RETAINING WALL	10,883	SF	$ 28.00	$ 304,724	$ 60,945	20.0%	1,4,6
14.0.3.B	RETAINING WALL RIPRAP	544	TON	$ 21.00	$ 11,424	$ 2,285	20.0%	1,4,6
14.0.3.B	FENCE	1,451	LF	$ 29.00	$ 42,079	$ 4,208	10.0%	3,6
14.0.3.B	FRENCH DRAIN	1,654	LF	$ 7.00	$ 11,578	$ 2,316	20.0%	1,4,6
14.0.3.B	DITCH EROSION PROTECTION	5,000	SY	$ 1.35	$ 6,750	$ 1,350	20.0%	3,6
14.0.3.B	P.C.C. PAVEMENT	2,278	SY	$ 20.00	$ 45,560	$ 4,556	10.0%	2,5,6
14.0.3.B	BRIDGE	1,930	SF	$ 95.00	$ 183,350	$ 27,503	15.0%	1,3,5
14.0.3.B	SEEDING	8.80	ACR	$ 892.00	$ 7,850	$ 1,962	25.0%	1,3,5
14.0.3.B	LANDSCAPING	1.23	MI	$ 33,000.00	$ 40,590	$ 4,059	10.0%	1,3,5
14.0.3.B	LANDSCAPING PARKING LOT	1	EA	$ 5,815.00	$ 5,815	$ 1,163	20.0%	1,3,5
14.0.3.B	PARKING LOT	1	EA	$ 63,500.00	$ 63,500	$ 9,525	15.0%	1,3,5
14.0.3.B	SIGNS	1	JOB	SUM	$ 2,800	$ 560	20.0%	1,3,5
14.0.3.B	SEEDING OF BORROW AREA #1	6.90	ACR	$ 892.00	$ 6,155	$ 1,539	25.0%	1,3,5
	SUBTOTAL				$ 1,257,896			
	CONTINGENCIES, Average of	16.81%				$ 211,469		
	TOTAL, SEGMENT 4A, PART 1				$ 1,469,364			

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

TABLE 5-4: Project Cost Estimate for Segment 4A, Part 2

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4, SEGMENT 4A, PART 2
PROJECT COST ESTIMATE, MARCH 1995

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
14.	**RECREATION**							
14.0.3.-	**BICYCLE TRAIL**							
14.0.3.B	MOBILIZATION & DEMOBILIZATION	1	JOB	SUM	$ 22,804	$ 2,280	10.0%	2,5
14.0.3.B	CLEARING AND GRUBBING	22.10	ACR	$ 2,400.00	$ 53,040	$ 5,304	10.0%	1
14.0.3.B	STRIPPING	8,330	CY	$ 2.00	$ 16,660	$ 3,332	20.0%	1,2,6
14.0.3.B	BIKE TRAIL EMBANKMENT	28,133	CY	$ 6.00	$ 168,798	$ 42,200	25.0%	1,6
14.0.3.B	AGGREGATE BASE COURSE	3,381	TON	$ 21.00	$ 71,001	$ 7,100	10.0%	2,3,5
14.0.3.B	PRIME COAT	3,700	GAL	$ 1.60	$ 5,920	$ 592	10.0%	3,6
14.0.3.B	BITUMINOUS CONCRETE PAVEMENT	1,654	TON	$ 50.00	$ 82,700	$ 8,270	10.0%	2,3,5
14.0.3.B	PAVEMENT PAINT STRIPING	8,820	LF	$ 0.15	$ 1,323	$ 132	10.0%	6
14.0.3.B	STABILIZED AGGREGATE SHOULDER	447	SY	$ 1.10	$ 492	$ 49	10.0%	2,3,5
14.0.3.B	STEEL BARRIER POSTS	4	EA	$ 640.00	$ 2,560	$ 256	10.0%	1,4,6
14.0.3.B	CULVERT, 18" DIA.	535	LF	$ 20.00	$ 10,700	$ 1,070	10.0%	1,4,6
14.0.3.B	CULVERT, 24" DIA.	547	LF	$ 29.00	$ 15,863	$ 1,586	10.0%	1,4,6
14.0.3.B	CULVERT, 30" DIA.	67	LF	$ 35.00	$ 2,345	$ 235	10.0%	1,4,6
14.0.3.B	CULVERT APRONS	52	EA	$ 140.00	$ 7,280	$ 728	10.0%	1,4,6
14.0.3.B	CULVERT RIPRAP	273	TON	$ 21.00	$ 5,733	$ 573	10.0%	1,4,6
14.0.3.B	CULVERT BEDDING STONE	1,017	SY	$ 4.15	$ 4,221	$ 422	10.0%	1,4,6
14.0.3.B	CULVERT EXTENSION, 24"	65	LF	$ 75.00	$ 4,875	$ 488	10.0%	1,4,6
14.0.3.B	RETAINING WALL	8,800	SF	$ 28.00	$ 246,400	$ 49,280	20.0%	1,4,6
14.0.3.B	RETAINING WALL RIPRAP	150	TON	$ 21.00	$ 3,150	$ 630	20.0%	1,4,6
14.0.3.B	FENCE	920	LF	$ 30.00	$ 27,600	$ 2,760	10.0%	3,6
14.0.3.B	SHEET PILE WALL	2,262	SF	$ 25.00	$ 56,5[illegible]	$ 11,310	20.0%	1,3,6
14.0.3.B	FRENCH DRAIN	613	LF	$ 7.00	$ 4,291	$ 858	20.0%	1,4,6
14.0.3.B	DITCH EROSION PROTECTION	5,000	SY	$ 1.35	$ 6,750	$ 1,350	20.0%	3,6
14.0.3.B	SEEDING	9	ACR	$ 892.00	$ 8,028	$ 2,007	25.0%	1,3,5
14.0.3.B	LANDSCAPING	0.85	MI	$ 33,000.00	$ 28,050	$ 2,805	10.0%	1,3,5
14.0.3.B	LANDSCAPING PARKING LOT	1	EA	$ 5,815.00	$ 5,815	$ 1,163	20.0%	1,3,5
14.0.3.B	PARKING LOT	1	EA	$ 63,500.00	$ 63,500	$ 9,525	15.0%	1,3,5
14.0.3.B	SIGNS	1	JOB	SUM	$ 2,500	$ 500	20.0%	1,3,5
14.0.3.B	SEEDING OF BORROW AREA #3	1.9	ACR	$ 892.00	$ 1,695	$ 424	25.0%	1,3,5
	SUBTOTAL				$ 930,643			
	CONTINGENCY, Average of	16.89%				$ 157,229		
	TOTAL, SEGMENT 4A, PART 2				$ 1,087,872			

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

TABLE 5-5: Project Cost Estimate for Additive 1

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4, ADDITIVE 1
PROJECT COST ESTIMATE, MARCH 1995

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
14.	**RECREATION**							
14.0.3.-	**BICYCLE TRAIL**							
14.0.3.B	CLEARING AND GRUBBING	12.40	ACR	$ 4,800.00	$ 59,520	$ 5,952	10.0%	1
14.0.3.B	STRIPPING	4,100	CY	$ 2.00	$ 8,200	$ 1,640	20.0%	1,2,6
14.0.3.B	BIKE TRAIL EMBANKMENT	10,248	CY	$ 6.00	$ 61,488	$ 15,372	25.0%	1,6
14.0.3.B	AGGREGATE BASE COURSE	2,800	TON	$ 21.00	$ 58,800	$ 5,880	10.0%	2,3,5
14.0.3.B	PRIME COAT	3,075	GAL	$ 1.60	$ 4,920	$ 492	10.0%	3,6
14.0.3.B	BITUMINOUS CONCRETE PAVEMENT	1,377	TON	$ 50.00	$ 68,850	$ 6,885	10.0%	2,3,5
14.0.3.B	PAVEMENT PAINT STRIPING	7,379	LF	$ 0.15	$ 1,107	$ 111	10.0%	6
14.0.3.B	STABILIZED AGGREGATE SHOULDER	2,600	SY	$ 1.10	$ 2,860	$ 286	10.0%	2,3,5
14.0.3.B	STEEL BARRIER POSTS	3	EA	$ 640.00	$ 1,920	$ 192	10.0%	1,4,6
14.0.3.B	CULVERT, 18" DIA.	73	LF	$ 20.00	$ 1,460	$ 146	10.0%	1,4,6
14.0.3.B	CULVERT, 24" DIA.	324	LF	$ 29.00	$ 9,396	$ 940	10.0%	1,4,6
14.0.3.B	CULVERT APRONS	12	EA	$ 134.00	$ 1,608	$ 161	10.0%	1,4,6
14.0.3.B	CULVERT RIPRAP	65	TON	$ 30.00	$ 1,950	$ 195	10.0%	1,4,6
14.0.3.B	CULVERT BEDDING STONE	2,004	SY	$ 4.15	$ 8,317	$ 832	10.0%	1,4,6
14.0.3.B	RETAINING WALL	14,889	SF	$ 28.00	$ 416,892	$ 83,378	20.0%	1,4,6
14.0.3.B	RETAINING WALL RIPRAP	1,288	TON	$ 21.00	$ 27,048	$ 5,410	20.0%	1,4,6
14.0.3.B	FENCE	6,034	LF	$ 29.00	$ 174,986	$ 17,499	10.0%	3,6
14.0.3.B	REMOVE AND REINSTALL GUARDRAIL	2,600	LF	$ 2.80	$ 7,280	$ 728	10.0%	1,5
14.0.3.B	DITCH EROSION PROTECTION	667	SY	$ 1.35	$ 900	$ 180	20.0%	3,6
14.0.3.B	FRENCH DRAIN	2,512	LF	$ 6.60	$ 16,579	$ 3,316	20.0%	1,4,6
14.0.3.B	SEEDING	11	ACR	$ 892.00	$ 9,812	$ 2,453	25.0%	1,3,5
14.0.3.P	LANDSCAPING	0.3	MI	$ 33,000.00	$ 9,900	$ 990	10.0%	1,3,5
14.0.3.B	LANDSCAPING PARKING LOT	1	EA	$ 5,815.00	$ 5,815	$ 1,163	20.0%	1,3,5
14.0.3.B	PARKING LOT	1	EA	$ 63,500.00	$ 63,500	$ 9,525	15.0%	1,3,5
14.0.3.B	SIGNS	1	JOB	SUM	$ 2,100	$ 420	20.0%	1,3,5
	SUBTOTAL				$ 1,025,208			
	CONTINGENCY, Average of	16.01%				$ 164,144		
	TOTAL, ADDITIVE 1				$ 1,189,352			

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

TABLE 5-6: Project Cost Estimate for Additive 2

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4, ADDITIVE 2
PROJECT COST ESTIMATE, MARCH 1995

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
14.	**RECREATION**							
14.0.3.-	BICYCLE TRAIL							
14.0.3.B	CLEARING AND GRUBBING	7	ACR	$ 4,800.00	$ 33,600	$ 3,360	10.0%	1
14.0.3.B	STRIPPING	2,234	CY	$ 2.00	$ 4,468	$ 894	20.0%	1,2,6
14.0.3.B	BIKE TRAIL EMBANKMENT	16,219	CY	$ 7.30	$ 118,399	$ 29,600	25.0%	1,6
14.0.3.B	AGGREGATE BASE COURSE	1,762	TON	$ 21.00	$ 37,002	$ 3,700	10.0%	2,3,5
14.0.3.B	PRIME COAT	1,933	GAL	$ 1.60	$ 3,093	$ 309	10.0%	3,6
14.0.3.B	BITUMINOUS CONCRETE PAVEMENT	866	TON	$ 80.00	$ 69,280	$ 6,928	10.0%	2,3,5
14.0.3.B	PAVEMENT PAINT STRIPING	4,640	LF	$ 0.15	$ 696	$ 70	10.0%	6
14.0.3.B	STABILIZED AGGREGATE SHOULDER	279	SY	$ 1.10	$ 307	$ 31	10.0%	2,3,5
14.0.3.B	STEEL BARRIER POSTS	2	EA	$ 640.00	$ 1,280	$ 128	10.0%	1,4,6
14.0.3.B	CULVERT, 18" DIA.	145	LF	$ 20.00	$ 2,900	$ 290	10.0%	1,4,6
14.0.3.B	CULVERT, 24" DIA.	444	LF	$ 29.00	$ 12,876	$ 1,288	10.0%	1,4,6
14.0.3.B	CULVERT, 30" DIA.	120	LF	$ 35.00	$ 4,200	$ 420	10.0%	1,4,6
14.0.3.B	CULVERT, 36" DIA.	75	LF	$ 51.00	$ 3,825	$ 383	10.0%	1,4,6
14.0.3.B	CULVERT APRONS	25	EA	$ 145.00	$ 3,625	$ 363	10.0%	1,4,6
14.0.3.B	CULVERT RIPRAP	125	TON	$ 23.00	$ 2,875	$ 288	10.0%	1,4,6
14.0.3.B	CULVERT BEDDING STONE	687	SY	$ 4.15	$ 2,851	$ 285	10.0%	1,4,6
14.0.3.B	CULVERT EXTENSION, 30"	70	LF	$ 75.00	$ 5,250	$ 525	10.0%	1,4,6
14.0.3.B	RETAINING WALL	6,462	SF	$ 28.00	$ 180,936	$ 36,187	20.0%	1,4,6
14.0.3.B	RETAINING WALL RIPRAP	104	TON	$ 21.00	$ 2,184	$ 437	20.0%	1,4,6
14.0.3.B	FENCE	1,123	LF	$ 29.00	$ 32,567	$ 3,257	10.0%	3,6
14.0.3.B	DITCH EROSION PROTECTION	333	SY	$ 1.35	$ 450	$ 90	20.0%	3,6
14.0.3.B	FRENCH DRAIN	419	LF	$ 7.00	$ 2,933	$ 587	20.0%	1,4,6
14.0.3.B	SEEDING	6	ACR	$ 892.00	$ 5,352	$ 1,338	25.0%	1,3,5
14.0.3.B	LANDSCAPING	0.67	MI	$ 33,000.00	$ 22,110	$ 2,211	10.0%	1,3,5
14.0.3.B	LANDSCAPING PARKING LOT	1	EA	$ 5,815.00	$ 5,815	$ 1,163	20.0%	1,3,5
14.0.3.B	PARKING LOT	1	EA	$ 63,500.00	$ 63,500	$ 9,525	15.0%	1,3,5
14.0.3.B	SIGNS	1	JOB	SUM	$ 1,325	$ 265	20.0%	1,3,5
	SUBTOTAL				$ 623,698			
	CONTINGENCY, Average of	16.66%				$ 103,918		
	TOTAL, ADDITIVE 2				$ 727,616			

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

TABLE 5-7: Project Cost Estimate for Segment 4B

DES MOINES RECREATIONAL RIVER AND GREENBELT, RED ROCK MULTI-PURPOSE TRAIL, SEGMENT 4, SEGMENT 4B
PROJECT COST ESTIMATE, MARCH 1995

ACCOUNT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	CON %	REASONS
14.	**RECREATION**							
14.0.3.-	BICYCLE TRAIL							
14.0.3.B	MOBILIZATION & DEMOBILIZATION	1	JOB	SUM	$ 22,804	$ 2,280	10.0%	2,5
14.0.3.B	CLEARING AND GRUBBING	12	ACR	$ 4,800.00	$ 57,600	$ 5,760	10.0%	1
14.0.3.B	STRIPPING	7,015	CY	$ 2.00	$ 14,030	$ 2,806	20.0%	1,2,6
14.0.3.B	BIKE TRAIL EMBANKMENT	31,466	CY	$ 5.50	$ 173,063	$ 43,266	25.0%	1,6
14.0.3.B	AGGREGATE BASE COURSE	5,530	TON	$ 21.00	$ 116,130	$ 11,613	10.0%	2,3,5
14.0.3.B	PRIME COAT	6,070	GAL	$ 1.60	$ 9,712	$ 971	10.0%	3,6
14.0.3.B	BITUMINOUS CONCRETE PAVEMENT	2,719	TON	$ 50.00	$ 135,950	$ 13,595	10.0%	2,3,5
14.0.3.B	PAVEMENT PAINT STRIPING	14,568	LF	$ 0.15	$ 2,185	$ 219	10.0%	6
14.0.3.B	STABILIZED AGGREGATE SHOULDER	449	SY	$ 1.10	$ 494	$ 49	10.0%	2,3,5
14.0.3.B	STEEL BARRIER POSTS	4	EA	$ 640.00	$ 2,560	$ 256	10.0%	1,4,6
14.0.3.B	CULVERT, 18" DIA.	595	LF	$ 20.00	$ 11,900	$ 1,190	10.0%	1,4,6
14.0.3.B	CULVERT, 24" DIA.	513	LF	$ 29.00	$ 14,877	$ 1,488	10.0%	1,4,6
14.0.3.B	CULVERT, 30" DIA.	189	LF	$ 35.00	$ 6,615	$ 662	10.0%	1,4,6
14.0.3.B	CULVERT, 36" DIA.	208	LF	$ 51.00	$ 10,608	$ 1,061	10.0%	1,4,6
14.0.3.B	CULVERT, 48" DIA.	87	LF	$ 64.00	$ 5,568	$ 557	10.0%	1,4,6
14.0.3.B	CULVERT APRONS	64	EA	$ 157.00	$ 10,048	$ 1,005	10.0%	1,4,6
14.0.3.B	CULVERT RIPRAP	367	TON	$ 21.00	$ 7,707	$ 771	10.0%	1,4,6
14.0.3.B	CULVERT BEDDING STONE	544	SY	$ 4.15	$ 2,258	$ 226	10.0%	1,4,6
14.0.3.B	CULVERT EXTENSION, 18"	38	LF	$ 99.00	$ 3,762	$ 376	10.0%	1,4,6
14.0.3.B	CULVERT EXTENSION, 36"	90	LF	$ 92.00	$ 8,280	$ 828	10.0%	1,4,6
14.0.3.B	CULVERT EXTENSION, 48"	90	LF	$ 120.00	$ 10,800	$ 1,080	10.0%	1,4,6
14.0.3.B	DITCH EROSION PROTECTION	6,466	SY	$ 1.35	$ 8,729	$ 1,746	20.0%	3,6
14.0.3.B	FRENCH DRAIN	674	LF	$ 6.80	$ 4,583	$ 917	20.0%	1,4,6
14.0.3.B	COVERED BRIDGE	1	EA	$ 25,100.00	$ 25,100	$ 5,020	20.0%	1,5,6
14.0.3.B	SEEDING	8.3	ACR	$ 892.00	$ 7,404	$ 1,851	25.0%	1,3,5
14.0.3.B	LANDSCAPING	2.76	MI	$ 33,000.00	$ 91,080	$ 9,108	10.0%	1,3,5
14.0.3.B	LANDSCAPING PARKING LOT	1	EA	$ 5,815.00	$ 5,815	$ 1,163	20.0%	1,3,5
14.0.3.B	PARKING LOT	1	EA	$ 63,500.00	$ 63,500	$ 9,525	15.0%	1,3,5
14.0.3.B	SIGNS	1	JOB	SUM	$ 4,125	$ 825	20.0%	1,3,5
14.0.3.B	SEEDING OF BORROW AREA #4	2.2	ACR	$ 892.00	$ 1,962	$ 491	25.0%	1,3,5
14.0.3.B	SEEDING OF BORROW AREA #5	3.8	ACR	$ 892.00	$ 3,390	$ 847	25.0%	1,3,5
	SUBTOTAL				$ 842,639			
	CONTINGENCY, Average of	14.42%				$ 121,550		
	TOTAL, SEGMENT 4B				$ 964,188			

REASONS FOR CONTINGENCIES: 1. UNKNOWN SITE CONDITIONS, 2. UNKNOWN HAUL DISTANCE, 3. UNIT PRICE UNKNOWN, 4. QUANTITY UNKNOWNS, 5. DIFFICULT SITE ACCESS, 6. UNKNOWN FINAL DESIGN

involved, and uncertainties associated with the work and schedule. Costs were not added to contingency amounts to cover items which are identified project requirements. The following discussion of major project features indicates the basis for contingency selection and assumptions made. For other elements not addressed below, the assignment of contingencies was deemed appropriate to account for the uncertainty in design and quantity calculation and further discussion is not included.

(2) 14.0.3.B Bike Trail Embankment. Quantities for this feature were developed by the Engineering Consulting firm, Hanson Engineers, Inc., during the design process. Construction methods for this work are similar to previously constructed trails in the Lake Red Rock area. For this reason, contingency amounts for this concern are not excessive. The most important consideration on this work item is the fact that the trail alignment is not finalized at this time and may change slightly during the development of plans and specifications. Thus, the bike trail embankment item is given 25 percent contingency to account for the differing haul distances and the changes in the cut and fill amounts which may occur and that are unknown at this time.

(3) 14.0.3.B Retaining Wall. Quantities and layout for this feature were developed by Hanson Engineers, Inc. and are based on historical records that they have compiled on projects of similar scope. The work in this item is the installation of a retained earth system consisting of a layered grid backfilled with granular material. This wall would then have a facing panel system attached to it. The facing panels assumed for the cost estimate are composed of concrete blocks. The cost for this item was a historical unit price provided by Hanson Engineers, Inc. so the contingency assigned to it was kept lower than a developed cost contingency would have been. The contingency amount attached to this work is 20 percent.

(4) 14.0.3.B Bridge. This item describes the installation of a prefabricated steel bridge with a cast in place concrete deck. The material cost of the bridge is based on a quote from an established supplier which supplied several other bridges for projects of this type in the Lake Red Rock area. The chief concern for changes in design at this time are the overall length of the bridge and the size and dimensions of the abutments and mid-span concrete pier, any one of which could effect the cost. For this reason the contingency of 15 percent is applied, a number that is high enough to cover the risks mentioned and at the same time not excessive.

(5) 14.0.3.B Sheet Pile Wall. Quantities for this feature of work were developed by Hanson Engineers, Inc. The structure consists of a steel sheet pile wall with attached precast concrete panels to provide an aesthetic enhancement. There are some design considerations to be finalized on this item so the contingency of 20 percent is given to account for the changes that may occur.

(6) 14.0.3.B Covered Bridge. This work item is for the relocation and installation of an existing covered bridge that is being donated by Marion County.

The bridge is presently located about 8 miles away from its proposed location on the trail (Station 59+80). The costs involved will be to: (a) move bridge to new site on trail, (b) install new abutments, (c) install new floor support beams, and (d) install bridge. Since the costs for the tasks just described are not based on historical records and had to be developed using assumptions, the contingency of 20 percent is applied to the item.

(7) The project's overall construction cost contingency is 13.9 percent.

e. Feature 30. Planning, Engineering and Design

The engineering and design for this project includes all planning and design work necessary to complete the Feature Design Memorandum and prepare construction plans and specifications. This cost also includes engineering support during construction. The design effort for the construction was analyzed to determine the man-year effort required. This estimate is based on monies expended to date, discussions between the project engineer and project manager, and historical data and experience gained on other projects of similar nature.

f. Feature 31. Construction Management

Construction management includes the following items: review of project reports, plans and specifications, and conferences of construction staff to become familiar with design requirements; biddability, constructability, and operability reviews; pre-award activities to acquaint prospective bidders with the nature of work; administration of construction contracts; administration of A/E contracts which provide for supervision and inspection; establishment of benchmarks and baselines required for layouts of construction, relocations, and clearing; review of shop drawings, manuals, catalog cuts, and other information submitted by the construction contractor; assure specifications compliance by supervision and inspection on construction work, conferences with the contractors to coordinate various features of the project and enforce compliance with schedules; sampling and testing during the construction phase to determine suitability and compliance with plans and specifications; negotiation with the contractor on all contract modifications, including preparation of all contract documents required therefore; estimate quantities, determine periodic payments to contractors, and prepare, review and approve contract payments; review and approve construction schedules and progress charts; prepare progress and completion reports; project management and administration not otherwise identified; and district overhead. These costs may be incurred at the job site, an area office, or at the District Office. For the construction of the Red Rock Multi-Purpose Trail, Segment 4, the estimated cost of construction management is $490,000 for a construction contract with a 2 year duration and an estimated value of $5.5 million.

7. PLAN IMPLEMENTATION

a. Schedule for Design and Construction

(1) The project has been broken into five parts to facilitate the award of construction contracts. The project parts were determined based upon logical points to end the trail facility in the event parts of the project cannot be constructed due to real estate or future funding constraints. The five trail parts are:

Segment 4A, Part 1: Station 397+90 to 498+27
Segment 4A, Part 2: Station 309+70 to 397+90
Additive 1: Station 236+00 to 309+79
Additive 2: Station 189+60 to 236+00
Segment 4B: Station 43+92 to 189+60

(2) Plans and specifications are scheduled to be completed and construction initiated in FY 95 for Segment 4A, Parts 1 and 2. The initiation of construction in FY 95 of Segment 4A, Part 2, is dependent upon the acquisition of private lands by June 30, 1995. In the event that the required lands to construct Segment 4A, Part 2 are not available by June 30, 1995, then construction will be initiated in FY 95 on Segment 4A, Part 1, Segment 4B, Additive 1 and Additive 2. The scheduled completion date for the construction contract initiated in FY95 is the first quarter of FY 97.

(3) Plans and specifications are scheduled to be completed and construction initiated in FY 96 for the parts of Segment 4 which are not covered under the first construction contract. The second construction contract is scheduled for completion in the fourth quarter of FY 97. The initiation of the second construction contract for Segment 4 is dependent upon future federal funding for the Des Moines Recreational River and Greenbelt Program.

(4) Landscaping for the Segment 4 trail is scheduled for design completion and contract award in FY 97 with a completion date in FY 99. The initiation of landscaping for the Segment 4 trail is also dependent upon future federal funding for the Des Moines Recreational River and Greenbelt Program.

b. Implementation Responsibilities

The Corps of Engineers is responsible for design, construction, and operation and maintenance of this project.

c. Coordination

(1) Close coordination has been maintained between planning, engineering, and operations personnel within the Rock Island District. Government officials from the State of Iowa, Marion County, City of Pella and the City of Knoxville have been kept informed of the projects status through the Greenbelt Advisory Committee meetings. There is strong local support for the project.

(2) The Rock Island District has coordinated with the Marion County Conservation Board for the segment of trail within Cordova Park and Robert' Creek Park and with the Marion County Engineer for the portions of the trail which will be built within the existing right-of way for Marion County Highway G-28.

9. RECOMMENDATION

I recommend the construction of the Red Rock Multi-Purpose Trail, Segment 4, under the authority of the Des Moines Recreational Greenbelt, at a Federal cost of $6,828,000. The Federal government is responsible for operation and maintenance of this project.

_____
Date

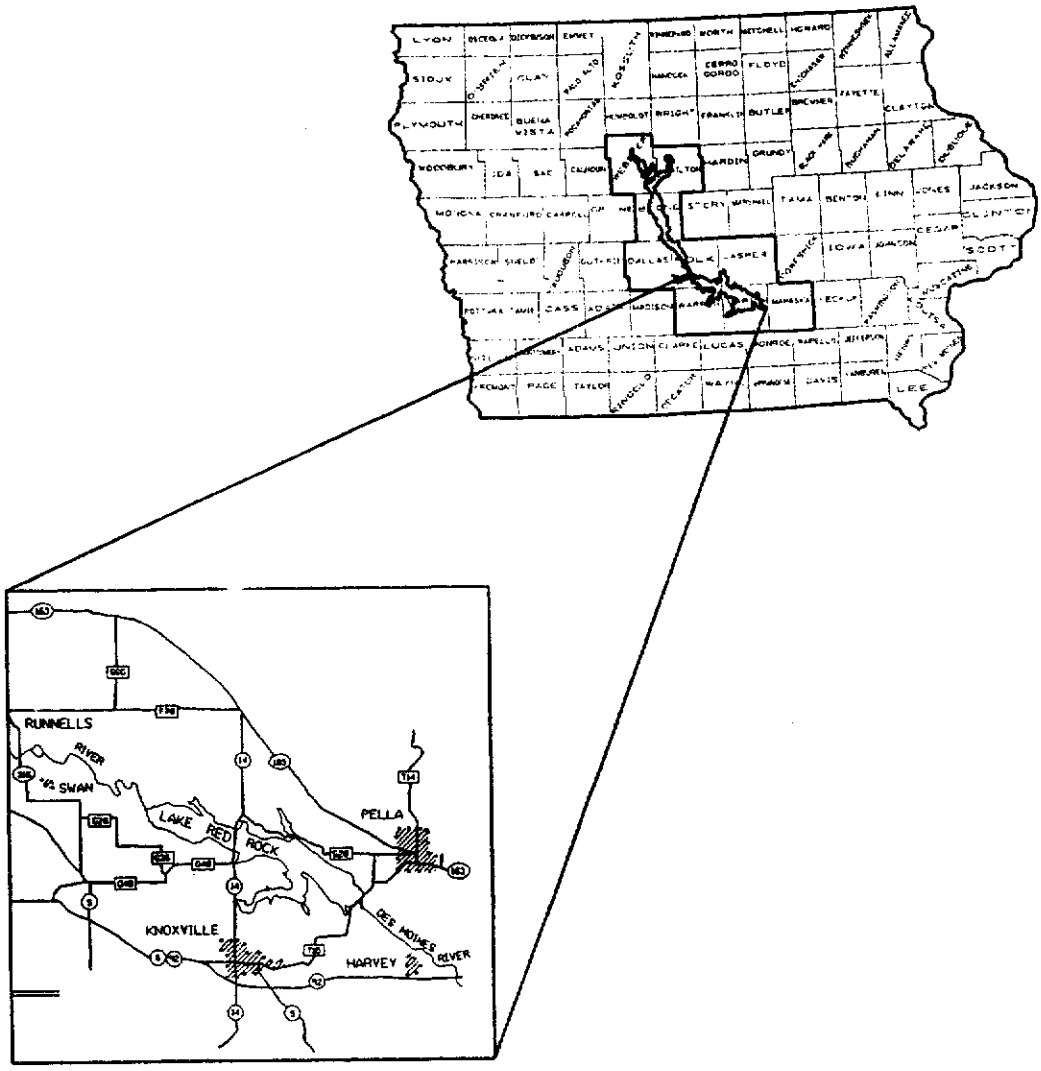
Charles S. Cox
Colonel, U.S. Army
District Engineer

CONSULTANT'S REPORT

STUDY REPORT

LAKE RED ROCK MULTI-PURPOSE TRAIL SEGMENT 4

LAKE RED ROCK, IOWA



Prepared For:

US Army Corps
of Engineers
Rock Island District

Prepared By:

HANSON ENGINEERS INCORPORATED
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

LAKE RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

FEBRUARY 1995

HANSON ENGINEERS, INC
1525 SOUTH SIXTH STREET
SPRINGFIELD, IL 62703

LAKE RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

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LAKE RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

1. INTRODUCTION

a. Purpose and Scope of Report

The purpose of this report is to document the efforts of Hanson Engineers Incorporated on the Lake Red Rock Multi-Purpose Trail Segment 4 planning study. This report includes a project description, design considerations, design methods and survey control, supporting documentation and calculations, and plates of the proposed plans.

2. DESCRIPTION OF PROJECT

a. Project Purpose

The purpose of Segment 4 is to provide a recreational facility for use by the public. The project makes areas of publicly owned land, which are presently accessible only to hikers, accessible to pedestrians, bicyclists, and cross country skiers. Segment 4 will connect to a previously constructed trail at Wallashuck Recreational Area. Segment 4 is the last in a series of trail segments, which will provide a continuous multi-purpose trail between the Red Rock Dam Tailwater Area and State Highway 14.

b. Project Location

The project is located along the northeast shore of Lake Red Rock in Township 77 North, Range 19 West, Sections 33, 32, and 31 and Township 76 North, Range 19 West, Sections 12, 11, 1, 2, 3, 4, and 5 (U.S.G.S., Pella and Otley, 15' quadrangles), Marion County, Iowa. The project begins at Wallashuck Recreational Area and runs northwest alongside Lake Red Rock for approximately 8.6 miles.

c. Project Description

The project involves the construction of 43,360 feet of asphalt surfaced trail and 2,050 feet of concrete surfaced trail. The trail will have a paved width of 10 feet with a 2-foot or 3-foot earth shoulder on each

side depending on right-of-way availability. The trail crosses several small drainage channels. All drainage channels are crossed via culvert and embankment except for two locations, which will be crossed via a bridge. The terrain the trail passes through is generally very hilly with both forested and grassland areas.

3. DESIGN CONSIDERATIONS

a. Civil Design

The proposed horizontal alignment and vertical profile were designed to minimize alterations of the natural terrain and clearing of vegetative cover while maintaining gradients and curves that would not be too difficult or dangerous for the users to negotiate. The proposed trail design was selected because it provides a recreational facility that best meets both environmental and user requirements.

Geometrics are based on August 1991 American Association of State Highway and Transportation Officials (AASHTO) criteria for the development of new bicycle facilities. Grades on the trail are kept below or close to 5 percent. Vertical crest curves were selected to allow for adequate stopping sight distance at 20 mph, and vertical sag curves were selected to avoid abrupt changes in grade. All horizontal curves have a minimum design speed of 20 miles per hour. The trail is 10 feet wide to accommodate both bicycle and pedestrian traffic. The design criteria for the project is shown in Table 1. Documentation of the design criteria is in Appendix E.

b. Conservation of Existing Resources

One of the major design objectives for this project is to minimize disturbance to existing natural resources. Particular care was taken in selecting the horizontal alignment to follow the natural contours of the land as much as possible and still maintain geometric design criteria. The design profile was determined by following the existing ground line as close as practical. During the preparation of plans and specifications, minor changes will be incorporated into the horizontal alignment to minimize the clearing of large diameter trees, and to incorporate the resource management needs of the park managers.

TABLE 1

Design Criteria
Lake Red Rock
Multi-Purpose Trail Segment 4

Project Type:	New Construction
Facility Type:	Multi-Purpose Trail (Bicycles, Pedestrians, Cross Country Skiers)
Design Speed:	General - 20 mph Grades > 4% - 30 mph
Lanes:	10 ft (2% cross slope) - 8 ft (min.)
Shoulders:	3 ft (8% cross slope) - 2 ft (min.)
Earth Slopes & Ditches:	Fills: 3:1 Cuts: 3:1 Ditch Depth: 1 ft (min.)
Grades:	5% (max.) 500 ft maximum length on 5% grade
Vertical Alignment:	Sag Curves: $K_{sag} = 12.0$ $L=KA$ $L_{min} = 40$ ft Crest Curves: $A < 4$ $L = L_{min} = 40$ ft $A = 4 - 7$ $L = AS^2/900$ $A > 7$ $K_{crest} = 18.0$ $L=KA$ $S = (400/(7.5 + 3G)) + 73.4$ (when G is negative grade) S = Stopping Sight Distance (ft) G = Grade (ft/ft) A = Algebraic Grade Difference (%) L = Curve Length (ft)
Horizontal Alignment:	$R_{20\ mph} = 95$ ft $R_{30\ mph} = 250$ ft
Vertical Clear Zone:	10 ft
Horizontal Clear Zone:	10 ft each side of centerline
Superelevation:	2% (min.) - 4% (max.)
Roadway Barriers:	4.5 ft height (min.)
Bridge Width:	10 ft (min.)
Drainage, Culverts:	18 in. pipe (min.)

c. Crossing at Station 432+00

i. Description

The trail crosses a large drainage channel at Station 432+00. The drainage area is 23.04 acres. Two alternatives for crossing the channel were considered. The following is a brief discussion of each alternative.

ii. Bridge Crossing

A 193-foot long prefabricated bridge was designed to cross the channel. The bridge deck will be 10 feet wide. The bridge would be supported by one concrete pier and two concrete abutments. A structural analysis and cost estimate for the bridge is located in Appendix C. The preliminary estimated construction cost for the bridge is $171,000.

The elevation of the bridge superstructure was based on AASHTO design criteria for safe approach gradients to the structure. The design profile for the trail would be a 300 foot vertical curve with a beginning grade of negative 4 percent and an ending grade of zero percent.

Crossing the channel via a bridge would minimize the clearing of existing trees and alterations to the existing natural terrain. A bridge would also require a higher maintenance cost than a culvert.

iii. Culvert and Embankment Crossing

The other viable alternative considered for crossing the channel was a culvert and embankment. This alternative would involve constructing a 7,600 cubic yard embankment over a 48 inch diameter culvert. The embankment would be constructed of fill from a borrow area and would have side slopes of 3H-1V. The preliminary estimated construction cost for this alternative is $122,000. The advantages of a culvert and embankment crossing are lower construction and maintenance costs. Based on this analysis, a culvert was selected as the best alternative for the crossing.

d. Crossing at Station 459+20

i. Description

The trail crosses a large drainage channel at Station 459+20. The drainage area is 65.3 acres. Two alternatives for crossing the channel were considered. The following is a brief discussion of each alternative.

ii. Bridge Crossing

A 193-foot long prefabricated bridge was designed to cross the channel. The bridge deck would be 10 feet wide and constructed of concrete to minimize maintenance. The bridge would be supported by one concrete pier and two concrete abutments. A structural analysis and cost estimate for the bridge is located in Appendix C. The preliminary estimated construction cost for the bridge is $191,000. See Bridge Drawings for more information.

The elevation of the bridge superstructure was determined from AASHTO design criteria for safe approach gradients to the structure. The design profile for the trail would be a 300 foot vertical curve with a beginning grade of negative 1.25 percent and an ending grade of 4 percent.

Crossing the channel via a bridge would minimize the clearing of existing trees and alterations to the existing natural terrain. A bridge would also require a higher maintenance cost than a culvert.

iii. Culvert and Embankment Crossing

The other viable alternative considered for crossing the channel was a culvert and embankment. This alternative would involve constructing a 11,500 cubic yard embankment over a 60 inch diameter culvert. The embankment would be constructed of fill from a borrow area and would have side slopes of 3H-1V. The preliminary estimated construction cost for this alternative is $176,000. The advantage of a culvert and embankment crossing is lower maintenance costs.

After considering costs, aesthetics, and impact to existing natural resources, and wildlife, a bridge was selected as the best alternative for the crossing.

e. Crossing at Station 59+80

The Marion County Conservation Service offered a covered bridge for use on the multi-purpose trail. The bridge is 40 feet long and 16 feet wide. The bridge will be located over a small drainage channel at Station 59+80. See Covered Bridge Drawings for more information.

f. Retaining Wall Evaluation

Embankment and retaining wall alternatives were investigated at several locations. These locations were selected for an analysis to determine if constructing a retaining wall system would be more economical than the required earthwork.

Most of the locations are where the proposed trail is to be constructed adjacent to the existing county highway (CH G-28). In each case, the earthwork required with or without a retaining wall was computed. The retaining wall was assumed to be some type of proprietary retained earth system consisting of a layered grid backfilled with granular material. Three facing types were evaluated: concrete panels, concrete blocks, and gabions.

In each case, the facing would be attached to the grid. A summary of the locations is in Table 2. The summary includes quantities, unit costs, total costs, and recommendation for each location.

Drainage at retaining walls would be determined during preparation of plans and specifications depending on the retaining wall facing selected.

g. Safety

The eight typical sections, as shown in Sheets 5 and 6 of the plans, were developed to provide safe travel for users of CH G-28 and the multi-purpose trail.

Typical Sections #1, #2, and #6 have more than 10 ft horizontal clearance between the road shoulder and trail shoulder. This clearance is more than double the recommended minimum distance of 5 ft in the AASHTO guide; therefore, guardrail protection was not considered necessary for these sections.

TABLE 2
Borrow/Retaining Wall Analysis

Start Station	End Station	Borrow Volume (cu yd)	Retaining Wall Volume (cu yd)	Retaining Wall Height (ft)	Retaining Wall Length (ft)	Retaining Wall Area (sq ft)	Excavation for fill < 780 ft (cu yds)	Borrow Cost	Retaining Wall Concrete Panel Cost	Retaining Wall Concrete Blocks Cost	Retaining Wall Gabions Cost	Recommendation and Comments
129+08 Rt	134+46 Rt	4772	1089	6	538	3228	4772	$52,492.00	$86,006.51	$72,377.18	$56,237.18	Borrow - Lower cost.
146+92 Rt	150+59 Rt	968	280	3	367	1101	0	$6,776.00	$29,103.28	$24,026.44	$18,521.44	Borrow - Lower cost.
177+00 Rt	180+50 Rt	3941	1724	6.5	350	2275	1970.5	$35,469.00	$67,248.37	$57,790.27	$46,415.27	Borrow - Lower cost.
196+00 Rt	202+00 Rt	8270	1703	6	600	3600	5540.9	$80,053.60	$99,310.67	$84,110.67	$66,110.67	Retaining Wall - Lower Cost, Minimize fill below 780 ft.
208+00 Rt	210+76 Rt	3536	667	6.5	276	1794	1768	$31,824.00	$48,232.46	$40,774.07	$31,804.07	Retaining Wall - Lower Cost, Minimize fill below 780 ft.
215+53 Rt	218+00 Rt	7383	1903	10	247	2470	0	$51,681.00	$72,402.05	$63,253.90	$50,903.90	Retaining Wall - Lower Cost, Minimize fill below 780 ft.
242+00 Rt	268+00 Rt	45221	1733	3	2600	7800	45221		$204,144.89	$168,178.22	$129,178.22	Retaining Wall - Robert's Creek Dam\protect rip-rap
284+00 Rt	292+34 Rt	19510	3064	8.5	834	7089	19510	$214,610.00	$191,246.66	$163,612.69	$128,167.69	Retaining Wall - Lower Cost, Minimize fill below 780 ft.
340+00 Rt	344+00 Rt	12562	1716	9	400	3600	11305.8	$133,157.20	$98,244.00	$84,444.00	$66,444.00	Retaining Wall - Lower cost, Minimize fill below 780 ft.
376+00 Rt	381+20 Rt	22530	3351	10	520	5200	7434.9	$187,449.60	$147,249.42	$127,990.16	$101,990.16	Retaining Wall - Lower cost, Minimize fill below 780 ft.
416+00 Rt	430+51 Rt	38309	5323	7.5	1451	10882.5	38309	$421,399.00	$299,040.76	$256,208.47	$200,795.97	Retaining Wall - Lower cost, Minimize fill below 780 ft.
430+51 Rt	433+56 Rt	10788	7272	14	305	4270	10788	$118,668.00	$150,950.25	$137,349.51	$115,999.51	Borrow - Culvert Location
430+51 Lt	433+56 Lt	10788	7819	13	305	3965	10788	$118,668.00	$148,080.08	$134,936.84	$115,111.84	Borrow - Culvert Location

Unit Costs	
Excavation	$4/cu yd
Borrow	$7/cu yd
Concrete Panel	$25/sq ft of wall face
Concrete Blocks	$20/sq ft of wall face
Gabions	$15/sq ft of wall face

Stationing based on 90% submittal alignment
Borrow Volume was calculated by road design software
Retaining Wall Volume was scaled from plotted cross-sections
Retaining Wall Height was scaled from plotted cross-sections
Borrow Cost is volume * unit cost
Retaining Wall Cost is face area * unit cost
Retaining Wall Cost includes cost of backfill material
Excavation cost for fill placed below 780 ft is added to Borrow Cost

All retaining walls are assumed to be reinforced earth systems of layered grid attached to a facing of concrete panels, concrete blocks, or gabions.

All feasible alternatives are highlighted for each section analyzed.
The facing design would be selected during preparation of plans and specifications.

Typical Sections #3, #5, and #7 have a 5 ft land strip between the county highway shoulder and the path as recommended in the AASHTO guide. The use of guardrail along the road is considered to be a danger to vehicles outweighing the benefit provided to the trail users and is not recommended.

Where possible, a vertical separation between the road and the trail will be provided to discourage trail users from going from the trail to the road.

Typical Section #4 provides a horizontal and vertical separation between the road and trail. This separation meets the requirements of the AASHTO guide and guardrail is not recommended.

Typical Section #8 is located on the Roberts Creek Dam. There is not enough width to provide a 5 ft land strip, so guardrail will be at the county highway shoulder's edge. A 4.5 ft fence or rail will be provided between the guardrail and the trail. A 4.5 ft fence or rail will also be provided between the trail and dam embankment which is protected with riprap.

Several fences and rail types were analyzed. A wooden fence is recommended over a chain link fence because of its lower construction cost and more appealing appearance when compared with the surrounding rural terrain. The preferred wooden fence is a four rail fence as used in Segment IIB.

During the plans and specifications phase, special consideration will need to be given to those locations where the trail crosses access roads, especially near intersections with the county highway (CH G-28). Signing and pavement markings, especially with regard to sight distances, grades, and turning movements, will need to be included.

Since some of the trail would be alongside the county highway, the impact of the trail on the county highway clear zone was evaluated.

Many of the existing county highway slopes are 2:1 which, according to the AASHTO Roadside Design Guide are non-recoverable and considered to be a hazard. There is therefore no clear zone outside of the edge of the shoulder. There is currently no guardrail along the county highway where the trail would be located. The trail would have a horizontal and vertical separation from the county highway. The trail would provide a recovery area for vehicles on the county highway. The county highway clear zone would not be reduced by the proposed trail and guardrail would not be required.

h. Profile Design

The trail profile is designed to follow the existing ground as close as feasible while maintaining AASHTO minimum grades and 20 mph design speed. The profile is designed to always be above the pool level of 780 ft except from Station 429+00 to Station 448+00. Some areas were analyzed to determine if lowering the profile would result in a significant decrease in the amount of embankment required and increase the separation between the county highway and the trail.

For grades greater than 4 percent, the horizontal alignment was designed for a 30 mph design speed. There are three locations of grades greater than 4 percent. The first location is from Station 352+00 to Station 355+00. The grade is 4.5 percent. The horizontal alignment is on tangent. The second location is from Station 355+00 to Station 358+00. The grade is 5.5 percent. The horizontal alignment has a design speed greater than 30 mph. The third location is from Station 365+50 to Station 374+50. The grade is 4.22 percent. The horizontal alignment is on tangent and a curve with a design speed greater than 30 mph.

i. Pavement Design

Five pavement designs were analyzed.

1. 4" full depth bituminous concrete on compacted subgrade.
2. 3" bituminous concrete on 6" compacted aggregate base.
3. 5" portland cement concrete on compacted subgrade.
4. 4" shredded wood on 4" compacted aggregate base.
5. 6" aggregate on compacted subgrade.

All five designs would support expected load of pedestrians and cyclists. Selection should be based on support of intended trail uses, reflection on local environment and harmony with landscape.

The 3" bituminous concrete on 6" compacted aggregate design is recommended for the following reasons:

1. Provides universal access to users.
2. Consistent with previous trail segments.
3. Requires low maintenance.
4. Provides an all weather surface.
5. Provides a smooth riding surface.

The 5" PCC on subgrade is recommended for the segment of trail that is below pool elevation (780 ft). This segment is from Station 429+00 to Station 448+00.

Construction inspection should be used to insure pavement depth and adequate compaction of subgrade and 6" aggregate base. Heavy vehicle loads should be restricted. Emergency and maintenance vehicles only should be allowed on the trail.

j. Pavement Cross Slope

The pavement cross slope would be 4 percent for all horizontal curves with a radius less than 250 feet (design speed = 30 mph). All other curves and tangents would have a cross slope of 2 percent. Cross slope would be to the inside of all horizontal curves.

k. Borrow Excavation Below 780 Feet and 748 Feet

Some material would be placed below the high water elevation of 780 feet. This amount is approximately 28,000 cubic yards. Of this 28,000 cubic yards, 7,360 cubic yards would be in the retaining wall systems. The borrow area at Station 450+00 can provide this quantity of material and replace the lost storage for the lake.

Some material would be placed below 748 feet from Station 431+00 to Station 434+00. This amount is approximately 1,320 cubic yards. The borrow area at Station 450+00 can provide this quantity of material.

l. Erosion, Scour Protection and Ditches

Erosion and scour protection at drainage structures were analyzed. Due to the high erodibility of the native soil, it was recommended that all drainage structure outlets be protected with riprap. A standard volume of riprap was assumed for all outlets. This volume was 6 ft wide, 12 ft long, and 1 ft deep. The width of riprap was increased accordingly for drainage structures with widths greater than 6 feet.

Erosion protection of ditches was analyzed. Due to the high erodibility of the native soil, it was recommended that all grades 4 percent or greater be provided with erosion protection until vegetation is established.

The county highway ditch would need regrading to inlet the left trail ditch at Station 150+00. The left trail ditch would need to be deepened to 2 feet. The culvert inlet would be at the left trail ditch and outlet to a ravine on the right. The regraded county highway ditch and the left trail ditch would need riprap protection.

The road ditch from Station 491+00 on the right would be filled in by the trail earthwork. This road ditch would need to be regraded during trail construction.

A ditch would be added to the top of the backslope from Station 490+50 to Station 494+00 on the left. This is shown on Typical Section #9 in the plans. A minimum 15 ft wide area would allow access to the ditch for maintenance.

The slopes between the county highway and the trail in typical sections #3 and #4 are recommended to be protection by erosion control measures. An open graded aggregate ditch, 2 ft wide and deep, is recommended between the slope and the left edge of the trail. Underdrains (6" dia.) are recommended every 50 ft to outlet the open graded aggregate left ditch to the right trail ditch.

Hydraulic calculations for all drainage structures are in Appendix B.

m. Quantities

The 8.6 mile project was broken into 4 segments. Segment 4B is from Station 43+92 to Station 189+60. Segment Add2 is from Station 189+60 to Station 236+00. Segment Add1 is from Station 236+00 to Station 309+79. Segment 4A is from Station 309+70 to Station 498+28. Construction quantities were calculated and reported for each segment. The quantities are in Appendix F. A mass diagram was developed for each segment. The mass diagrams are in Appendix G.

n. Utilities

Based on the incomplete utility information provided by the Corps, the utility relocation quantity is assumed to be minimal.

o. Alternative Alignment

An alternative alignment was analyzed for the area from Station 378+00 to Station 392+00. The alternate alignment is labeled as Alternative #2 on the plans. This alternate alignment diverts from

Alternative #1 at Station 378+00. Alternative #2 follows the government property line and joins Alternative #1 at Station 394+27 (Station 391+34).

4. DESIGN METHODS AND SURVEY CONTROL

a. Design and Survey Equipment and Methods

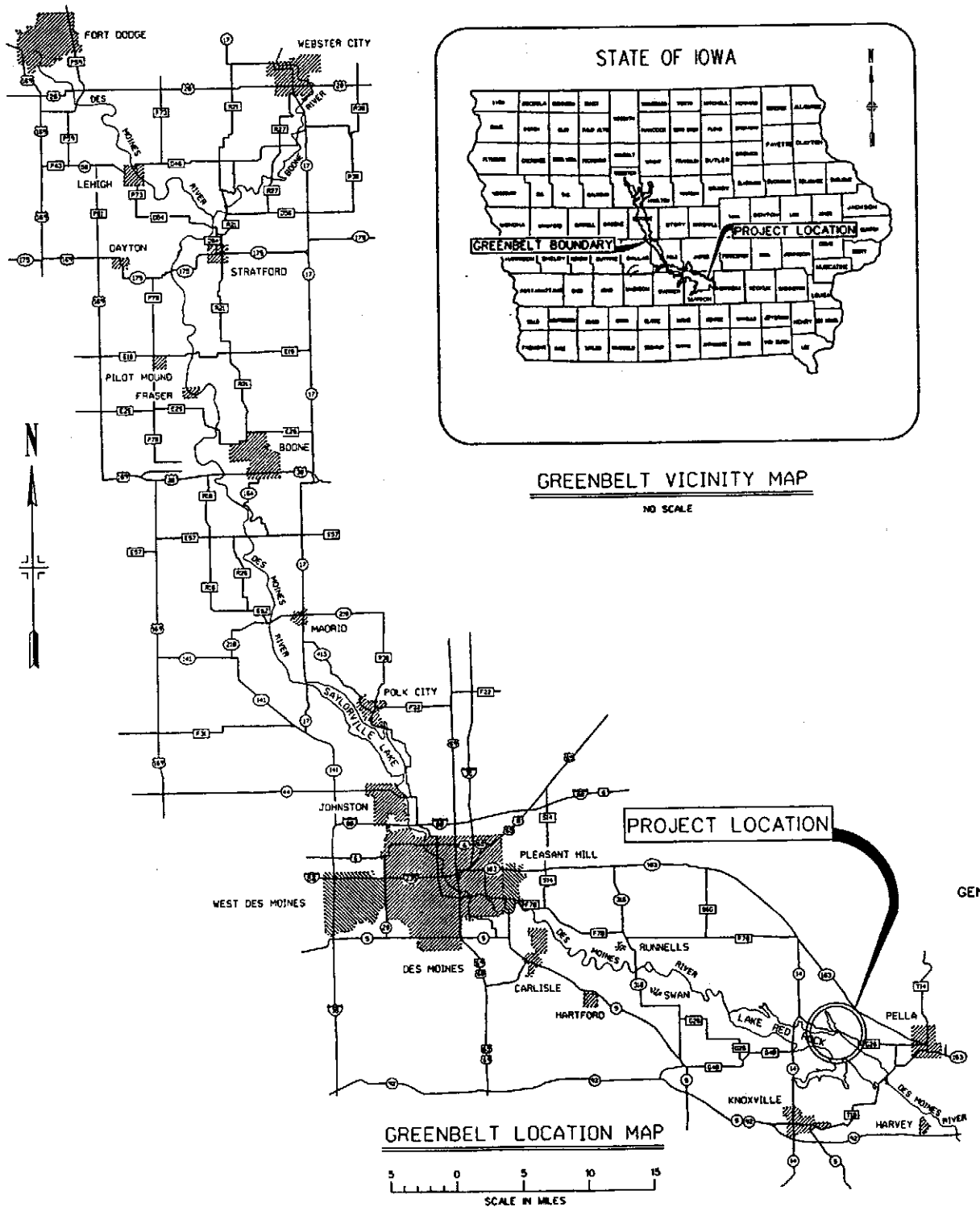
Microstation software by Intergraph, LACES (Lamutt and Associates Civil Engineering Software), and Geodimeter were used for survey and design. Design and survey were performed according to accepted engineering practice.

b. Horizontal and Vertical Control

Horizontal control was determined by traverse. Vertical control was determined by the provided mapping.

DES MOINES RECREATIONAL RIVER AND GREENBELT

RED ROCK MULTI-PURPOSE TRAIL - SEGMENT IV



GREENBELT LOCATION MAP

5 0 5 10 15

SCALE IN MILES

GREENBELT VICINITY MAP

NO SCALE

PROJECT LOCATION PLAN

2000 0 2000 4000 6000

APPROXIMATE SCALE IN FEET

GENERAL NOTES:

1. XXXX

INDEX		
COMPUTER FILE NAME	SHEET REF. NO.	TITLE OF DRAWING
COVER.DGN	SHT. 1	COVER SHEET
TRAVERSE.DGN	SHT. 2	TRAVERSE
TSL.DGN	SHT. 3	BRIDGE TYPE, SIZE & LOCATION
TSLCB.DGN	SHT. 4	COVERED BRIDGE TYPE, SIZE & LOCATION
TYP-SEC.DGN	SHT. 5	TYPICAL SECTIONS
TYP-SEC.DGN	SHT. 6	TYPICAL SECTIONS
DETAILS.DGN	SHT. 7	DETAILS
SHEET1.DGN	SHT. 8	PLAN AND PROFILE SHEET STA. 44+00 TO STA. 62+00
SHEET2.DGN	SHT. 9	PLAN AND PROFILE SHEET STA. 62+00 TO STA. 84+00
SHEET3.DGN	SHT. 10	PLAN AND PROFILE SHEET STA. 84+00 TO STA. 106+00
SHEET4.DGN	SHT. 11	PLAN AND PROFILE SHEET STA. 106+00 TO STA. 128+00
SHEET5.DGN	SHT. 12	PLAN AND PROFILE SHEET STA. 128+00 TO STA. 150+00
SHEET6.DGN	SHT. 13	PLAN AND PROFILE SHEET STA. 150+00 TO STA. 172+00
SHEET7.DGN	SHT. 14	PLAN AND PROFILE SHEET STA. 172+00 TO STA. 194+00
SHEET8.DGN	SHT. 15	PLAN AND PROFILE SHEET STA. 194+00 TO STA. 216+00
SHEET9.DGN	SHT. 16	PLAN AND PROFILE SHEET STA. 216+00 TO STA. 238+00
SHEET10.DGN	SHT. 17	PLAN AND PROFILE SHEET STA. 238+00 TO STA. 260+00
SHEET11.DGN	SHT. 18	PLAN AND PROFILE SHEET STA. 260+00 TO STA. 282+00
SHEET12.DGN	SHT. 19	PLAN AND PROFILE SHEET STA. 282+00 TO STA. 304+00
SHEET13.DGN	SHT. 20	PLAN AND PROFILE SHEET STA. 304+00 TO STA. 326+00
SHEET14.DGN	SHT. 21	PLAN AND PROFILE SHEET STA. 326+00 TO STA. 348+00
SHEET15.DGN	SHT. 22	PLAN AND PROFILE SHEET STA. 348+00 TO STA. 370+00
SHEET16.DGN	SHT. 23	PLAN AND PROFILE SHEET STA. 370+00 TO STA. 392+00
SHEET16A.DGN	SHT. 24	PLAN AND PROFILE SHEET STA. 378+89.92 TO STA. 394+27.3
SHEET17.DGN	SHT. 25	PLAN AND PROFILE SHEET STA. 392+00 TO STA. 414+00
SHEET18.DGN	SHT. 26	PLAN AND PROFILE SHEET STA. 414+00 TO STA. 436+00
SHEET19.DGN	SHT. 27	PLAN AND PROFILE SHEET STA. 436+00 TO STA. 458+00
SHEET20.DGN	SHT. 28	PLAN AND PROFILE SHEET STA. 458+00 TO STA. 480+00
SHEET21.DGN	SHT. 29	PLAN AND PROFILE SHEET STA. 480+00 TO STA. 498+00

LEGEND

- △ — PROFILE PI LOCATIONS
- ▯ — PROFILE CULVERT LOCATIONS
- o — PC AND PT LOCATIONS
- (20) — PLAN CURVE DATA NUMBERS
- RRB-94-30 — PLAN BORING * AND LOCATIONS
- CULVERT * 111 — PLAN CULVERT * AND LOCATIONS
- ---------- — EDGE OF DISTURBANCE

SIGNATURES AFFIXED BELOW INDICATE OFFICIAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDICATED ON EACH INDIVIDUAL TITLE BLOCK.

Prepared by: HANSON ENGINEERS, INC.	
Submitted by: CHIEF, DESIGN BR.	
CHIEF, HYDRAULICS BR.	
CHIEF, GEOTECHNICAL BR.	
Recommended by: CHIEF, ENGINEER DIV.	
Approved by: COL, CORPS OF ENGINEERS	Date:

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS INCORPORATED

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

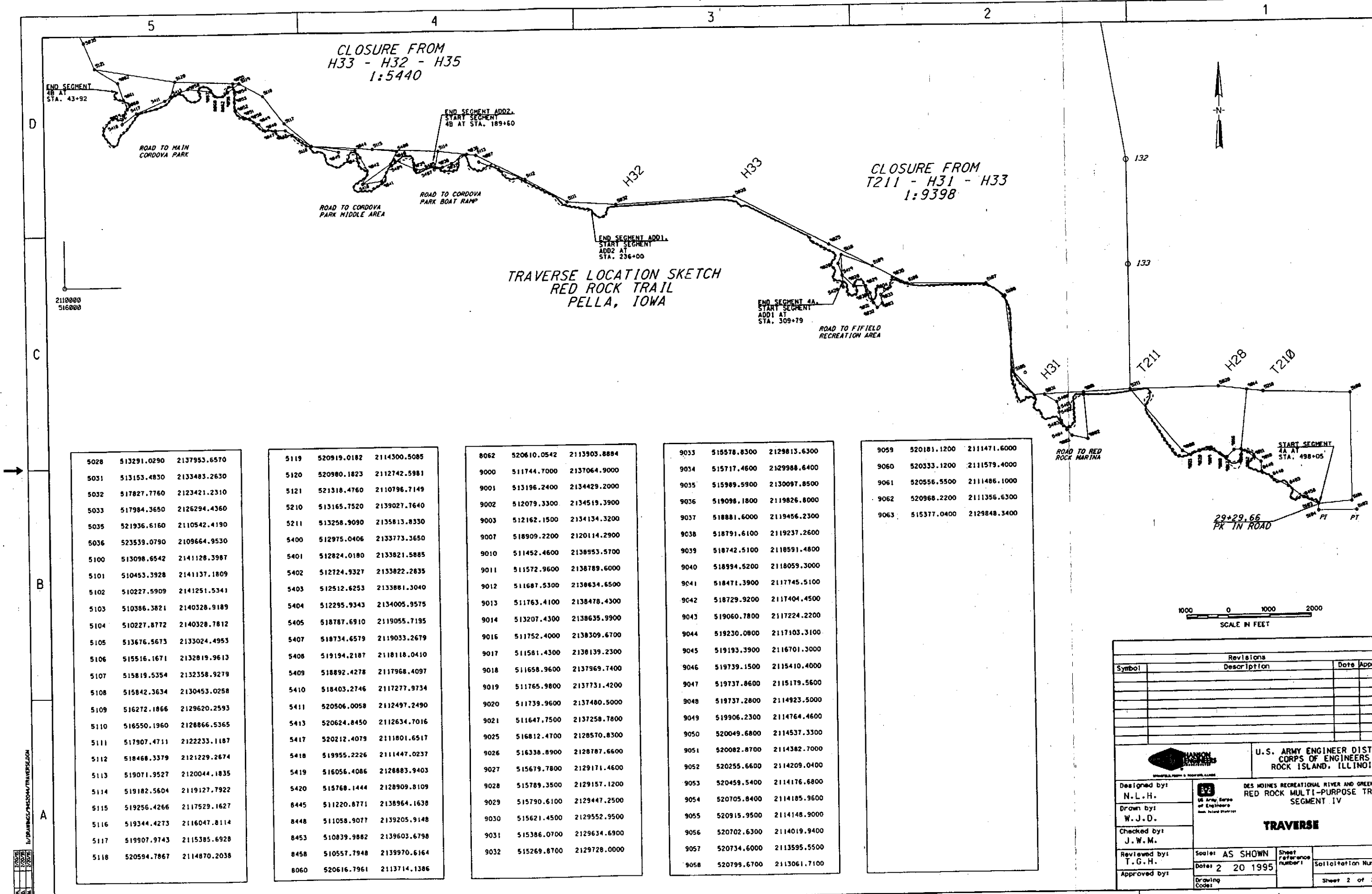
Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Drawn by: W.J.D.	**COVER SHEET**
Checked by: W.J.D.	
Reviewed by: T.G.H.	Scale: AS SHOWN
Approved by:	Date: 2 20 1995
	Drawing Code:
	Sheet reference number:
	Solicitation Number:
	Sheet 1 of 29

US Army Corps of Engineers Rock Island District

N.L.H.	2/20/95	
T.G.H.	2/20/95	
W.J.D.	2/20/95	

DESIGNED
DRAWN
CHECKED

I:/DRAWINGS/9452044/COVER



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5036	523539.0790	2109664.9530
5100	513098.6542	2141128.3987
5101	510453.3928	2141137.1809
5102	510227.5909	2141251.5341
5103	510386.3821	2140328.9189
5104	510227.8772	2140328.7812
5105	513676.5673	2133024.4953
5106	515516.1671	2132819.9613
5107	515819.5354	2132358.9279
5108	515842.3634	2130453.0258
5109	516272.1866	2129620.2593
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5111	517907.4711	2122233.1187
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5118	520594.7867	2114870.2038

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5211	513258.9090	2135813.8330
5400	512975.0406	2133773.3650
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9049	519906.2300	2114764.4600
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9063	515377.0400	2129848.3400

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

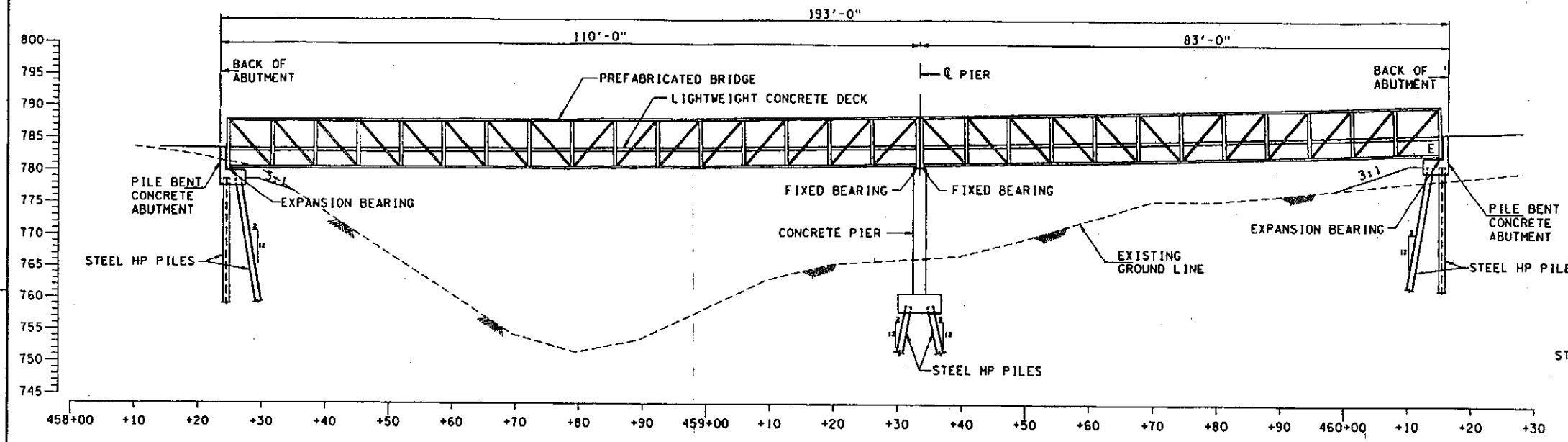
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

TRAVERSE

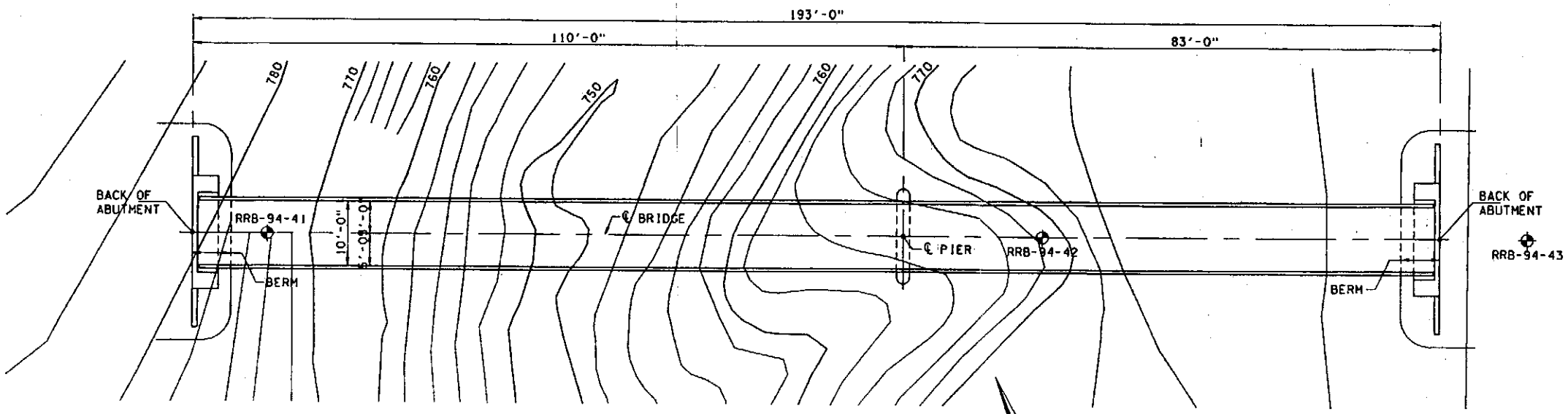
Designed by: N.L.H.	Scale: AS SHOWN	Sheet reference number:	
Drawn by: W.J.D.	Date: 2 20 1995		Solicitation Number:
Checked by: J.W.M.	Drawing Code:		Sheet 2 of 29
Reviewed by: T.G.H.			
Approved by:			

DESIGNED N.L.H. 7/20/95
DRAWN W.J.D. 7/20/95
CHECKED T.G.H. 7/20/95

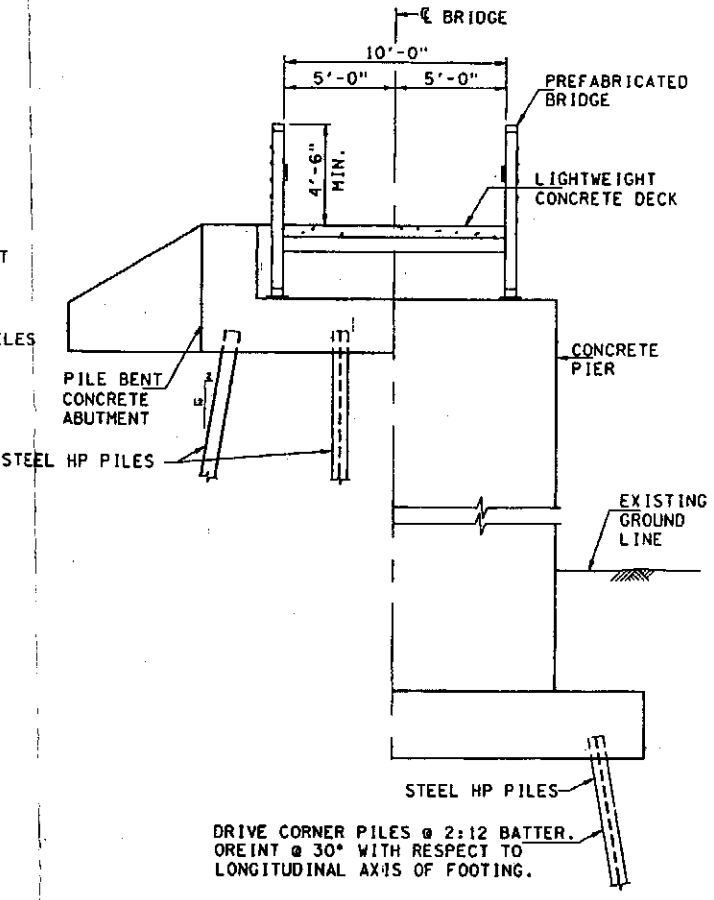
I:/DRAWINGS/PMS2044/TRAVERSE.IGH



ELEVATION

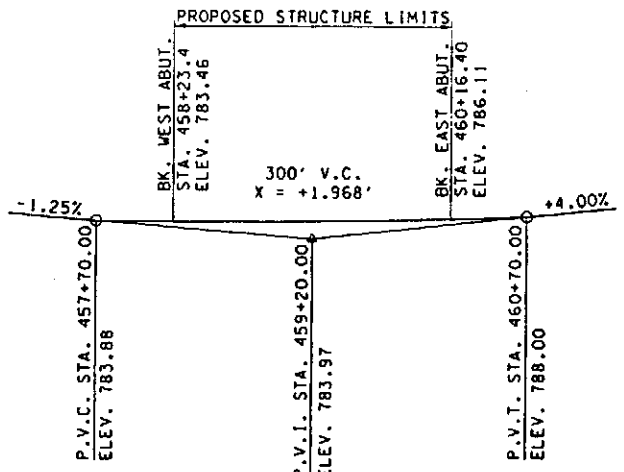


PLAN



HALF SECTION AT ABUTMENT

HALF SECTION AT PIER



PROPOSED PROFILE GRADE

DESIGN SPECIFICATIONS & MATERIAL PROPERTIES

1992 A.A.S.H.T.O. SPECIFICATIONS
WITH 1993 & 1994 INTERIMS.

PEDESTRIAN / BICYCLE LOADING = 85 P.S.F.
VEHICULAR LOADING = 10,000 LBS.

SUPERSTRUCTURE STEEL PROPERTIES:
STRUCTURAL TUBING: ASTM A588, GRADE B
SHAPES & PLATES: ASTM A588, GRADE B

SUBSTRUCTURE MATERIAL PROPERTIES:
CONCRETE: f'c = 4,000 P.S.I. (28 DAY)
REINFORCING STEEL: fy = 60,000 P.S.I., GRADE 60

PILE DATA:

TYPE:	STEEL HP8 X 36
CAPACITY:	48 TONS
ESTIMATED LENGTH:	33 FEET @ WEST ABUTMENT 35 FEET @ EAST ABUTMENT 13 FEET @ PIER
NO. REQUIRED:	4 @ WEST ABUTMENT 4 @ EAST ABUTMENT 8 @ PIER

Revisions			
Symbol	Description	Date	Approved

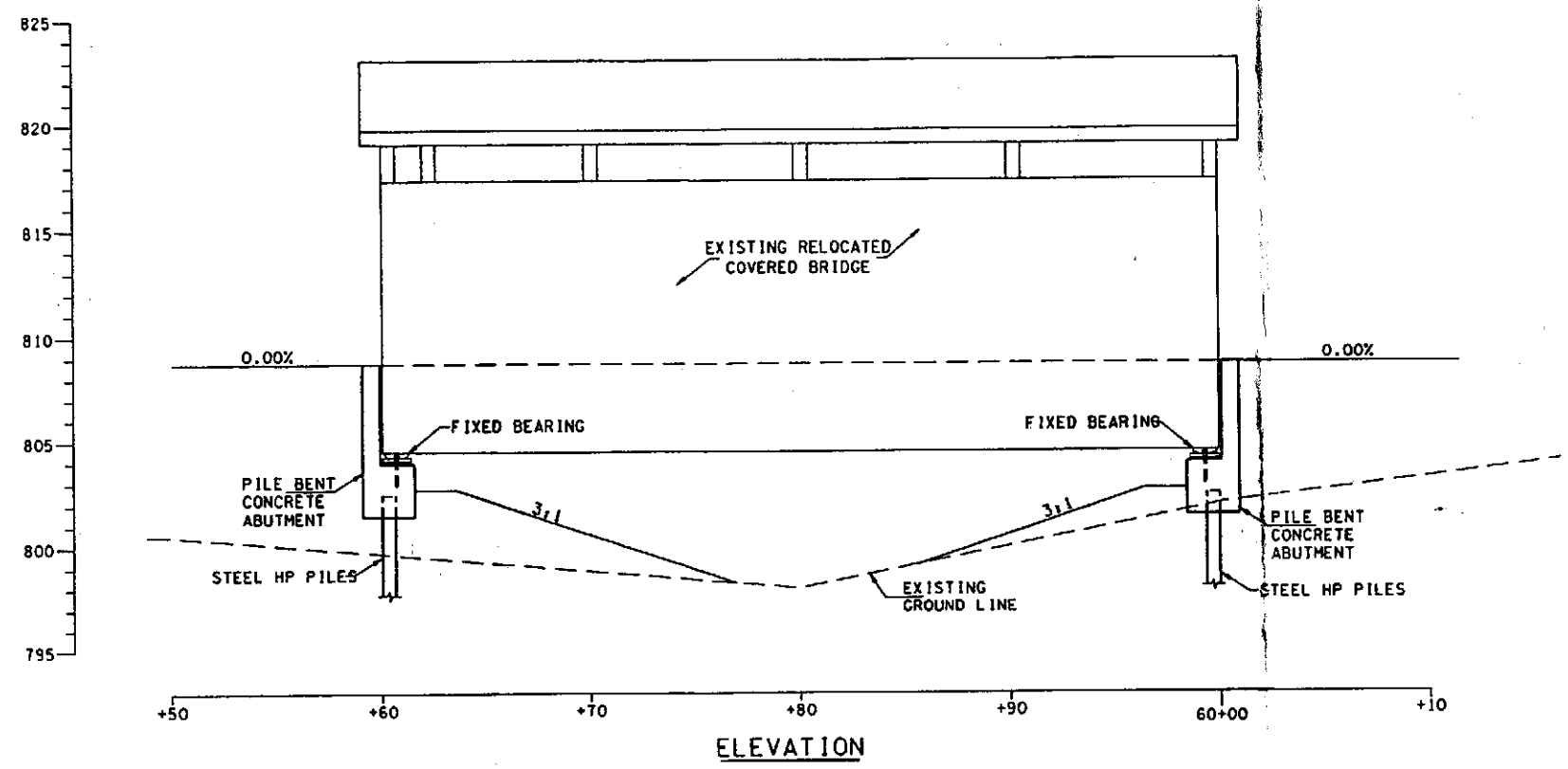
HANSON ENGINEERS INC.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: M.E.A.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: D.A.N.	RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Checked by: G.L.C.	**COVERED BRIDGE TYPE, SIZE AND LOCATION**
Reviewed by: T.G.H.	Scale: NO SCALE
Approved by:	Date: 02 20 1995
	Drawing Codes:
	Sheet reference number:
	Solicitation Number:
	Sheet 3 of 29

DESIGNED	M.E.A.	M.E.A.	7/95
DRAWN	D.A.N.	D.A.N.	7/95
CHECKED	G.L.C.	G.L.C.	7/95

IL/DRAWINGS/9452044/TSLDGN



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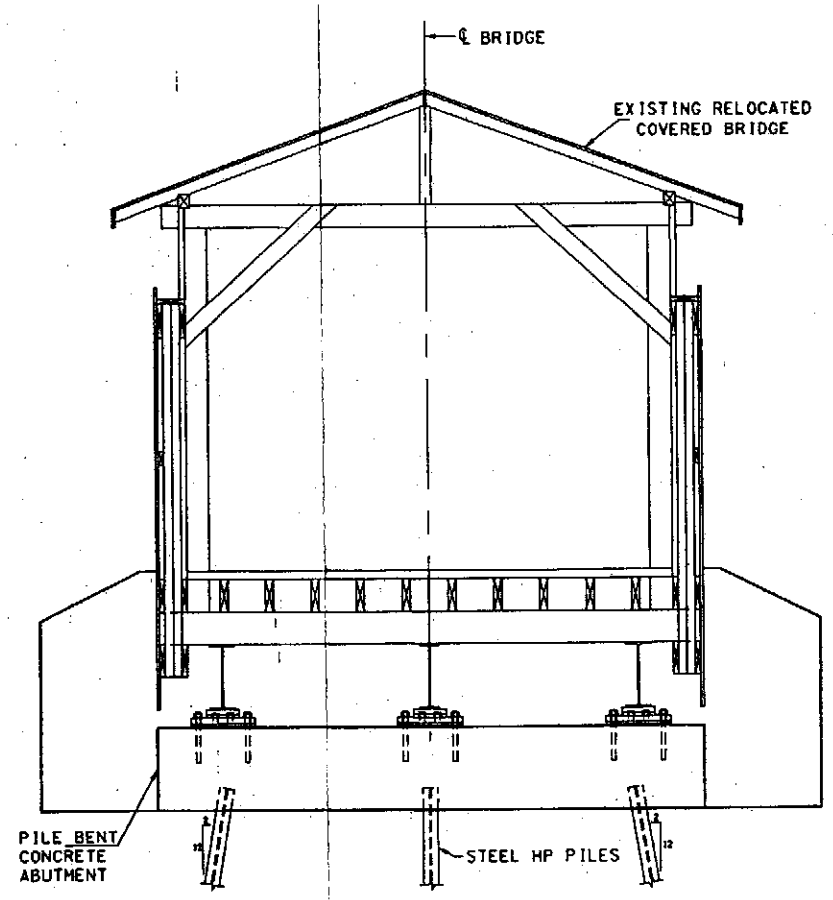
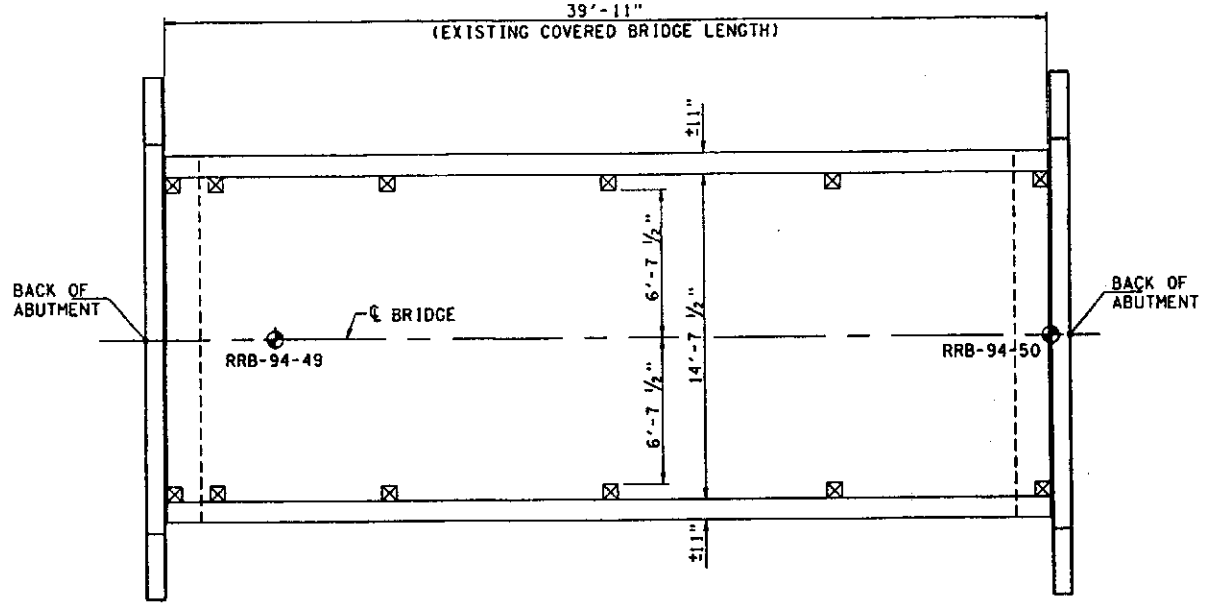


CROSS SECTION AT ABUTMENT



PLAN

DESIGN SPECIFICATIONS & MATERIAL PROPERTIES

DESIGN SPECIFICATIONS FOR NEW ABUTMENTS:
1992 A.A.S.H.T.O. SPECIFICATIONS
WITH 1993 & 1994 INTERIMS.

SUBSTRUCTURE MATERIAL PROPERTIES:
CONCRETE: f'c = 4,000 P.S.I. (28 DAY)
REINFORCING STEEL: fy = 60,000 P.S.I., GRADE 60

PILE DATA:
TYPE: STEEL HP8 X 36
CAPACITY: 48 TONS
ESTIMATED LENGTH: 16 FEET
NO. REQUIRED: 6

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: M.E.A.
Drawn by: D.A.N.
Checked by: G.L.C.
Reviewed by: T.G.H.
Approved by:

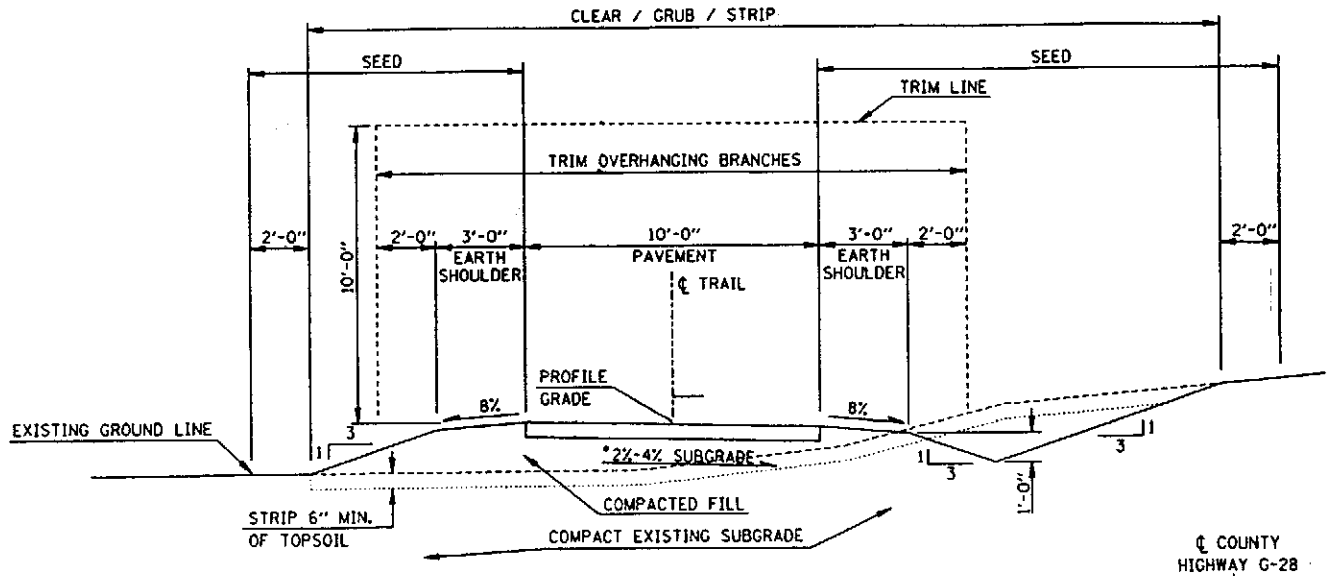
US Army Corps of Engineers Rock Island District

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

COVERED BRIDGE TYPE, SIZE AND LOCATION

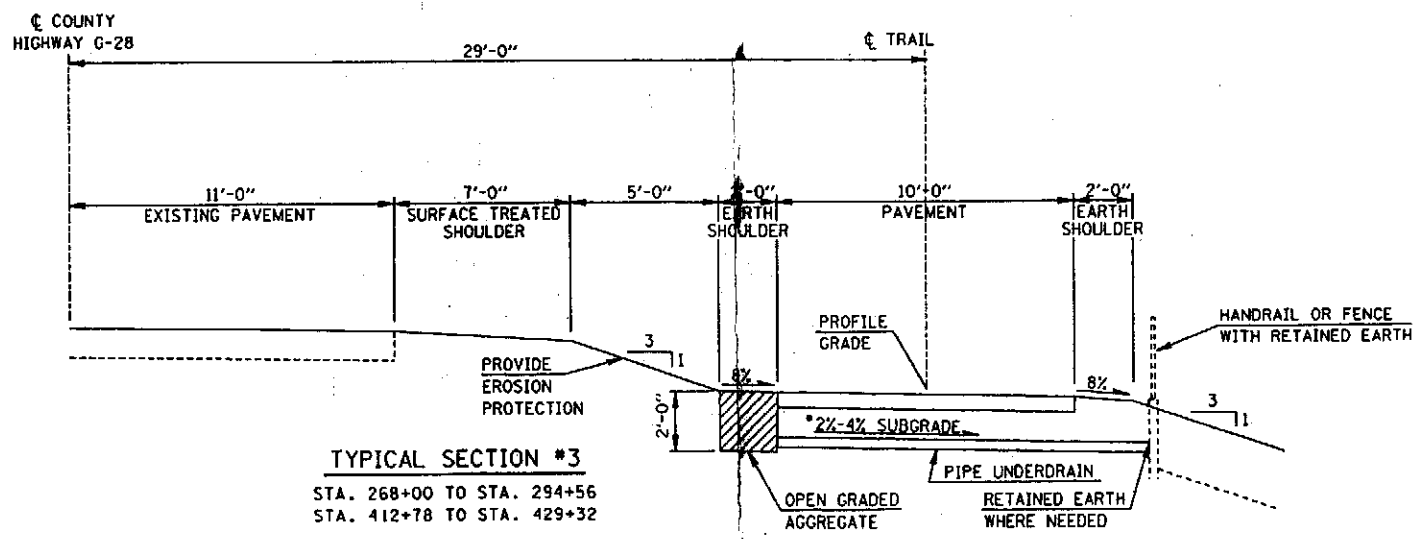
Scale: NO SCALE
Date: 02 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 4 of 29

I:/DRAWINGS/94S2044/TSLCBJDGN



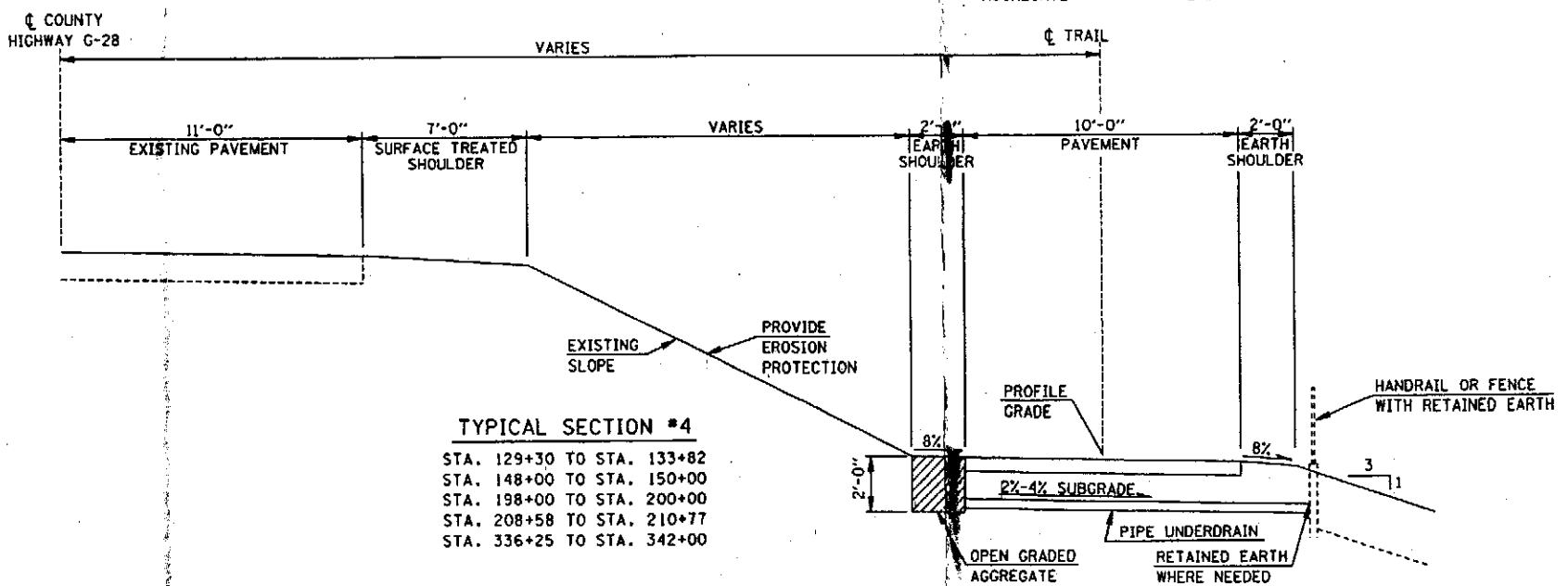
TYPICAL SECTION *1

STA. 43+93 TO STA. 129+30
STA. 133+82 TO STA. 148+00
STA. 150+00 TO STA. 198+00
STA. 200+00 TO STA. 208+58
STA. 210+77 TO STA. 216+52
STA. 226+66 TO STA. 232+00
STA. 236+00 TO STA. 242+67
STA. 300+09 TO STA. 336+25
STA. 389+00 TO STA. 412+88
STA. 429+42 TO STA. 490+50
STA. 494+00 TO STA. 498+00



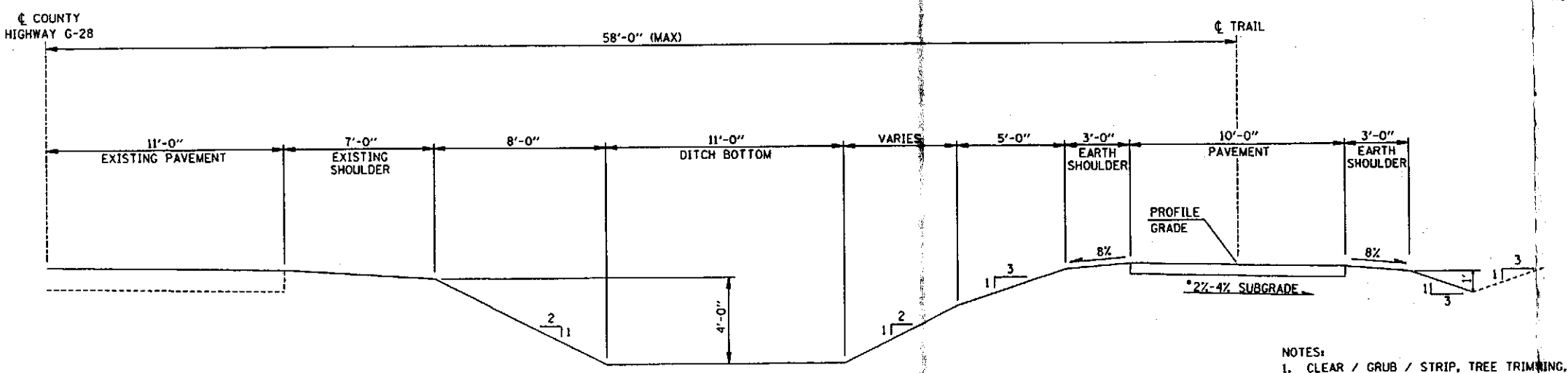
TYPICAL SECTION #3

STA. 268+00 TO STA. 294+56
STA. 412+78 TO STA. 429+32



TYPICAL SECTION #4

STA. 129+30 TO STA. 133+82
STA. 148+00 TO STA. 150+00
STA. 198+00 TO STA. 200+00
STA. 208+58 TO STA. 210+77
STA. 336+25 TO STA. 342+00



TYPICAL SECTION *2

STA. 232+00 TO STA. 236+00
STA. 294+56 TO STA. 300+09

NOTES:
1. CLEAR / GRUB / STRIP, TREE TRIMMING, AND SEEDING TYPICAL FOR ALL SECTIONS.

*2. CROSS SLOPE TO INSIDE OF HORIZONTAL CURVE.

3. DITCH DEPTH AND WIDTH WILL BE INCREASED WHERE REQUIRED FOR HYDRAULIC CAPACITY.

Revisions			
Symbol	Description	Date	Approved

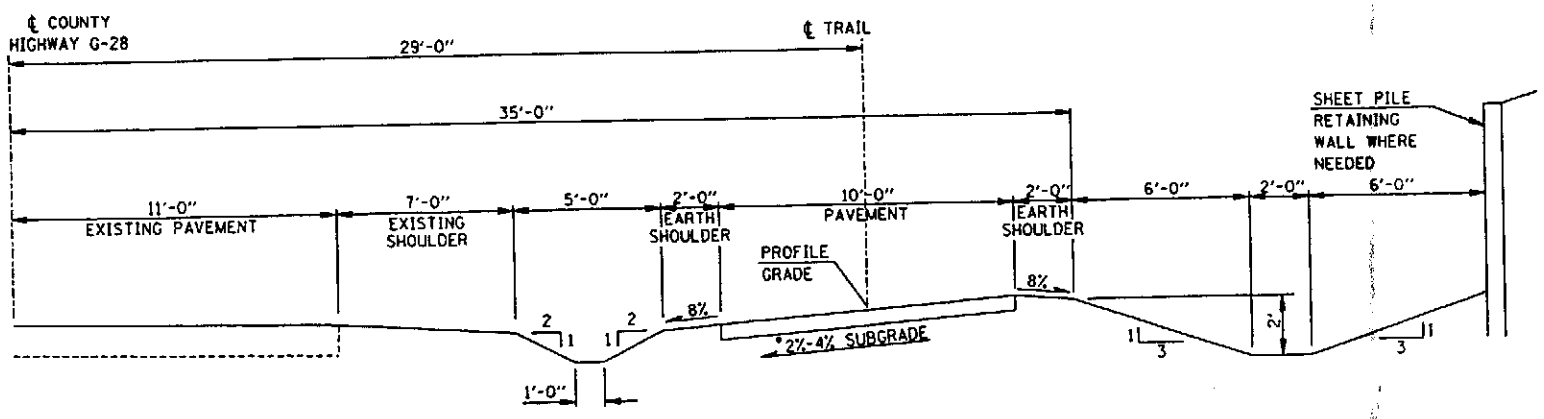
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: W.J.D.	RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Checked by: J.W.M.	**TYPICAL SECTIONS**
Reviewed by: T.G.H.	Scale: NO SCALE
Approved by:	Date: 02 20 1995
	Drawing Code:
	Sheet reference number:
	Solicitation Number:
	Sheet 5 of 29

US Army Corps of Engineers, Rock Island District

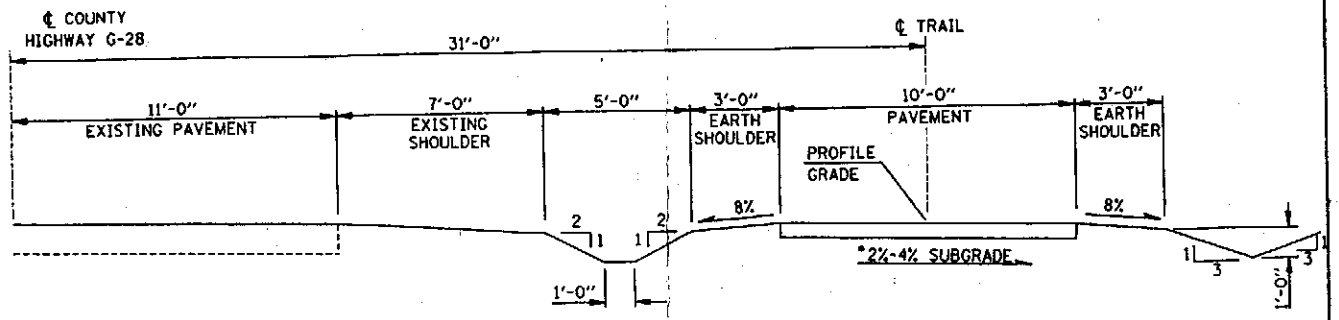
DESIGNED	J.W.M.	N.L.H.	1/20/95
DRAWN	W.J.D.	W.J.D.	1/20/95
REVIEWED	N.L.H.	J.W.M.	1/20/95

I:/DRAWINGS/94S2044/TYP-SEC



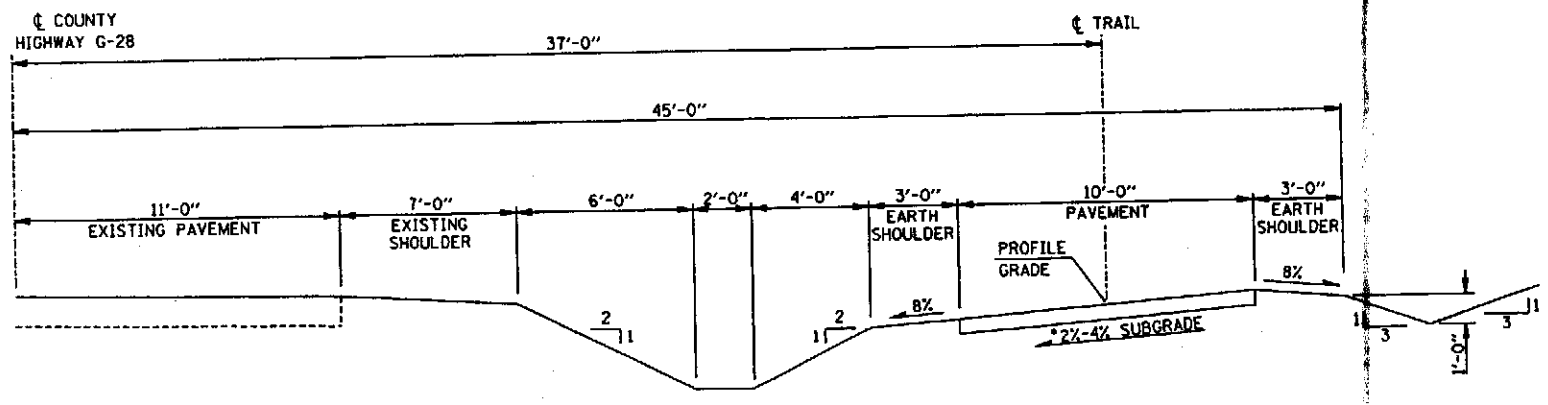
TYPICAL SECTION *5

STA. 342+00 TO STA. 382+00



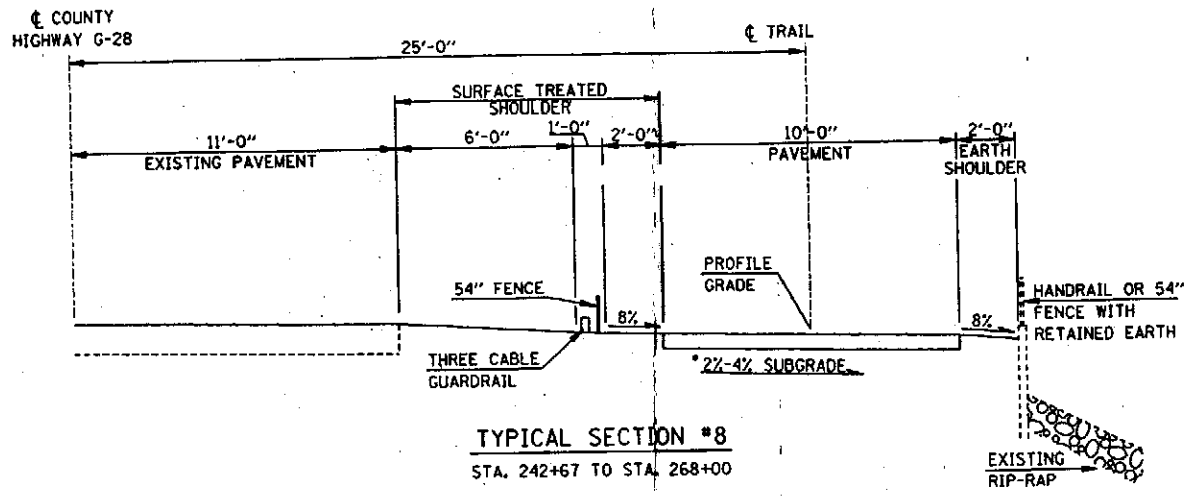
TYPICAL SECTION *7

STA. 382+00 TO STA. 389+00



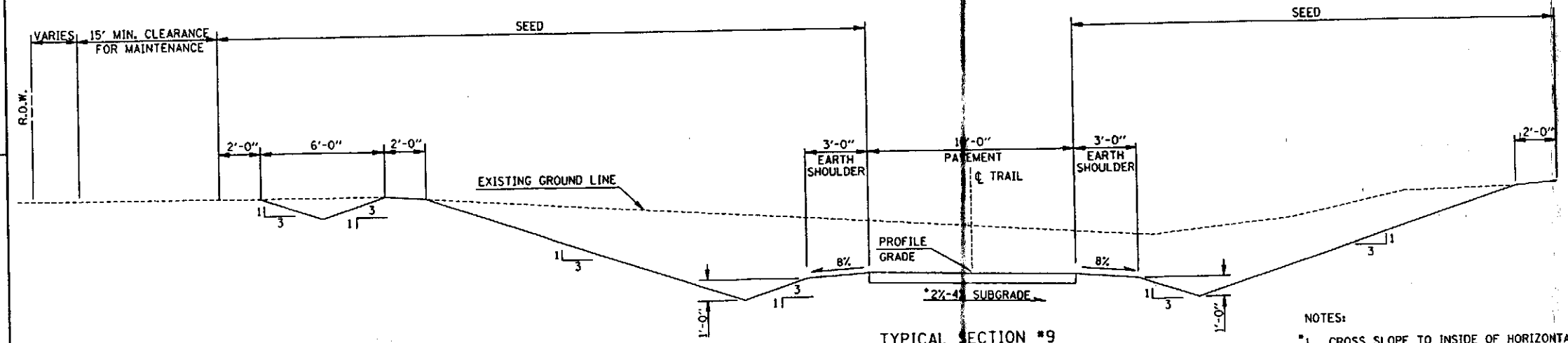
TYPICAL SECTION *6

STA. 216+52 TO STA. 226+66



TYPICAL SECTION *8

STA. 242+67 TO STA. 268+00



TYPICAL SECTION *9

STA. 490+50 TO STA. 494+00

NOTES:

*1. CROSS SLOPE TO INSIDE OF HORIZONTAL CURVE.

2. DITCH DEPTH AND WIDTH WILL BE INCREASED WHERE REQUIRED FOR HYDRAULIC CAPACITY.

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

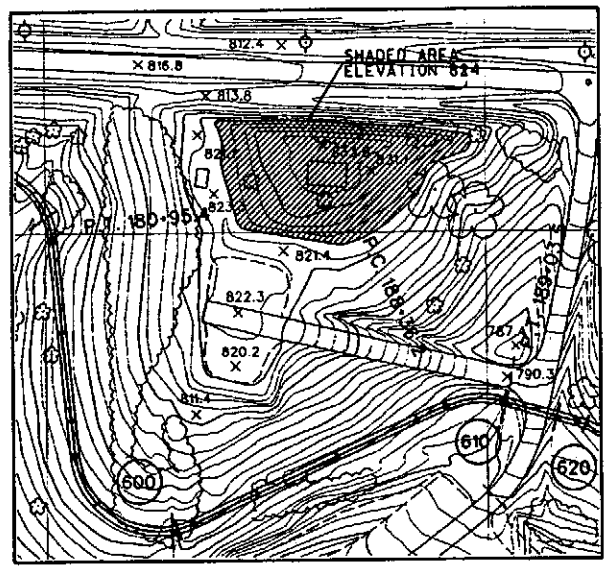
TYPICAL SECTIONS

Designed by: N.L.H.	Scale: NO SCALE	Sheet reference number:	Solicitation Number:
Drawn by: W.J.D.	Date: 02 20 1995		Sheet 5 of 29
Checked by: J.W.M.	Drawing Code:		
Reviewed by: T.G.H.			
Approved by:			

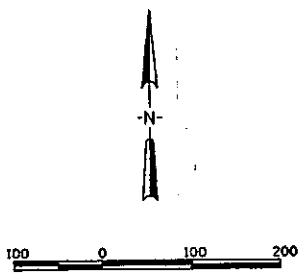
US Army Corps of Engineers, Rock Island District

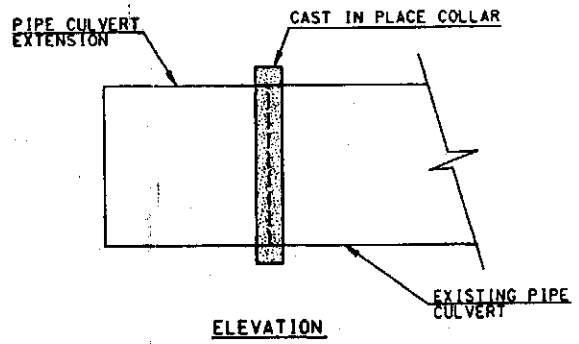
I:/DRAWINGS/9452044/TYP-SEC

ISSUED E.J.H. N.L.H. 7/20/95
DRAWN E.J.H. N.L.H. 7/20/95
REVISED N.L.H. J.E.H. 7/20/95

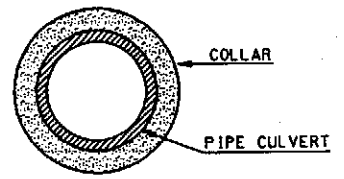


BORROW AREA #4
LT. STA. 181+00
6,500 CU. YDS



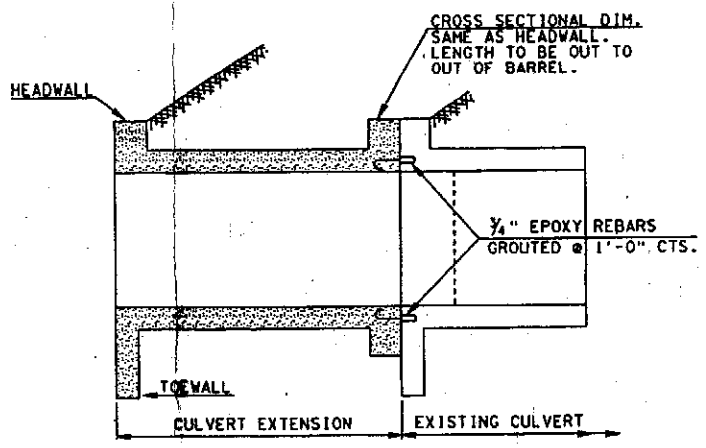


ELEVATION

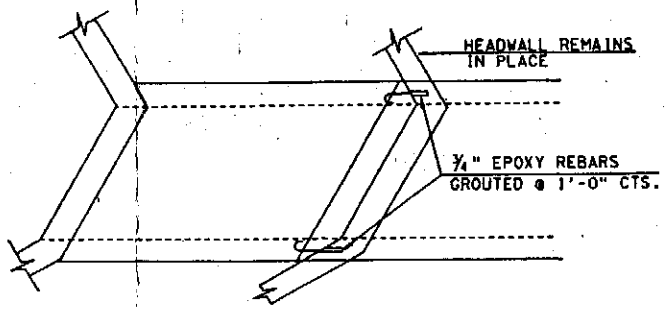


END SECTION

PIPE CULVERT EXTENSION
NO SCALE

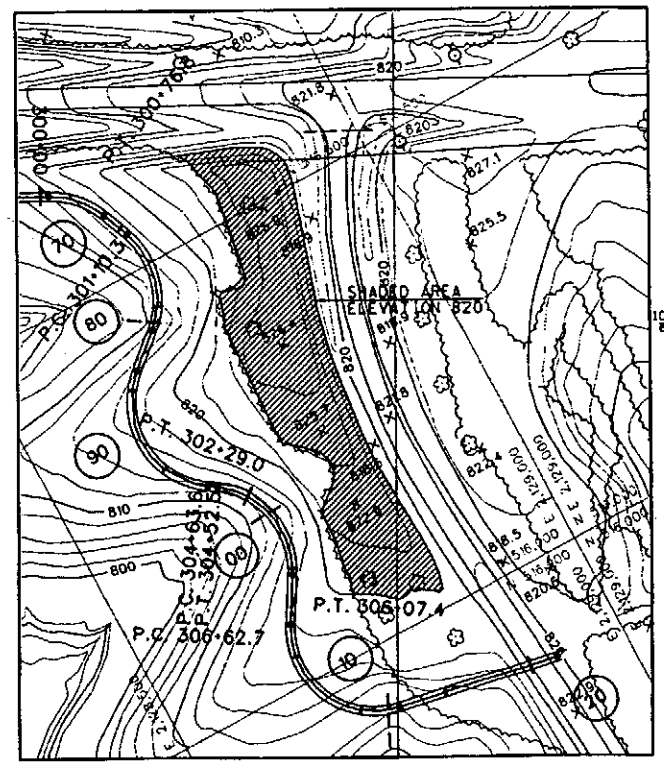


LONGITUDINAL SECTION

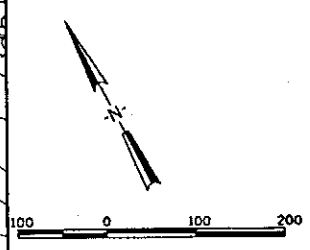


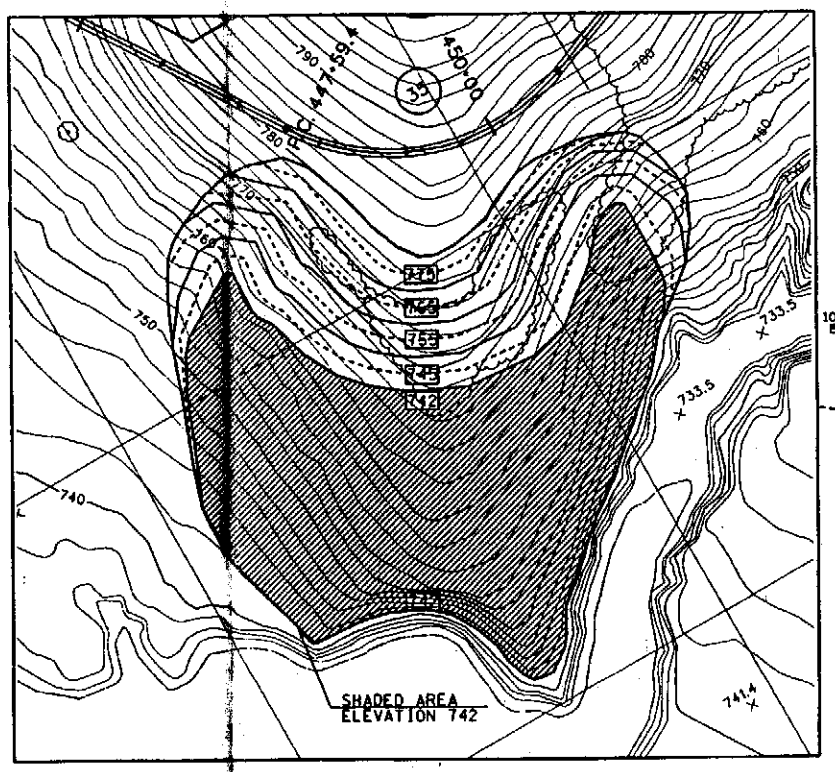
PLAN

BOX CULVERT EXTENSION
NO SCALE

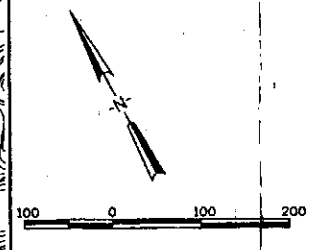


BORROW AREA #3
LT. STA. 301+00
7,500 CU. YDS





BORROW AREA #1
RT. STA. 450+00
100,000 CU. YDS



LEGEND

755 PROPOSED CONTOURS

Revisions			
Symbol	Description	Date	Approved

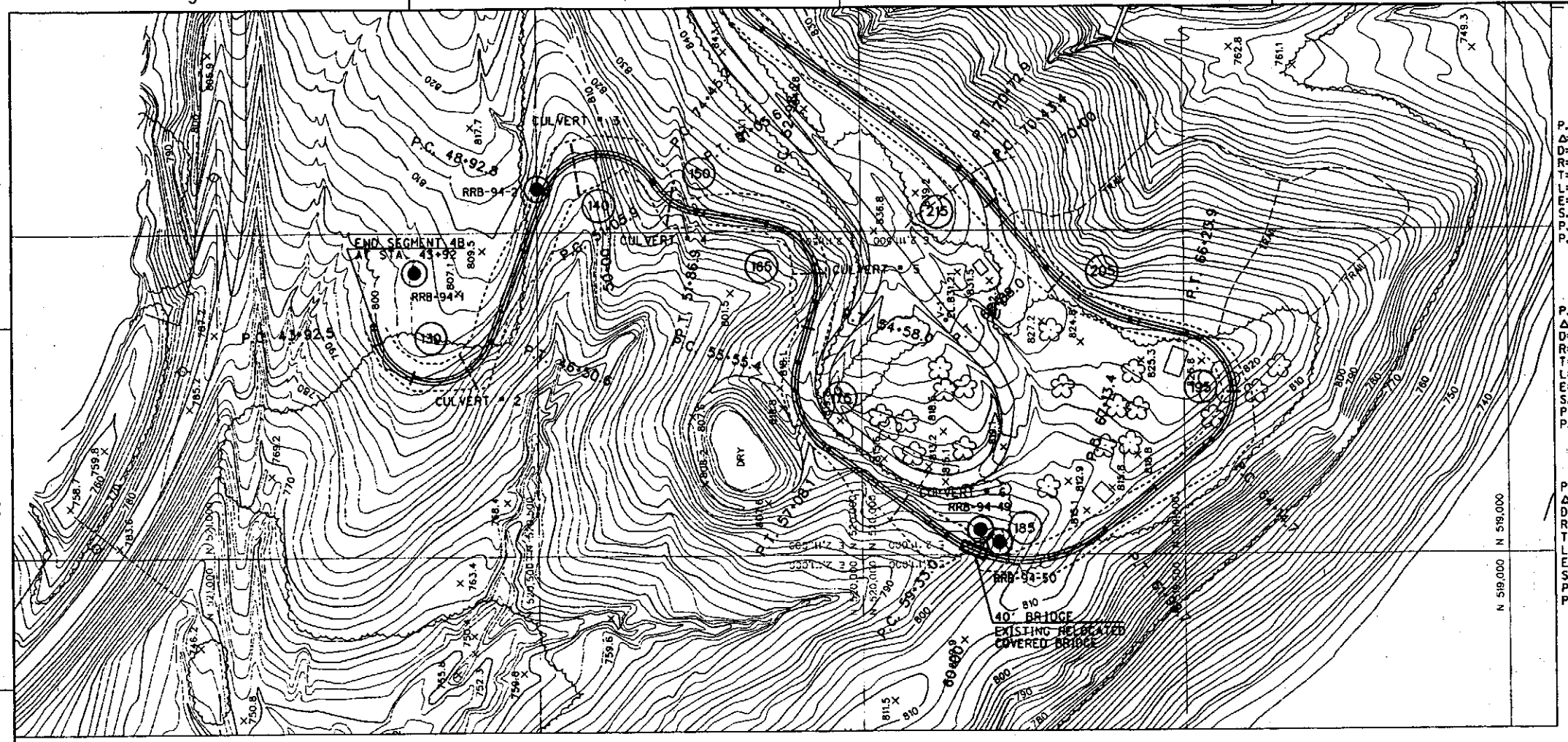
HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

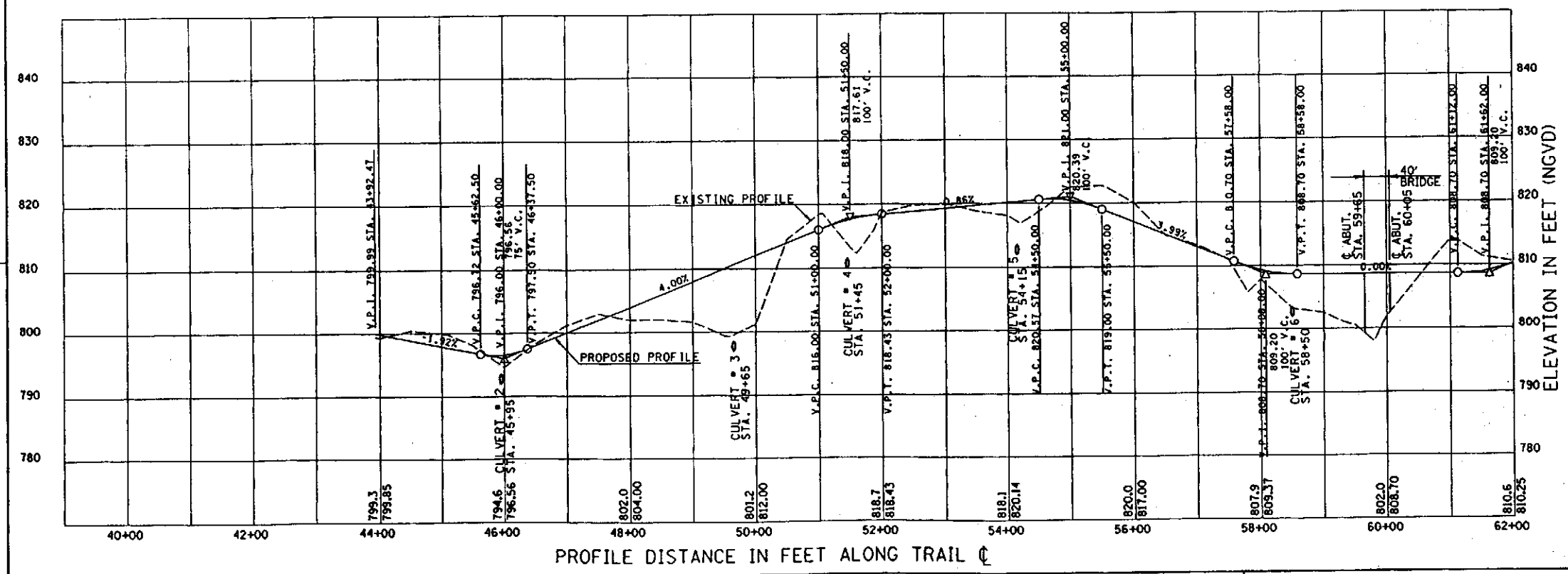
Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: W.J.D.	RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Checked by: J.W.M.	**DETAILS**
Reviewed by: T.G.H.	Scale: NO SCALE
Approved by:	Date: 2 20 1995
	Drawing Code:
	Sheet reference number:
	Solicitation Number:
	Sheet 7 of 29

DESIGNED	N.L.H.	7/20/95
DRAWN	W.J.D.	7/20/95
CHECKED	J.W.M.	7/20/95

I:\DRAWINGS\745204\DETAIL3.DGN



PLAN



CURVE 130	CURVE 140	CURVE 150
P.I. STA= 48+32.20	P.I. STA= 50+89.14	P.I. STA= 51+49.06
Δ= 155°-36'-53"	Δ= 128°-21'-21"	Δ= 48°-54'-19"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.00'	R= 95.0'	R= 95.0'
T= 439.67'	T= 196.32	T= 43.20'
L= 258.02'	L= 212.82'	L= 81.09'
E= 354.81'	E= 123.10'	E= 9.36'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 43+92.54	P.C. STA= 48+92.82	P.C. STA= 51+05.86
P.T. STA= 46.50.55	P.T. STA= 51+05.64	P.T. STA= 51+86.95

CURVE 165	CURVE 175	CURVE 185
P.I. STA= 54+04.42	P.I. STA= 56+42.89	P.I. STA= 60+89.55
Δ= 96°-22'-23"	Δ= 70°-00'-09"	Δ= 76°-06'-43"
D= 60°-18'-41"	D= 45°-50'-12"	D= 28°-38'-52"
R= 95.0'	R= 125.0'	R= 200.0'
T= 106.20'	T= 87.53'	T= 156.57'
L= 159.79'	L= 152.72'	L= 265.68'
E= 47.49'	E= 27.60'	E= 54.0'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 52+98.22	P.C. STA= 55+55.36	P.C. STA= 59+32.98
P.T. STA= 54+58.01	P.T. STA= 57+08.08	P.T. STA= 61+98.66

CURVE 195	CURVE 205	CURVE 215
P.I. STA= 66+01.88	P.I. STA= 67+93.23	P.I. STA= 70+58.19
Δ= 126°-10'-51"	Δ= 35°-25'-34"	Δ= 13°-30'-22"
D= 60°-18'-41"	D= 22°-55'-06"	D= 45°-50'-12"
R= 95.0'	R= 250.0'	R= 125.0'
T= 187.18'	T= 79.85'	T= 14.80'
L= 209.22'	L= 154.58'	L= 29.47'
E= 114.91'	E= 12.44'	E= 0.87'
S.E.= 0.04'/'	S.E.= 0.02'/'	S.E.= 0.04'/'
P.C. STA= 64+14.71	P.C. STA= 67+13.38	P.C. STA= 70+43.39
P.T. STA= 66+23.92	P.T. STA= 68+67.96	P.T. STA= 70+72.95

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

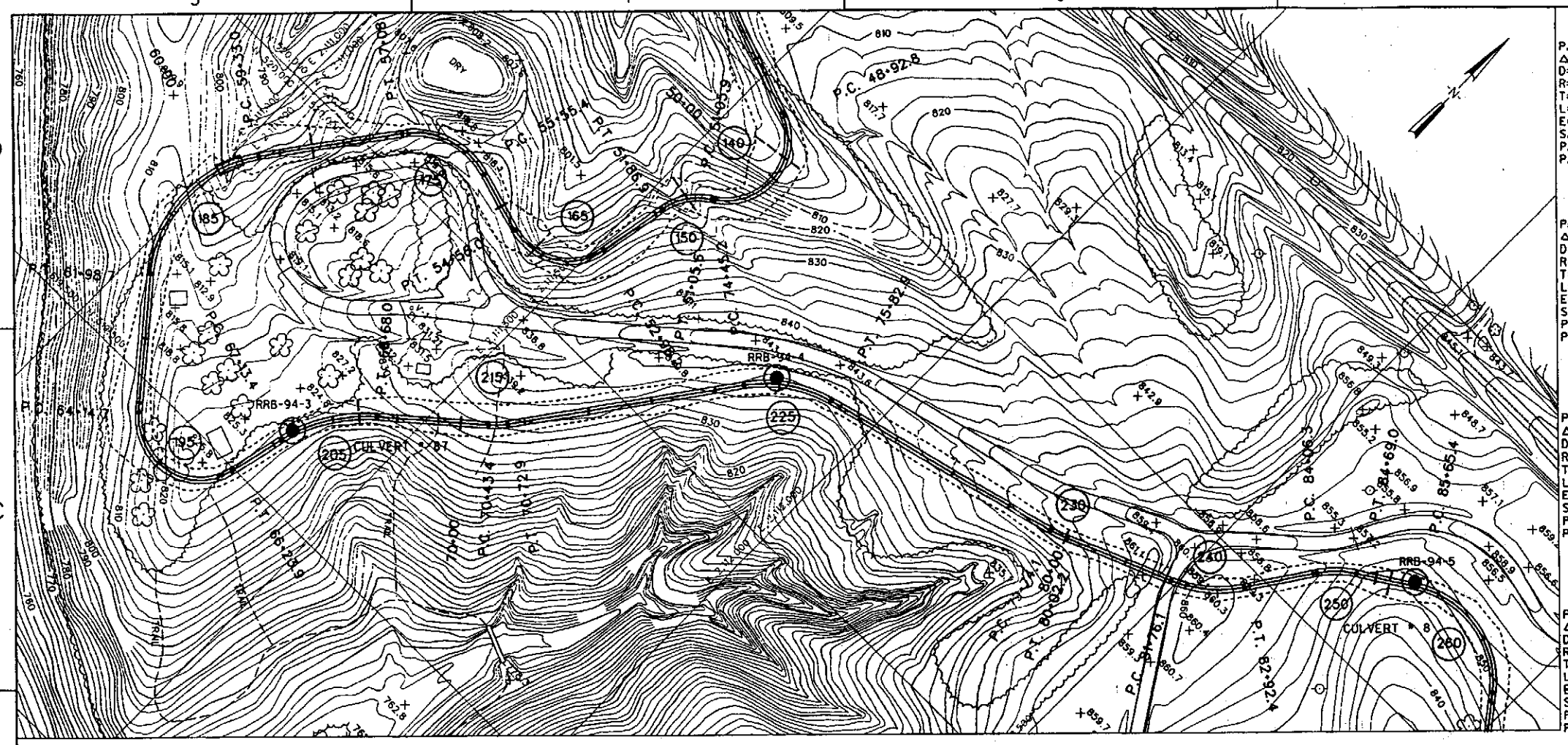
HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

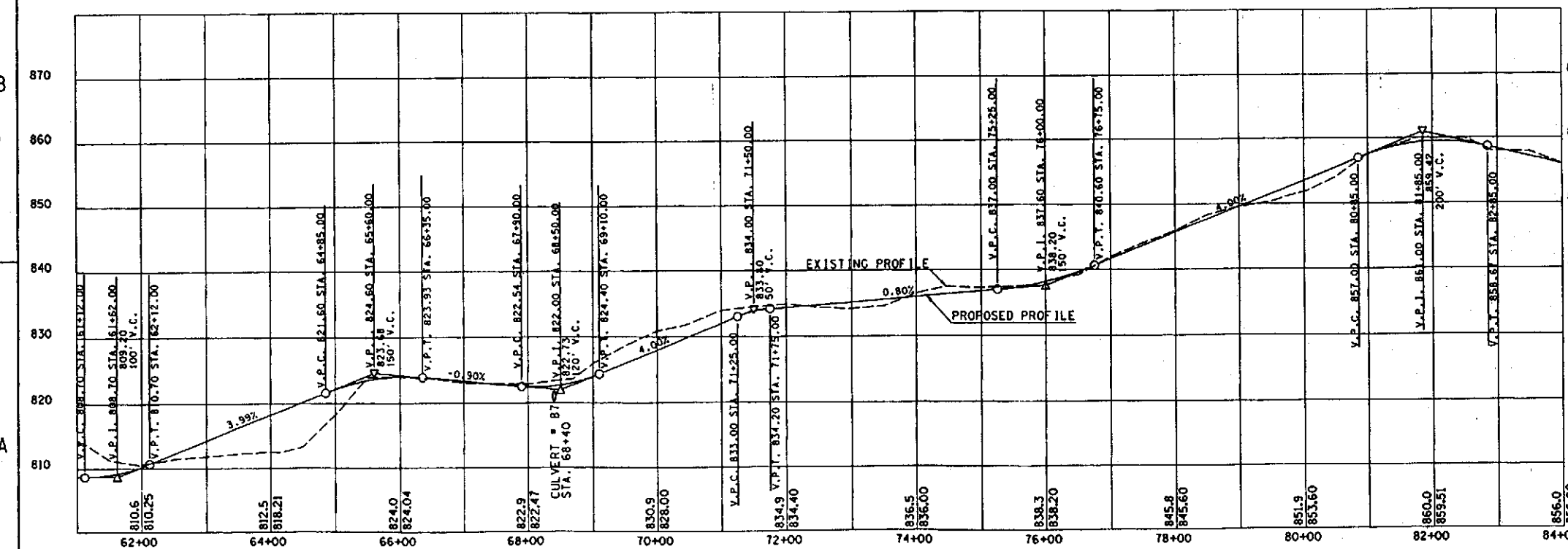
Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: W.J.D.	RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Checked by: J.W.M.	**PLAN AND PROFILE STA. 44+00 TO STA. 62+00**
Reviewed by: T.G.H.	Scale: AS SHOWN
Approved by:	Date: 2 20 1995
	Sheet reference number:
	Drawing Code:
	Solicitation Number:
	Sheet 8 of 29

DESIGNED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
REVIEWED	J.W.M.	2/20/95

D:\DRAWINGS\94S2004\SHEET1.DGN



PLAN



CURVE 140
P.I. STA= 50+89.14
Δ= 128°-21'-21"
D= 60°-18'-41"
R= 95.0'
T= 196.32'
L= 212.82'
E= 123.10'
S.E.= 0.04'/'
P.C. STA= 48+92.82
P.T. STA= 51+05.64

CURVE 150
P.I. STA= 51+49.06
Δ= 48°-54'-19"
D= 60°-18'-41"
R= 95.0'
T= 43.20'
L= 81.09'
E= 9.36'
S.E.= 0.04'/'
P.C. STA= 51+05.86
P.T. STA= 51+86.95

CURVE 165
P.I. STA= 54+04.42
Δ= 96°-22'-23"
D= 60°-18'-41"
R= 95.0'
T= 106.20'
L= 159.79'
E= 47.49'
S.E.= 0.04'/'
P.C. STA= 52+98.22
P.T. STA= 54+58.01

CURVE 175
P.I. STA= 56+42.89
Δ= 70°-00'-09"
D= 45°-50'-12"
R= 125.0'
T= 87.53'
L= 152.72'
E= 27.6'
S.E.= 0.04'/'
P.C. STA= 55+55.36
P.T. STA= 57+08.08

CURVE 185
P.I. STA= 60+89.55
Δ= 76°-06'-43"
D= 28°-38'-52"
R= 200.0'
T= 156.57'
L= 265.68'
E= 54.0'
S.E.= 0.04'/'
P.C. STA= 59+32.98
P.T. STA= 61+98.66

CURVE 195
P.I. STA= 66+01.88
Δ= 126°-10'-51"
D= 60°-18'-41"
R= 95.0'
T= 187.18'
L= 209.22'
E= 114.91'
S.E.= 0.04'/'
P.C. STA= 64+14.71
P.T. STA= 66+23.92

CURVE 205
P.I. STA= 67+93.23
Δ= 35°-25'-34"
D= 22°-55'-06"
R= 250.0'
T= 79.85'
L= 154.58'
E= 12.44'
S.E.= 0.02'/'
P.C. STA= 67+13.38
P.T. STA= 68+67.96

CURVE 215
P.I. STA= 70+58.19
Δ= 13°-30'-22"
D= 45°-50'-12"
R= 125.0'
T= 14.8'
L= 29.47'
E= 0.87'
S.E.= 0.04'/'
P.C. STA= 70+43.39
P.T. STA= 70+72.85

CURVE 225
P.I. STA= 75+16.89
Δ= 39°-27'-25"
D= 28°-38'-52"
R= 200.0'
T= 71.72'
L= 137.73'
E= 12.47'
S.E.= 0.04'/'
P.C. STA= 74+45.16
P.T. STA= 75+82.89

CURVE 230
P.I. STA= 79+88.21
Δ= 8°-03'+02"
D= 28°-38'-52"
R= 200.0'
T= 14.07'
L= 28.10'
E= 0.49'
S.E.= 0.04'/'
P.C. STA= 79+74.14
P.T. STA= 80+02.24

CURVE 240
P.I. STA= 82+35.92
Δ= 33°-19'-19"
D= 28°-38'-52"
R= 200.0'
T= 59.85'
L= 116.32'
E= 8.76'
S.E.= 0.04'/'
P.C. STA= 81+76.07
P.T. STA= 82+92.38

CURVE 250
P.I. STA= 84+38.14
Δ= 23°-55'-57"
D= 38°11'-50"
R= 150.0'
T= 31.79'
L= 62.66'
E= 3.33'
S.E.= 0.04'/'
P.C. STA= 84+06.35
P.T. STA= 84+69.00

CURVE 260
P.I. STA= 87+00.67
Δ= 84°-05'-31"
D= 38°-11'-50"
R= 150.0'
T= 135.28'
L= 220.15'
E= 52.0'
S.E.= 0.04'/'
P.C. STA= 85+65.39
P.T. STA= 87+85.55

100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers Rock Island District

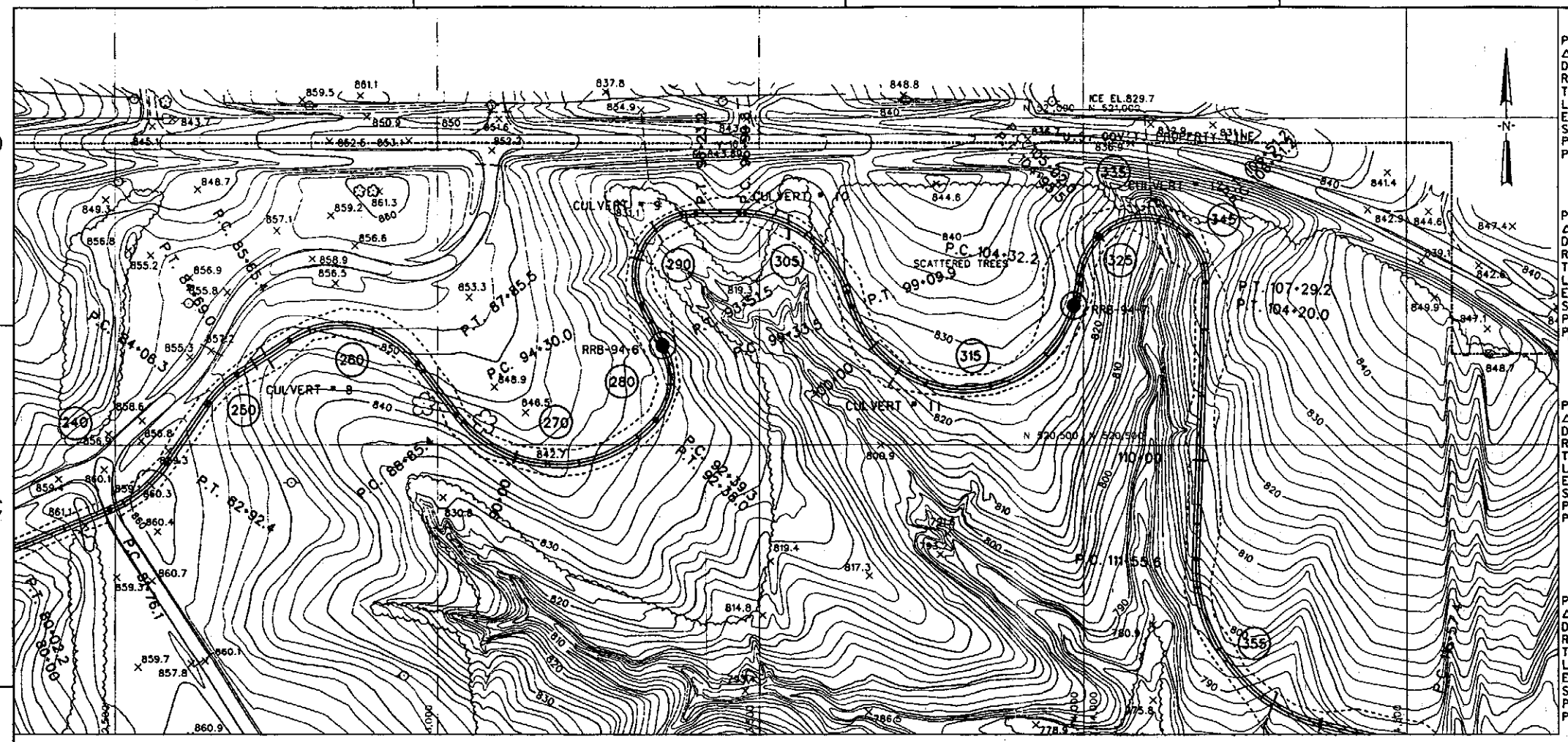
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 62+00 TO STA. 84+00

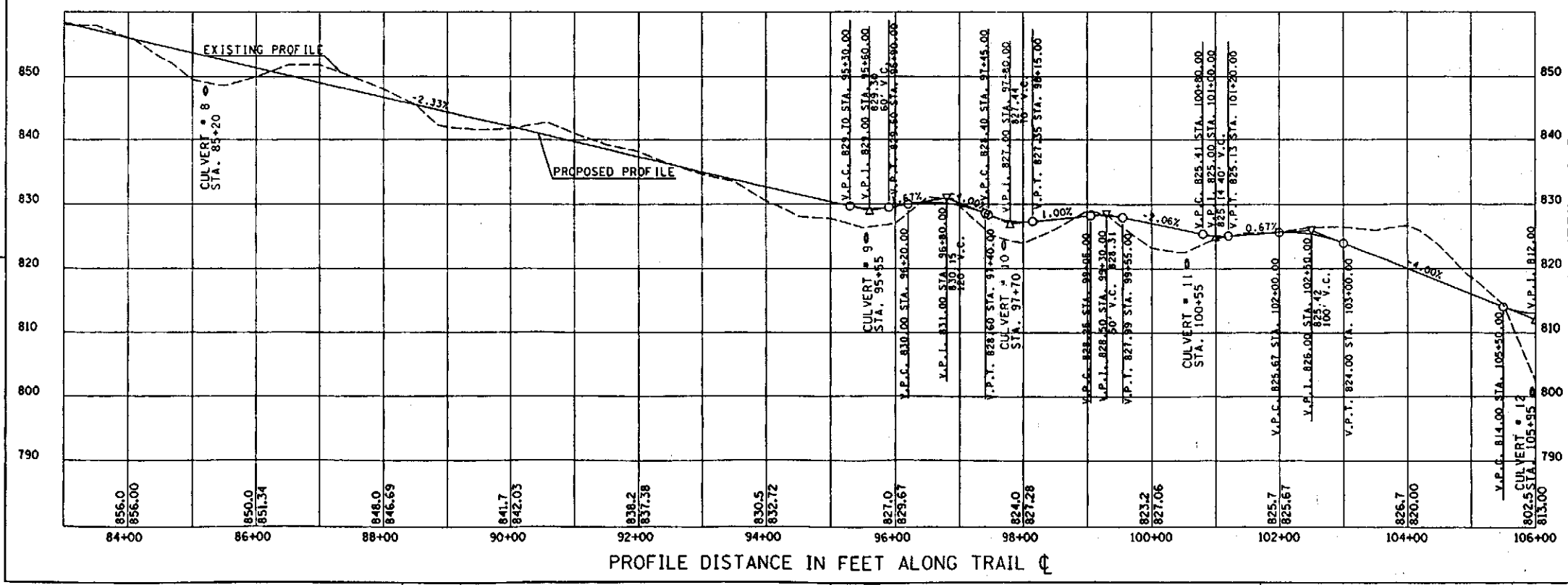
Scales: AS SHOWN
Dates: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 9 of 29

DESIGNED	N.L.H.	2/96/95
DRAWN	W.J.D.	2/96/95
CHECKED	J.W.M.	2/20/95

E:\DRAWINGS\MS2044\SHEET1.DGN



PLAN



CURVE 240	CURVE 250	CURVE 260
P.I. STA= 82+35.92	P.I. STA= 84+38.14	P.I. STA= 87+00.67
Δ= 33°-19'-19"	Δ= 236°-55'-57"	Δ= 84°-05'-31"
D= 28°-38'-52"	D= 38°-11'-50"	D= 38°-11'-50"
R= 200.0'	R= 150.0'	R= 150.0'
T= 59.85'	T= 31.79'	T= 135.28'
L= 116.32'	L= 62.66'	L= 220.15'
E= 8.76'	E= 3.33'	E= 51.99'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 81+76.07	P.C. STA= 84+06.35	P.C. STA= 85+65.39
P.T. STA= 82+92.38	P.T. STA= 84+69.00	P.T. STA= 87+85.55

CURVE 270	CURVE 280	CURVE 290
P.I. STA= 91+28.13	P.I. STA= 93+02.99	P.I. STA= 95+83.60
Δ= 101°-01'-39"	Δ= 67°-40'-34"	Δ= 116°-31'-53"
D= 28°-38'-52"	D= 60°-18'-41"	D= 60°-18'-41"
R= 200.0'	R= 95.0'	R= 95.0'
T= 242.74'	T= 63.69'	T= 153.61'
L= 352.65'	L= 112.21'	L= 193.22'
E= 114.52'	E= 19.37'	E= 85.61'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 88+85.39	P.C. STA= 92+39.30	P.C. STA= 94+29.99
P.T. STA= 92+38.05	P.T. STA= 93+51.52	P.T. STA= 96+23.21

CURVE 305	CURVE 315	CURVE 325
P.I. STA= 98+17.34	P.I. STA= 107+41.44	P.I. STA= 104+65.08
Δ= 71°-45'-03"	Δ= 154°-52'-56"	Δ= 38°-13'-44"
D= 32°-44'-26"	D= 31°-49'-52"	D= 60°-18'-41"
R= 175.0'	R= 180.0'	R= 95.0'
T= 126.56'	T= 807.99'	T= 32.92'
L= 219.15'	L= 486.58'	L= 63.39'
E= 40.97'	E= 647.80'	E= 5.54'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 96+90.78	P.C. STA= 99+33.45	P.C. STA= 104+32.16
P.T. STA= 99+09.93	P.T. STA= 104+20.03	P.T. STA= 104+95.54

CURVE 335	CURVE 345	CURVE 355
P.I. STA= 105+96.97	P.I. STA= 106+92.57	P.I. STA= 113+60.22
Δ= 90°-00'-06"	Δ= 47°-04'-03"	Δ= 78°-35'-50"
D= 60°-18'-41"	D= 60°-18'-41"	D= 22°-55'-06"
R= 95.0'	R= 95.0'	R= 250.0'
T= 95.0'	T= 41.37'	T= 204.61'
L= 149.23'	L= 78.04'	L= 342.95'
E= 39.35'	E= 8.62'	E= 73.06'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.02'/'
P.C. STA= 105+01.97	P.C. STA= 106+51.20	P.C. STA= 111+55.61
P.T. STA= 106+51.20	P.T. STA= 107+29.24	P.T. STA= 114+98.56

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS INC. SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers Rock Island District

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 84+00 TO STA. 106+00

Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 10 of 29

REVISED	N.L.H.	7/20/95
DRAWN	N.L.H.	7/20/95
CHECKED	J.W.M.	7/20/95
REVIEWED	T.G.H.	7/20/95

I:\DRAWINGS\943044\SHEET3.DGN

CURVE 325
P.I. STA= 104+65.08
Δ= 38°-13'-44"
D= 60°-18'-41"
R= 95.0'
T= 32.92'
L= 63.39'
E= 5.54'
S.E.= 0.04'/'
P.C. STA= 104+32.16
P.T. STA= 104+95.54

CURVE 335
P.I. STA= 105+96.97
Δ= 90°-00'-06"
D= 60°-18'-41"
R= 95.0'
T= 95.0'
L= 149.23'
E= 39.35'
S.E.= 0.04'/'
P.C. STA= 105+01.97
P.T. STA= 106+51.20

CURVE 345
P.I. STA= 106+92.57
Δ= 47°-04'-03"
D= 60°-18'-41"
R= 95.0'
T= 41.37'
L= 78.04'
E= 8.62'
S.E.= 0.04'/'
P.C. STA= 106+51.20
P.T. STA= 107+29.24

CURVE 355
P.I. STA= 113+60.22
Δ= 78°-35'-50"
D= 22°-55'-06"
R= 250.0'
T= 204.61'
L= 342.95'
E= 73.06'
S.E.= 0.02'/'
P.C. STA= 111+55.61
P.T. STA= 114+98.56

CURVE 350
P.I. STA= 117+19.14
Δ= 34°-18'-17"
D= 28°-38'-52"
R= 200.0'
T= 61.73'
L= 119.75'
E= 9.31'
S.E.= 0.04'/'
P.C. STA= 116+57.42
P.T. STA= 117+77.16

CURVE 360
P.I. STA= 120+82.85
Δ= 49°-23'-42"
D= 22°-55'-06"
R= 250.0'
T= 114.97'
L= 215.53'
E= 25.17'
S.E.= 0.02'/'
P.C. STA= 119+67.88
P.T. STA= 121+83.41

CURVE 80
P.I. STA= 123+62.52
Δ= 51°-35'-55"
D= 32°-44'-26"
R= 175.0'
T= 84.60'
L= 157.60'
E= 19.37'
S.E.= 0.04'/'
P.C. STA= 122+77.92
P.T. STA= 124+35.52

CURVE 85
P.I. STA= 126+69.68
Δ= 81°-46'-16"
D= 28°-38'-52"
R= 200.0'
T= 173.16'
L= 285.44'
E= 64.54'
S.E.= 0.04'/'
P.C. STA= 124+96.52
P.T. STA= 127+81.96

CURVE 90
P.I. STA= 128+73.63
Δ= 77°-09'-12"
D= 60°-18'-41"
R= 95.0'
T= 75.77'
L= 127.93'
E= 26.52'
S.E.= 0.04'/'
P.C. STA= 127+97.85
P.T. STA= 129+25.78

CURVE 405
P.I. STA= 131+47.02
Δ= 21°-19'-09"
D= 4°-58'-40"
R= 1151.00'
T= 216.62'
L= 428.23'
E= 20.21'
S.E.= 0.02'/'
P.C. STA= 129+30.41
P.T. STA= 133+58.63

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Symbol	Revisions Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 106+00 TO STA. 128+00

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:
Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet number:
Solicitation Number:
Sheet 11 of 29

PLAN

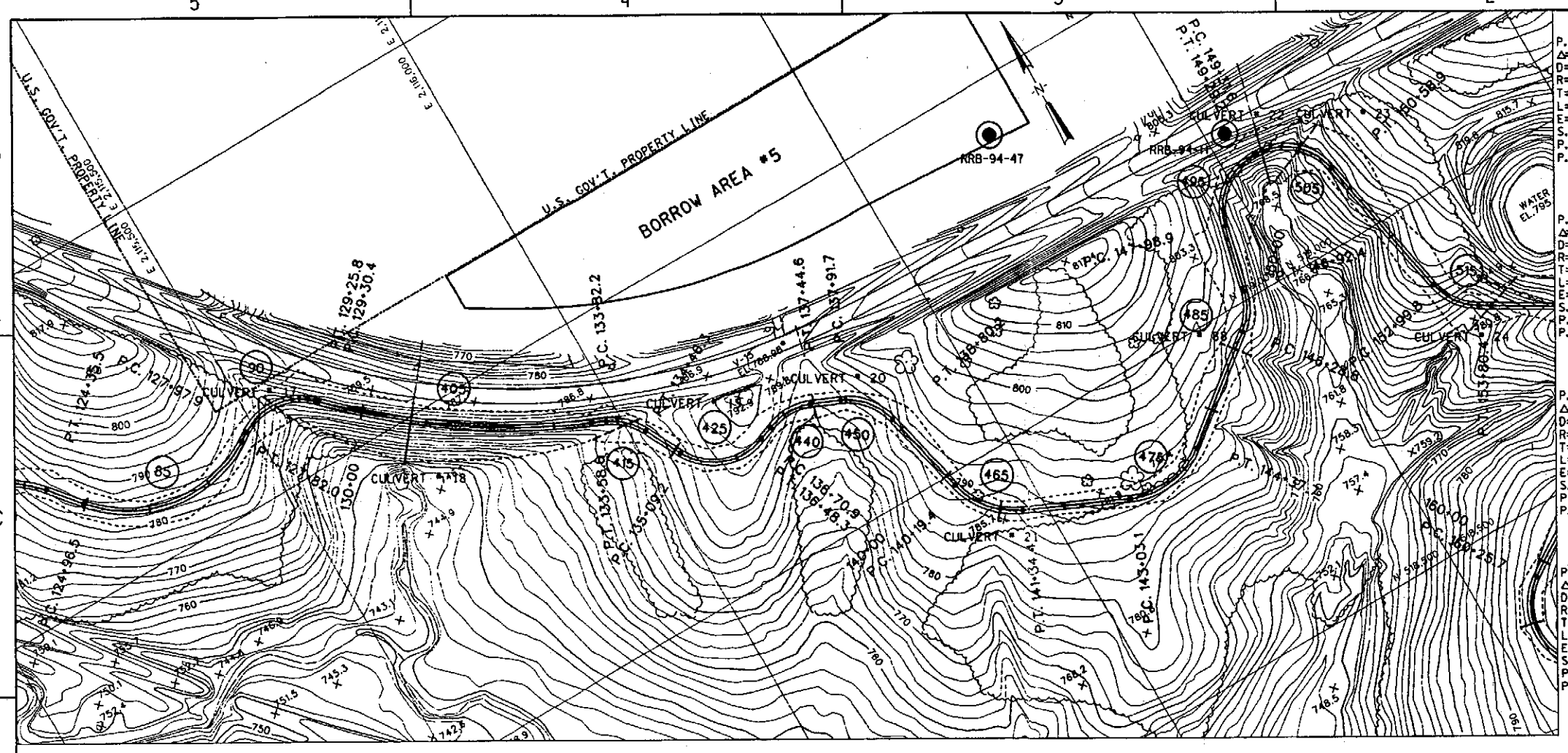
PROFILE DISTANCE IN FEET ALONG TRAIL ℄

ELEVATION IN FEET (NGVD)

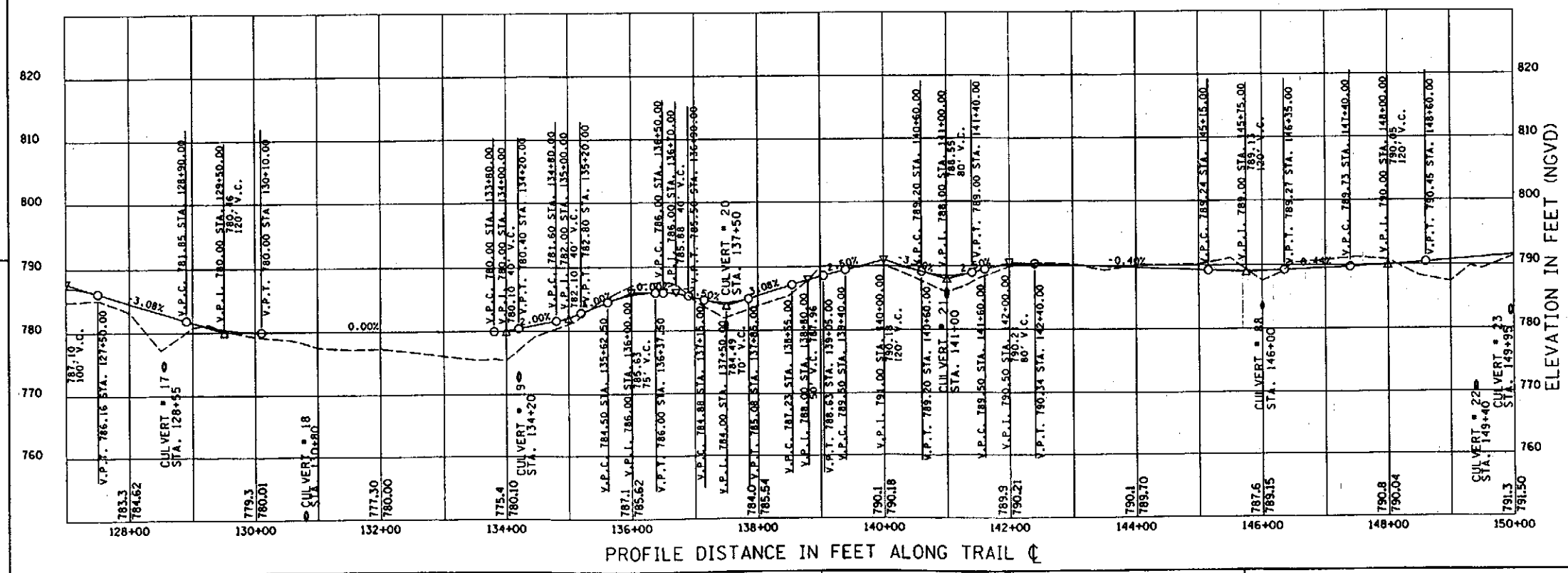
EXISTING PROFILE
PROPOSED PROFILE

DESIGNED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
REVIEWED	J.W.M.	2/20/95

I:/DRAWINGS/SHS2044/SHEET4.DGN



PLAN



CURVE 85	CURVE 90	CURVE 405
P.I. STA= 126+69.68	P.I. STA= 128+73.63	P.I. STA= 131+47.02
Δ= 81°-46'-16"	Δ= 77°-09'-12"	Δ= 21°-19'-00"
D= 28°-38'-52"	D= 60°-18'-41"	D= 4°-58'-40"
R= 200.0'	R= 95.0'	R= 1151.00'
T= 173.16'	T= 75.77'	T= 216.62'
L= 285.44'	L= 127.93'	L= 428.23'
E= 64.54'	E= 26.52'	E= 20.61'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.02'/'
P.C. STA= 124+96.52	P.C. STA= 127+97.85	P.C. STA= 129+30.41
P.T. STA= 127+81.96	P.T. STA= 129+25.78	P.T. STA= 133+58.63

CURVE 415	CURVE 425	CURVE 440
P.I. STA= 134+15.53	P.I. STA= 135+94.55	P.I. STA= 137+09.70
Δ= 38°-41'-32"	Δ= 83°-52'-20"	Δ= 44°-26'-44"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 33.35'	T= 85.35'	T= 38.81'
L= 64.15'	L= 139.07'	L= 73.69'
E= 5.69'	E= 32.71'	E= 7.62'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 133+82.18	P.C. STA= 135+09.20	P.C. STA= 136+70.89
P.T. STA= 134+46.33	P.T. STA= 136+48.27	P.T. STA= 137+44.58

CURVE 450	CURVE 465	CURVE 475
P.I. STA= 138+39.43	P.I. STA= 140+81.35	P.I. STA= 143+77.77
Δ= 53°-23'-52"	Δ= 52°-42'-32"	Δ= 61°-41'-26"
D= 60°-18'-41"	D= 45°-50'-12"	D= 45°-50'-12"
R= 95.0'	R= 125.0'	R= 125.0'
T= 47.78'	T= 61.93'	T= 74.65'
L= 88.54'	L= 114.99'	L= 134.59
E= 11.34'	E= 14.5'	E= 20.59'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 137+91.65	P.C. STA= 140+19.42	P.C. STA= 143+03.12
P.T. STA= 138+80.19	P.T. STA= 141+34.42	P.T. STA= 144+37.71

CURVE 485	CURVE 495	CURVE 505
P.I. STA= 146+61.82	P.I. STA= 148+76.65	P.I. STA= 150+06.88
Δ= 38°-22'-53"	Δ= 78°-36'-46"	Δ= 76°-49'-23"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 33.07'	T= 77.77'	T= 75.33'
L= 63.64'	L= 130.34'	L= 127.38'
E= 5.59'	E= 27.78'	E= 26.24'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 146+28.75	P.C. STA= 147+98.88	P.C. STA= 149+31.55
P.T. STA= 146+92.39	P.T. STA= 149+29.22	P.T. STA= 150+58.93

CURVE 515
P.I. STA= 153+42.67
Δ= 48°-36'-08"
D= 60°-18'-41"
R= 95.0'
T= 42.90'
L= 80.59'
E= 9.24'
S.E.= 0.02'/'
P.C. STA= 152+99.77
P.T. STA= 153+80.36

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

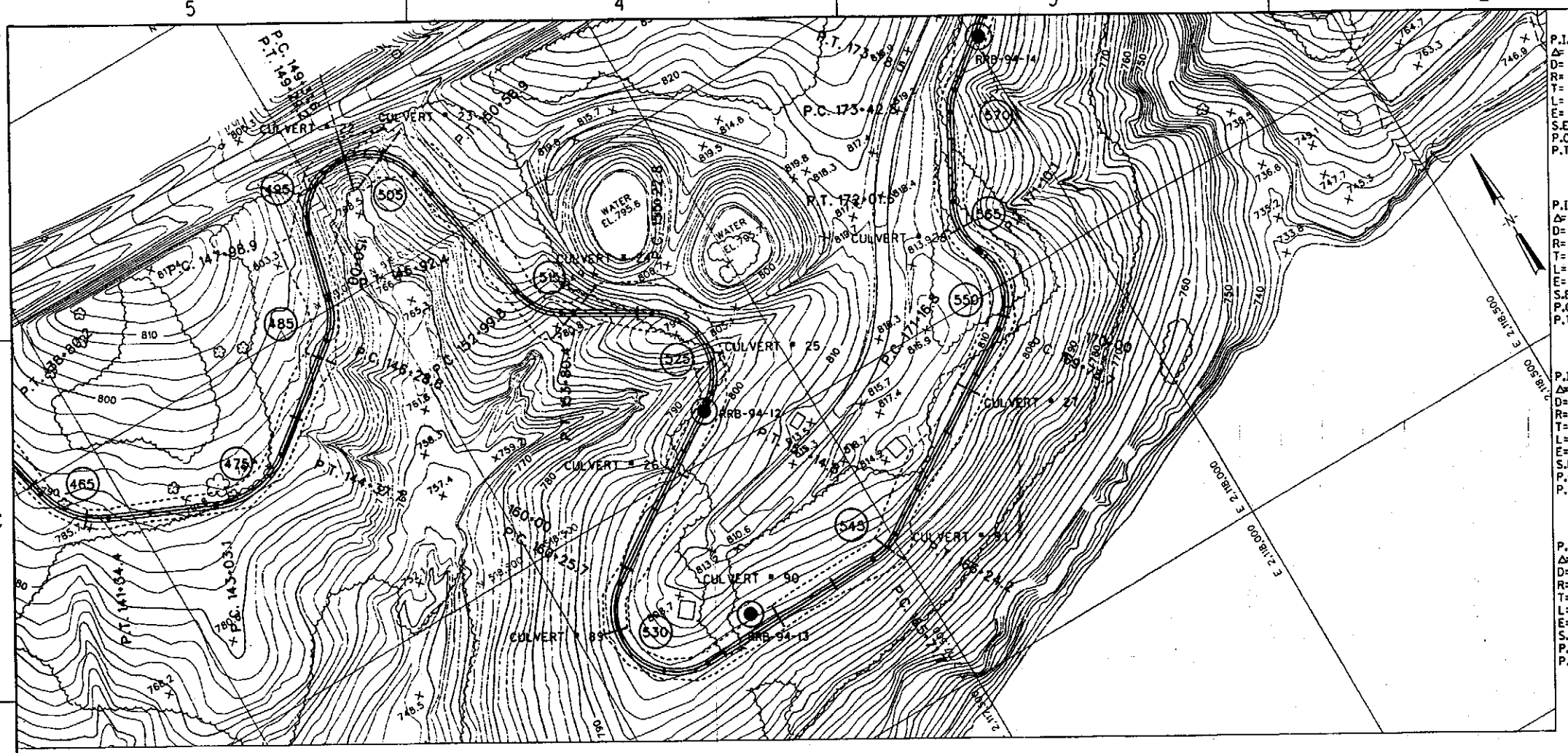
HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: W.J.D.	RED ROCK MULTI-PURPOSE TRAIL
Checked by: J.W.M.	SEGMENT IV
Reviewed by: T.G.H.	**PLAN AND PROFILE**
Approved by:	**STA. 128+00 TO STA. 150+00**
	Scale: AS SHOWN
	Date: 2 20 1995
	Drawing Code:
	Sheet reference number:
	Solicitation Number:
	Sheet 12 of 29

DESIGNED	N.L.H.	7/20/95
DRAWN	W.J.D.	7/20/95
REVIEWED	J.W.M.	7/20/95

J:\DRAWINGS\RRS2014\SHEETS.DGN



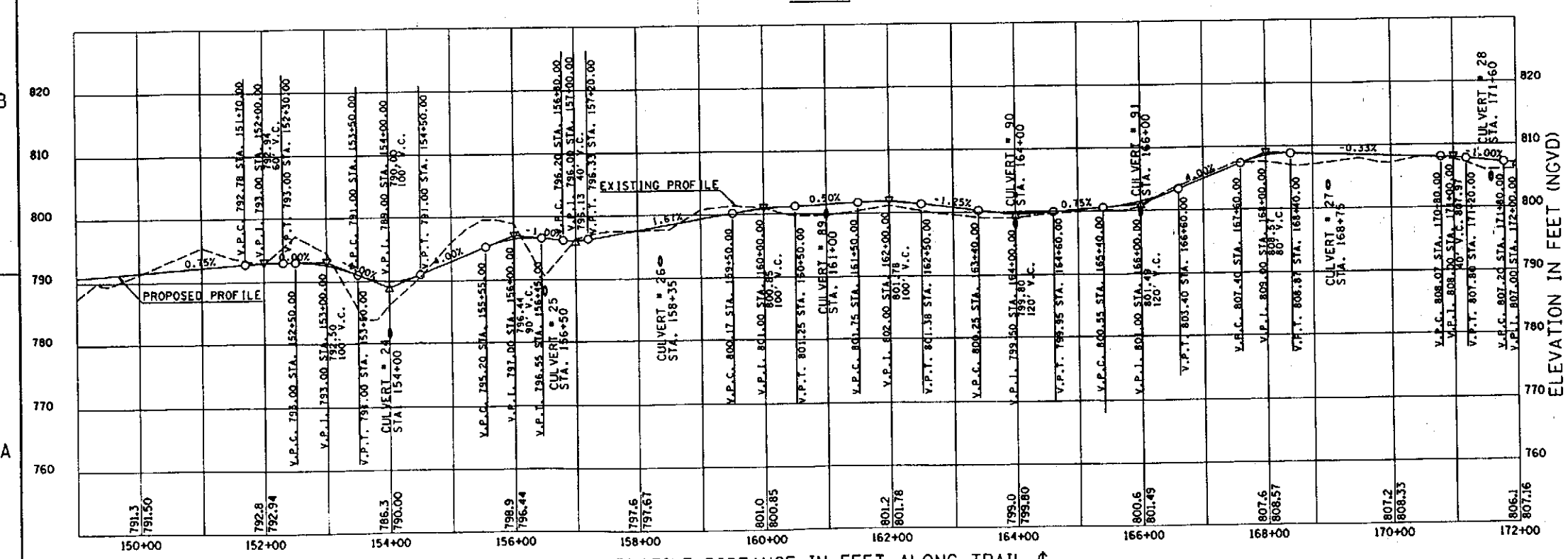
PLAN

CURVE 465	CURVE 475	CURVE 485
P.I. STA= 140+81.35	P.I. STA= 143+77.77	P.I. STA= 146+61.82
Δ= 52°-42'-32"	Δ= 61°-41'-26"	Δ= 38°-22'-53"
D= 45°-50'-12"	D= 45°-50'-12"	D= 60°-18'-41"
R= 125.0'	R= 125.0'	R= 95.0'
T= 61.93'	T= 74.65'	T= 33.07'
L= 114.99'	L= 134.59'	L= 63.64'
E= 14.50'	E= 20.59'	E= 5.59'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 140+19.42	P.C. STA= 143+03.12	P.C. STA= 146+28.75
P.T. STA= 141+34.42	P.T. STA= 144+37.71	P.T. STA= 146+92.39

CURVE 495	CURVE 505	CURVE 515
P.I. STA= 148+76.65	P.I. STA= 150+06.88	P.I. STA= 153+42.67
Δ= 78°-36'-46"	Δ= 76°-49'-23"	Δ= 48°-36'-08"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 77.77'	T= 75.33'	T= 42.90'
L= 130.34'	L= 127.38'	L= 80.59'
E= 27.78'	E= 26.24'	E= 9.24'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 147+98.88	P.C. STA= 149+31.55	P.C. STA= 152+99.77
P.T. STA= 149+29.22	P.T. STA= 150+58.93	P.T. STA= 153+80.36

CURVE 525	CURVE 530	CURVE 545
P.I. STA= 156+74.30	P.I. STA= 163+53.98	P.I. STA= 165+98.61
Δ= 115°-49'-51"	Δ= 147°-43'-11"	Δ= 31°-38'-52"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 151.53'	T= 328.27'	T= 26.93'
L= 192.06'	L= 244.93'	L= 52.47'
E= 83.85'	E= 246.74'	E= 3.74'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 155+22.77	P.C. STA= 160+25.71	P.C. STA= 165+71.68
P.T. STA= 157+14.83	P.T. STA= 162+70.64	P.T. STA= 166+24.16

CURVE 550	CURVE 565	CURVE 570
P.I. STA= 170+57.35	P.I. STA= 171+62.23	P.I. STA= 173+60.85
Δ= 79°-15'-06"	Δ= 51°-09'-50"	Δ= 21°-31'-30"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 78.66'	T= 45.48'	T= 18.06'
L= 131.40'	L= 84.83'	L= 35.69'
E= 28.34'	E= 10.33'	E= 1.70'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 169+78.68	P.C. STA= 171+16.75	P.C. STA= 173+42.80
P.T. STA= 172+10.09	P.T. STA= 172+01.58	P.T. STA= 173+78.49



HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers Rock Island District

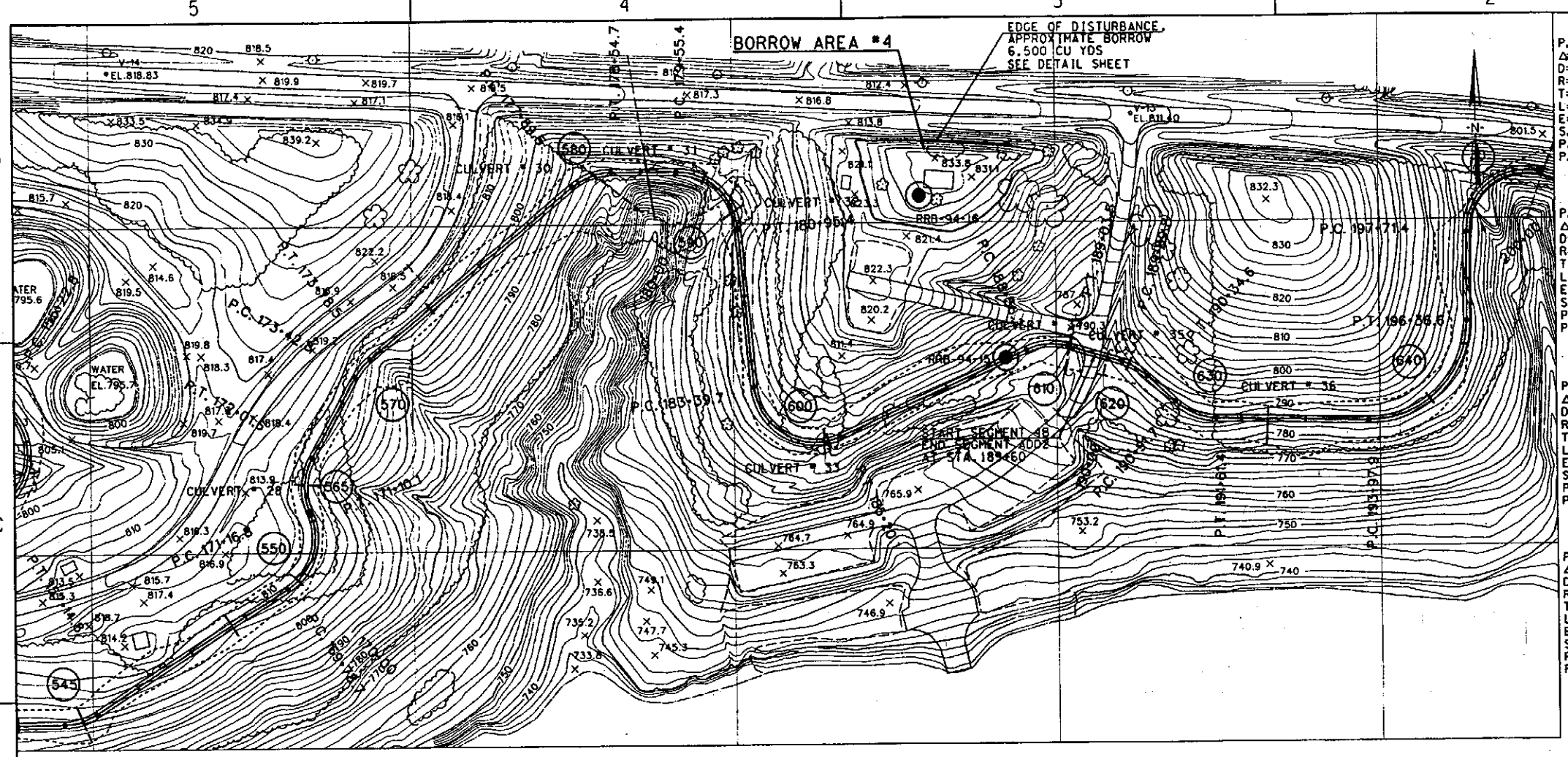
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 150+00 TO STA. 172+00

Scale: AS SHOWN
Date: 2 20 1995
Drawing Codes:
Sheet Reference Number:
Solicitation Number:
Sheet 13 of 29

DESIGNED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
REVIEWED	J.W.M.	2/20/95

D:\DRAWINGS\94520044\SHEET13.DGN



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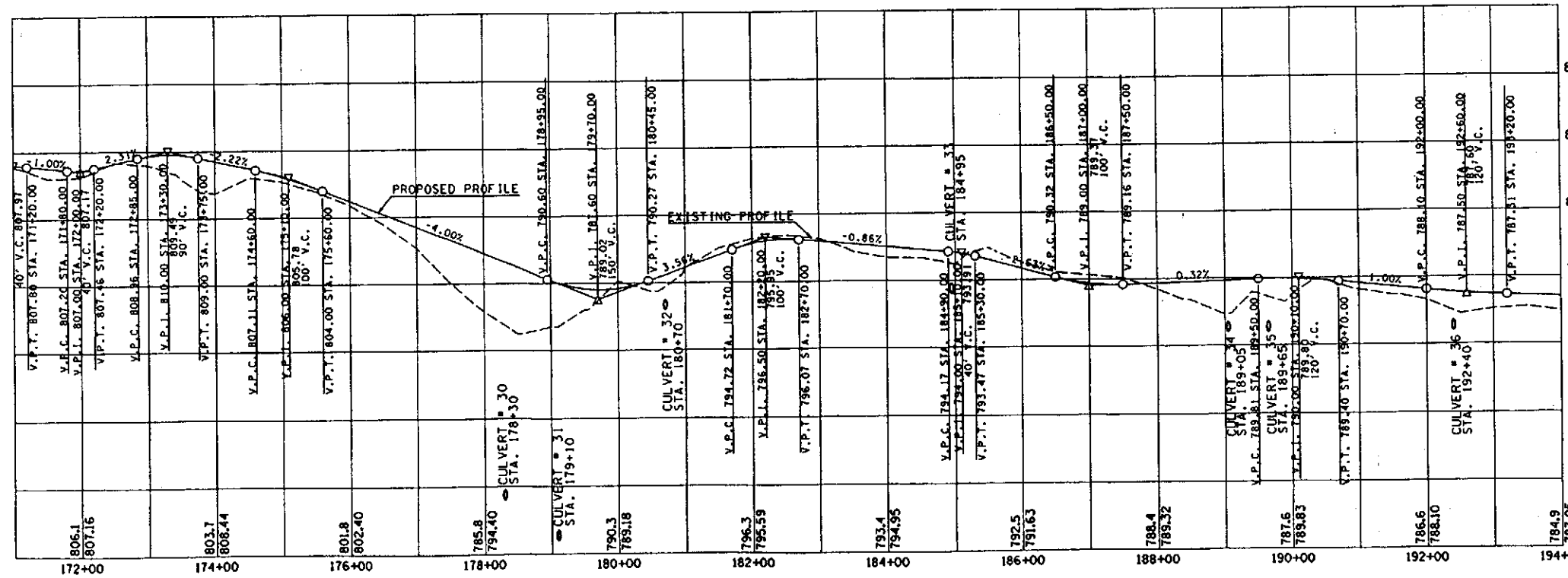

CURVE 545	CURVE 550	CURVE 565
P.I. STA= 165+98.61	P.I. STA= 170+57.35	P.I. STA= 171+62.23
Δ= 31°-38'-52"	Δ= 79°-15'-06"	Δ= 51°-09'-50"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 26.93'	T= 78.66'	T= 45.48'
L= 52.47'	L= 131.40'	L= 84.83'
E= 3.74'	E= 28.34'	E= 10.32'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 165+71.68	P.C. STA= 169+78.68	P.C. STA= 171+16.75
P.T. STA= 166+24.16	P.T. STA= 171+10.09	P.T. STA= 172+01.58

CURVE 570	CURVE 580	CURVE 590
P.I. STA= 173+60.85	P.I. STA= 178+23.42	P.I. STA= 180+41.61
Δ= 21°-31'-30"	Δ= 39°-20'-15"	Δ= 84°-25'-01"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 18.06'	T= 33.96'	T= 86.17'
L= 35.69'	L= 65.22'	L= 139.97'
E= 1.70'	E= 5.89'	E= 33.26'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 173+42.80	P.C. STA= 177+89.46	P.C. STA= 179+55.44
P.T. STA= 173+78.49	P.T. STA= 178+54.69	P.T. STA= 180+95.41

CURVE 600	CURVE 610	CURVE 620
P.I. STA= 184+72.45	P.I. STA= 188+71.32	P.I. STA= 190+12.59
Δ= 108°-49'-37"	Δ= 40°-33'-49"	Δ= 27°-00'-41"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 132.76'	T= 35.11'	T= 22.82'
L= 180.44'	L= 67.26'	L= 44.79'
E= 68.31'	E= 6.33'	E= 2.68'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 183+39.69	P.C. STA= 188+36.21	P.C. STA= 189+89.77
P.T. STA= 185+20.13	P.T. STA= 189+03.47	P.T. STA= 190+34.56

CURVE 630	CURVE 640	CURVE 30
P.I. STA= 191+28.19	P.I. STA= 195+50.97	P.I. STA= 198+86.19
Δ= 41°-59'-32"	Δ= 91°-10'-23"	Δ= 100°-45'-42"
D= 60°-18'-41"	D= 38°-11'-50"	D= 60°-18'-41"
R= 95.0'	R= 150.0'	R= 95.0'
T= 36.46'	T= 153.10'	T= 114.76'
L= 69.63'	L= 238.69'	L= 167.07'
E= 6.76'	E= 64.34'	E= 53.98'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 190+91.73	P.C. STA= 193+97.86	P.C. STA= 197+71.43
P.T. STA= 191+61.35	P.T. STA= 196+36.55	P.T. STA= 199+38.50

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Symbol	Revisions Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

US Army Corps of Engineers

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 172+00 TO STA. 194+00

Designed by: N.L.H.	Scale: AS SHOWN	Sheet reference number:	Solicitation Number:
Drawn by: W.J.D.	Date: 2 20 1995		
Checked by: J.W.M.	Drawing Code:		Sheet 14 of 29
Reviewed by: T.G.H.			
Approved by:			

DESIGNED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
REVIEWED	J.W.M.	2/20/95

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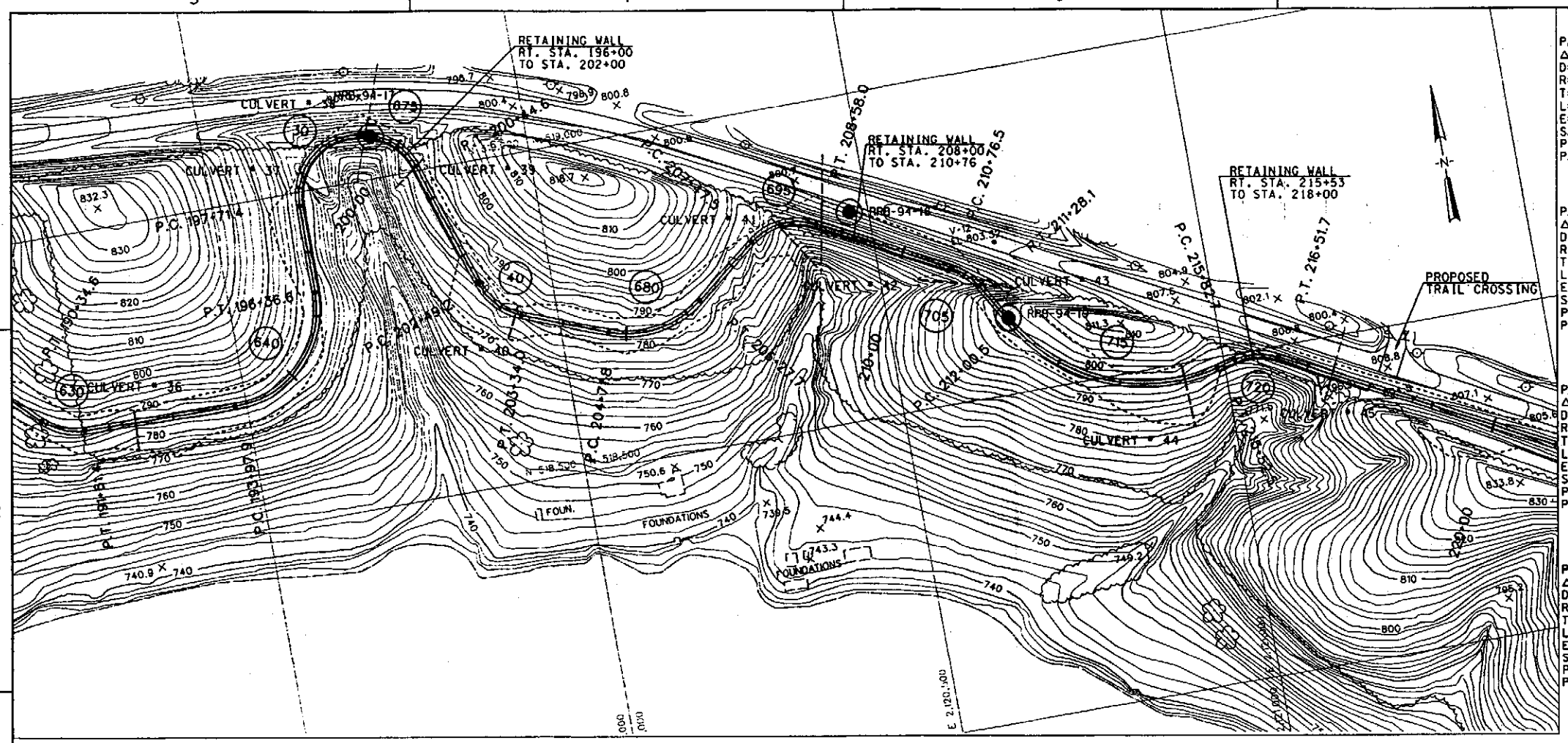
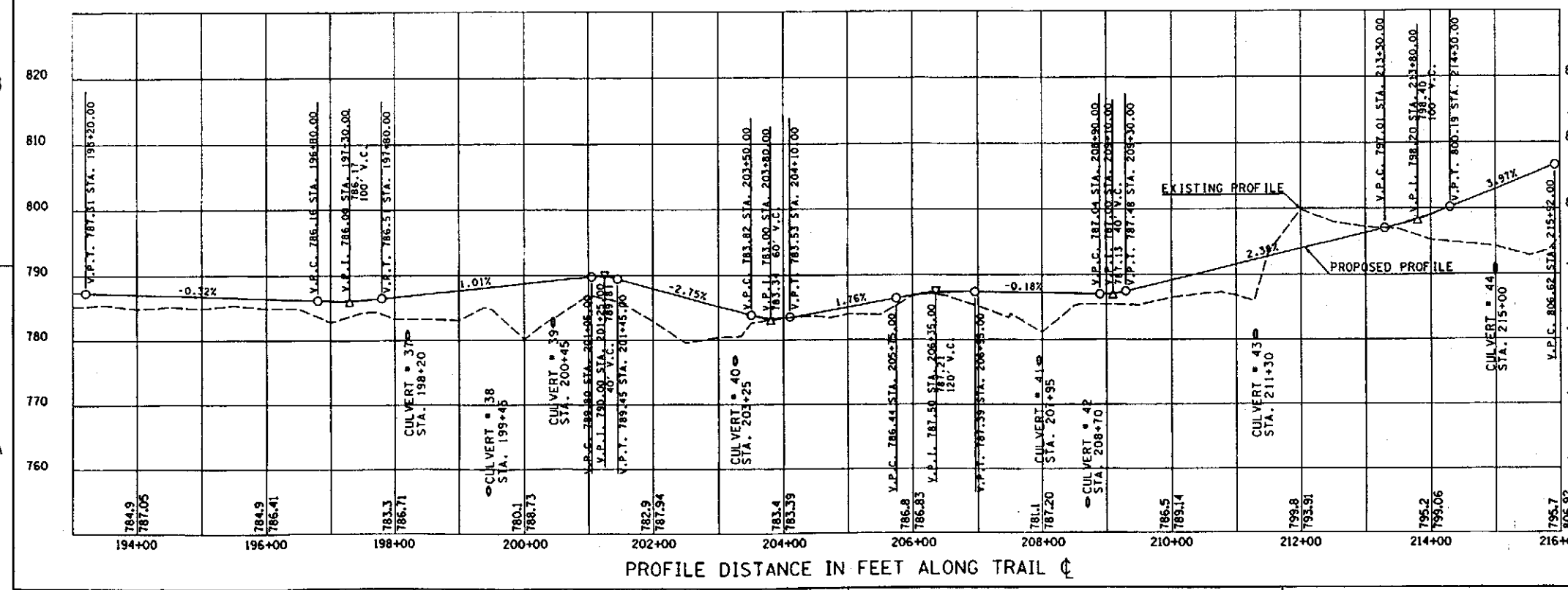


PLAN



CURVE 630	CURVE 640	CURVE 30
P.I. STA= 191+28.19	P.I. STA= 195+50.97	P.I. STA= 198+86.19
Δ= 41°-59'-32"	Δ= 91°-10'-23"	Δ= 100°-45'-42"
D= 60°-18'-41"	D= 38°-11'-50"	D= 60°-18'-41"
R= 95.0'	R= 150.0'	R= 95.0'
T= 36.46'	T= 153.10'	T= 114.76'
L= 69.63'	L= 238.69'	L= 167.07'
E= 6.76'	E= 64.34'	E= 53.98'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 190+91.73	P.C. STA= 193+97.86	P.C. STA= 197+71.43
P.T. STA= 191+61.35	P.T. STA= 196+36.55	P.T. STA= 199+38.50

CURVE 675	CURVE 40	CURVE 680
P.I. STA= 199+99.23	P.I. STA= 202+94.63	P.I. STA= 205+57.58
Δ= 61°-22'-36"	Δ= 51°-08'-12"	Δ= 59°-33'-07"
D= 60°-18'-41"	D= 60°-18'-41"	D= 38°-11'-50"
R= 95.0'	R= 95.0'	R= 150.0'
T= 56.38'	T= 45.45'	T= 85.82'
L= 101.77'	L= 84.79'	L= 155.91'
E= 15.47'	E= 10.31'	E= 22.82'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 199+42.85	P.C. STA= 202+49.17	P.C. STA= 204+71.76
P.T. STA= 200+44.62	P.T. STA= 203+33.96	P.T. STA= 206+27.67

CURVE 695	CURVE 705	CURVE 715
P.I. STA= 208+09.98	P.I. STA= 211+02.93	P.I. STA= 214+05.26
Δ= 66°-38'-03"	Δ= 31°-08'-26"	Δ= 73°-20'-08"
D= 60°-18'-41"	D= 60°-18'-41"	D= 20°-50'-05"
R= 95.0'	R= 95.0'	R= 275.0'
T= 62.44'	T= 26.47'	T= 204.74'
L= 110.48'	L= 51.63'	L= 351.99'
E= 18.68'	E= 3.62'	E= 67.84'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.02'/'
P.C. STA= 207+47.53	P.C. STA= 210+76.46	P.C. STA= 212+00.52
P.T. STA= 208+58.02	P.T. STA= 211+28.09	P.T. STA= 215+52.50

CURVE 720
P.I. STA= 216+18.81
Δ= 41°-39'-24"
D= 60°-18'-41"
R= 95.0'
T= 36.14'
L= 69.07'
E= 6.64'
S.E.= 0.04'/'
P.C. STA= 215+82.67
P.T. STA= 216+51.74

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

US Army Corps of Engineers Rock Island District

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 194+00 TO STA. 216+00

Designed by:	N.L.H.
Drawn by:	W.J.D.
Checked by:	J.W.M.
Reviewed by:	T.G.H.
Approved by:	
Scale:	AS SHOWN
Date:	2 20 1995
Drawing Code:	
Sheet reference number:	
Solicitation Number:	
Sheet 15 of 29	

DESIGNED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
CHECKED	J.W.M.	2/20/95
REVIEWED	T.G.H.	2/20/95

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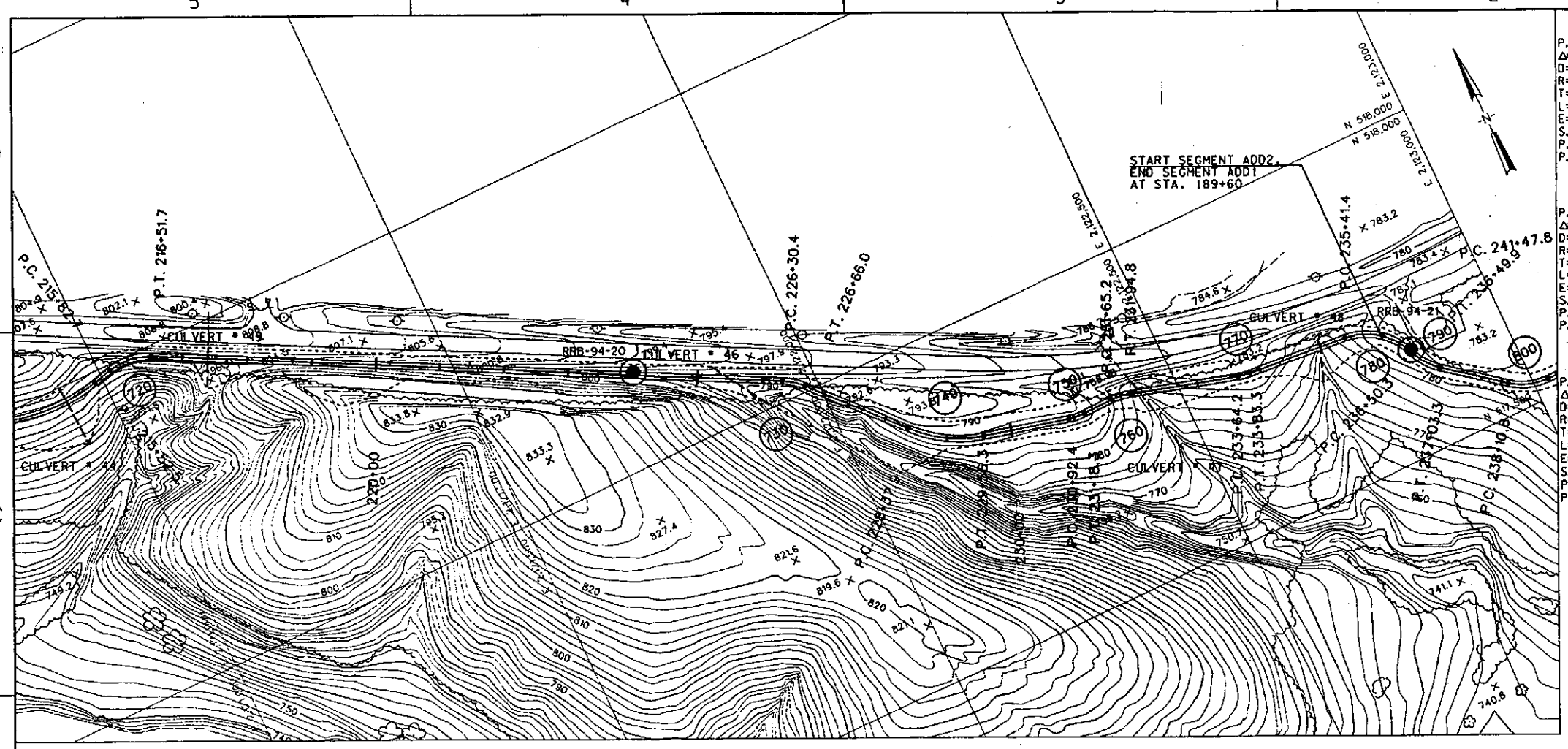
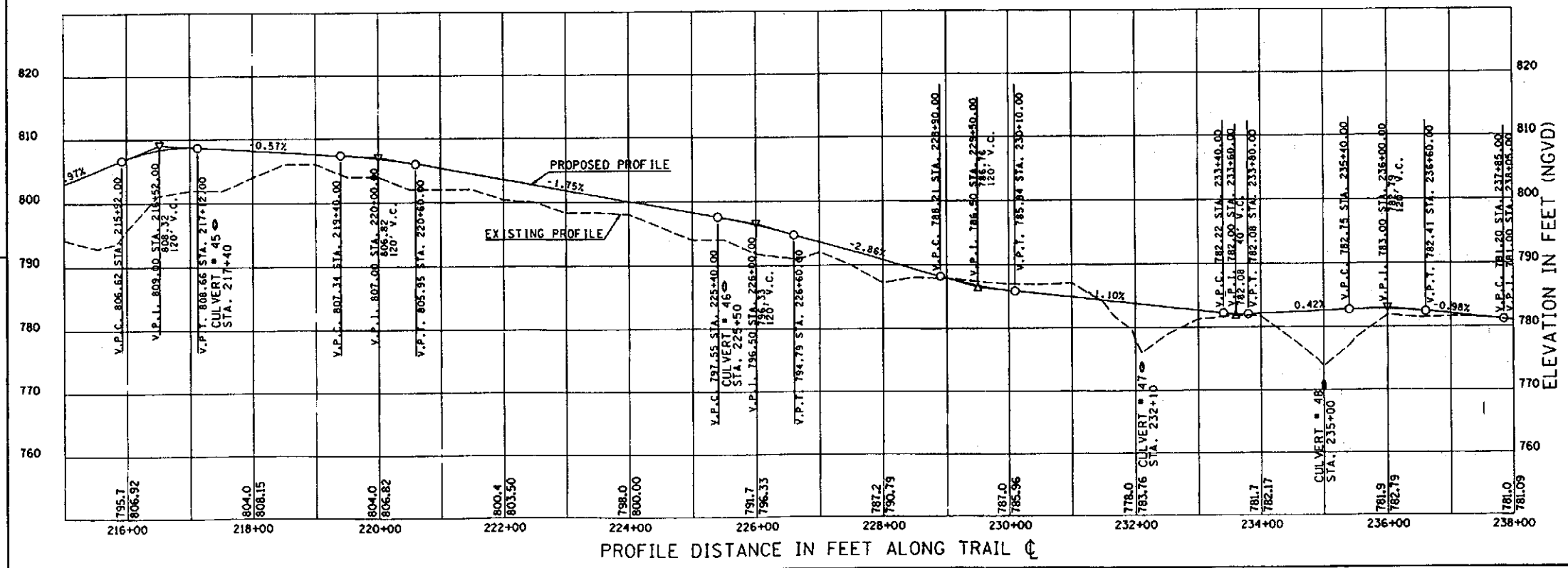


PLAN



CURVE 720	CURVE 730	CURVE 740
P.I. STA= 216+18.81	P.I. STA= 226+48.41	P.I. STA= 228+98.86
Δ= 41°-39'-24"	Δ= 20°-23'-51"	Δ= 33°-55'-18"
D= 60°-18'-41"	D= 57°-17'-45"	D= 28°-38'-52"
R= 95.0'	R= 100.0'	R= 200.0'
T= 36.14'	T= 17.99'	T= 61.0'
L= 69.07'	L= 35.60'	L= 118.41'
E= 6.64'	E= 1.61'	E= 9.09'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 215+82.67	P.C. STA= 226+30.41	P.C. STA= 228+37.86
P.T. STA= 216+51.74	P.T. STA= 226+66.02	P.T. STA= 229+56.27

CURVE 750	CURVE 760	CURVE 770
P.I. STA= 231+05.42	P.I. STA= 231+80.14	P.I. STA= 233+73.76
Δ= 15°-38'-09"	Δ= 17°-50'-38"	Δ= 11°-31'-39"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 13.04'	T= 14.91'	T= 9.59'
L= 25.93'	L= 29.59'	L= 19.11'
E= 0.89'	E= 1.16'	E= 0.48'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 230+92.38	P.C. STA= 231+65.23	P.C. STA= 233+64.17
P.T. STA= 231+18.30	P.T. STA= 231+94.82	P.T. STA= 233+83.28

CURVE 780	CURVE 790	CURVE 800
P.I. STA= 236+02.41	P.I. STA= 236+77.53	P.I. STA= 238+44.02
Δ= 65°-26'-50"	Δ= 32°-00'-18"	Δ= 38°-32'-44"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 61.04'	T= 27.25'	T= 33.22'
L= 108.52'	L= 53.07'	L= 63.91'
E= 17.92'	E= 3.83'	E= 5.64'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 235+41.36	P.C. STA= 236+50.28	P.C. STA= 238+10.80
P.T. STA= 236+49.88	P.T. STA= 237+03.35	P.T. STA= 238+74.71

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

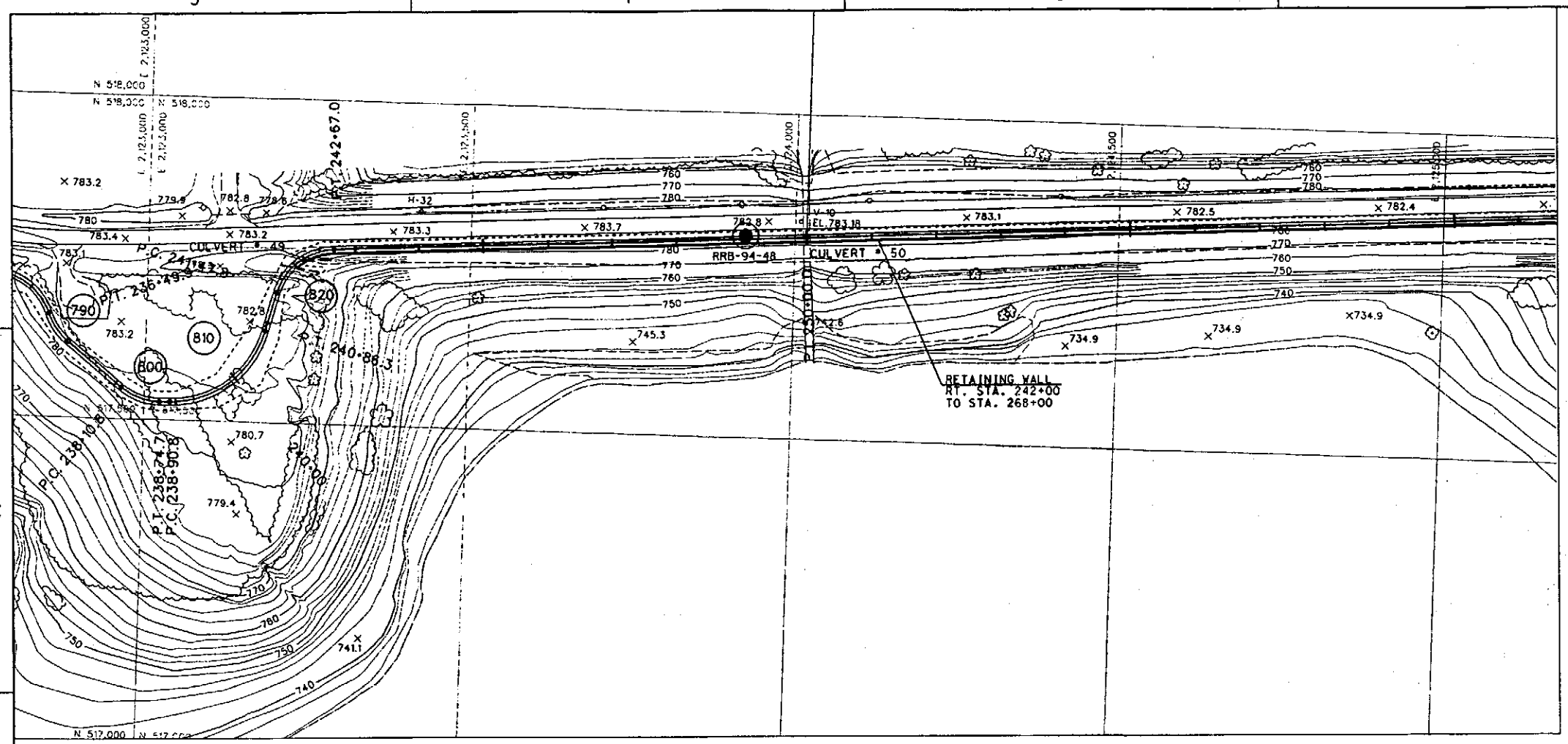
HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

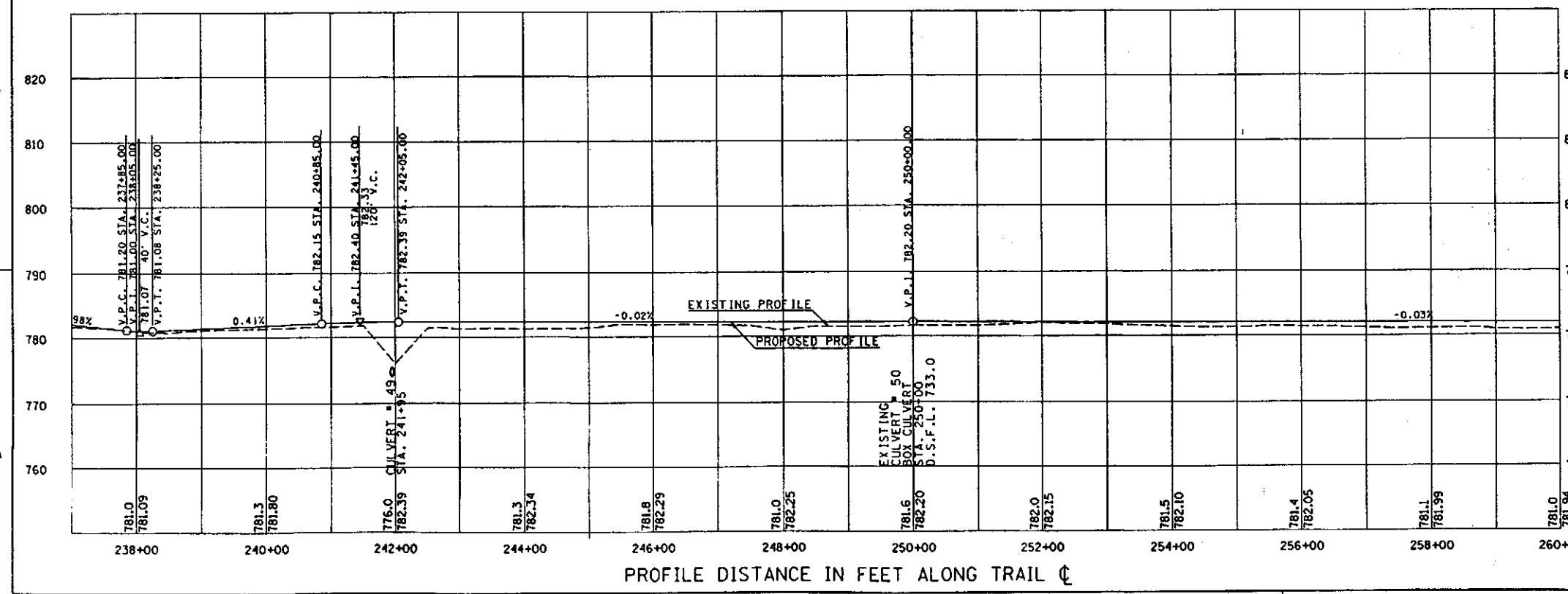
Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: W.J.D.	RED ROCK MULTI-PURPOSE TRAIL
Checked by: J.W.M.	SEGMENT IV
Reviewed by: T.G.H.	**PLAN AND PROFILE**
Approved by:	**STA. 216+00 TO STA. 238+00**
US Army Corps of Engineers	Scale: AS SHOWN
	Date: 2 20 1995
	Drawing Code:
	Sheet reference number:
	Solicitation Number:
	Sheet 16 of 029

DESIGN	N.L.H.	2/20/95
Drawn	W.J.D.	2/20/95
Revised	J.W.M.	2/20/95

I:\DRAWINGS\95SEG04\SHEET16.DGN



PLAN



PROFILE DISTANCE IN FEET ALONG TRAIL ℄

CURVE 790
P.I. STA= 236+77.53
Δ= 32°-00'-18"
D= 60°-18'-41"
R= 95.0'
T= 27.25'
L= 53.07'
E= 3.83'
S.E.= 0.04'/'
P.C. STA= 236+50.28
P.T. STA= 237+03.35'

CURVE 800
P.I. STA= 238+44.02
Δ= 38°-32'-44"
D= 60°-18'-41"
R= 95.0'
T= 33.22'
L= 63.91'
E= 5.64'
S.E.= 0.04'/'
P.C. STA= 238+10.80
P.T. STA= 238+74.71

CURVE 810
P.I. STA= 240+05.24
Δ= 74°-40'-22"
D= 38°-11'-50"
R= 150.0'
T= 114.42'
L= 195.49'
E= 38.46'
S.E.= 0.04'/'
P.C. STA= 238+90.82
P.T. STA= 240+86.31

CURVE 820
P.I. STA= 242+16.65
Δ= 71°-53'-16"
D= 60°-18'-41"
R= 95.0'
T= 68.88'
L= 119.19'
E= 22.34'
S.E.= 0.04'/'
P.C. STA= 241+47.77
P.T. STA= 242+66.97

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

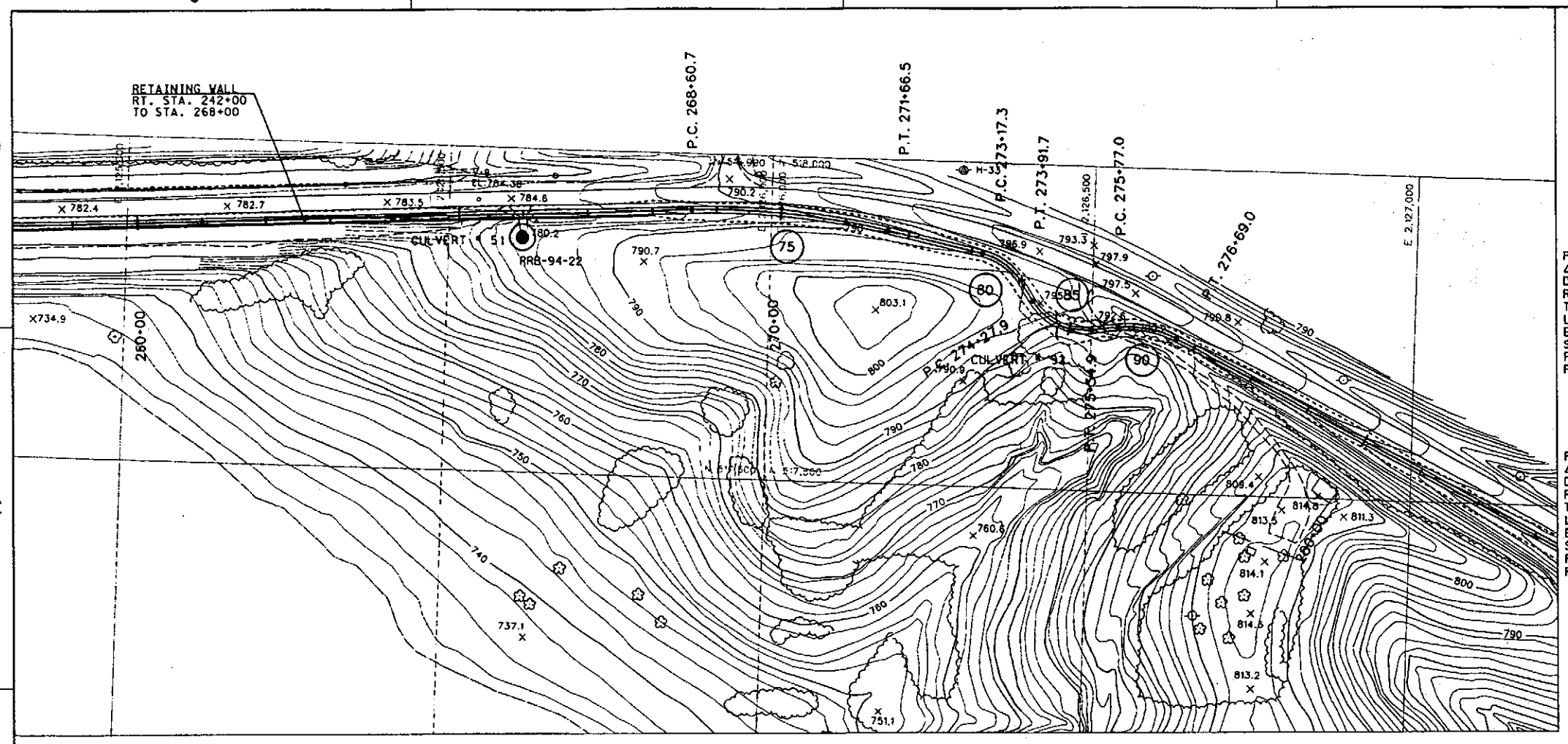
PLAN AND PROFILE
STA. 238+00 TO STA. 260+00

Designed by:	N.L.H.
Drawn by:	W.J.D.
Checked by:	J.W.M.
Reviewed by:	T.G.H.
Approved by:	
Scale:	AS SHOWN
Date:	2 20 1995
Drawing Code:	
Sheet reference number:	
Solicitation Number:	
Sheet 17 of 29	

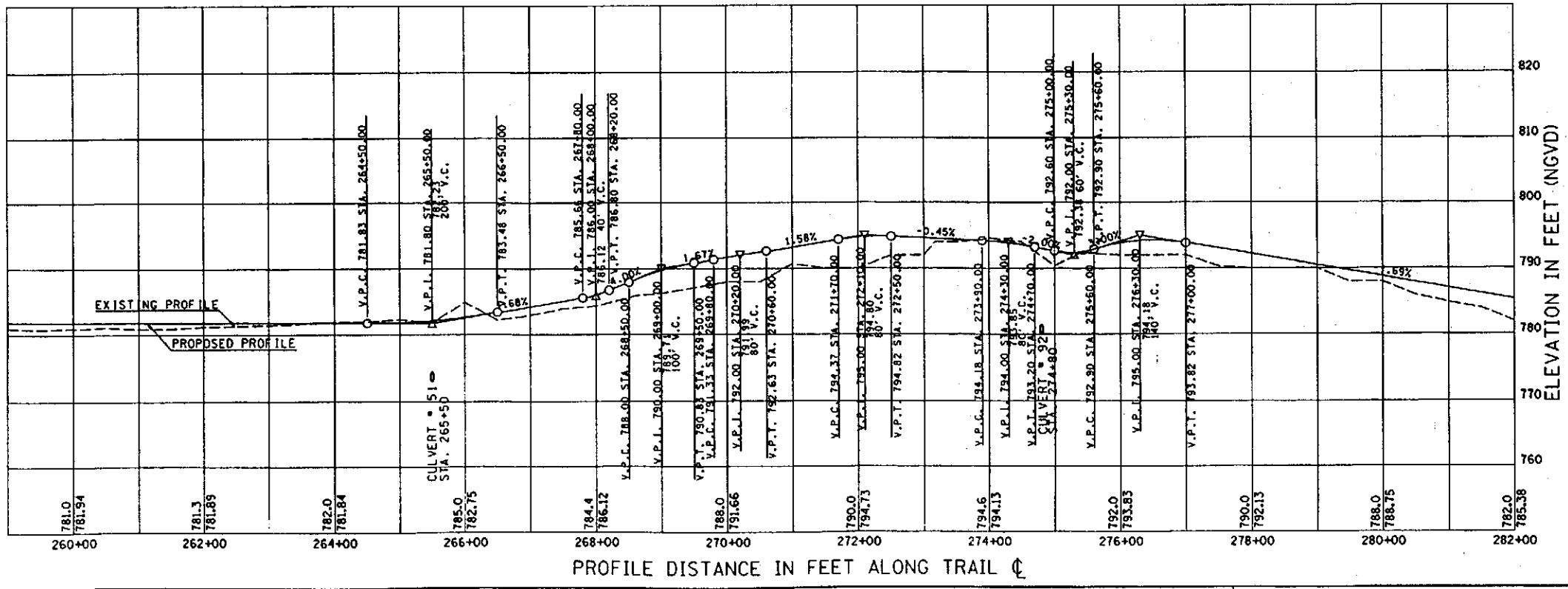
US Army Corps of Engineers, Rock Island District

I:\DRAWINGS\94320447\SHEET10.DGN

DESIGNED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
CHECKED	J.W.M.	2/20/95
REVIEWED	T.G.H.	2/20/95



PLAN



CURVE 75
P.I. STA= 270+14.42
Δ= 14°-35'-55"
D= 4°-46'-29"
R= 1200.0'
T= 153.71'
L= 305.76'
E= 9.80'
S.E.= 0.02'/'
P.C. STA= 268+60.71
P.T. STA= 271+66.46

CURVE 80
P.I. STA= 273+56.57
Δ= 44°-52'-21"
D= 60°-18'-41"
R= 95.0'
T= 39.23'
L= 74.40'
E= 7.78'
S.E.= 0.04'/'
P.C. STA= 273+56.57
P.T. STA= 273+91.74

CURVE 85
P.I. STA= 274+87.87
Δ= 64°-29'-33"
D= 60°-18'-41"
R= 95.0'
T= 59.93'
L= 106.93'
E= 17.32'
S.E.= 0.04'/'
P.C. STA= 274+27.94
P.T. STA= 275+34.87

CURVE 90
P.I. STA= 276+24.50
Δ= 35°-09'-55"
D= 38°-11'-50"
R= 150.0'
T= 47.53'
L= 92.06'
E= 7.35'
S.E.= 0.04'/'
P.C. STA= 275+76.97
P.T. STA= 276+69.03

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 260+00 TO STA. 282+00

Designed by:	N.L.H.
Drawn by:	W.J.D.
Checked by:	J.W.M.
Reviewed by:	T.G.H.
Approved by:	
Scale:	AS SHOWN
Date:	2 20 1995
Drawing Code:	
Sheet reference number:	
Solicitation Number:	
Sheet 18 of 29	

DESIGNED N.L.H. 2/20/95
DRAWN W.J.D. 2/20/95
CHECKED J.W.M. 2/20/95
QUANTITIES
APPROVED T.G.H. 2/20/95

I:/DRAWINGS/96520447/SHEET11.DGN

CURVE 070
P.I. STA= 300+44.47
Δ= 40°-49'-57"
D= 60°-18'-41"
R= 95.0'
T= 35.36'
L= 67.70'
E= 6.37'
S.E.= 0.04'/'
P.C. STA= 300+09.11
P.T. STA= 300+76.81

CURVE 065
P.I. STA= 294+18.88
Δ= 47°-06'-28"
D= 60°-18'-41"
R= 95.0'
T= 41.41'
L= 78.11'
E= 8.63'
S.E.= 0.04'/'
P.C. STA= 293+77.47
P.T. STA= 294+55.57

CURVE 100
P.I. STA= 305+53.29
Δ= 86°-44'-21"
D= 60°-18'-41"
R= 95.0'
T= 89.74'
L= 143.82'
E= 35.68'
S.E.= 0.04'/'
P.C. STA= 304+63.55
P.T. STA= 306+07.37

CURVE 090
P.I. STA= 304+02.54
Δ= 105°-33'-57"
D= 60°-18'-41"
R= 95.0'
T= 125.08'
L= 175.03'
E= 62.07'
S.E.= 0.04'/'
P.C. STA= 302+77.46
P.T. STA= 304+52.50

CURVE 080
P.I. STA= 301+78.77
Δ= 71°-38'-23"
D= 60°-18'-41"
R= 95.0'
T= 68.5'
L= 118.76'
E= 22.12'
S.E.= 0.04'/'
P.C. STA= 301+10.27
P.T. STA= 302+28.97

CURVE 110
P.I. STA= 307+98.16
Δ= 109°-44'-11"
D= 60°-18'-41"
R= 95.0'
T= 135.43'
L= 182.2'
E= 70.43'
S.E.= 0.04'/'
P.C. STA= 306+62.73
P.T. STA= 308+44.96

CURVE 780
P.I. STA= 293+13.04
Δ= 47°-06'-28"
D= 60°-18'-41"
R= 95.0'
T= 41.41'
L= 78.11'
E= 8.63'
S.E.= 0.04'/'
P.C. STA= 292+71.63
P.T. STA= 293+49.73

HORIZONTAL SCALE IN FEET
100 50 0 100 200 FT

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 282+00 TO STA. 304+00

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Revised by: T.G.H.
Approved by:
Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet Reference Number:
Solicitation Number:
Sheet 19 of 29

PLAN

PROFILE DISTANCE IN FEET ALONG TRAIL ℄

ELEVATION IN FEET (NGVD)

PROPOSED PROFILE

EXISTING PROFILE

-0.07%

CULVERT = 54 Q'

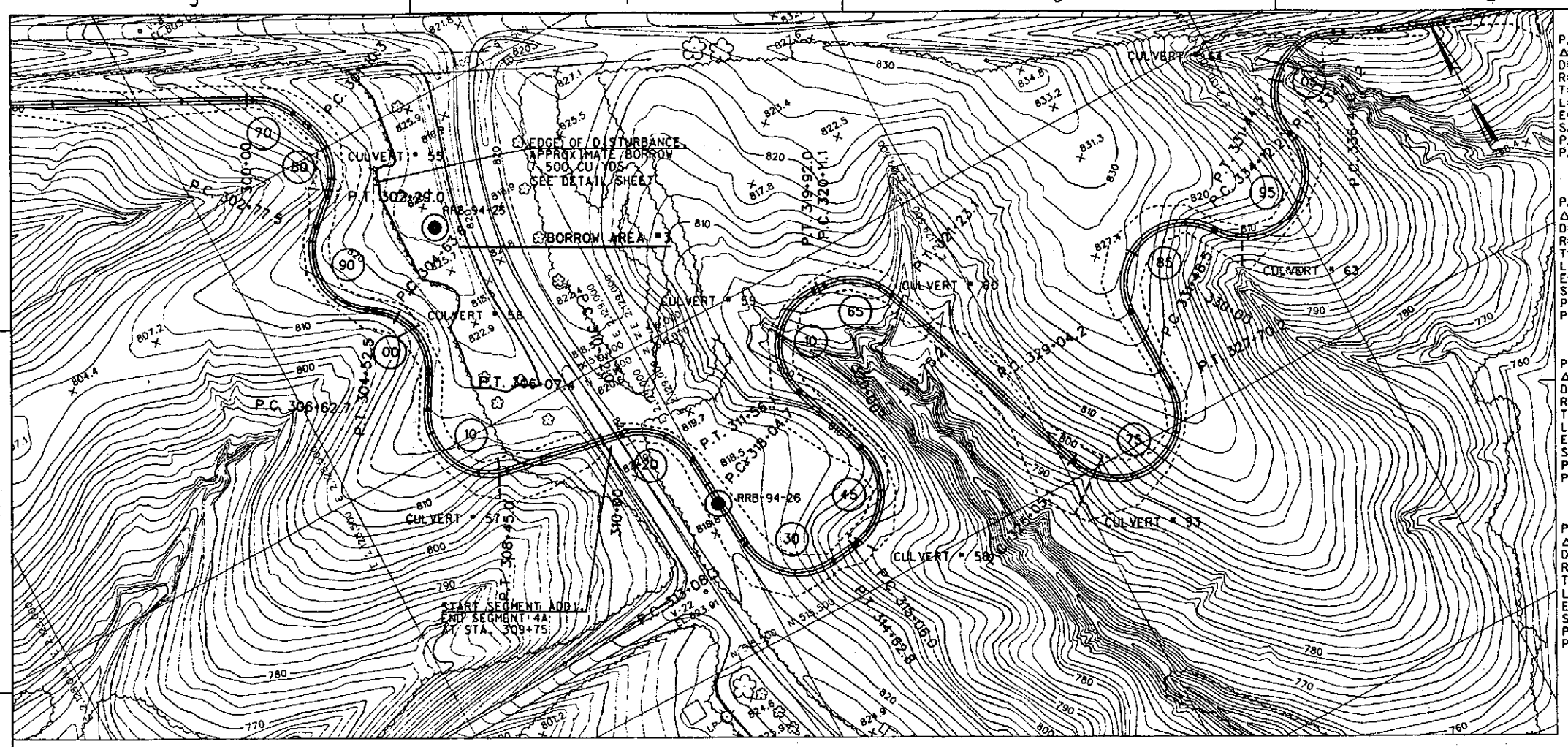
CULVERT = 55 Q'

CULVERT = 53 Q'

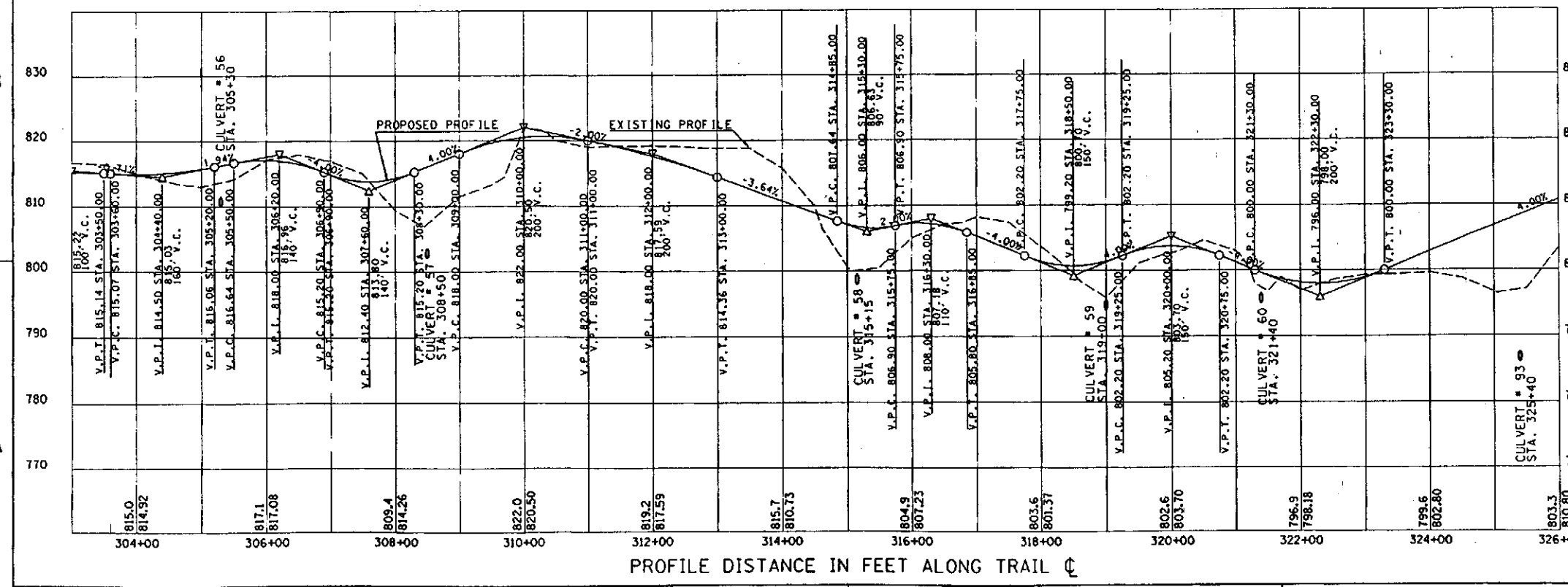
RETAINING WALL
RT. STA. 284+00
TO STA. 292+34

REVISED	NL.H.	2/20/95
DRAWN	W.J.D.	2/20/95
CHECKED	T.G.H.	2/20/95

L:/DRAWINGS/SM5204/SHEET12.DGN



PLAN



CURVE 70	CURVE 080	CURVE 090
P.I. STA= 300+44.47	P.I. STA= 301+78.77	P.I. STA= 304+02.54
Δ= 40°-49'-57"	Δ= 71°-35'-23"	Δ= 105°-33'-57"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 35.36'	T= 68.5'	T= 125.08'
L= 67.70'	L= 118.70'	L= 175.03'
E= 6.37'	E= 22.12'	E= 62.07'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 300+09.11	P.C. STA= 301+10.27	P.C. STA= 302+77.46
P.T. STA= 300+76.81	P.T. STA= 302+28.97	P.T. STA= 304+52.50

CURVE 100	CURVE 110	CURVE 20
P.I. STA= 305+15.29	P.I. STA= 307+98.16	P.I. STA= 311+04.69
Δ= 86°-44'-21"	Δ= 109°-54'-11"	Δ= 74°-39'-06"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 89.74'	T= 135.43'	T= 72.70'
L= 143.82'	L= 182.23'	L= 124.11'
E= 35.68'	E= 70.43'	E= 24.63'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 304+63.55	P.C. STA= 306+62.73	P.C. STA= 310+31.99
P.T. STA= 306+07.37	P.T. STA= 308+44.96	P.T. STA= 311+56.10

CURVE 30	CURVE 45	CURVE 710
P.I. STA= 314+08.77	P.I. STA= 316+23.48	P.I. STA= 319+48.04
Δ= 93°-13'-04"	Δ= 102°-05'-28"	Δ= 112°-55'-00"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 100.48'	T= 117.51'	T= 143.30'
L= 154.56'	L= 169.27'	L= 187.22'
E= 43.29'	E= 56.10'	E= 76.93'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 313+08.28	P.C. STA= 315+05.97	P.C. STA= 318+04.73
P.T. STA= 314+62.84	P.T. STA= 316+75.25	P.T. STA= 319+91.96

CURVE 165	CURVE 175	CURVE 185
P.I. STA= 320+74.61	P.I. STA= 330+39.98	P.I. STA= 332+03.54
Δ= 67°-30'-54"	Δ= 159°-51'-24"	Δ= 144°-47'-06"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 63.49'	T= 534.86'	T= 299.34'
L= 111.94'	L= 265.05'	L= 240.06'
E= 19.27'	E= 448.23'	E= 219.06'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 320+11.11	P.C. STA= 325+05.12	P.C. STA= 329+04.20
P.T. STA= 321+23.06	P.T. STA= 327+70.18	P.T. STA= 331+44.26

CURVE 195	CURVE 205
P.I. STA= 336+47.39	P.I. STA= 336+09.12
Δ= 158°-26'-16"	Δ= 128°-29'-44"
D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'
T= 498.90'	T= 196.94'
L= 262.70'	L= 213.05'
E= 412.87'	E= 123.65'
S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 331+48.49	P.C. STA= 334+12.19
P.T. STA= 334+11.19	P.T. STA= 336+25.24

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

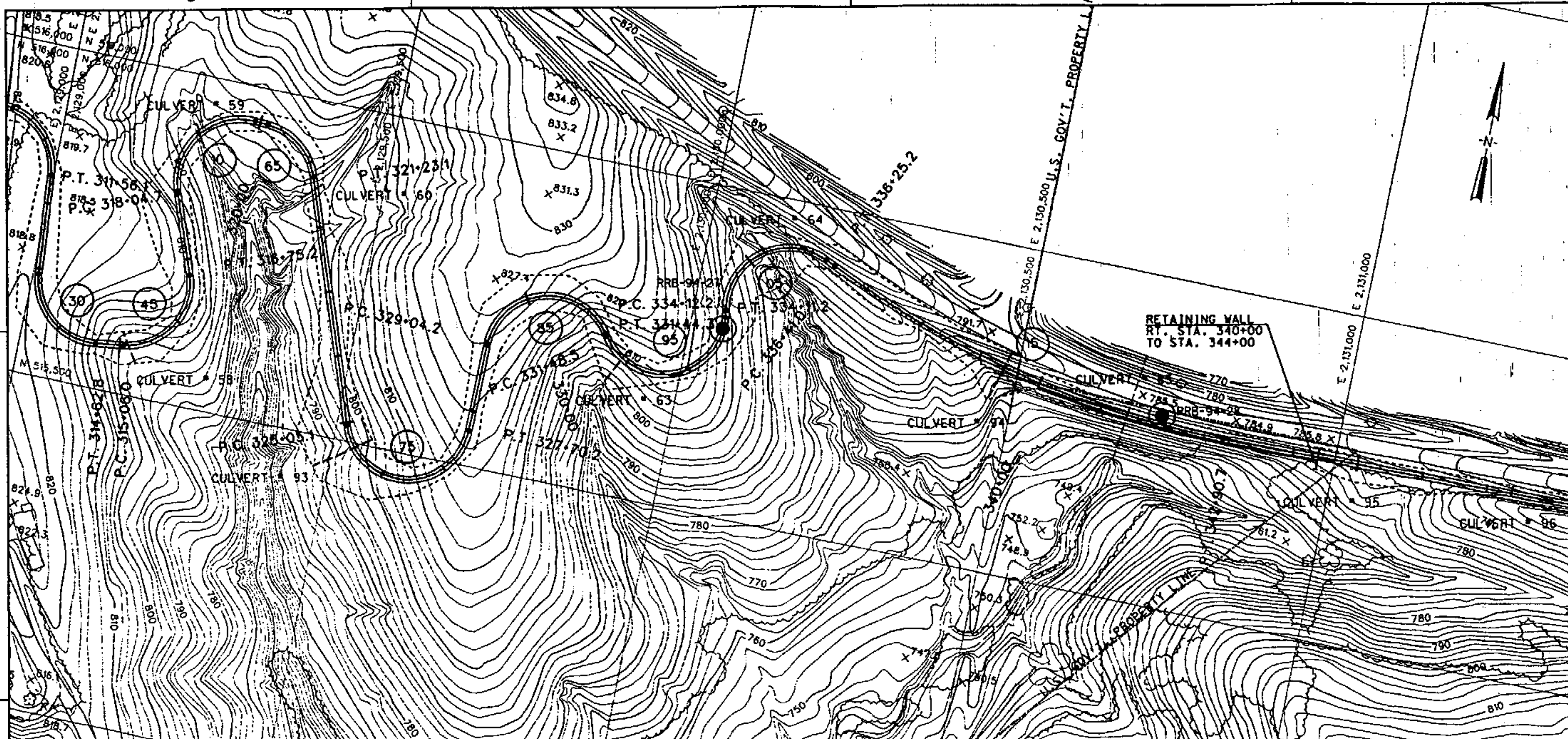
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: W.J.D.	RED ROCK MULTI-PURPOSE TRAIL
Checked by: J.W.M.	SEGMENT IV
Reviewed by: T.G.H.	**PLAN AND PROFILE**
Approved by:	**STA. 304+00 TO STA. 326+00**
	Scale: AS SHOWN
	Date: 2 20 1995
	Drawing Code:
	Sheet reference number:
	Solicitation Number:
	Sheet 20 of 29

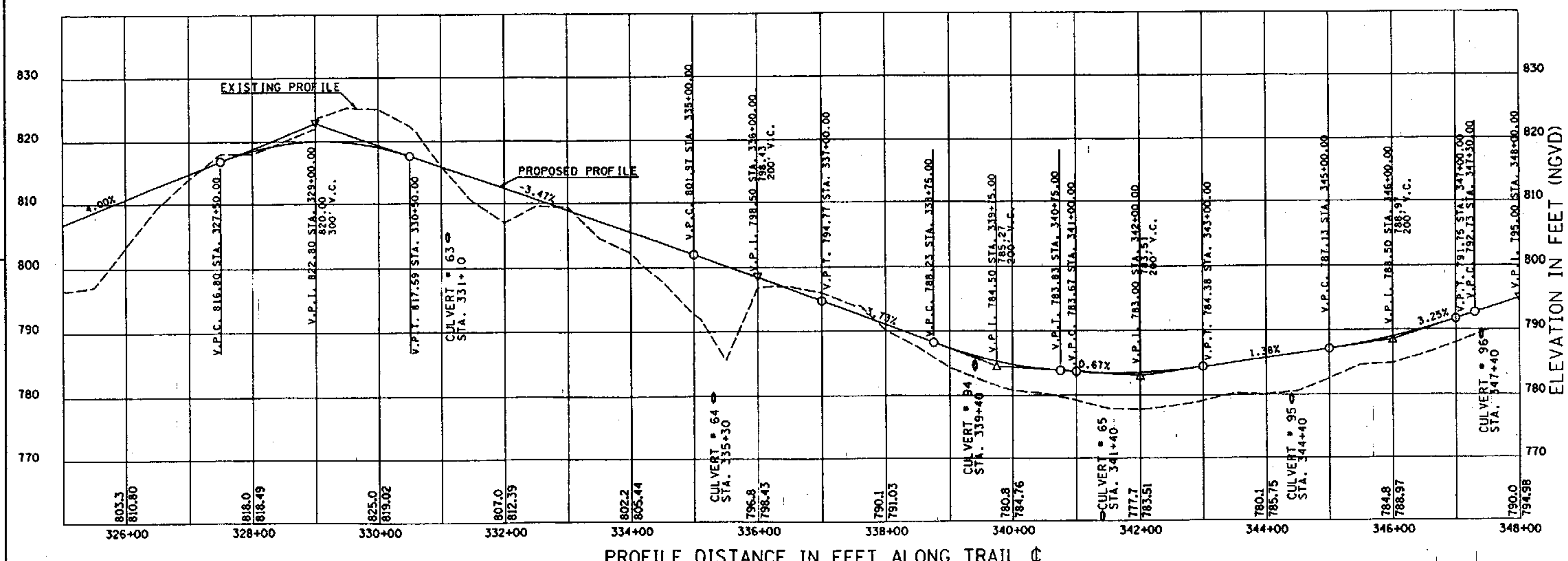
US Army Corps of Engineers Rock Island District

DESIGNED	N.L.H.	7/20/95
DRAWN	W.J.D.	7/20/95
REVIEWED	J.W.M.	7/20/95

I:/DRAWINGS/94S044/SHEET1.DGN



PLAN



CURVE 20
P.I. STA= 311+04.69
Δ= 74°-51'-06"
D= 60°-18'-41"
R= 95.0'
T= 72.70'
L= 124.11'
E= 24.63'
S.E.= 0.04'/'
P.C. STA= 310+31.99
P.T. STA= 311+56.10

CURVE 30
P.I. STA= 314+08.77
Δ= 93°-13'-04"
D= 60°-18'-41"
R= 95.0'
T= 100.49'
L= 154.56'
E= 43.29'
S.E.= 0.04'/'
P.C. STA= 313+08.28
P.T. STA= 314+62.84

CURVE 145
P.I. STA= 316+23.48
Δ= 102°-05'-28"
D= 60°-18'-41"
R= 95.0'
T= 117.51'
L= 169.27'
E= 56.10'
S.E.= 0.04'/'
P.C. STA= 315+05.97
P.T. STA= 316+75.25

CURVE 710
P.I. STA= 319+48.04
Δ= 112°-55'-00"
D= 60°-18'-41"
R= 95.0'
T= 143.30'
L= 187.22'
E= 76.93'
S.E.= 0.04'/'
P.C. STA= 318+04.73
P.T. STA= 319+91.96

CURVE 165
P.I. STA= 320+74.61
Δ= 67°-30'-54"
D= 60°-18'-41"
R= 95.0'
T= 63.49'
L= 111.94'
E= 19.27'
S.E.= 0.04'/'
P.C. STA= 320+11.11
P.T. STA= 321+23.06

CURVE 175
P.I. STA= 330+39.98
Δ= 159°-51'-24"
D= 60°-18'-41"
R= 95.0'
T= 534.86'
L= 265.05'
E= 448.23'
S.E.= 0.04'/'
P.C. STA= 325+05.12
P.T. STA= 327+70.18

CURVE 185
P.I. STA= 332+03.54
Δ= 144°-47'-06"
D= 60°-18'-41"
R= 95.0'
T= 299.34'
L= 240.06'
E= 219.06'
S.E.= 0.04'/'
P.C. STA= 329+04.20
P.T. STA= 331+44.26

CURVE 195
P.I. STA= 336+47.39
Δ= 158°-26'-16"
D= 60°-18'-41"
R= 95.0'
T= 498.90'
L= 262.70'
E= 412.87'
S.E.= 0.04'/'
P.C. STA= 331+48.49
P.T. STA= 334+11.19

CURVE 205
P.I. STA= 336+09.12
Δ= 128°-29'-44"
D= 60°-18'-41"
R= 95.0'
T= 196.94
L= 213.05'
E= 123.65'
S.E.= 0.04'/'
P.C. STA= 334+12.19
P.T. STA= 336+25.24

CURVE 15
P.I. STA= 339+71.79
Δ= 26°-35'-18"
D= 4°-05'-33"
R= 1400.0'
T= 330.79'
L= 649.67'
E= 38.55'
S.E.= 0.02'/'
P.C. STA= 336+40.99
P.T. STA= 342+90.67

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

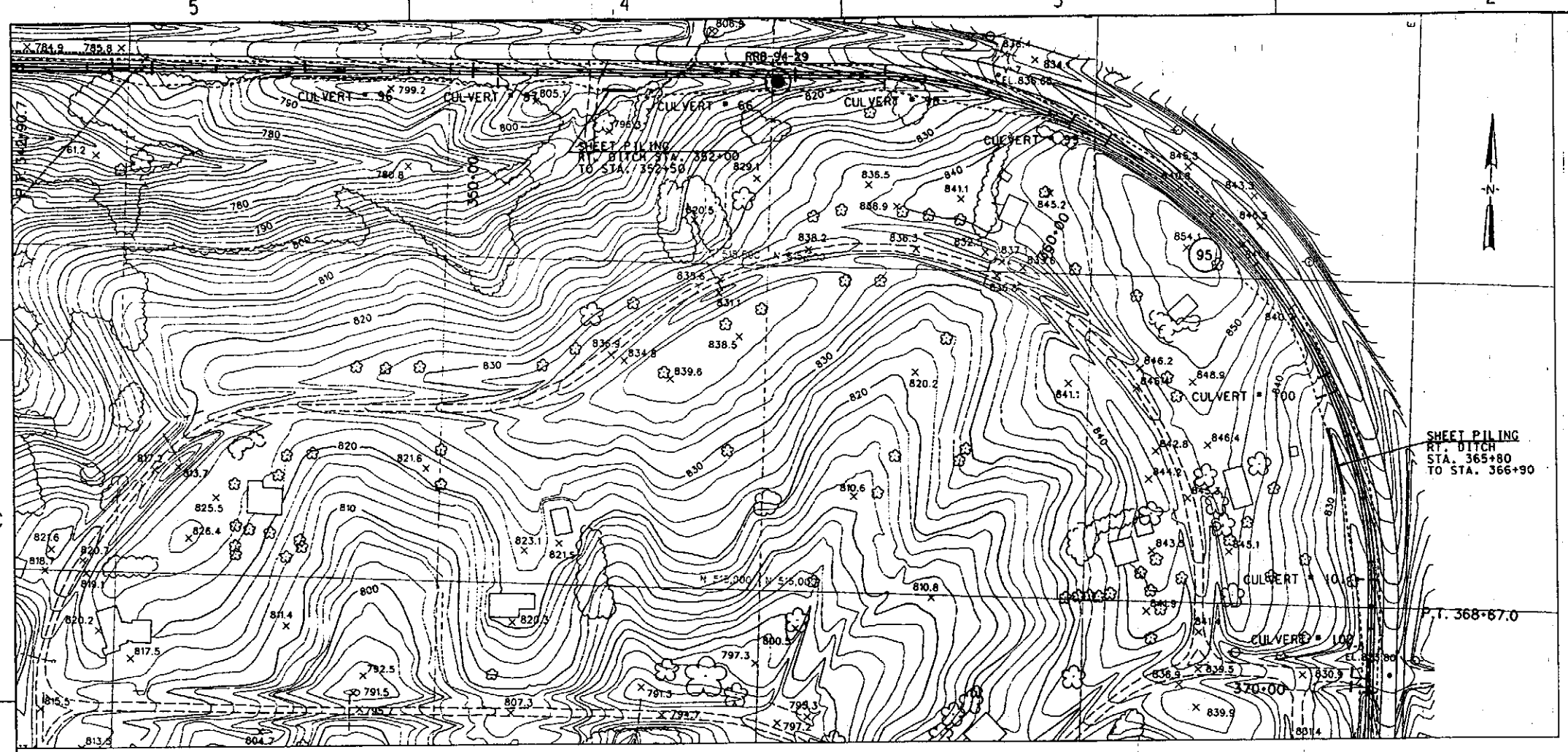
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

US Army Corps of Engineers

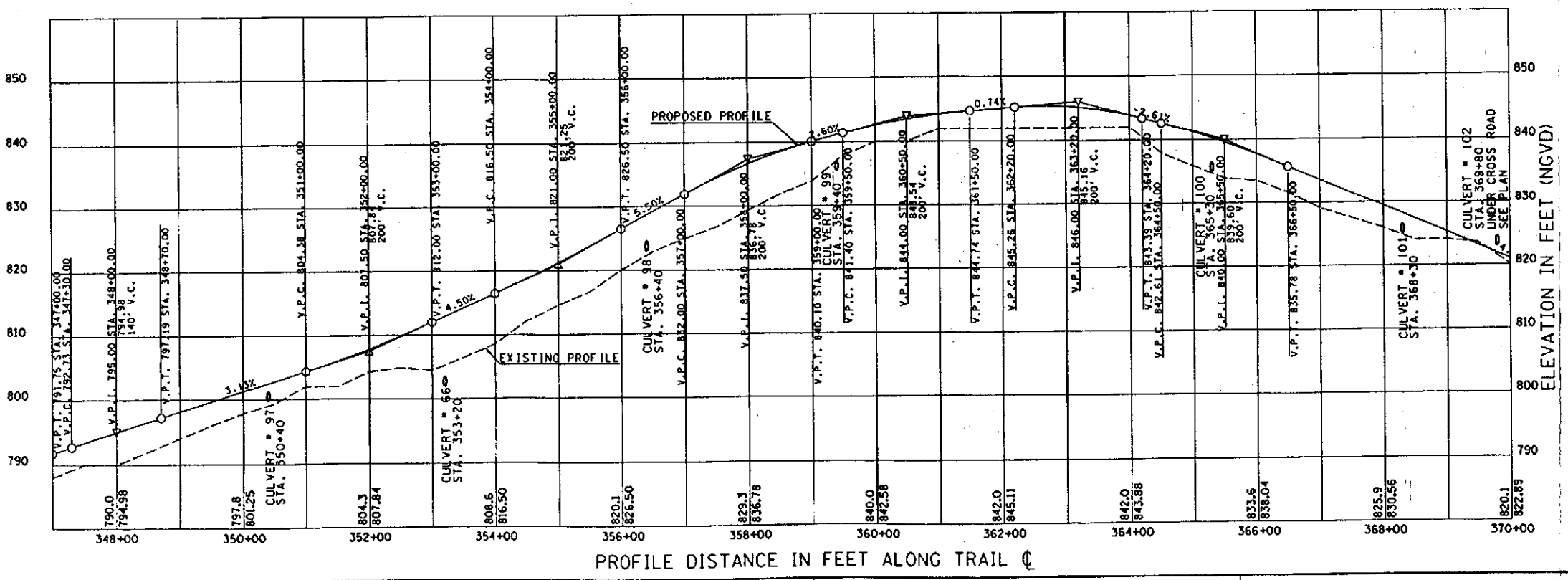
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 326+00 TO STA. 348+00

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:
Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 21 of 29



PLAN



HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers

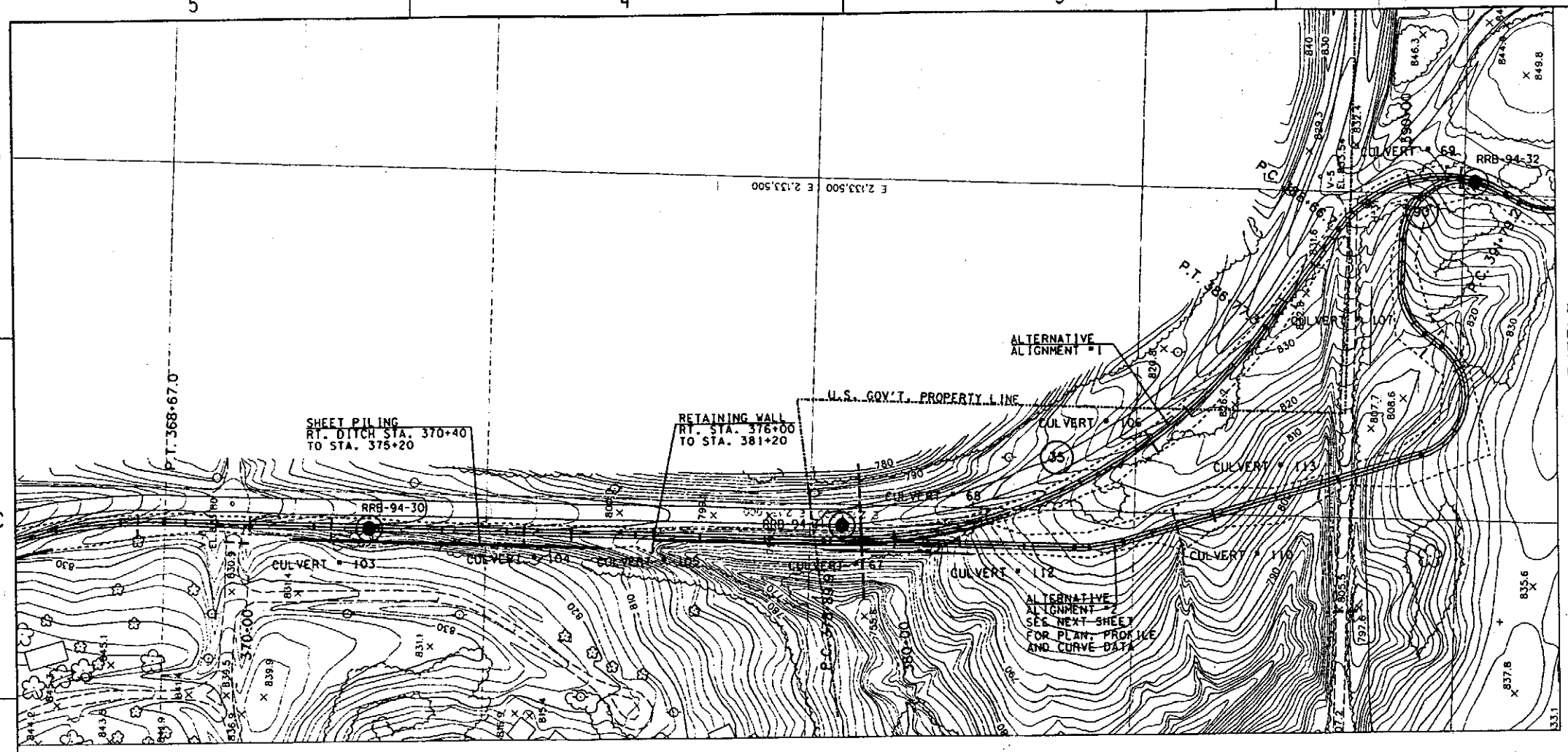
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 348+00 TO STA. 370+00

Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 22 of 29

DESIGNED	N.L.H.	7/20/95
DRAWN	W.J.D.	7/20/95
REVISED		

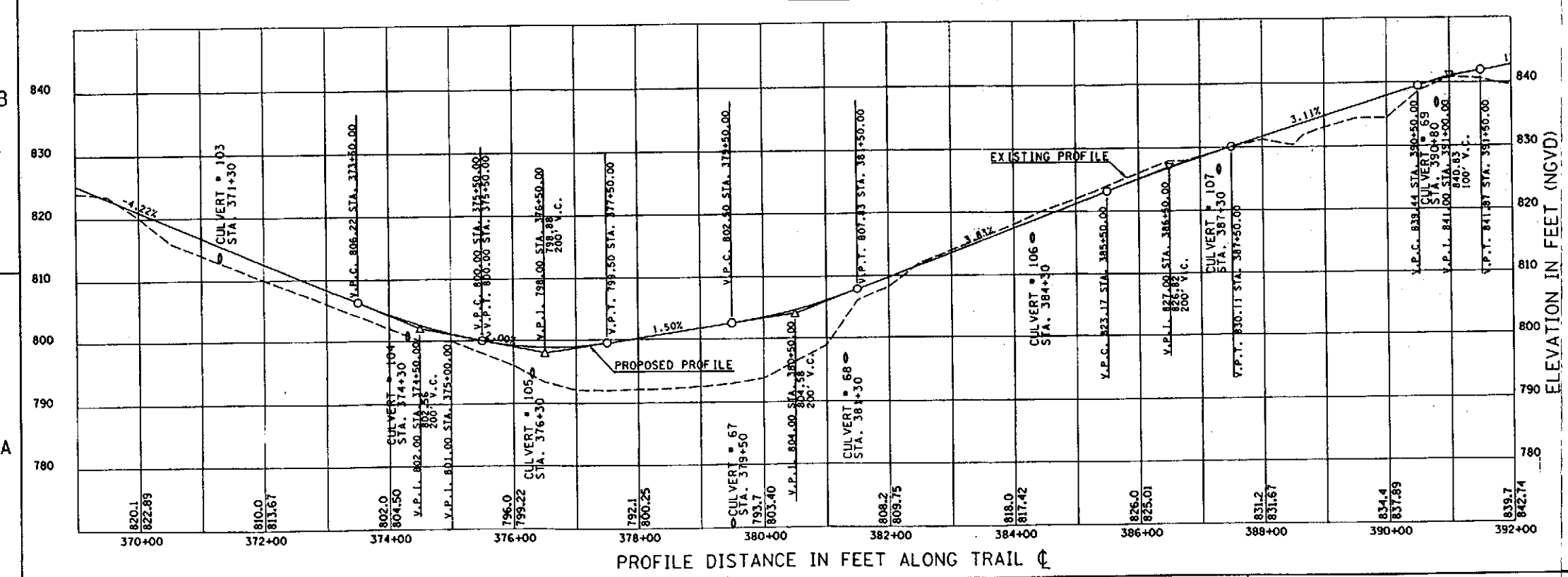
I:\DRAWINGS\9452044\SHEET15.DGN



PLAN

CURVE 35
P.I. STA= 383+16.00
Δ= 54°-17'-27"
D= 6°-53'-41"
R= 831.0'
T= 426.08'
L= 787.42'
E= 102.86'
S.E.= 0.02'/'

CURVE 90
P.I. STA= 390+41.27
Δ= 82°-14'-27"
D= 28°-38'-52"
R= 200.0'
T= 174.60'
L= 287.08'
E= 65.49'
S.E.= 0.02'/'



HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers Rock Island District

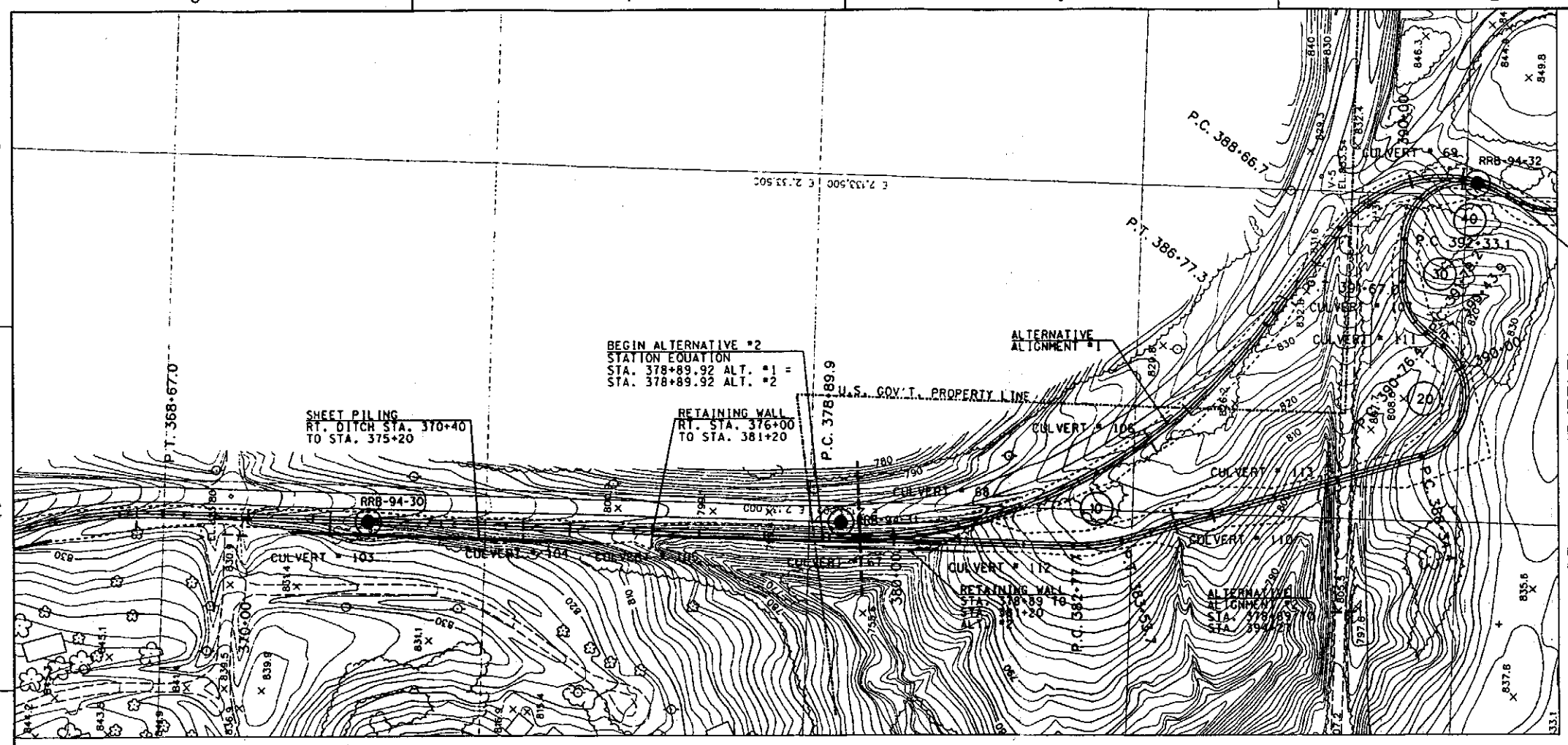
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 370+00 TO STA. 392+00

Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 23 of 29

ISSUED	N.L.H.	7/20/95
DRAWN	R.A.S.	7/20/95
REVIEWED	J.R.K.	7/20/95

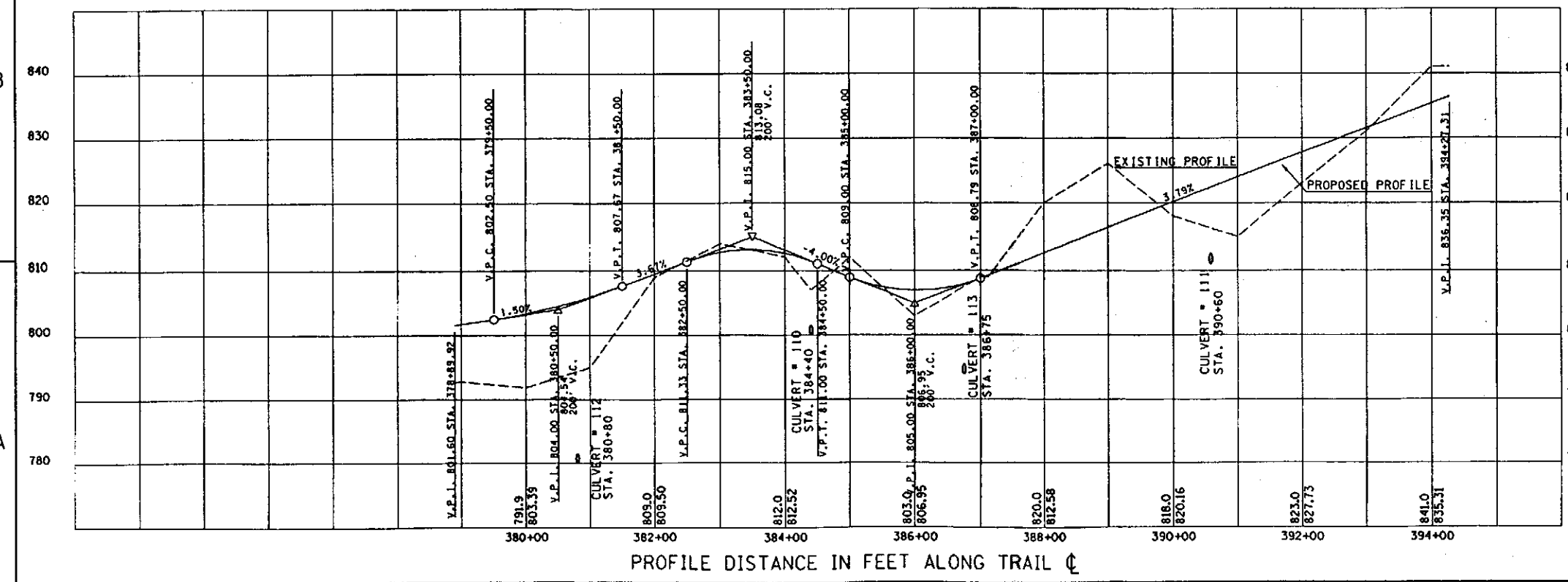
J:\DRAWINGS\94550\44\SHEET16.DGN



CURVE 10	CURVE 20
P.I. STA= 383+16.00	P.I. STA= 390+22.22
Δ= 17°-25'-50"	Δ= 126°-19'-50"
D= 22°-55'-5.9"	D= 60°-18'-41"
R= 250.0'	R= 95.0'
T= 38.32'	T= 187.78'
L= 76.05'	L= 209.46'
E= 2.92'	E= 115.45'
S.E.= 0.02'/'	S.E.= 0.02'/'
P.C. STA= 382+77.67	P.C. STA= 388+34.43
P.T. STA= 383+53.73	P.T. STA= 390+43.90

CURVE 30	CURVE 40
P.I. STA= 391+25.46	P.I. STA= 393+88.48
Δ= 54°-36'-28"	Δ= 117°-06'-12"
D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'
T= 49.04'	T= 155.34'
L= 90.54'	L= 194.16'
E= 11.91'	E= 87.09'
S.E.= 0.02'/'	S.E.= 0.02'/'
P.C. STA= 390+76.42	P.C. STA= 392+33.14
P.T. STA= 391+66.96	P.T. STA= 394+27.31

PLAN



HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

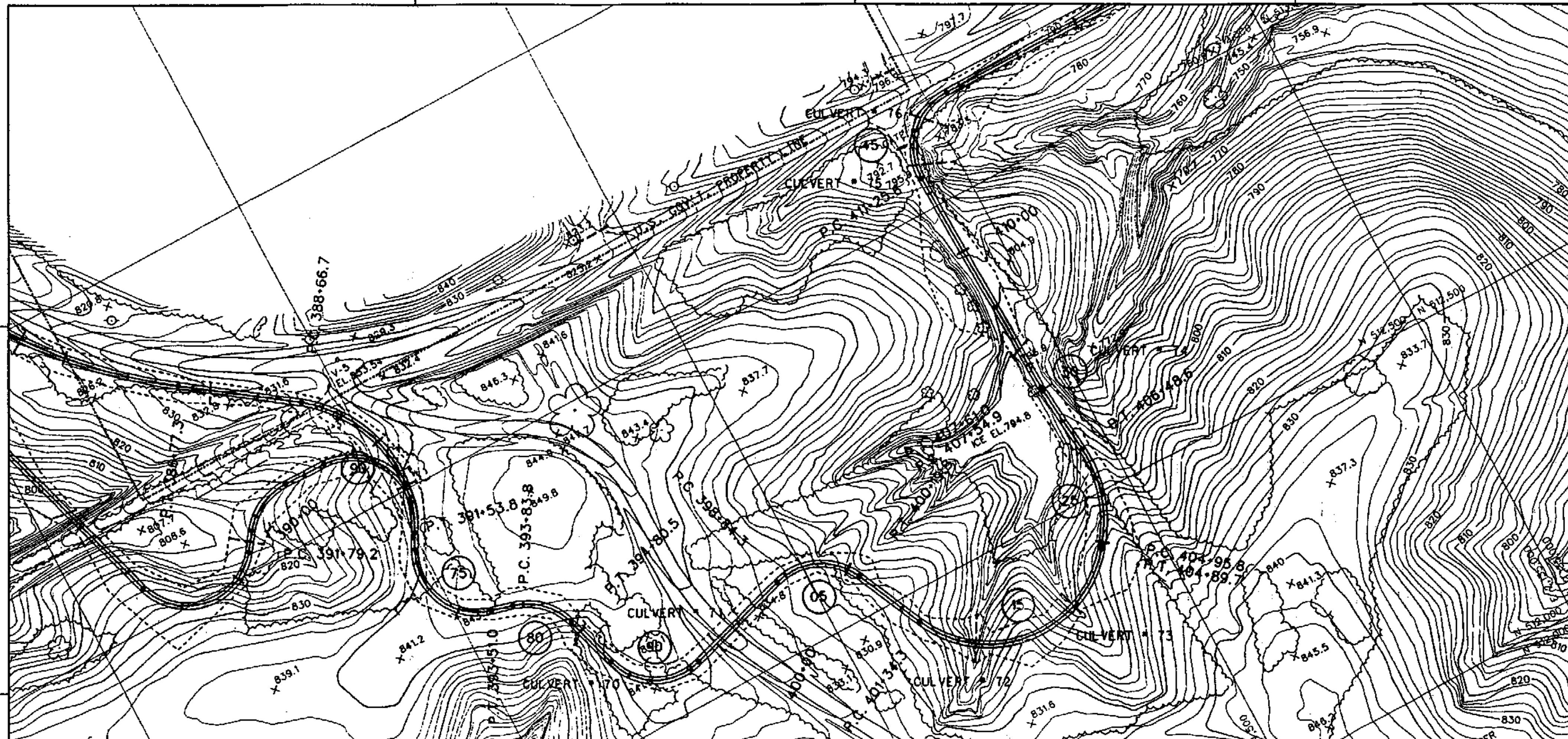
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 378+89.9 TO STA. 394+27.3

Designed by: N.L.H.	Scale: AS SHOWN
Drawn by: W.J.D.	Date: 2 20 1995
Checked by: J.W.M.	Drawing Code:
Reviewed by: T.G.H.	Sheet reference number:
Approved by:	Solicitation Number:
	Sheet 24 of 29

DESIGNED	N.L.H.	1/20/95
DRAWN	W.J.D.	1/20/95
CHECKED	J.W.M.	1/20/95
REVIEWED	T.G.H.	1/20/95

D:\DRAWINGS\945204\SHEET16.DGN

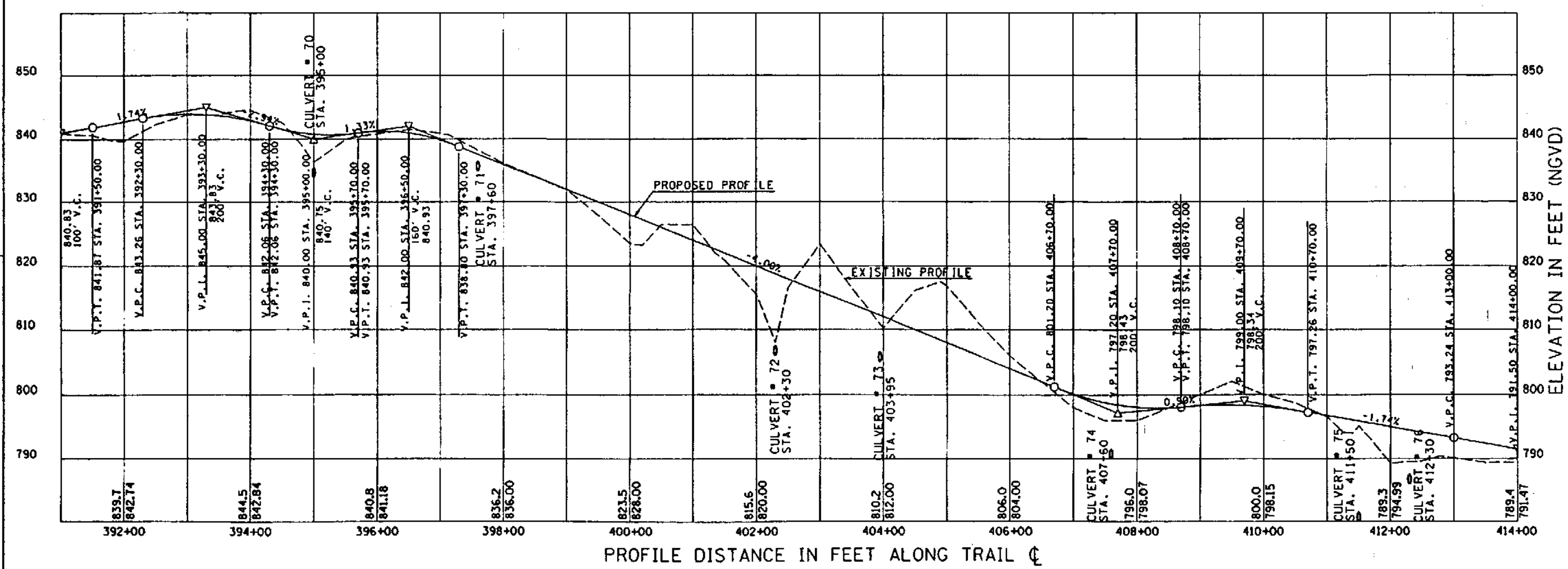


PLAN

CURVE 90	CURVE 275	CURVE 280
P.I. STA= 390+41.27	P.I. STA= 392+99.95	P.I. STA= 394+36.81
Δ= 82°-14'-27"	Δ= 103°-36'-55"	Δ= 58°-18'-32"
D= 28°-38'-52"	D= 60°-18'-41"	D= 60°-18'-41"
R= 200.0'	R= 95.0'	R= 95.0'
T= 174.60'	T= 120.76'	T= 52.99'
L= 287.08'	L= 171.80'	L= 96.68'
E= 65.49'	E= 58.65'	E= 13.78'
S.E.= 0.02'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 388+66.68	P.C. STA= 391+79.19	P.C. STA= 393+83.81
P.T. STA= 391+53.75	P.T. STA= 393+50.99	P.T. STA= 394+80.49

CURVE 290	CURVE 05	CURVE 15
P.I. STA= 396+60.85	P.I. STA= 399+66.43	P.I. STA= 403+16.40
Δ= 89°-30'-24"	Δ= 81°-43'-11"	Δ= 116°-22'-10"
D= 60°-18'-41"	D= 60°-18'-41"	D= 32°-44'-26"
R= 95.0'	R= 95.0'	R= 175.0'
T= 94.73'	T= 82.18'	T= 282.08'
L= 148.96'	L= 135.50'	L= 355.43'
E= 39.16'	E= 30.61'	E= 156.95'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 395+66.11	P.C. STA= 398+84.25	P.C. STA= 401+34.32
P.T. STA= 397+15.07	P.T. STA= 400+19.75	P.T. STA= 404+89.75

CURVE 25	CURVE 30	CURVE 45
P.I. STA= 405+76.17	P.I. STA= 407+57.91	P.I. STA= 412+23.99
Δ= 43°-45'-16"	Δ= 3°-40'-42"	Δ= 92°-01'-52"
D= 28°-38'-52"	D= 60°-18'-41"	D= 60°-18'-41"
R= 200.0'	R= 95.0'	R= 95.0'
T= 80.34'	T= 3.05'	T= 98.43'
L= 152.71'	L= 6.10'	L= 152.59'
E= 15.53'	E= 0.05'/'	E= 41.80'
S.E.= 0.04'/'	S.E.= 0.02'/'	S.E.= 0.04'/'
P.C. STA= 404+95.83	P.C. STA= 407+54.86	P.C. STA= 411+25.56
P.T. STA= 406+48.62	P.T. STA= 407+60.96	P.T. STA= 412+78.15



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SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 392+00 TO STA. 414+00

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 25 of 29

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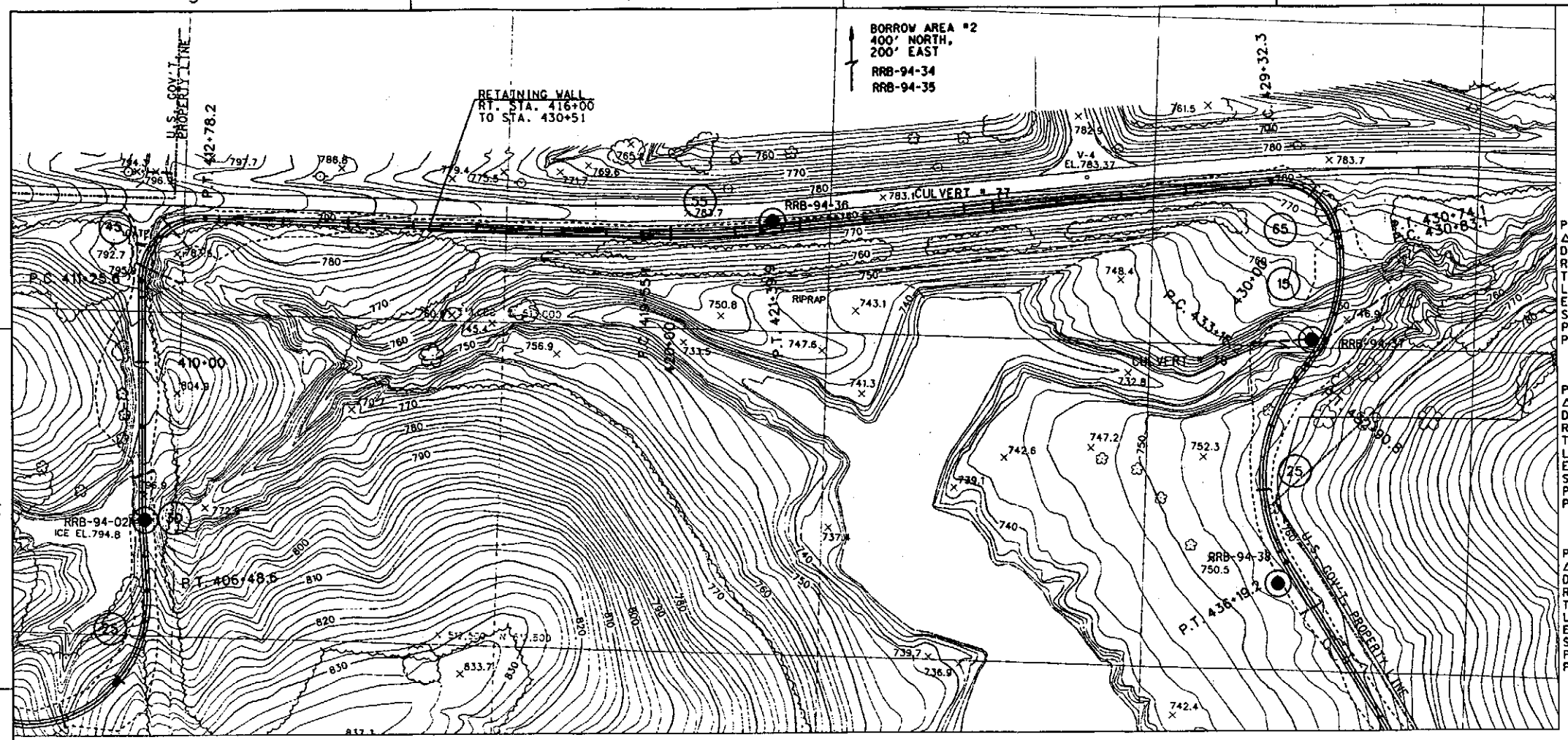
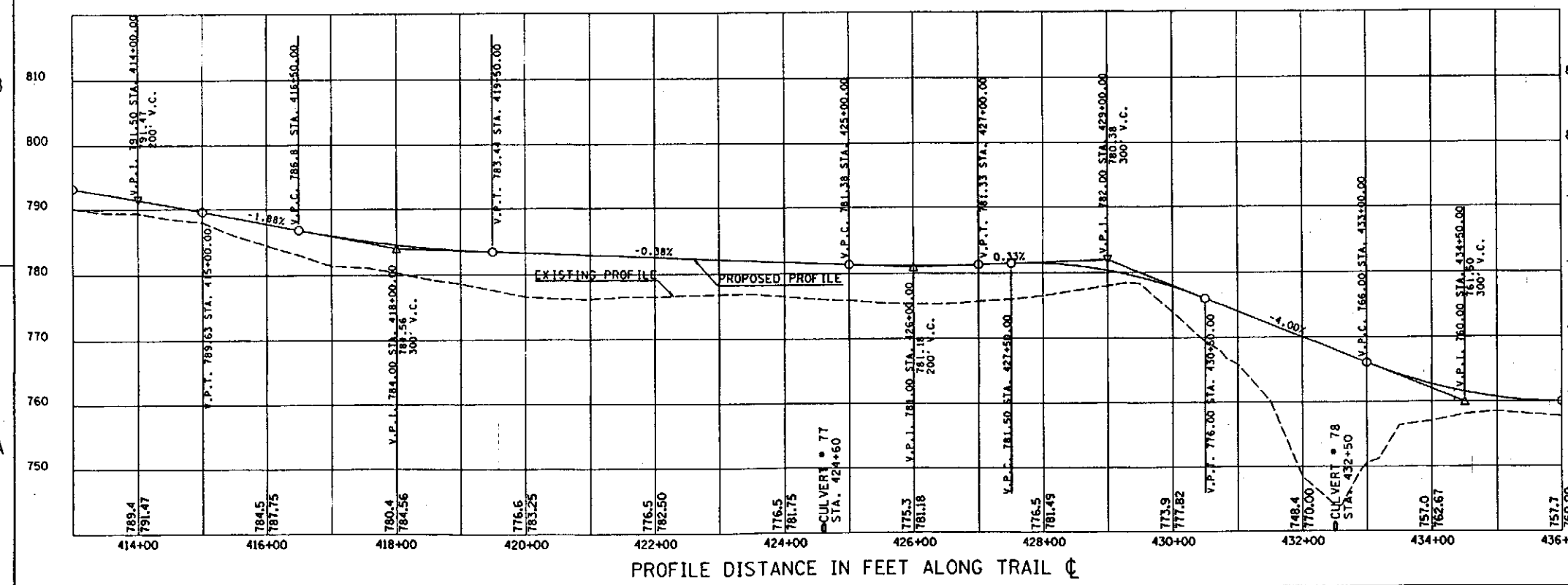


PLAN



CURVE 25	CURVE 30	CURVE 45
P.I. STA= 405+76.17	P.I. STA= 407+57.91	P.I. STA= 412+23.99
Δ= 43°-46'-16"	Δ= 3°-40'-42"	Δ= 92°-01'-52"
D= 28°-38'-52"	D= 60°-18'-41"	D= 60°-18'-41"
R= 200.0'	R= 95.0'	R= 95.0'
T= 80.34'	T= 3.05'	T= 98.43'
L= 152.79'	L= 6.10'	L= 152.59'
E= 15.53'	E= 0.05'	E= 41.80'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 404+95.83	P.C. STA= 407+54.86	P.C. STA= 411+25.56
P.T. STA= 406+48.62	P.T. STA= 407+60.96	P.T. STA= 412+78.15

CURVE 55	CURVE 65	CURVE 15
P.I. STA= 420+47.60	P.I. STA= 430+20.19	P.I. STA= 431+93.35
Δ= 7°-24'-29"	Δ= 85°-34'-50"	Δ= 47°-36'-08"
D= 4°-00'-34"	D= 60°-18'-41"	D= 22°-55'-06"
R= 1429.0'	R= 95.0'	R= 250.0'
T= 92.51'	T= 87.94'	T= 110.27'
L= 184.76'	L= 141.90'	L= 207.70'
E= 2.99'	E= 34.46'	E= 23.24'
S.E.= 0.02'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 419+55.09	P.C. STA= 429+32.25	P.C. STA= 430+83.08
P.T. STA= 421+39.85	P.T. STA= 430+74.15	P.T. STA= 432+90.79

CURVE 25
P.I. STA= 434+89.93
Δ= 68°-58'-42"
D= 22°-55'-06"
R= 250.0'
T= 171.75'
L= 300.97'
E= 53.31'
S.E.= 0.04'/'
P.C. STA= 433+18.18
P.T. STA= 436+19.16

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers, Rock Island District

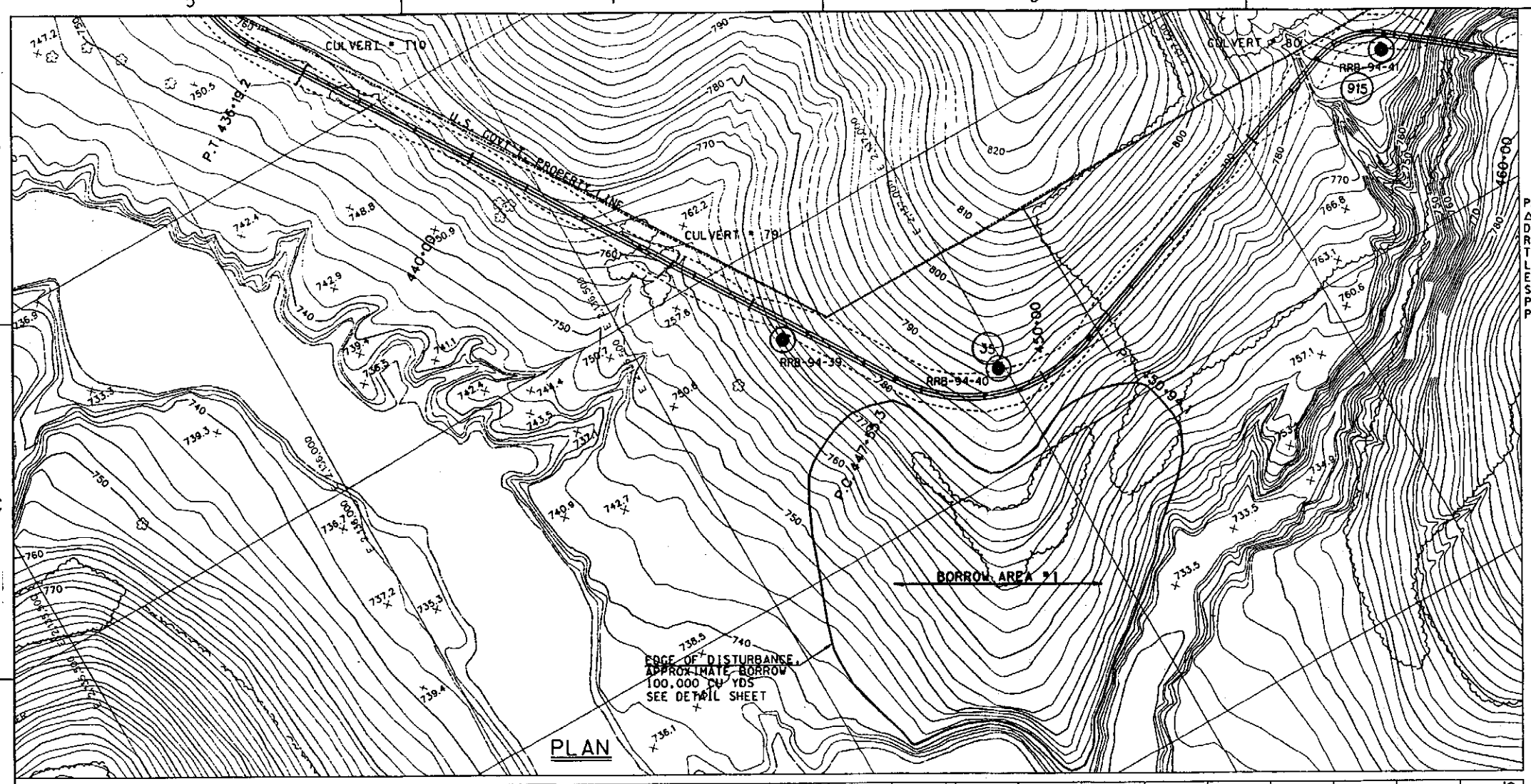
DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 414+00 TO STA. 436+00

Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 26 of 29

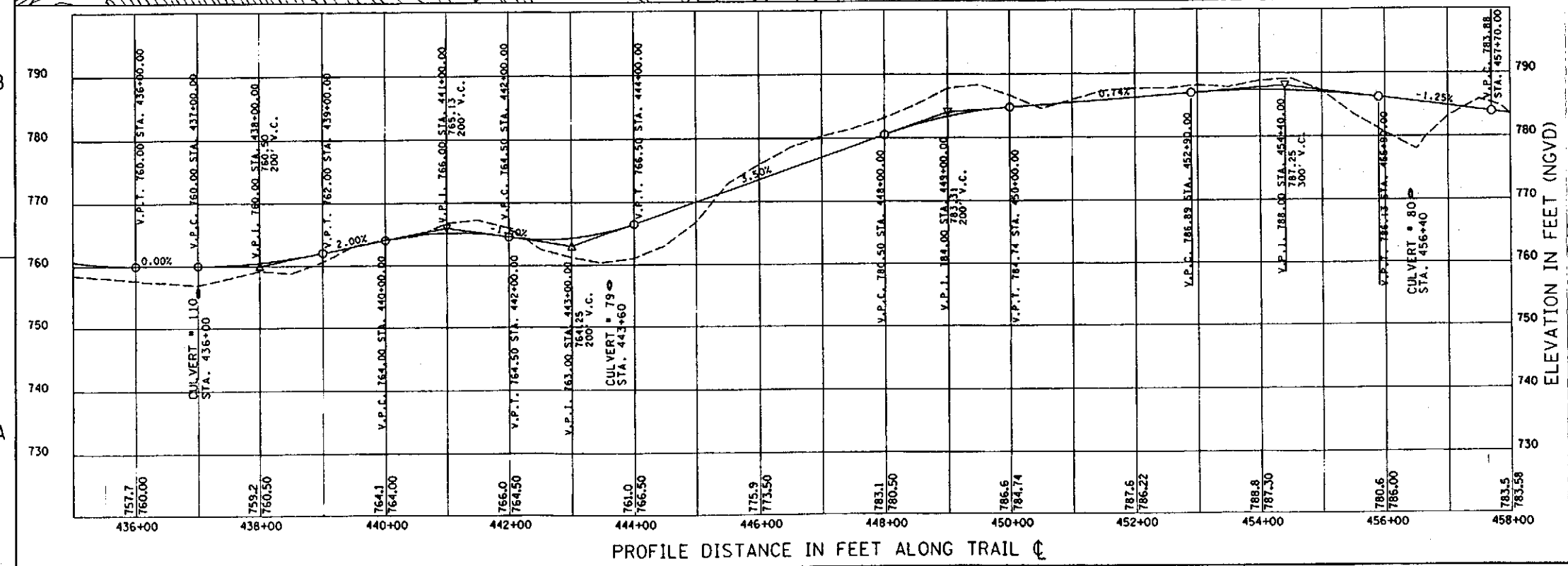
ISSUED	M.L.A.	7/20/95
DRAWN	W.J.D.	7/20/95
REVISED	N.L.H.	7/20/95

I:/DRAWINGS/94S204/SHEET/LDSN



CURVE 35
P.I. STA= 449+56.51
Δ= 77°-39'-43"
D= 22°-58'-06"
R= 250.0'
T= 201.23'
L= 338.86'
E= 70.92'
S.E.= 0.04'/'
P.C. STA= 447+55.28
P.T. STA= 450+94.14

CURVE 915
P.I. STA= 457+30.37
Δ= 59°-08'-55"
D= 50°-15'-34"
R= 114.0'
T= 64.69'
L= 117.69'
E= 17.08'
S.E.= 0.04'/'
P.C. STA= 456+65.67
P.T. STA= 457+83.36



HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Symbol	Description	Date	Approved

HANSON ENGINEERS Inc.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.L.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers Rock Island District

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 436+00 TO STA. 458+00

Scale: AS SHOWN
Date: 2 20 1995
Drawing Code:
Sheet reference number:
Solicitation Number:
Sheet 27 of 29

ISSUED	N.L.H.	2/20/95
DRAWN	W.J.D.	2/20/95
REVIEWED	T.G.H.	2/20/95

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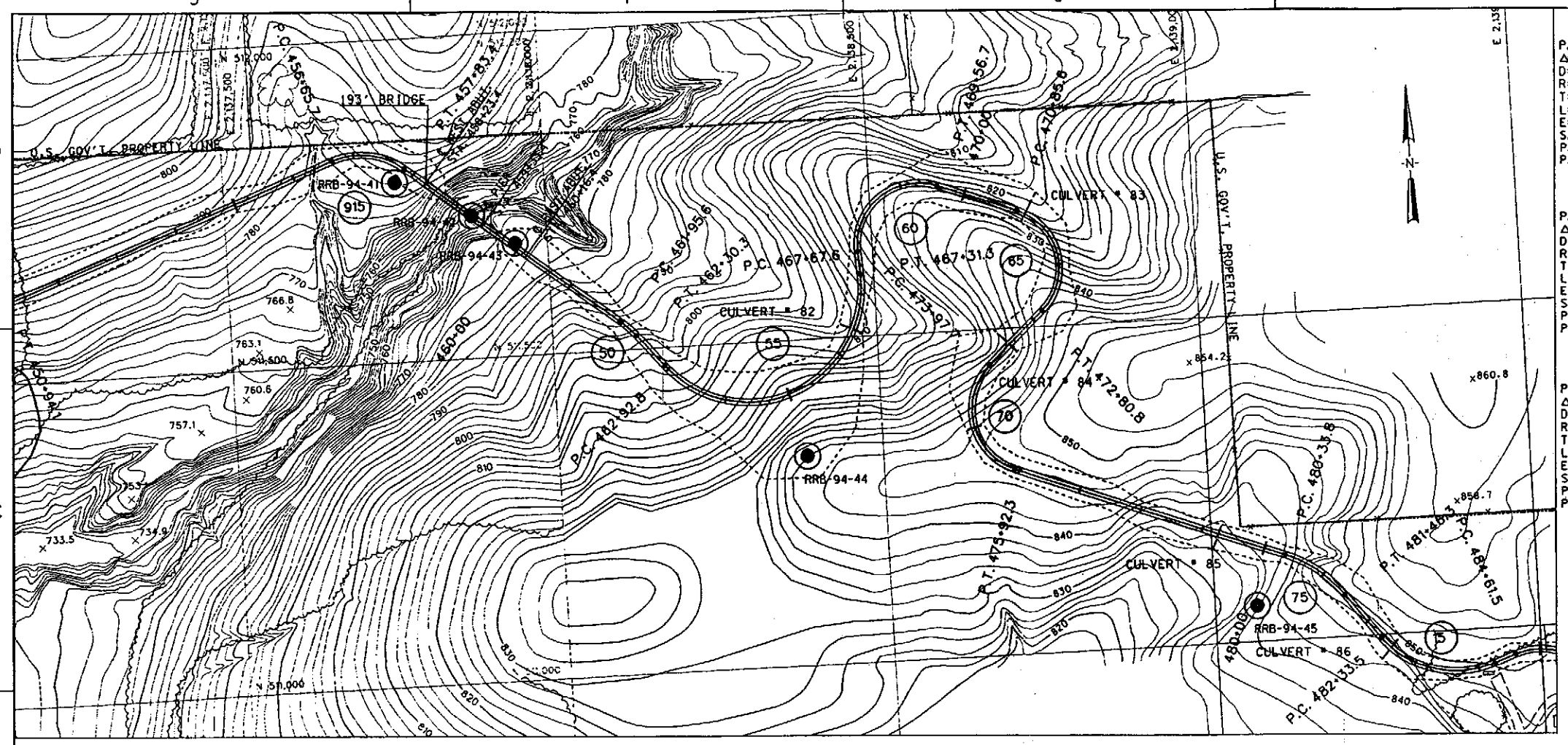

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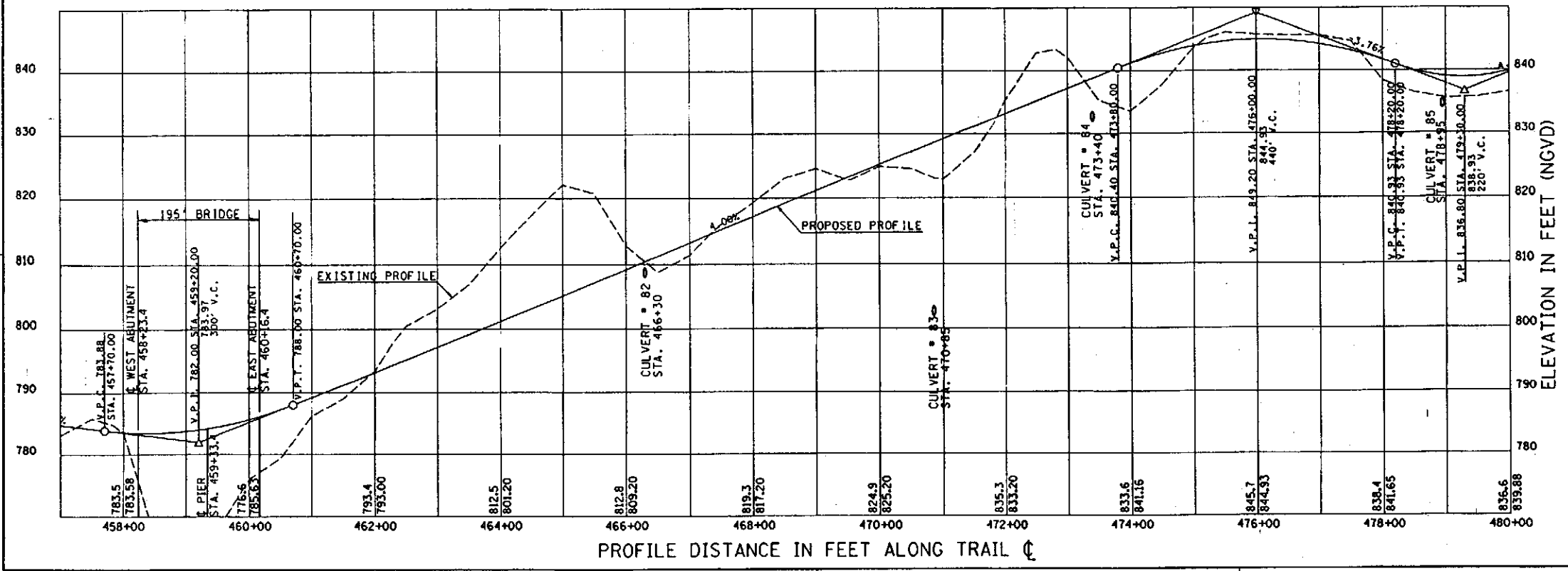

CURVE 915	CURVE 50	CURVE 55
P.I. STA= 457+30.37	P.I. STA= 462+13.00	P.I. STA= 468+24.85
Δ= 59°-08'-55"	Δ= 11°-20'-48"	Δ= 143°-35'-18"
D= 50°-15'-34"	D= 32°-44'-26"	D= 32°-44'-26"
R= 114.0'	R= 175.0'	R= 175.0'
T= 64.69'	T= 17.38'	T= 532.08'
L= 117.69'	L= 34.66'	L= 438.57'
E= 17.08'	E= 0.86'	E= 385.12'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 456+65.67	P.C. STA= 461+95.62	P.C. STA= 462+92.77
P.T. STA= 457+83.36	P.T. STA= 462+30.27	P.T. STA= 467+31.34

CURVE 60	CURVE 65	CURVE 70
P.I. STA= 469+14.04	P.I. STA= 472+42.74	P.I. STA= 475+53.74
Δ= 114°-02'-25"	Δ= 117°-40'-41"	Δ= 117°-19'-07"
D= 60°-18'-41"	D= 60°-18'-41"	D= 60°-18'-41"
R= 95.0'	R= 95.0'	R= 95.0'
T= 146.40'	T= 157.10'	T= 156.0'
L= 189.09'	L= 195.12'	L= 194.52'
E= 79.52'	E= 88.59'	E= 87.65'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 467+67.64	P.C. STA= 470+85.64	P.C. STA= 473+97.74
P.T. STA= 469+56.73	P.T. STA= 472+80.75	P.T. STA= 475+92.27

CURVE 75	CURVE 15	CURVE 900
P.I. STA= 480+91.61	P.I. STA= 483+45.90	P.I. STA= 485+62.31
Δ= 32°-12'-56"	Δ= 73°-42'-38"	Δ= 93°-26'-30"
D= 28°-38'-52"	D= 38°-11'-50"	D= 60°-18'-41"
R= 200.0'	R= 150.0'	R= 95.0'
T= 57.76'	T= 112.44'	T= 100.88'
L= 112.45'	L= 192.97'	L= 154.93'
E= 8.11'	E= 37.46'	E= 43.57'
S.E.= 0.04'/'	S.E.= 0.04'/'	S.E.= 0.04'/'
P.C. STA= 480+33.85	P.C. STA= 482+33.46	P.C. STA= 484+61.53
P.T. STA= 481+46.30	P.T. STA= 484+26.43	P.T. STA= 486+16.46

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 458+00 TO STA. 480+00

Designed by: N.L.H.	Scale: AS SHOWN	Sheet reference number:	Solicitation Number:
Drawn by: W.J.D.	Date: 2 20 1995		Sheet 28 of 29
Checked by: J.W.M.	Drawing Code:		
Reviewed by: T.G.H.			
Approved by:			

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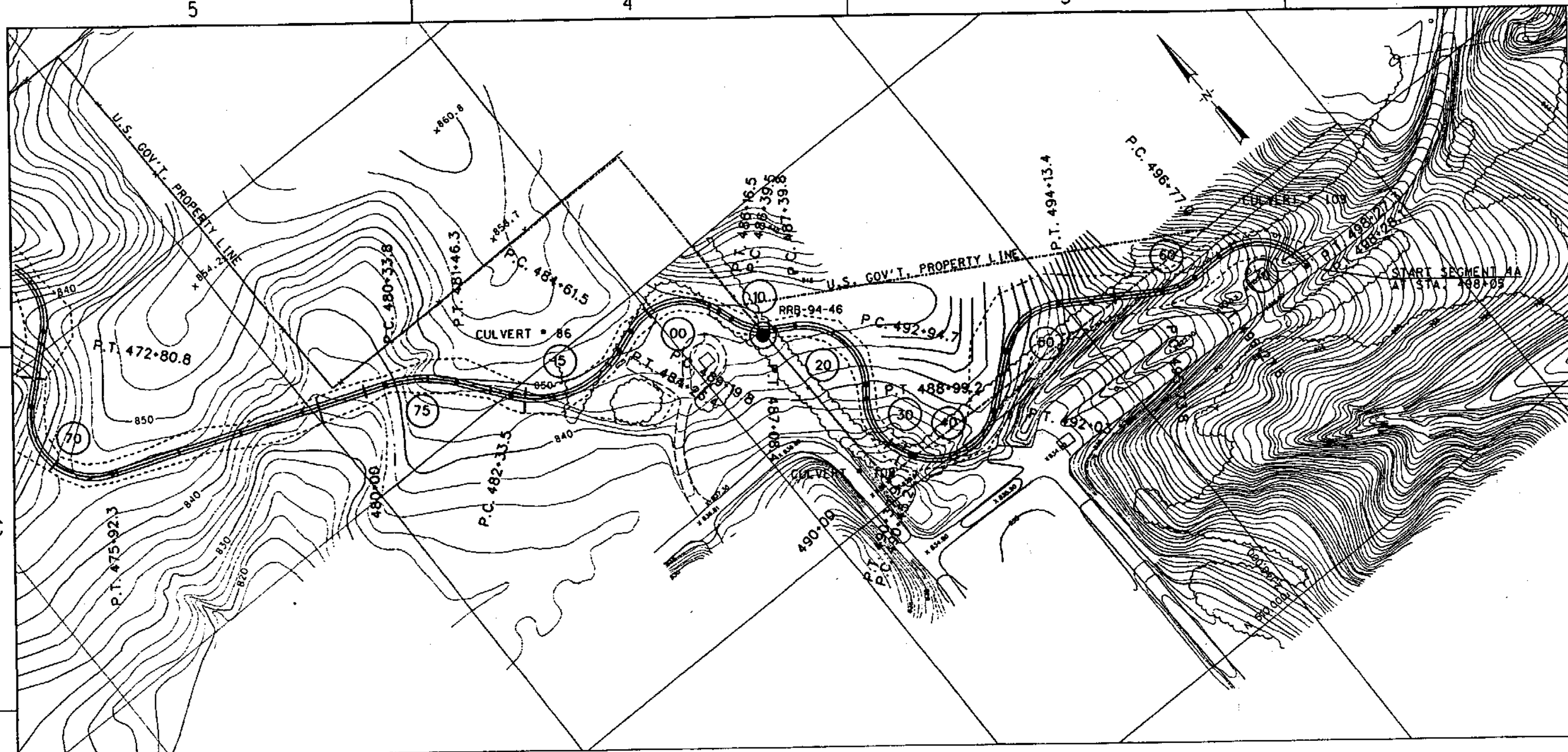
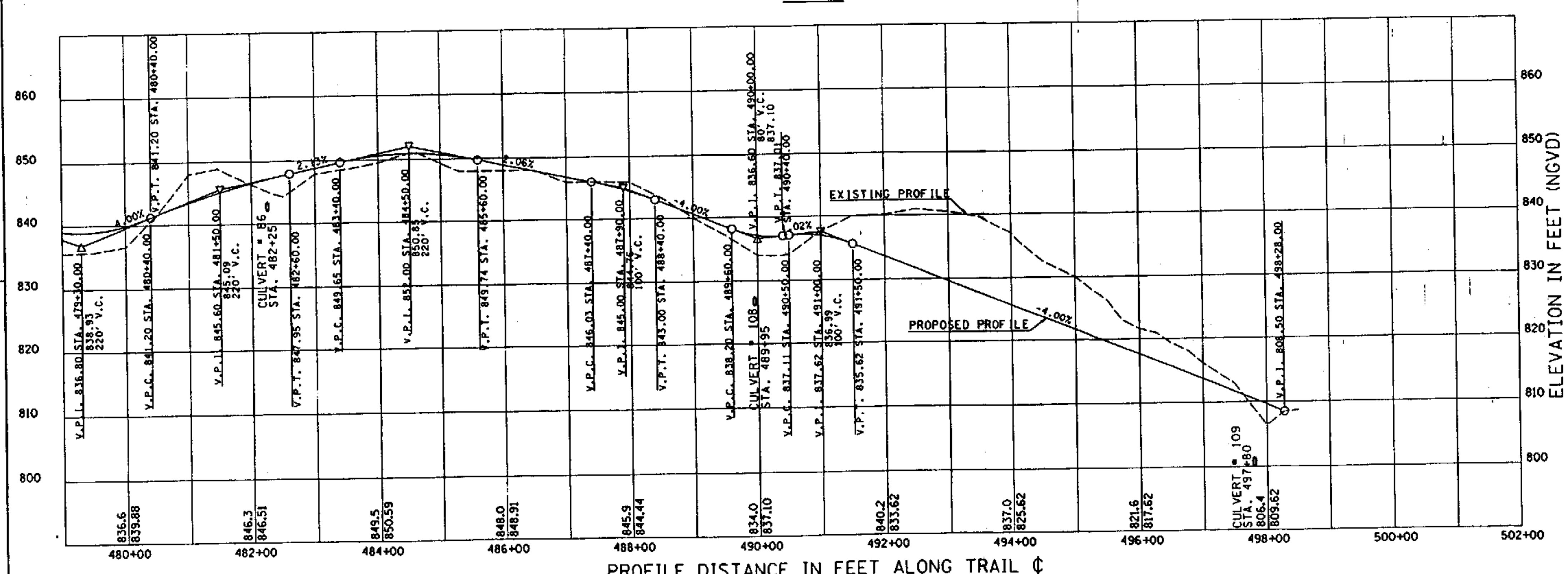


PLAN



CURVE 70
P.I. STA= 475+53.74
Δ= 117°-19'-07"
D= 60°-18'-41"
R= 95.0'
T= 156.0'
L= 194.52'
E= 87.65'
S.E.= 0.04'/'
P.C. STA= 473+97.74
P.T. STA= 475+92.27

CURVE 75
P.I. STA= 480+91.61
Δ= 32°-12'-56"
D= 28°-38'-52"
R= 200.0'
T= 57.76'
L= 112.45'
E= 8.17'
S.E.= 0.04'/'
P.C. STA= 480+33.85
P.T. STA= 481+46.30

CURVE 15
P.I. STA= 483+45.90
Δ= 73°-42'-38"
D= 38°-11'-50"
R= 150.0'
T= 112.44'
L= 192.97'
E= 37.46'
S.E.= 0.04'/'
P.C. STA= 482+33.46
P.T. STA= 484+26.43

CURVE 900
P.I. STA= 485+62.41
Δ= 93°-26'-30"
D= 60°-18'-41"
R= 95.0'
T= 100.88'
L= 154.93'
E= 43.57'
S.E.= 0.04'/'
P.C. STA= 484+61.53
P.T. STA= 486+16.46

CURVE 910
P.I. STA= 486+75.53
Δ= 41°-35'-44"
D= 60°-18'-41"
R= 95.0'
T= 36.08'
L= 68.97'
E= 6.62'
S.E.= 0.04'/'
P.C. STA= 486+39.47
P.T. STA= 487+08.44

CURVE 920
P.I. STA= 488+45.50
Δ= 96°-05'-22"
D= 60°-18'-41"
R= 95.0'
T= 105.67'
L= 159.32'
E= 47.10'
S.E.= 0.04'/'
P.C. STA= 487+39.83
P.T. STA= 488+99.15

CURVE 930
P.I. STA= 489+87.87
Δ= 71°-17'-00"
D= 60°-18'-41"
R= 95.0'
T= 68.12'
L= 118.19'
E= 21.90'
S.E.= 0.04'/'
P.C. STA= 489+19.75
P.T. STA= 490+37.94

CURVE 940
P.I. STA= 491+49.93
Δ= 95°-33'-25"
D= 60°-18'-41"
R= 95.0'
T= 104.69'
L= 158.44'
E= 46.37'
S.E.= 0.04'/'
P.C. STA= 490+45.24
P.T. STA= 4912+03.67

CURVE 950
P.I. STA= 493+63.22
Δ= 71°-35'-14"
D= 60°-18'-41"
R= 95.0'
T= 68.5'
L= 118.70'
E= 22.12'
S.E.= 0.04'/'
P.C. STA= 492+94.72
P.T. STA= 494+13.42

CURVE 960
P.I. STA= 496+01.45
Δ= 32°-25'-10"
D= 60°-18'-41"
R= 95.0'
T= 27.62'
L= 53.75'
E= 3.93'
S.E.= 0.04'/'
P.C. STA= 495+73.83
P.T. STA= 496+27.59

CURVE 970
P.I. STA= 497+73.11
Δ= 90°-38'-16"
D= 60°-18'-41"
R= 95.0'
T= 96.06'
L= 150.28'
E= 40.10'
S.E.= 0.04'/'
P.C. STA= 496+77.04
P.T. STA= 498+27.33

HORIZONTAL
100 50 0 100 200 FT
SCALE IN FEET

Revisions			
Symbol	Description	Date	Approved

HANSON ENGINEERS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: N.J.H.
Drawn by: W.J.D.
Checked by: J.W.M.
Reviewed by: T.G.H.
Approved by:

US Army Corps of Engineers

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

PLAN AND PROFILE
STA. 480+00 TO STA. 498+00

Scale: AS SHOWN
Date: 2 20 1995
Sheet reference number:
Solicitation Number:
Drawing Code:
Sheet 29 of 29

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ENVIRONMENTAL ASSESSMENT

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

ENVIRONMENTAL ASSESSMENT

TABLE OF CONTENTS

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

ENVIRONMENTAL ASSESSMENT

I. PROJECT PURPOSE AND ALTERNATIVES

(1) The purpose of this Environmental Assessment is to address the environmental impacts of construction of a multi-purpose trail segment described in Section 2 of the main report. Alternatives to the proposed action include the No Federal Action alternative and other designs and alignments for trail construction.

(2) The selected design will traverse a variety of landscapes and will combine with previously constructed trail segments to provide non-motorized access between the Wallashuck Recreation Area and Iowa State Highway 14. Objectives considered in formulating trail design and alignment included remaining within existing Federal boundaries, maximizing user safety, minimizing impacts to terrestrial habitat, minimizing impacts to wetlands and other aquatic habitat, minimizing trail length below the Red Rock flood pool elevation, and maximizing aesthetic values.

(3) Preliminary review of alternative trail designs included examination of alignments which would have increased trail length, and of designs which would either raise the trail above the flood pool to increase its usability or would lower it to decrease embankment needs. (See Section 3 for additional information on design alternatives.) Alternatives which increased trail length could have increased aesthetic benefits for trail users; however, greater adverse effects on terrestrial and aquatic resources would be expected during construction. Designs or alignments which kept the trail surface above the flood pool would, in most cases, reduce impacts to aquatic resources, but would significantly increase project costs or require condemnation of private lands. Consequently, the overall impact of these alternatives to the human environment natural resources is expected to be equal or greater than those anticipated for the preferred plan. With no Federal action, no project impacts would occur; however, no long-term benefits to recreation would be expected.

II. MAJOR FINDINGS AND CONCLUSIONS

The project is expected to be beneficial to recreation resources in the Lake Red Rock area with no significant impacts to natural, cultural, economic, or social resources. For this reason, an Environmental Impact Statement (EIS) will not be prepared for this action. Construction of Segment 4 will require the placement of earth fill below the calculated Ordinary High Water (OHW) elevation of 748.0 NGVD in an area designated as a wetland. State of Iowa Section 401 Water Quality Certification has been requested for compliance with the Clean Water Act, and a Section 404(b)(1) Evaluation has been prepared (Appendix B).

III. RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

(1) The project will comply with Federal environmental laws, Executive orders and policies, and State and local policies including the **Clean Air Act**, as amended; the **Clean Water Act**, as amended; the **Endangered Species Act of 1973**, as amended; the **Federal Water Project Recreation Act**; the **Fish and Wildlife Coordination Act of 1958**, as amended; the **Land and Water Conservation Fund Act of 1966**, as amended; the **National Environmental Policy Act of 1969**, as amended; and the **National Historic Preservation Act of 1966**, as amended.

(2) The project is located primarily on federally owned lands and Marion County owned right-of-way for Highway G-28. Approximately 2.5 acres of land will be purchased from a neighboring landowner and result in the conversion of land currently farmed to other uses. Approximately 0.4 acre of this parcel is considered prime and unique farmland. A Farmland Conversion Impact Rating has been prepared and coordinated with the Marion County Soil Conservation Service (see Appendix A-14). A loss of 0.63 acres of wetlands will occur from construction. One of the borrow sites to be used for the project is located within the flood control pool of Lake Red Rock so that flood storage volume will not be decreased by the placement of earth fill in that wetland. This borrow site will be excavated and shaped to create a 1.25 acre wetland to serve as mitigation for the 0.63 acre fill (see plates B-1,2, and 3 of Appendix B). This segment of the Des Moines River is not a federally recognized wild or scenic river. Therefore, this action will not conflict with the provisions of the **Farmland Protection Policy Act of 1981**; **Executive Order 11990**, Protection of Wetlands; **Executive Order 11988**, Flood Plain Management; or the **Wild and Scenic Rivers Act of 1968**.

IV. AFFECTED ENVIRONMENT

(1) The project site is located in Sections 2, 3, 4, 5, 11, and 12, Township 76 North, Range 19 West, and in Sections 31, 32, and 33, Township 77 North, Range 19 West, Marion County, Iowa. Segment 4 begins at the entrance road to Wallashuck Recreation Area at the northern terminus of Segment 3 construction (Greenbelt Multi-Purpose Trail at Red Rock).

(2) The portion of the proposed alignment located on Federal property is zoned for low density recreation, high density recreation, or forest. The alignment traverses a variety of land use and habitat types, including second-growth forest

areas, wooded ravines, agricultural fields, sparsely vegetated flood control pool, developed recreation areas, plantations of trees and prairie grasses, and county roadsides. The compartment report for the Natural Resources Inventory System states that management emphasis in this area will be placed on improving the value for recreational pursuits, protecting and enhancing unique habitats, improving forest, and improving wildlife viewing possibilities and aesthetics.

(3) Field reconnaissance of the proposed alignment revealed several areas to contain very high quality stands of native oak-hickory forest. Station locations through these high quality timber stands include 116+00-124+00, 140+00-144+00, 186+00, 191+00-193+00, 201+00-204+00, and 311+00-320+00 (see plan and profile plates from Consultants Report). These areas will receive minimal disturbance during the clearing and grubbing stage of trail construction. Several locations along the preliminary alignment contained sapling-sized oak and hickory suitable for transplanting prior to clearing and grubbing. Reforestation efforts will attempt to utilize these forest resources.

(4) Borrow material to be used for trail construction will likely be obtained from three out of five designated sites (see plate #7 of Consultants Report). Site #1 (6.9 acres) is a lake shoreline site located within the flood control pool of Lake Red Rock in Section 12, Township 76 North, Range 19 West (Station 450+00). Approximately 100,000 cubic yards of borrow material is available, including 1,320 cubic yards used to compensate for construction fill below elevation 748.0. This site will be excavated and shaped to create wetland conditions. Site #3 (1.9 acres) is an upland location along the entrance road to Fifield Recreation Area (Section 3, Township 76 North, Range 19 West, Station 301+00). Approximately 7,500 cubic yards of borrow material will be removed from the west roadside. Site #4 (2.2 acres) is an upland location in Cordova Recreation Area (Section 32, Township 77 North, Range 19 West, Station 181+00). The site is currently occupied by a picnic shelter which will be replaced after removing approximately 6,500 cubic yards of borrow material. Two additional borrow sites have been identified as back-up sites should any problems arise with the areas listed above. Sites #2 and #5 are both upland areas north of Marion County Highway G-28. Site #2 (12.6 acres) is in Section 12, Township 76 North, Range 19 West (north of Station 425+00). Site #5 (3.8 acres) is in Section 31, Township 77 North, Range 19 West (north of Station 405+00-485+00). No more than 100,000 cubic yards would be removed from either back-up borrow site should one of the aforementioned sites be unavailable. Borrow sites will be shaped and groomed to blend in with the local terrain after construction. Borrow activity will not affect significant cultural resources or other environmental concerns.

(5) Wildlife species found in the project area include songbirds and small mammals such as mice, shrews, voles, squirrels, rabbits, opossums, raccoons, and skunks. In addition, game species such as white-tailed deer, bobwhite quail, ring-necked pheasant, and wild turkey may utilize this area. The mature forest also provides habitat for the northern flicker and other woodpecker species, as well as nesting cavities for owls and small mammals.

V. AFFECTED NATURAL RESOURCES

(1) Construction of the Segment 4 trail alignment will result in the loss of some woody and herbaceous vegetation. The area to be cleared and grubbed for construction of the 43,360-foot trail segment is approximately 80.2 acres (53.1 for the trail and 27.1 for all borrow activity). Approximately one-third of this area is forested habitat that will be affected. Following construction, all disturbed areas outside the paved trail surface will be reseeded and reforested where appropriate; however, replacement of mature trees will require several decades to complete.

(2) The long-term effect of the project is expected to be beneficial to **man-made resources** in the area with no significant adverse effect **on natural resources**. No mining activity is present in the project area, and no **mineral resources** will be affected by the proposed action. Minor, temporary impacts to **noise levels** and **air quality** may occur as a result of construction and transportation of materials. No long-term significant impacts are anticipated, and no air quality standards should be violated.

(3) Minor, temporary increases in turbidity and levels of suspended sediments would occur but are expected to return to original levels following construction. No long-term adverse impacts to **water quality** are anticipated. Construction of Segment 4 will require the placement of fill below the calculated OHW elevation of 748.0 into an area designated as a wetland; therefore, a Section 404(b)(1) Evaluation has been prepared (Appendix B).

(4) Two federally threatened species, prairie bush clover *(Lespedeza leptostachya)* and western prairie fringed orchid (*Platanthera praeclara*); and two federally endangered species, bald eagle (*Haliaeetus leucocephalus*) and Indiana bat (*Myotis sodalis*), are listed for Marion County, Iowa.

(a) The prairie bush clover and the western prairie fringed orchid are considered to potentially occur statewide in Iowa based on historical habitat. The prairie bush clover occupies dry to mesic prairies with gravelly soil. The western prairie fringed orchid occupies wet grassland habitats. These species will be searched for before any prairie remnants are disturbed. The project is not expected to impact either species.

(b) Bald eagles utilize large trees along the shoreline of the Des Moines River below Red Rock Dam as resting and feeding perches during winter months. The proposed alignment is primarily located in upland areas upstream of the dam, and construction and use of the trail are not expected to disrupt eagle feeding or roosting habits.

(c) The Indiana bat uses large trees with cavities or loose bark as summer roosts, and uses caves as winter hibernacula. The presence of the species in the vicinity of the proposed project was documented by Dr. John Bowles of Central College in Pella, Iowa, during surveys conducted from 1980 through 1983. Although the Indiana bat may potentially occur within any of the habitat types found in the

project area, the mature upland forest tracts have the greatest potential for utilization as summer maternity roosting habitat.

(d) In planning and designing the proposed trail alignment, the Rock Island District has incorporated several measures to avoid direct impacts to the Indiana bat and minimize adverse effects to potential summer roosting habitat for the species. The trail alignment was designed to minimize impacts to mature woody vegetation where possible. To avoid the potential for direct impacts to summer maternity roosts, no clearing of wooded areas will be allowed during the period from May 1 through August 30, and minimal clearing will be allowed of trees with a diameter at breast height (dbh) of 11 inches or more. Prior to construction, the alignment will be reinspected and minor adjustments will be made, where possible, to further minimize loss of potential roost trees.

(e) State-listed endangered, threatened, or special concern species for Marion County include only the Indiana bat, and no adverse impacts to the species are expected to result from this action.

VI. AFFECTED CULTURAL RESOURCES

(1) Four archeological sites are recorded within the proposed multi-purpose trail and borrow site project areas. Sites 13MA271 and 275 were recorded in 1986 by Gilbert Commonwealth for the Corps (Roper 1986). Additional investigation was recommended for these sites at that time. Site 13MA538 and 539 were identified by American Resources Group under contract for the present action.

(2) Sites 13MA271 and 275 were reevaluated for the present action. Site 13MA271 was intensively shovel tested (n=35) and found to be completely destroyed by erosion. Thirty-one shovel tests were excavated on site 13MA275 yet only one artifact was recovered. Neither site is considered eligible for the National Register of Historic Places.

(3) Sites 13MA538 consists of a Woodland period artifact scatter and feature remnant. The site is limited to the severely eroded terminus of a southerly trending ridge spur. The artifact scatter consisted of nondiagnostic chipped lithic debitage and prehistoric ceramic material. The feature remnant consisted of a scattering of burnt sandstone. The scatter and feature remnant were devoid of archeological integrity as the original artifact bearing A-horizon had completely eroded away. Shovel testing, post hole excavations, and cutbank inspection failed to identify buried cultural horizons. The site was determined to ineligible for inclusion into the National Register of Historic Places.

(4) Site 13MA539 is a late nineteenth/early twentieth century farmstead/residence located primarily outside of the proposed impact area. The site has been severely disturbed by park development. Due to the poor integrity and the relatively recent age of site 13MA539, it is not considered eligible for inclusion into the National Register of Historic Places.

(5) The multi-purpose trail and borrow areas were surveyed and cleared for cultural resources. The Corps letters dated 17 January and 27 February 1995 and the State Historical Society of Iowa (Iowa State Historic Preservation Office, SHPO) replies of 1 February and 7 March 1995 (R&C#: 950163098) document this clearance (Appendix A).

(6) If the scope or design of the project should change, or if the execution of the project should uncover any item of archaeological, historical, or architectural interest, the Corps will ensure that reasonable efforts are taken to avoid or minimize harm to the property until its significance can be determined (36 CFR 800.11).

VII. SOCIAL IMPACT ASSESSMENT

(1) Community and Regional Growth. No significant impacts to community or regional growth would result from construction of the proposed multi-purpose trail.

(2) Displacement of People. The proposed project would not require any residential relocations or displacement of people.

(3) Farm Displacement. No farmstead displacement would result from the proposed project.

(4) Community Cohesion. The construction of the multi-purpose trail segment will have a positive impact on community cohesion. The proposed project will add new recreation facilities and extend an existing multi-purpose trail from one recreation area to another. The planned facilities will enhance the recreation opportunities available at Lake Red Rock, making the site accessible to more recreationists and attracting visitors from beyond the immediate area.

(5) Public Facilities and Services. Public facilities and services would greatly benefit from the proposed trail which would allow greater accessibility for trail users and provide for a more enjoyable recreation experience. Construction of the trail segment will help fulfill the current and projected public demand for recreation trails within the Des Moines Recreational River and Greenbelt boundaries.

(6) Life, Health, and Safety. The new multi-purpose trail would provide non-motorized passage between the affected recreation amenities, reducing potential life, health, and safety threats associated with the highway routes that trail users currently travel to access the recreation areas. Portions of reservoir land in the project area are currently open to public hunting. Use of these portions of trail may need to be restricted during late fall and winter to avoid conflicts in use. Trail use is low at these times, and, because the trail will remain open in areas where hunting is not currently allowed, no significant reduction in use is anticipated.

(7) Property Values and Tax Revenues. The property is located on Federal lands, county right-of-way, and a small portion of privately owned land to be purchased by the Government. The project is not anticipated to significantly affect property values or tax revenues.

(8) Business and Industrial Growth. No business relocations would be necessitated by the proposed multi-purpose trail. No changes in business activity would be noticed during or after construction. For these reasons, the project is not expected to affect business and industrial growth in the region.

(9) Employment and Labor Force. Construction of the project would slightly increase employment in the area but would have no noticeable effect on the employment and labor force in Marion County, Iowa.

(10) Noise Levels. Heavy machinery would generate temporary increases in noise levels during construction. This increase has the potential to disturb visitors or users of the existing trail. There will be no permanent impact to sensitive receptors.

(11) Aesthetic Values. There will be a temporary adverse impact to aesthetic values during construction of the proposed trail. In areas where trail bridges will be constructed, a slight, negative impact will remain for a few years because of the clearing necessary to allow access of construction equipment. There will be no permanent negative impact on the aesthetic values of the project area.

VIII. COORDINATION

(1) Coordination has been maintained throughout the planning and design process with the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Iowa Department of Natural Resources, and the State Historic Preservation Officer (SHPO). Copies of coordination letters and telephone conversation records are contained in Appendix A. Development of the multi-purpose trails at Lake Red Rock was proposed and coordinated in the *Resource Master Plan, Design Memorandum No. 24b for Red Rock Dam and Lake Red Rock* (December 1976).

(2) The Greenbelt Multi-Purpose Trail project was documented and coordinated in the programmatic EIS for the *Greenbelt General Design Memorandum*, dated September 1987. FDMs with environmental assessments were prepared for Segments I, II, and III of the Red Rock component of the Multi-Purpose Trail in May 1989, January 1991, and March 1993, respectively. This action was not selected for review by the State of Iowa under Executive Order 12372, State Single Point of Contact; therefore, the project has been coordinated with the Governor's Representative for Civil Works, which is the Department of Natural Resources.

IX. FONSI

FINDING OF NO SIGNIFICANT IMPACT

DES MOINES RECREATIONAL RIVER AND GREENBELT FEATURE DESIGN MEMORANDUM NO. 10

RED ROCK MULTI-PURPOSE TRAIL SEGMENT 4

LAKE RED ROCK, IOWA

I have reviewed the information provided by this Environmental Assessment, along with the data obtained from cooperating Federal, State, and local agencies and from the interested public. Based on this review, I find that construction of the proposed trail segment will not significantly affect the quality of the human environment. Therefore, it is my determination that an Environmental Impact Statement is not required for this action. This determination will be reevaluated if warranted by later developments.

Alternatives considered along with the preferred action were:

- No Federal Action

- Other trail alignments and designs

Factors considered in making a determination that an Environmental Impact Statement was not required are as follows:

a. The action is expected to enhance low-density recreational use on land zoned for that purpose.

b. The selected alignment was designed to minimize adverse effects on natural resources while providing non-motorized access between developed recreation areas across public lands.

c. No significant social, economic, environmental, or cultural resource impacts are anticipated as a result of this action.

_____
(Date)

Charles S. Cox
Colonel, U.S. Army
District Engineer

APPENDIX A

CORRESPONDENCE

U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

APPENDIX A
CORRESPONDENCE

TABLE OF CONTENTS

GRIGGS/dmd/5547

SEPTEMBER 21, 1994

Planning Division (1165-2-26a)

SEE DISTRIBUTION LIST

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is preparing plans to construct a segment of bike trail on the north side of Lake Red Rock. The trail segment will be located in Sections 2, 3, 4, 5, 11 and 12, Township 76 North, Range 19 West, and in Sections 31, 32, and 33, Township 77 North, Range 19 West, Marion County, Iowa (see attached map).

This action represents one component of the Des Moines Recreational River and Greenbelt, Multi-Purpose Trail project. The Multi-Purpose Trail project was included in the Greenbelt General Design Memorandum and programmatic Environmental Impact Statement (GDM/EIS), prepared by Rock Island District in September 1987. This component will be referred to in future correspondence as Red Rock, Segment 4.

The proposed action involves construction of an asphalt-surfaced or Portland cement multi-purpose trail approximately 8.7 miles long. This trail will provide access by foot and bicycle traffic between Wallashuck, Fifield, and Cordova Park Recreation Areas on the north side of the reservoir. The trail will be located on federally owned property, Marion County owned right-of-way, and on one parcel to be purchased from a neighboring landowner. All Federal land is zoned for recreation and forest.

The trail alignment traverses a variety of land use and habitat types. These include lake shoreline areas, developed recreation areas, plantations of trees and prairie grasses, and natural areas with herbaceous, shrub, or deciduous forest cover. The alignment will be refined to minimize disturbance to natural areas and to be compatible with existing recreation uses.

A Feature Design Memorandum with Environmental Assessment (EA) is being prepared for this action and, when completed, will be provided to your office for review. We request your comments on this action concerning your agency's area of interest, in writing, within 30 days of the date of this letter. Comments received in response to this letter will be incorporated into the EA.

If you have any questions or need additional information regarding this project, please call Mr. Kevin Griggs of our Environmental Analysis Branch, telephone 309/794-5547. Written responses may be sent to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY
PATRICK T BURKE, P.E.

Gary L. Loss, P.E.
Chief, Planning Division

Attachment

CF (all w/atch):
Dist File (PD)
PD (Herrmann) (wo/atch)
ED-DG (Monfelli)
OD-RR
PD-E
RE

ASST/CH, PD
CHIEF, PD
PROGRAM ANALYST
PD FILE

United States Department of the Interior

IN REPLY REFER TO:

FISH AND WILDLIFE SERVICE
Rock Island Field Office (ES)
4469 - 48th Avenue Court
Rock Island, Illinois 61201

COM: 309/793-5800
FAX: 309/793-5804

October 18, 1994

Colonel Charles S. Cox
District Engineer
Department of the Army
Rock Island District Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Dear Colonel Cox:

We have reviewed your September 21, 1994, request for information concerning listed or proposed threatened and endangered species that may be affected by the proposed multi-purpose trail on the north side of Lake Red Rock in Marion County, Iowa.

To facilitate compliance with Section 7(c) of the Endangered Species Act of 1973, as amended, Federal agencies are required to obtain from the Fish and Wildlife Service information concerning any species, listed or proposed to be listed, which may be present in the area of a proposed action. Therefore, we are furnishing you the following list of species which may be present in the concerned area:

Classification	Common Name (Scientific Name)	Habitat
Endangered	Indiana bat (Myotis sodalis)	small stream corridors with well developed riparian woods
Endangered	Bald eagle (Haliaeetus leucocephalus)	wintering
Threatened	Prairie bush clover (Lespedeza leptostachya)	dry to mesic prairies with gravelly soil
Threatened	Western prairie fringed orchid (Platanthera praeclara)	mesic to wet prairies

The endangered Indiana bat (Myotis sodalis) is known to occur in Marion County, Iowa. Based on our phone conversation of September 23, 1994, we understand that approximately 15 to 20 acres of forest will be cleared. The forest consists predominantly of elm and ash with some hickories. Construction through this area will avoid all trees with a diameter at breast height of eleven inches or more.

The endangered bald eagle (Haliaeetus leucocephalus) is listed as wintering along large rivers, lakes and reservoirs in Marion County, Iowa. During the winter, they perch in large shoreline trees to rest or feed on fish. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. There is no critical habitat designated for this species and the only restrictions that apply to the eagle are that it not be harassed, harmed or disturbed when present.

The prairie bush clover (Lespedeza leptostachya) and the western prairie fringed orchid (Platanthera praeclara) are considered to potentially occur statewide in Iowa based on historical habitat. The prairie bush clover occupies dry to mesic prairies with gravelly soil. The western prairie fringed orchid occupies wet grassland habitats. There is no critical habitat designated for these species. Federal regulations prohibit any commercial activity involving these species or the destruction, malicious damage or removal of these species from Federal land or any other lands in knowing violation of State law or regulation, including State criminal trespass law. These species should be searched for whenever prairie remnants are encountered.

These comments provide technical assistance only and do not constitute the report of the Secretary of the Interior on the project within the meaning of Section 2(b) of the Fish and Wildlife Coordination Act, do not fulfill the requirements under Section 7 of the Endangered Species Act, nor do they represent the review comments of the U.S. Department of the Interior on any forthcoming environmental statement.

We appreciate the opportunity to comment on this project. If you have additional questions, please contact Melanie Kruse.

Sincerely,

for Wayne A. Fischer

Richard C. Nelson
Field Supervisor

MK:sjg

GRIGGS/dmd/5547

December 5, 1994

Planning Division (1165-2-26a)

Mr. Marvin Mensching
Marion County Soil
Conservation Service
P.O. Box 47
1445 Lake Drive
Knoxville, Iowa 50138

Dear Mr. Mensching:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) requests action for processing of Form AD-1006 Farmland Conversion Impact Rating (Enclosure 1).

The area for potential conversion is a 2.49-acre parcel located in the S1/4 of NE1/4 of Section 12; Township 76 North; Range 19 West; Marion County, Iowa (see enclosed map, Enclosure 2).

Also enclosed are copies of the initial coordination letter (Enclosure 3) and an internal Corps memo (Enclosure 4) describing the purpose for land aquisition and landowner information.

Due to time constraints for awarding a construction contract in FY 95, the scheduled completion date for the Environmental Assessment has been moved up to February 15, 1995. An expeditious response would be appreciated.

If you have questions or need additional information regarding this project, please call Mr. Kevin Griggs of our Environmental Analysis Branch, telephone 309/794-5547. Written responses may be sent to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY
PATRICK T. BURKE, P.E.

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosures

CF (all wo/encls):
Dist File (PD)
PD (Herrmann)

√PD-E (Griggs)
ED-DG (Monfelli)
RE

CONVERSATION RECORD

TIME: 1320 | DATE: 7 Dec 94

TYPE: ☐ VISIT ☐ CONFERENCE ☐ TELEPHONE ☐ INCOMING ☐ OUTGOING

Location of Visit/Conference:

NAME OF PERSON(S) CONTACTED OR IN CONTACT WITH YOU	ORGANIZATION (Office, dept., bureau, etc.)	TELEPHONE NO:
DeWayne Knott	USEPA Region 7	

ROUTING

NAME/SYMBOL	INT

SUBJECT: Returning Kevin Griggs' call to Gene Gunn

SUMMARY: I answered Kevin's phone. DeWayne Knott was returning Kevin's call of yesterday concerning the coordination letter he (Kevin) sent to Region 7 on Sep. 21, 1994. DeWayne indicated that, because of heavy workload and limited manpower (only 2 people in their office at this time), they will not be responding to such coordination letters unless they have comments to make. I asked if this pertained to other projects as well as Kevin's (Red Rock Trails Segment IV) and he indicated it did. I told DeWayne I would pass this message on to Kevin.

ACTION REQUIRED

NAME OF PERSON DOCUMENTING CONVERSATION	SIGNATURE	DATE
Charlene Carmack	Charlene Carmack	12/7/94

ACTION TAKEN

SIGNATURE	TITLE	DATE

STATE OF IOWA

TERRY E. BRANSTAD, GOVERNOR

ASSOCIATED PROGRAM ANALYST
PD FILE

DEPARTMENT OF NATURAL RESOURCES
LARRY J. WILSON, DIRECTOR

January 3, 1995

District Engineer
U.S. Army Corps of Engineers
ATTN: Planning Division
Rock Island District, Clock Tower Bldg.
P.O. Box 2004
Rock Island, Illinois 61204-2004

Re: Des Moines Recreational River and Greenbelt, Multi-Purpose Trail Project, Red Rock, Segment 4

Dear Sir:

The Iowa Department of Natural Resources has reviewed the FAX in regard to the preparation of plans to construct a segment of the bike trail on the north side of Lake Red Rock, referred to as the Red Rock, Segment 4.

The following comments were received in regard to this proposed construction work: The Indiana bat (Myotis sodalis, state and federal endangered) is known from this part of the state and may occur in the area of this project. Indiana bats are found in areas of mature upland forest and along the wooded corridors of small streams. They forage for insects beneath the canopy. Females form maternity colonies under loose bark of trees. Trees 11 inches or greater in diameter as described in the attached guidelines are potential roost trees.

If trees of this size are to be cleared between May 1 and August 31, please contact the IDNR Division of Parks, Recreation and Preserves at (515) 281-8524 or 8967. You may need to survey habitat in the construction zone to determine if the area is potential summer habitat for the Indiana bat. The enclosed guidelines provide information about the habitat requirements and survey methods for Indiana bat summer habitat. Enclosed is a copy of the IDNR GUIDELINES FOR PROTECTION OF INDIANA BAT SUMMER HABITAT.

WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319 / 515-281-5145 / TDD 515-242-5967

If it appears that you will disturb potential Indiana Bat summer habitat, we suggest that you contact the U.S. Fish and Wildlife Service regarding this project. Their office at Rock Island may be reached at telephone number (309) 793-5800.

Thank you for the opportunity to review and comment on these proposed trail projects.

Sincerely,

LARRY J. WILSON, DIRECTOR
IOWA DEPARTMENT OF NATURAL RESOURCES

Enclosure

ROSS/dmd/5540

January 17, 1995

Planning Division

Ms. Patricia Ohlerking
Chief, Community Programs Bureau
Review and Compliance Program
State Historical Society of Iowa
Capitol Complex
Des Moines, Iowa 50319

Dear Ms. Ohlerking:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a draft report (enclosure 1) entitled Phase I Archaeological Investigations for the Greenbelt Segment IV Trail Alignment, Lake Red Rock, Marion County, Iowa, authored by Jim Snyder and David McConkey. The report was completed by American Resources Group, Limited of Carbondale, Illinois, and is Cultural Resources Management Report No. 256. The work was performed under Contract DACW25-93-D-0012, Work Order No. 22.

The field investigation identified two previously unrecorded archeological sites, Sites 13MA538 and 13MA539, and revisited two previously recorded sites, Sites 13MA271 and 13MA275. The Contractor evaluated these sites and has recommended clearance from an archeological perspective due to extensive erosion and disturb-ance. After reviewing the report, the opinion of the Corps is that no significant historic properties are located within the Red Rock Segment IV Greenbelt trail alignment or borrow areas.

Two additional borrow areas will be utilized which were not surveyed under the present work order. Borrow area B is an existing quarry measuring approximately 2 acres and is located in the SE 1/4, SE1/4, SE1/4 of Section 2, Township 76 North, Range 19 West (grid overlay on the southwest corner of section) United States Geological Survey, Pella, Iowa, 7.5 quadrangle topographic map (enclosure 2). Excavations will be limited to previously impacted areas of the existing quarry.

Borrow area D measures approximately 2 acres and is located in the NW1/4, SE1/4, SW1/4 of Section 32, Township 77 North Range 19 West (grid overlay on the southwest corner of section) United States Geological Survey, Pella, Iowa, 7.5 quadrangle

topographic map (enclosure 3). This area was surveyed for historic properties in 1986 by Gilbert Commonwealth for the Corps and was cleared at that time. The opinion of the Corps is that no significant historic properties are located within these additional borrow areas.

We request your written comments on this project within 30 days of the date of this letter. If you have any questions, please call Mr. Jim Ross of our Environmental Analysis Branch, telephone 309/794-5540, or write to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY
PATRICK T. BURKE, P.E.

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosures

CF:
Dist File (PD) (w/encls)
PD (Herrmann) (wo/encls)
PD-E (Ross) (wo/encls)

Ross

State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

February 1, 1995

In reply please refer to
RC#: 950163098

PD.E

Dudley M. Hanson, P.E.
Chief, Planning Division
Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

RE: COE - MARION COUNTY - CONTRACT NUMBER DACW25-93-D-0012, WORK ORDER NO. 22 - GREENBELT SEGMENT IV TRAIL ALIGNMENT, LAKE RED ROCK - REVIEW OF PHASE I SURVEY AND ADDITIONAL BORROW AREA LOCATIONS

Dear Mr. Hanson,

We have received and reviewed the information you submitted to our office concerning the above referenced project, including the draft report by Jim Snyder and David McConkey of American Resources Group, Ltd. entitled Phase I Archaeological Investigations for the Greenbelt Segment IV Trail Alignment, Lake Red Rock, Marion County, Iowa. Based on your project description, a review of the above referenced report, and a review of our records and maps, we make the following comments and recommendations.

In general, the draft report was well written and comprehensive. We concur with the consultant's opinions regarding the National Register eligibility of three of the four archeological sites involved in the proposed project area. The fourth site (13MA538) was not adequately shovel tested during the Phase I survey for its potential National Register eligibility to be assessed.

Previously recorded site 13MA271 appears to be a limited activity site that has been almost completely destroyed by erosion. It was tested with 35 shovel tests, only one of which yielded a single flake. This site is not eligible for the National Register of Historic Places. Site 13MA275 was also previously recorded and produced a Middle Archaic point in 1986. Thirty-one shovel tests excavated at the site produced only a single flake. This site is not eligible for the National Register.

Newly recorded site 13MA539 is located almost entirely outside the proposed impact area and consists of a destroyed nineteenth to early twentieth century farmstead or residence. This site was thoroughly shovel tested and documented. Because of the poor integrity and relatively recent date of this historic site, it is not considered eligible for nomination to the National Register.

☐ 402 Iowa Avenue
Iowa City, Iowa 52240-1806
(319) 335-3916

☐ 600 E. Locust
Des Moines, Iowa 50319-0290
(515) 281-6412

☐ Montauk
Box 372
Clermont, Iowa 52135-0372

Newly recorded site 13MA358 yielded a surface scatter of chipped lithic and prehistoric ceramic material as well as the remains of a feature. Shovel testing consisted of eight tests excavated away from the area of the surface scatter. The area documented as the main site area (Figure 6, page 34) was not subjected to shovel testing and provided fair to good (25%-50%) surface visibility. The feature remnant was located adjacent to the cutbank in the main site area. Apparently no further documentation in the form of photographs, sketch maps, etc. has been provided for this feature. Although this site appears to have been subjected to extensive erosion along the shoreline and possibly to deflation within the main site area, the Phase I testing and documentation strategy was not adequate to document these facts. The fact that this site yielded one feature along with an artifact scatter indicates that other subsurface features and cultural material may be present.

Limited Phase II testing is recommended for the main area of 13MA538. A series of shovel tests should be excavated in the area which yielded the cultural material. Based on the results of these shovel tests, one or two 1 m x 1 m tests might be determined appropriate, at the consultant's discretion. Such additional testing should provide a better basis for a determination of the site's National Register eligibility.

Proposed Borrow Area B is located in an existing quarry with low archeological potential. This area has also been previously surveyed (Review and Compliance #850463072) with no archeological sites recorded. There is a small cemetery (Karr Cemetery) recorded on the 1965 Otley topographic map east of Borrow Area B. This cemetery should be avoided by all construction and activity.

Proposed Borrow Area D is located in an area which has been previously surveyed by Gilbert Commonwealth in 1986 (Review and Compliance #860963000) with no archeological sites recorded. Both borrow areas are located on the Otley 7.5' USGS quadrangle map.

In summary, 13MA271, 13MA275 and 13MA539 are not eligible for the National Register of Historic Places. 13MA538 will require limited Phase II testing before its eligibility can be adequately determined. New borrow areas "B" and "D" are in areas that have already been subjected to archeological survey. With the stipulation that all construction and activity in the vicinity of Borrow Area D should avoid completely the nearby Karr Cemetery to the east, project approval is recommended for the new borrow areas. At this time, project approval is recommended for all but Survey Area 1 in the vicinity of 13MA538. This office should be notified of testing results.

Should you have any questions or if this office can be of further assistance to you, please contact the Review and Compliance program at 515-281-8743.

Sincerely,

Kirsten Hoffman, Archeologist
Community Programs Bureau

cc: David McConkey, American Resources Group, Ltd.
Jim Ross, Planning Division, Rock Island Corps of Engineers

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	
Name Of Project: Lake Red Rock Trails, Segment 4	Date Of Land Evaluation Request: 2 December 1994
Proposed Land Use: Alignment of Multi-Purpose Trail	Federal Agency Involved: U.S. Army Corps of Engineers
	County And State: Marion County, Iowa
PART II *(To be completed by SCS)*	Date Request Received By SCS: 12/8/94
Does the site contain prime, unique, statewide or local important farmland? (If no, the FPPA does not apply -- do not complete additional parts of this form)	Yes ☒ No ☐
Acres Irrigated: 0	Average Farm Size: 320
Major Crop(s): Corn	Farmable Land In Govt. Jurisdiction: Acres: 279,315 (78%)
Amount Of Farmland As Defined In FPPA: Acres: 194,636 (36%)	
Name Of Land Evaluation System Used: Marion County	Name Of Local Site Assessment System: Nine-Point
Date Land Evaluation Returned By SCS: 1/6/95	

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly	2.49			
B. Total Acres To Be Converted Indirectly	0			
C. Total Acres In Site	2.49			
PART IV *(To be completed by SCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland	0.4			
B. Total Acres Statewide And Local Important Farmland	2.09			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted	.001			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value	55			
PART V *(To be completed by SCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	60			
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points			
1. Area In Nonurban Use		15		
2. Perimeter In Nonurban Use		10		
3. Percent Of Site Being Farmed		20		
4. Protection Provided By State And Local Government		0		
5. Distance From Urban Builtup Area		15		
6. Distance To Urban Support Services		15		
7. Size Of Present Farm Unit Compared To Average		0		
8. Creation Of Nonfarmable Farmland		0		
9. Availability Of Farm Support Services		5		
10. On-Farm Investments		15		
11. Effects Of Conversion On Farm Support Services		0		
12. Compatibility With Existing Agricultural Use		0		
TOTAL SITE ASSESSMENT POINTS	160	95		
PART VII *(To be completed by Federal Agency)*				
Relative Value Of Farmland *(From Part V)*	100	60		
Total Site Assessment *(From Part VI above or a local site assessment)*	160	95		
TOTAL POINTS *(Total of above 2 lines)*	260	155		

Site Selected: SITE A | Date Of Selection: 8 February 1995 | Was A Local Site Assessment Used? Yes ☐ No ☒

Reason For Selection:

Site A was the only site considered for alignment of Lake Red Rock Trails, Segment 4.

(See Instructions on reverse side)

Form AD-1006 (10-83)

C:\ROSS\DOC\GBELT\SEG4\ARG-1.DOC ROSS/dmd/5540

February 13, 1995

Planning Division

Mr. Michael J. McNerney
American Resources Group, Ltd.
127 North Washington Street
Carbondale, Illinois 62901

Dear Mr. McNerney:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) has reviewed your draft report prepared under Contract DACW25-93-D-0012, Work Order No. 22, for the Greenbelt Segment IV Trail Alignment, Lake Red Rock, Marion County, Iowa.

The Iowa State Historic Preservation Office (SHPO) did not accept portions of the draft report and recommended additional fieldwork. Enclosed is a copy of the SHPO letter for your files and for inclusion as part of a correspondence appendix to the revised draft and final reports. Please include this letter in that appendix as well.

Additional fieldwork is required at Site 13MA538 in order to adequately assess the National Register of Historic Places (NRHP) potential significance. Per telephone conversations between the district archeologist and SHPO representative, specific fieldwork requirements have been developed. These requirements differ somewhat from those stated in the SHPO letter and include the following: photographic documentation of the archeological site and feature remnant; a detailed plan view of the feature remnant; documentation of the vertical extent of the feature; shovel testing (if possible) within the surface scatter to determine the presence/absence of subsurface archeological deposits; and photographic documentation, mapping, and evaluation of a sample of the cutbank exposure profile in order to determine the presence and/or potential for buried archeological remains.

Complete documentation is necessary in order to adequately evaluate the recommendations made about site 13MA538 in the draft report. It is imperative that the field investigation be completed no later than February 17, 1995.

Also enclosed is a marked-up copy of the draft report containing recommended revisions. Please submit the revised draft report with the revisions and additions by February 24, 1995.

If you have any questions regarding this matter, please call Mr. Jim Ross of our Environmental Analysis Branch, telephone 309/794-5540 (FAX 309/794-5157), or write to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY

J. Paul VanHoorebeke
Authorized Representative
of the Contracting Officer

Enclosures

CF (all wo/encls):
Dist File (PD)
PD (Herrmann)
PD-E (Ross, Griggs)
ED-DG (Hess)

ROSS/dmd/5540

February 27, 1995

Planning Division

Ms. Patricia Ohlerking
Chief, Community Programs Bureau
Review and Compliance Program
State Historical Society of Iowa
Capitol Complex
Des Moines, Iowa 50319

Dear Ms. Ohlerking:

The Rock Island District of the U.S. Army Corps of Engineers (Corps) is forwarding a revised draft report (Enclosure 1) entitled Phase I Archaeological Investigations for the Greenbelt Segment IV Trail Alignment, Lake Red Rock, Marion County, Iowa, authored by Jim Snyder and David McConkey. The report was completed by American Resources Group, Limited, of Carbondale, Illinois, and is Cultural Resources Management Report No. 256. The work was performed under Contract DACW25-93-D-0012, Work Order No. 22.

A revised draft report was requested by the Corps in order to adequately document Site 13MA538. Since the writing of the original draft report, the Corps has identified the location of Site 13MA538 as a potential flood pool borrow site. Therefore, it was necessary for a Corps archeologist to visit the location and evaluate its potential for deeply buried historic properties. The borrow site will be located in the fractional E1/2, SW1/4, NW1/4, Section 12, Township 76 North, Range 19 West, Otley, Iowa, 7.5 United States Geological Survey (USGS) topographic map (taken from northwest corner of Section) and will measure approximately 3 acres. Site 13MA538 occupies the eastern half of the proposed borrow area (Enclosure 2).

Additional fieldwork was conducted at Site 13MA538 on February 15, 1995. The investigation addressed deficiencies in the original documentation as identified in the State Historic Preservation Office letter dated February 1, 1995 (RC#: 950163098). A Corps archeologist monitored the additional investigation which consisted of photographic documentation of the site, feature remnant, and cutbank profile; plan view mapping of the feature remnant; limited shovel testing within the artifact scatter; and determination of the vertical extent of the feature remnant. The Corps archeologist evaluated the

potential for Site 13MA538 and the new borrow site location for containing buried historic properties. That investigation consisted of ground truthing the Contractor's original description of the topographical location of the site and profile mapping of the cutbank exposures.

The investigation confirmed the Contractor's original evaluation of the site as severely eroded (Enclosures 3 and 4). Shovel testing identified approximately 5 cm of A horizon in one test located in the northernmost portion of the surface scatter limits. The remainder of the site, including the artifact scatter and feature remnant, were documented on sterile B horizon, exposed through deflation and completely devoid of archeological integrity. This was determined on the basis of surface examination and shovel test excavation. This is also true of the feature remnant (Enclosure 5). The red sandstone is no longer in context, as any associated fill or cultural horizon has eroded away. Soil probes were advanced into the feature in order to determine if there was any vertical extent. The tests documented yellowish brown clayey loam that was consistent with sterile subsoil identified on the surface and documented in shovel test excavations across the site.

Visual inspection of the entire cutbank profile and eroding bank failed to document any buried historic properties or buried surfaces with archeological potential (Enclosure 6). The topographical location of the site is at the terminus of a southerly trending ridge spur overlooking the Des Moines River floodplain. The potential for a buried archeological site on this ridge spur is very low. The Corps archeologist excavated a series of overlapping profiles along two transects from elevation 744 to 760 feet Above Sea Level (ASL). Two generalized profiles were developed from this data (Enclosures 7 and 8). Detailed soil information is presented in Enclosure 7).

Examination of the two exposures failed to identify any buried historic properties or any buried surfaces with archeological potential. Shovel test excavations above elevation 760 ASL documented surface soils consistent with that identified as Stratum 1 in Enclosure 8. This would suggest that the generalized soil profiles are representative of the higher elevations as well in light of the topographical setting. These facts, coupled with the severe erosion documented at Site 13MA538, indicate that the Phase I survey documentation exhausted the research potential of the site and that the newly proposed borrow excavations will not impact buried historic properties.

After reviewing the revised draft report and having had a Corps archeologist visit Site 13MA538 and evaluate its potential for containing buried historic properties, the opinion of the Corps is that Site 13MA538 is not significant and that no significant historic properties are located within the Red Rock Segment IV Greenbelt trail alignment or proposed borrow areas.

We request your written comments on this project as soon as possible. If you have any questions regarding this matter, please call Mr. Jim Ross of our Environmental Analysis Branch, telephone 309/794-5540, or write to our address above, ATTN: Planning Division.

Sincerely,

ORIGINAL SIGNED BY
PATRICK T. BURKE, P.E.

Dudley M. Hanson, P.E.
Chief, Planning Division

Enclosures

CF (wo/encls):
Dist File (PD) (w/encls)
PD (Herrmann)
PD-E (Ross, Griggs)
ED-DG (Hess)

State Historical Society of Iowa

The Historical Division of the Department of Cultural Affairs

March 7, 1995

In reply please refer to:
RC#: 950163098

Mr. Dudley M. Hanson, P.E.
Chief, Planning Division
Department of the Army
Rock Island District, Corps of Engineers
Clock Tower Building, P.O. Box 2004
Rock Island, IL 61204-2004

RE: COE - MARION COUNTY - CONTRACT NUMBER DACW25-93-D-0012, WORK ORDER NO. 22 - GREENBELT SEGMENT IV TRAIL ALIGNMENT, LAKE RED ROCK - 13MA538 - ADDITIONAL BORROW DESIGNATION AND ADDITIONAL PHASE I SURVEY

Dear Mr. Hanson:

We have received and reviewed the information you submitted to our office concerning the above referenced project, including the revised draft Phase I report entitled, Phase I Archaeological Investigations for the Greenbelt Segment IV Trail Alignment, Lake Red Rock, Marion County, Iowa, submitted by American Resources Group, Ltd. Based on a review of this report and other additional information submitted, we make the following comments and recommendations.

We concur with the consultant and Corps that 13MA538 contains no intact subsurface deposits of prehistoric cultural material and is not eligible for the National Register of Historic Places. Additional Phase I investigation and documentation carried out at the site indicate that 13MA538 has been severely eroded. The sandstone feature recorded during the Phase I survey is out of context, and there is no evidence at this site for deeply buried components.

The vicinity of 13MA538 has been designated as an additional borrow area associated with the above referenced project. Because these site has poor integrity and no evidence of buried components, project approval is recommended for the use of this area for borrow as well as for trail construction. Because 13MA538 is not National Register eligible, there are no potentially significant historic properties within the Red Rock Segment IV Greenbelt trail alignment or borrow areas. Project approval is therefore recommended.

However, if the proposed project work uncovers an item or items which might be of archeological, historical, or architectural interest, or if important new data come to light in the project area, you should make reasonable efforts to avoid or minimize harm to the

☐ 402 Iowa Avenue
Iowa City, Iowa 52240
(319) 335-3916

☐ Capitol Complex
Des Moines, Iowa 50319
(515) 281-5111

☐ Montauk
Box 372
Clermont, Iowa 52135
(319) 423-7173

property until the significance of the discovery can be determined. If additional borrow areas or other design modifications are designated in association with this project, additional Phase I surveys should be conducted. Our office should be notified of survey results.

Should you have any questions or if this office can be of further assistance, please contact me at the phone number listed below.

Sincerely,

Kirsten Hoffman

Kirsten Hoffman, Archeologist
Community Programs Bureau
(515) 281-4358

cc: Jim Ross, Rock Island COE

TOTAL P.03

DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT, CORPS OF ENGINEERS
CLOCK TOWER BUILDING – P.O. BOX 2004
ROCK ISLAND, ILLINOIS 61204-2004

REPLY TO ATTENTION OF:

March 7, 1995

Engineering Division
General Engineering Section

Mr. Ralph Turkle
Water Quality Planning Section
Iowa Department of Natural Resources
Wallace State Office Building
900 East Grand Street
Des Moines, Iowa 50319-0034

Dear Mr. Turkle:

The Corps of Engineers, Rock Island District, is constructing a "Des Moines Recreational River and Greenbelt" project called "Red Rock Multi-Purpose Trail - Segment 4." This project will connect to an existing multi-purpose trail at the Wallashuck Recreation Area and run northwest along the shore of Lake Red Rock to Highway 14.

The trail in the project is approximately 8.6 miles in length and has an asphalt paved width of 10 feet with 3-foot-shoulders on each side. The trail will cross several small intermittent streams and drainages via culverts and fill and one intermittent stream via a 193-foot-long steel-truss bridge.

The construction of the trail will involve placing approximately 28,000 cubic yards of earth fill material and 1,400 cubic yards of riprap bank protection within the Lake Red Rock flood control pool between the elevations of 742 and 780. The borrow site for the earth fill material is located within the Red Rock flood control pool so that flood storage volume will not be decreased by the placement of the earth fill. The riprap will be clean quarry run rock.

The total estimated volume of fill materials to be placed below the calculated Ordinary High Water (OHW) elevation of 748 is 1,320 cubic yards. The fill material placed below the calculated Ordinary High Water (OHW) elevation of 748 will consist entirely of earth fill material.

An Environmental Assessment (EA) will be prepared by the Rock Island District. Aspects requiring processing under Section 404 of the Clean Water Act are in progress. A copy of our report will be forwarded to your office for review. We are requesting your expedient review and issuance of 401 Water Quality Certification for the proposed project. Enclosed is an application packet containing the required forms and project information.

If you have any questions regarding the project, please call Mr. Timothy Hess of my staff at 309/794-5587, or you may write to the following address:

District Engineer
U.S. Army Engineer District, Rock Island
ATTN: Engineering Division (Tim Hess)
Clock Tower Building, P.O. Box 2004
Rock Island, Illinois 61204-2004

Sincerely,

Robert W. Kelley

Robert W. Kelley, P.E.
Chief, Engineering Division

Enclosure

APPENDIX B

CLEAN WATER ACT
SECTION 404(B)(1) EVALUATION

U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT 4

LAKE RED ROCK, IOWA

APPENDIX B
CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

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LAKE RED ROCK, IOWA

APPENDIX B
CLEAN WATER ACT
SECTION 404(b)(1) EVALUATION

1. PROJECT DESCRIPTION

a. Location. The project is located along the northeast shore of Lake Red Rock, about 4 miles southwest of the town of Pella in Marion County, Iowa.

b. General Description. The project is an 8.6-mile multi-purpose trail segment. The trail will have a surfaced width of 10 feet with 2- or 3-foot shoulders on each side. The majority of the trail will be asphalt surfaced, except for a portion within the Red Rock flood pool that will be paved with concrete. The trail alignment will cross several intermittent streams via culvert and embankment, except for two locations, which will be crossed via a bridge. Trail construction will involve placement of fill material in a 0.63 acre site classified by Federal regulatory jurisdiction as wetland or "waters of the United States", necessitating the preparation of this 404(b)(1) Evaluation. Mitigation for this wetland impact will be excavating and shaping a nearby upland shoreline borrow site (Borrow site #1) to maximize potential wetland benefits at that location (see plates B-1,2, and 3 of this appendix).

c. Authority and Purpose. The Des Moines Recreational River and Greenbelt was authorized and funded by Public Law 99-88, as approved on August 15, 1985. The project is for the development, operation, and maintenance of a recreational and greenbelt area on and along the Des Moines River in Iowa from U.S. Highway 20 in Fort Dodge, downstream to U.S. Highway 92 in the vicinity of the Red Rock Dam. Development of multi-purpose trails is one of the projects included in the comprehensive plan for the Greenbelt.

d. General Description of Dredged and/or Fill Material. Earth fill, composed of silt and clay alluvium, will be obtained from a site in the NE 1/4 of the SW 1/4 of Section 12, Township 76 North, Range 19 West (Borrow site #1, Station 450+00). Because this borrow site is located within the Lake Red Rock flood control pool, flood storage volume will not be reduced by the fill required at Station 431+00 - 434+00. Borrow activity will remain above the 748.0 shoreline contour (OHW elevation). The borrow area will be scalloped and shaped with relatively flat slopes to maximize potential wetland habitat. This effort will serve as mitigation for the wetland fill described below (see plate B-2). Slopes on the land-side of the borrow

area will be shaped approximately 4:1. Lake-side slopes will be shaped approximately 5:1 and will include a culvert at elevation 741.25. Skimmed topsoil will be spread over shallow excavated areas to a depth of one-foot to facilitate plant growth through natural revegetation from the existing seed bank. After final grade the culvert will maintain a 2-foot, 1.25 acre wetland at normal pool (see plate B-3). The borrow area has been designed to avoid additional wetland impacts while creating wetland mitigation.

e. Description of Proposed Discharge Site. Construction of the trail will involve placing approximately 1,320 cubic yards of earth fill material within Lake Red Rock below the calculated Ordinary High Water (OHW) elevation of 748.0 NGVD. The fill is necessary to cross a small drainage (via culvert) in the NE 1/4 of the SW 1/4 of Section 12, Township 76 North, Range 19 West (Station 431+00 to 434+00). The area of wetland to be impacted is 0.63 acres.

f. Description of Disposal Method. The fill material will be placed at the construction site by mechanical means.

2. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations. The substrate of the Des Moines River at the project site is generally composed of sand, silt, and gravel. The riverbank under the embankment site contains varying layers of modern alluvium of mixed sand and silt.

b. Water Circulation, Fluctuation, and Salinity Determinations. Water chemistry, clarity, color, odor, taste, dissolved gas levels, nutrients, and eutrophication will not be affected by the project. Salinity determinations are not applicable to the area. Circulation, flow, velocity, stratification, and hydrologic regime will not be significantly affected. Water level fluctuations are primarily determined by Red Rock Reservoir which both stores and releases water in conjunction with its flood control purpose. The proposed project would cause no noticeable change in water level fluctuations. Current pattern may be slightly altered near the fill area.

c. Suspended Particulate/Turbidity Determinations. There will be a minor, temporary increase in suspended particulates and turbidity during construction. Following project completion, these factors should return to pre-construction levels.

d. Contaminant Determinations. Construction materials will be chemically stable and noncontaminating. Construction will take place in a non-industrial, non-commercial area where the soil is unlikely to be contaminated. Neither the fill nor its placement will cause relocation or increases of contaminants in the aquatic ecosystem. Certification of the project under Section 401 of the Clean Water Act has been requested from the Iowa Department of Natural Resources, and all requirements will be met prior to construction.

e. Aquatic Ecosystem Determinations. The proposed action should have no noticeable adverse effect on the aquatic ecosystem. No significant impacts to benthos, plankton, or nekton are anticipated. The mitigation wetland is expected to enhance the local aquatic ecosystem by providing protected shallow water habitat.

f. Threatened and Endangered Species Determinations. Two federally threatened species, prairie bush clover (*Lespedeza leptostachya*) and western prairie fringed orchid (*Platanthera praeclara*); and two federally endangered species, bald eagle (*Haliaeetus leucocephalus*) and Indiana bat (*Myotis sodalis*), are listed for Marion County, Iowa. Threatened and endangered species are discussed in the preceding Environmental Assessment. It was determined that there would be no significant impacts to any of the listed species. The Indiana bat is the only state-listed threatened or endangered species in the project area and again, no significant impacts are anticipated.

g. Proposed Placement Site Determinations. Alternatives to avoid filling wetlands were explored as were methods to minimize any adverse impacts. The zone of wetland impact is located within a narrow corridor bordered by Lake Red Rock to the west and private property, which the owner is unwilling to sell, on the east. The proposed project may cause minor, temporary increases in turbidity during construction; however, no violations of water quality standards should occur and turbidity levels are expected to return to original levels following construction. The proposed action will have no effect on municipal or private water supplies; recreational or commercial fisheries; or water-related recreation, aesthetics, parks, national historic monuments, or similar preserves.

h. Determination of Cumulative Effects on the Aquatic Ecosystem. Cumulative impacts from construction would be minor. A loss of 0.63 acres of wetland would occur with the creation of 1.25 acres of replacement wetland to be developed from the borrow area. The earth fill would be chemically stable and noncontaminating. Therefore, no detrimental cumulative or secondary impacts are expected to occur.

i. Determination of Secondary Effects on the Aquatic Ecosystem. No adverse secondary effects are expected.

3. FINDINGS OF COMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

a. No significant adaptations of the 404(b)(1) guidelines were made relating to this evaluation.

b. The alternative of No Federal Action was not feasible because it did not provide non-motorized access to surrounding recreational areas.

c. Certification under Section 401 of the Clean Water Act has been requested from the Iowa Department of Natural Resources and will be acquired prior to project construction.

d. The project would not introduce toxic substances into nearby waters or result in appreciable increases in existing levels of toxic materials.

e. No significant impacts to Federal or State listed threatened or endangered species will result from the project.

f. The project is located in an inland freshwater system. No marine sanctuaries are involved.

g. No municipal or private water supplies would be affected. Minor impacts would result from construction. No sensitive or critical habitats would be affected, and no long-term adverse impacts would occur.

h. Project construction materials will be physically and chemically stable.

i. A 0.63 acre wetland area will be impacted by earth filling. Mitigation for this impact will be the excavation and shaping of a borrow area and installation of a culvert to create a 1.25 acre wetland.

j. The proposed actions will not significantly affect water quality or the aquatic ecosystem and are in compliance with the requirements of guidelines for Section 404(b)(1) of the Clean Water Act, as amended.

_____
(Date)

Charles S. Cox
Colonel, U.S. Army
District Engineer

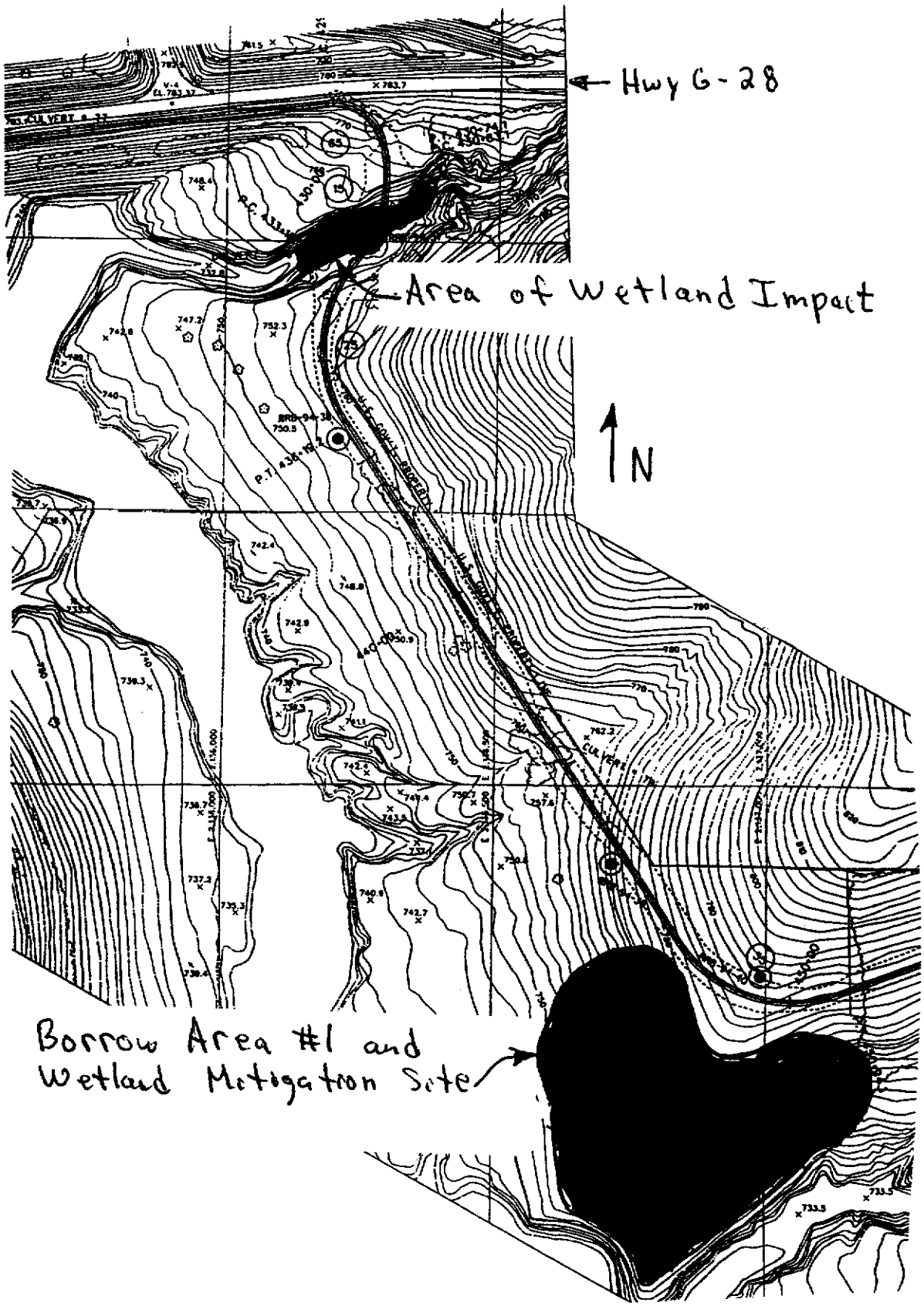

PLATE B-1: LOCATION PLAN

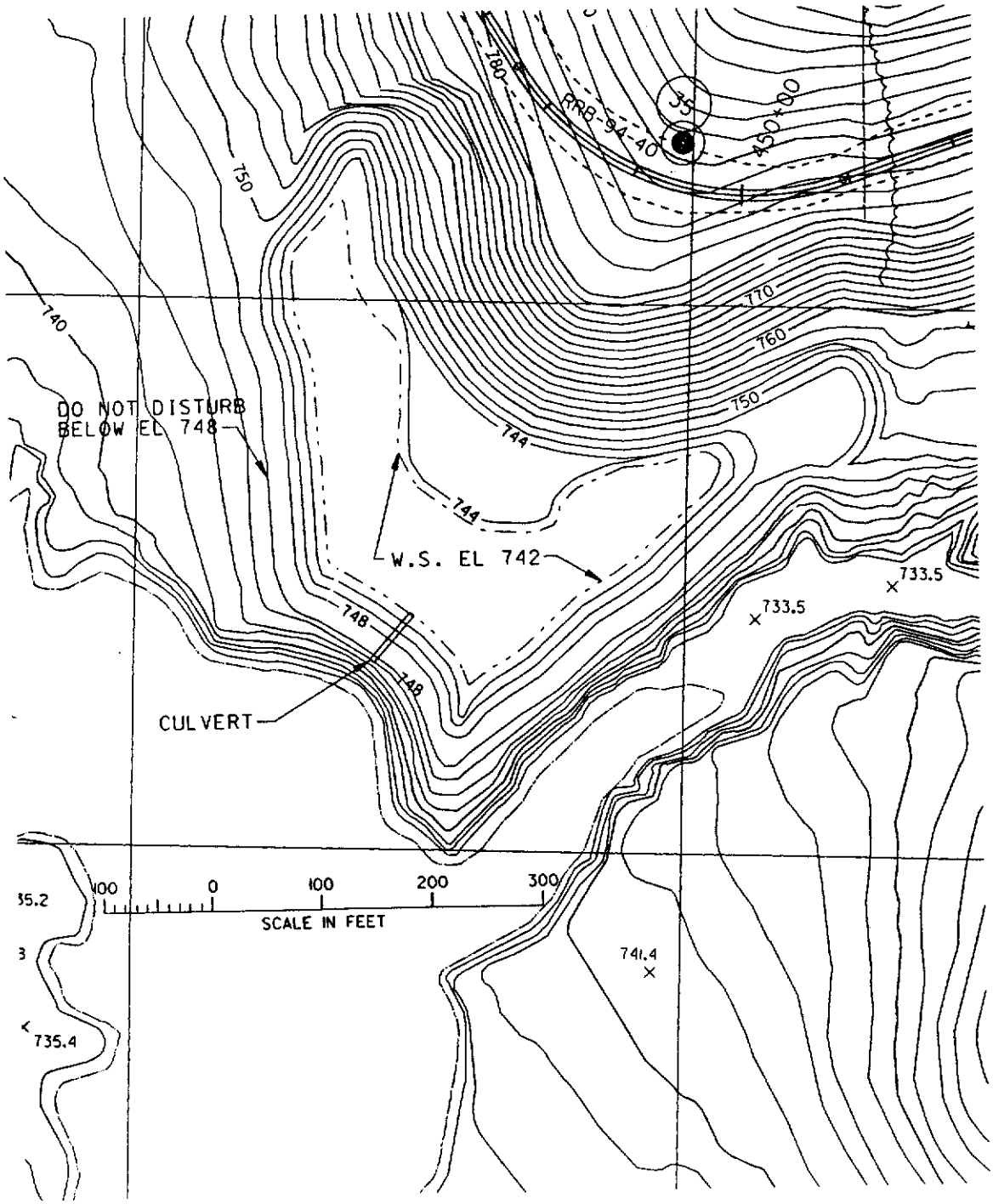

PLATE B-2: WETLAND MITIGATION SITE PLAN

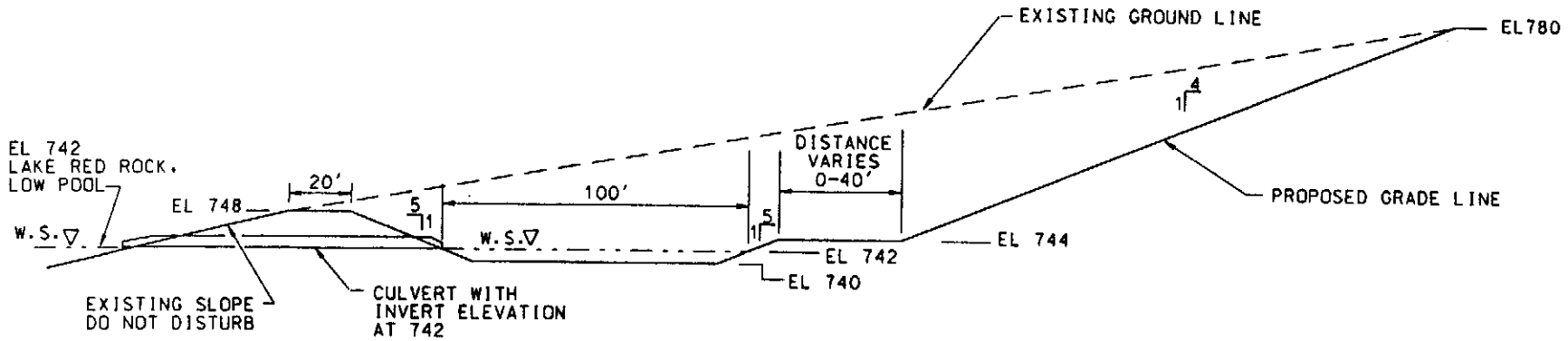

PLATE B-3: WETLAND MITIGATION SITE, TYPICAL SECTION

APPENDIX C

GEOTECHNICAL ANALYSIS

U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM NO. 10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

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FEATURE DESIGN MEMORANDUM NO. 10
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

APPENDIX C
GEOTECHNICAL APPENDIX

1. PURPOSE AND SCOPE

This appendix presents the soil exploration program and the geology, design, and analysis of the proposed project based on soil conditions encountered in the field. The scope of the study includes the review of Red Rock Dam foundation reports, field trips by the Geotechnical Branch personnel to the proposed project site, analyses of the detailed geotechnical investigation, and discussions with in-house personnel.

2. LOCATION

The project is located along the northeast shore of Lake Red Rock, about six miles east of the town of Pella in Marion County, Iowa. It begins at Wallashuck Recreational Area and runs northwest alongside Lake Red Rock for about 8.6 miles, paralleling County Road G-28 much of the way.

3. PROJECT DESCRIPTION

The proposed project consists of the construction of approximately 8.2 miles of asphalt-surfaced trail and 0.4 miles of concrete-surfaced trail. The trail will consist of ten feet of paved width with 2-3 feet of earth shoulder on each side. The trail crosses several small drainage channels. All drainage channels are crossed via culvert and embankment except for two locations which will be crossed via a 193-foot prefabricated bridge and a 40-foot wooden bridge. In several cases, the proposed trail will run along the existing embankment slope of County Road G-28. The trail will require a retaining wall at these locations (see plate 5 of the main report).

4. REGIONAL AND SITE GEOLOGY

a. The area surrounding Lake Red Rock lies in the province known as the Southern Iowa Drift Plain. Throughout most of the region, the glacial drift consists of till belonging to the Kansan stage of glaciation underlain by some earlier

Nebraskan till. The Kansan age ended approximately one-half million years ago. The surface has not been glaciated since and very little, if any, direct glacial topography remains. Since the Kansan age, the valleys south of Des Moines have established broad floodplains with far-reaching tributaries. At the beginning of the Wisconsinan glaciation 14,000 to 16,000 years ago, loess was deposited across the area and the present landscape began to develop its current form. On the uplands the loess averages fifteen feet in thickness, thinning to little or nothing on the steeper valley sides.

b. The topography of this area is one of steeply rolling hills interspersed with areas of uniformly level upland divides and level alluvial lowlands. Individual hillsides often display a texture of fine rills or drainageways that give a ribbed or furrowed appearance. Near the larger drainage features such as the Des Moines River, the tributary valleys become more deeply incised into the drift until they encounter bedrock, an ancient soil profile, or paleosol, whereupon downward erosion slows and lateral erosion and valley widening begins.

c. The paleosol is a clay rich layer, often several feet thick, below the loess, which retards the downward percolation of water and may produce seeps or springs where it intercepts the surface. The upper bedrock in this area consists of Pennsylvanian age cyclic deposits of sandstone, siltstone, shale, limestone and coal. The more resistant units are occasionally exposed at tributary valley nick points or along eroded hillsides and often are stained red to yellow by iron compounds. Older Mississippian age deposits of carbonates and sandstones underlie these but are not exposed in the project area.

5. GEOTECHNICAL INVESTIGATION

a. A detailed geotechnical investigation was conducted to obtain subsurface information and engineering properties of different soils encountered along the proposed project site. This investigation included soil drilling and sampling, field testing, and laboratory testing.

b. A total of fifty borings were taken along the proposed trail alignment. Borings were taken at the worst of the existing County Road G-28 embankment slopes where the trail will be located; proposed trail embankment locations; the two bridge locations; the proposed borrow areas; and along the trail alignment. The borings were drilled to depths varying from 5 to 45 feet below the ground surface. The boring locations are shown on plates 8 through 28 in the main report. The boring logs are shown in plate C-1 through C-4.

6. DRILLING PROCEDURES

a. The subsurface exploration procedures were in accordance with U.S. Army Corps of Engineers and ASTM standards as follows:

(1) EM 1110-1-1804, "Geotechnical Investigations"
(2) EM 1110-2-1907, "Soil Sampling"
(3) ASTM D 1586, "Penetration Test and Split-Barrel Sampling of Soils"

b. The fifty soil borings (5 to 45 feet deep) were made with an all-terrain vehicle (ATV) mounted rotary drilling rig Central Mine Equipment (CME) Model 850. The borings were advanced using hollow stem augers (3-1/4" inside diameter) to stabilize the sides of the borehole.

7. SAMPLING PROCEDURES

a. Structure and embankment soil samples were obtained using a 2-inch outside diameter split spoon sampler as part of the standard penetration test (ASTM D 1586). These borings were sampled at 2-1/2 foot intervals. The CME Auto Hammer used to drive the standard split spoon has an assumed efficiency of 90%. "N" value data should be normalized to 60% as per ETL-1110-1-138.

b. Sampling at borrow sites and along the trail alignment was accomplished using a five foot long 3 inch O.D. split barrel continuous system. Bag samples (about 50 lbs. each) from the five borrow sites were also obtained to perform representative standard proctor compaction tests.

8. TESTING PROGRAM

The purpose of the laboratory testing program was to classify and provide engineering properties of the soils encountered. The laboratory testing program consisted of the following tests: (a) visual classification, (b) moisture content, and (c) Atterberg limits. Visual classification was performed on all samples. All soil samples were tested for moisture content. Selected fine-grained representative samples were tested for Atterberg limits. The standard proctor compaction tests were also performed on samples from representative borrow sites in accordance with ASTM D 698.

9. EARTH EMBANKMENTS

a. The highest compacted embankment will be constructed between Stations 430+00 and 434+00 and is shown on plate 25 of the main report. It will be approximately 34 feet high at its highest point with a 16 foot crown to accommodate the multi-purpose trail (see plate C-12). Both side slopes of the embankments will be constructed to a uniform slope of 1 vertical (V) on 3 horizontal (H).

b. The embankment will be constructed of impervious materials classified as CL, CL-CH, and CH with not less than 50 percent by weight passing the no. 200 sieve. The embankment's low point will be at elevation 744 MSL . Elevation 742 is normal low pool; however, every year during autumn (Sep 15 to Dec 15), the conservation pool is raised to 744 for the benefit of the migrating water fowl. Therefore, the embankment will not be under water under normal circumstances.

c. Construction of the compacted impervious embankment will be controlled by moisture and density control to eliminate slope stability problems and to provide an embankment of low compressibility. For moisture control, a range of plus 2 to minus 2 percentage points deviation from the optimum moisture content will be used (see plates C-8 through C-11). For density control, the uncompacted lift thickness (9 inches with tamper-type roller and 12 inches with rubber-tired roller) of impervious fill will be compacted to not less than 95 percent of maximum density, utilizing a 25-blow proctor compaction test in accordance with EM 1110-2-1906 while using standard compaction equipment.

d. Both contractor quality control (CQC) and government quality assurance (GQA) testing will serve to assure that a quality embankment is constructed using this construction plan. The contractor should be required to run field in-place density tests (ASTM D 1556 or ASTM D 2167) for every 4,000 cubic yards of embankment placed (minimum of one test per day during embankment placement). Any materials encountered that become too wet or too dry for proper compaction will require the contractor to either dry-back or pre-wet the material prior to rolling operations.

10. EMBANKMENT PROTECTION

a. Based on observations along County Road G-28, no embankment protection due to wave action is necessary. The highest pool elevation ever was 782.67 MSL in July 1993. Except for Stations 429+00 to 448+00, the multi-purpose trail is above elevation 780. The lowest point on the trail is at Station 436+00 at elevation 760.

b. The proposed embankment at Station 432+50 has its low point at elevation 744 MSL (sheet 25 of 28 in the main report). However, due to the fact that it is on a 100 foot wide inlet that is about 3,100 feet from the main pool, no wave action is expected to occur at this point.

11. FOUNDATION FOR THE EARTH EMBANKMENT AT STATION 432+50

a. The entire foundation beneath the proposed embankment at Station 432+50 will be cleared and stripped to remove vegetation and other deleterious materials to a depth of 6 inches. All tap roots, lateral roots, or other projections over 1.5 inches in diameter within the embankments' foundation areas will be removed to a depth of three feet below natural ground surface.

b. A field investigation was made to ascertain the proposed earth embankment's foundation conditions (Bore RRB-94-37 in plate C-4). The top stratum consists of a gray lean clay(CL). It is five feet thick and has a moisture content ranging from 18 to 30 percent. The standard penetration test "N" values that were recorded during the drilling operation ranged from 2 to 4 blow counts. Beneath this strata is a black shale bedrock from elevation 739 MSL. The bore was extended eight feet into the bedrock. The standard penetration test "N" values recorded for the shale ranged from 8 to 74 blow counts.

12. FOUNDATION FOR THE 193 FOOT PREFABRICATED BRIDGE

a. Two abutments and one pier (Stations 458+23 to 460+16) will be built on steel HP piles to support a 193-foot long prefabricated bridge as shown on plates 3 and 27 in the main report. Borings RRB-94-41, RRB-94-42, and RRB-94-43 were taken to determine the engineering characteristics of the foundation materials and to provide criteria for the proposed bridge foundation design (see plate C-3).

b. The bridge soil borings are about 20 feet from the final location of the abutments and pier due to a realignment of the trail after the borings were completed. The subsurface information seems consistent enough not to warrant obtaining additional borings for the final plans and specifications portion of the project.

c. Based on the borings in plate C-3, the top 17 to 32 feet of stratum consist of sandy lean clay (CL) and clayey sand (SC). This material has a natural moisture content ranging from 8 to 25 percent with an average natural moisture content of 19 percent. The standard penetration test "N" values were also recorded during drilling operation. The

values ranged from 3 to 23 blow counts with an average "N" value of 14 blow counts.

d. All three borings were extended to bedrock. A soft to moderately soft shale layer was encountered beneath the top strata. The top elevation at which this shale was encountered ranged approximately from 748 to 749.5 MSL and had a strata thickness of 9 to 13 feet. The standard penetration test "N" values ranged from 33 to 71 blow counts with an average "N" value of 52 blow counts.

e. A dark gray hard, massive, shale was encountered at elevations 736.6 to 740.1 MSL. The piles will need to be driven to this layer indicating a length of about 41 feet in the ground for the piles at the west abutment, a length of about 28 feet at the pier, and a length of about 38 feet at the east abutment.

13. FOUNDATION FOR THE 40' WOODEN BRIDGE

a. Two abutments (Stations 59+60 to 60+00) will be built on steel HP piles to support a 40-foot long wooden covered bridge as shown on plates 4 and 8 in the main report. Borings RRB-94-49 and RRB-94-50 were taken to determine the engineering characteristics of the foundation materials and to provide criteria for the proposed bridge foundation design (see plate C-4).

b. These soil borings are about 30 feet from the final location of the abutments due to a realignment of the trail after the borings were completed. The subsurface information seems consistent enough not to warrant additional borings for the final plans and specifications portion of the project.

c. Based on the borings in plate C-4, the top 11 to 13.5 feet of stratum consist of a brown lean clay (CL). This material has a natural moisture content ranging from 15 to 25 percent with an average natural moisture content of 21 percent. The standard penetration test "N" values were also recorded during the drilling operation. The values ranged from 7 to 25 blow counts with an average "N" value of 13 blow counts.

d. Beneath the lean clay, a layer of clayey sand with sandstone (SP-SC), shale with sandstone (SH), and sandstone (SS) was encountered. The top elevation of this material ranged approximately from 791.5 to 793.4 MSL and had a strata thickness of 7 to 11 feet. The natural moisture content ranged from 8 to 26 percent with an average of 15 percent. The standard penetration test "N" values ranged from 60 to 90 blow counts with an average "N" value of 73 blow counts.

e. A black shale bedrock was encountered at elevations 782.4 to 784.5 MSL. This bedrock had standard penetration test "N" values of 55 to 131+ with an average "N" value of 81 blow counts. The piles need to be driven to this layer (although the layer above this one indicated high "N" values as well). If this is the case, the piles will have a length of about 22 feet in the ground at both the east and west abutments.

14. GROUNDWATER

a. Groundwater level observations were monitored during drilling operations and were noted on the boring logs as shown in plates C-1 through C-4. Based on these observations, groundwater levels were only encountered at borings RRB-94-41, RRB-94-42, and RRB-94-43 (the prefabrication bridge location). The groundwater elevations ranged from 729 to 733 MSL. The water levels should be expected to fluctuate with changes in the climatic conditions and reservoir levels.

b. The only other boring where a groundwater level was observed was at boring RRB-94-49 (wooden bridge location) where the groundwater elevation was 784.4 MSL. Since the highest pool elevation ever was 782.67 MSL and since normal pool is 742 MSL, it is suspected that this groundwater is from a pinched water table.

15. SLOPE STABILITY

a. The stability of slopes was analyzed by Spencer's procedure for Circular Arc and Non-circular Slope Stability Analysis in accordance with EM 110-2-1902, "Engineering Design Stability of Earth and Rockfill Dams," dated 1 April 1970. The selected critical section was determined with the UTEXAS3 software program.

b. A detailed study of all embankment sections and soil profiles along the trail alignment indicated that the most critical embankments were the existing County Road G-28 embankments when the proposed trail alignment runs along the embankment slope, especially since a retaining wall will be used at these locations (note Typical Section #3 on sheet 5 of 28 of the main report). Two areas appeared to have surface sloughing (later found to be surface erosion), one at Station 289+00 and the other at Station 421+60, and were therefore analyzed for slope stability. A third critical area was determined by analyzing the remaining worst embankment sections and soil profiles along the trail alignment as shown in Table C-1. The area at Station 208+90 was determined to be the most critical.

c. To estimate the stability of each embankment, a range of conservative unconsolidated undrained shear strengths (Q) was assumed for the most severe configuration of compacted embankment and foundation. The undrained shear strength of the compacted impervious embankment was estimated based on test results of similar soils from construction of similar projects. This was then compared to undrained shear strengths (Q) determined from "N" values. In all cases, the undrained shear strength from "N" values was lower and therefore more conservative, and was therefore used.

d. The District's experience with the performance of impervious embankments during high water provided a basis for judging the adequacy of the proposed sections for slope stability during falling or constant Lake Red Rock Reservoir stages. Slope stability analyses were considered unnecessary for any loading condition other than the end of construction condition.

e. The slope stability analysis for the embankment after construction at Station 208+90 is shown in plate C-5. Boring RRB-94-18 in plate C-2 was used to provide the information for the analysis. The computed minimum safety factor was found to be 2.14. This exceeds the 1.3 that is required by EM 1110-2-1913, "Design and Construction of Levees," dated March 31, 1978. Therefore, no slope stability problems are expected at this embankment.

f. The slope stability analysis for the embankment after construction at Station 289+00 is shown in plate C-6. Boring RRB-94-23 in plate C-2 was used to provide the information for the analysis. The computed minimum safety factor was found to be 2.70. This exceeds the 1.3 that is required by EM 1110-2-1913, "Design and Construction of Levees," dated March 31, 1978. Therefore, no slope stability problems are expected at this embankment.

g. Due to the appearance of an area that appeared to be a slough along the slope of the embankment at Station 289+00, a further investigation was performed. It was determined that surface erosion rather than sloughing is responsible for a 1:1.3 vertical to horizontal bench between elevations 776.0 MSL and 779.8 MSL along the embankment slope. The bench runs from Station 284+60 to 290+90 (a total of 630 feet). This is verified by the fact that the Red Rock pool level was above elevation 776.0 in 1993 for a total of 55 days. Lack of vegetation on the bench and driftwood at the base of the bench verifies this conclusion. Further, digging was performed at various places along the base of the bench and it was discovered that a sandy topsoil layer 18 inches thick covered a much stronger and firmer lean clay as shown in boring RRB-94-23. It is recommended that the retaining wall footing at this location be placed at least

three feet into the embankment or below the frost line, whichever is deeper.

h. The slope stability analysis for the embankment after construction at Station 421+60 is shown in plate C-7. Boring RRB-94-36 in plate C-4 was used to provide the information for the analysis. The computed minimum safety factor was found to be 2.87. This exceeds the 1.3 that is required by EM 1110-2-1913, "Design and Construction of Levees," dated March 31, 1978. Therefore, no slope stability problems are expected at this embankment.

i. Due to the appearance of a slough area along the slope of the embankment at Station 421+60, a further investigation was performed. It was determined that surface erosion rather than sloughing is responsible for a 1:0.72 vertical to horizontal bench between elevations 774.7 and 778.6 MSL along the embankment slope. The bench runs from Station 417+80 to 430+20 (a total of 1,240 feet). This is verified by the fact that the Red Rock pool level was above elevation 774.7 in 1993 for a total of 62 days. Lack of vegetation along the bench and driftwood at the base of the bench, verifies this conclusion.. Further, digging was performed at various places along the base of the bench and it was discovered that a sandy topsoil layer 18-24 inches thick covered a much stronger and firmer lean clay as shown in bore hole RRB-94-36. It is recommended that the retaining wall at this location be placed at least three feet into the embankment.

j. The entire contact surface between the multipurpose trail and the existing slope embankment along County Road G-28 is to be cleared and stripped to remove vegetation and other deleterious materials to a depth of 6 inches. All tap roots, lateral roots, or other projections over 1.5 inches in diameter within the embankments' foundation areas are to be removed to a depth of three feet below natural ground surface.

16. SETTLEMENT

The proposed earth embankment at Station 432+50 was found by far to be most critical with respect to settlement. The 34-foot high embankment will impose a maximum load of 2.13 tons per square foot on a 5-foot thick stratum of lean consistency clay foundation stratum. A summary of the settlement analysis is shown in plates C-12 through C-15; it indicates total settlement to be approximately nine inches. The specifications will require that the embankment be overbuilt by two percent to allow for any consolidation of the embankment and settlement in the foundation. The embankment will require three months for 80% primary consolidation.

17. BORROW MATERIAL

a. The borrow material for the proposed multi-purpose trail embankment will be removed from areas as shown on sheet 7 of 28 of the main report. The borrow areas, their stationing, and their corresponding bore holes are listed below:

BORROW AREA	STATION	BORING (RRB-94-)	BORING LOCATION
1	450+00, 200 LT	40	Plate C-4
2	420+00, 900 LT	34,35	Plate C-4
3	301+00, 100 LT	25	Plate C-2
4	181+00, 300 LT	16	Plate C-1
5	148+50, 300 LT	47	Plate C-4

b. The material indicated by the borings consists of clays (CL, CL-CH, and CH). The borrow sites are relatively similar in soil content although stratas of the different types of clay are different at each site. Therefore, three representative samples were selected for compaction test results (see plates C-8 through C-11).

c. The natural moisture content in the borrow sites ranges from 12 to 29 percent with an average moisture content of about 19 percent. Atterberg limits testing revealed a range of 32/21 (liquid limit/plastic limit) to 51/28. The optimum moisture content was determined to vary from 15 to 20 percent with a maximum dry density of 104.2 to 112.8 lbs/cu ft. Groundwater was not encountered in any borings.

d. The borrow materials appear suitable for the multi-purpose trail and embankment construction. The borrow material will require some drying prior to placement. No compaction or shear strength difficulties with this material are anticipated.

REDROCK TRAIL SEGMENT IV

Station	Worst Slope Along Embankment	Soil Type	Moisture Content (%)	Cohesion c (psf)	Angle of Internal Friction (degrees)	Elevation Difference From Top of Levee to Toe (ft)	Elevation Difference From Proposed Trail to Toe (ft)
131+20	1:2.1	CL	22.5	1200	0	44	36
149+15	1:2.6	CL	22.5	1200	0	36	18
208+90	1:1.9	CL	23.5	850	0	50	35.1
341+20	1:2.6	CL	24.5	950	0	39.3	33.6
378+44	1:2.5	CL	24.5	950	0	39	34.9

COMPARISON OF VARIOUS SLOPES WITH POSSIBLE SLOPE STABILITY PROBLEMS

TABLE C-1

RRB-94-1

HS 805.4

CH BR FAT CLAY

CL BR SANDY LEAN CLAY

520,694 N 2,111,439 E
12/8/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 3" DIA CONTINUOUS SAMPLER.

RRB-94-2

HS 805.0

CL BR LEAN CLAY

CL BR SANDY LEAN CLAY (TILL)

520,300 N 2,111,367 E
12/9/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-3

RS 824.0

CH BR FAT CLAY

519,805 N 2,111,365 E
12/9/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
NO PENETROMETER DATA OBTAINED AT THIS HOLE.

RRB-94-4

RS 839.9

CH BR FAT CLAY

520,192 N 2,111,892 E
12/9/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-5

HS 849.5

CL-CH BR MEDIUM CLAY

520,663 N 2,112,763 E
12/9/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-6

HS 834.4

CL-CH BR MEDIUM CLAY

520,652 N 2,113,349 E
12/9/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-7

HS 828.0

CH BR FAT CLAY

CL-CH BR MEDIUM CLAY

CL BR LEAN CLAY

520,772 N 2,113,984 E
12/12/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-8

RS 786.0

CL-CH BR MEDIUM CLAY

CL GR AND BR SANDY LEAN CLAY (TILL)

520,122 N 2,114,266 E
12/12/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-9

HS 778.0

CL-CH GR MEDIUM CLAY

519,691 N 2,116,151 E
12/12/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-10

RS 787.2

CL BR LEAN CLAY

CL BR SANDY LEAN CLAY

CL GR LEAN CLAY (TILL)

CL BR GR LEAN CLAY

CL BR LEAN CLAY WITH HARD NODULES

CL BR SANDY LEAN CLAY (TILL)

CL GR LEAN CLAY

519,483 N 2,115,770 E
12/12/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.

RRB-94-11

HS 806.8

CL BR LEAN CLAY

SS BR WEATHERED SANDSTONE

CL BR LEAN CLAY

519,238 N 2,117,030 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.

RRB-94-12

RS 797.0

CH BR FAT CLAY

518,568 N 2,117,348 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-13

RS 789.5

CL BR LEAN CLAY

CH BR FAT CLAY

518,263 N 2,117,350 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-14

HS 806.0

CL BR LEAN CLAY

CH BR FAT CLAY

CL BR LEAN CLAY

518,850 N 2,118,005 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-15

HS 789.8

CL BR SANDY LEAN CLAY

CL-CH BR MEDIUM CLAY

518,793 N 2,118,322 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.

RRB-94-16

HS 831.5

CL BR SANDY LEAN CLAY

CL-CH BR MEDIUM CLAY

CL BR LEAN CLAY

519,041 N 2,118,792 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
BULK SAMPLES TAKEN AT 0.0' - 6.0', 7.0' - 12.0'

RRB-94-17

FA 783.8

CL-CH BR MEDIUM CLAY

519,063 N 2,119,763 E
12/13/94

NO WATER LEVEL ENCOUNTERED.
SAMPLES TAKEN FROM FLIGHT AUGER.

LOCATIONS GIVEN IN IOWA COORDINATE SYSTEM - SOUTH ZONE

LEGEND

BORING NUMBER

HOLE ADVANCED BY 4" FLIGHT AUGER
HOLE ADVANCED BY 3¼" HOLLOW STEM

TOP ELEVATION

MAJOR STRATA BREAK

MINOR STRATA BREAK

COHESIVE AND PLASTIC SOILS: 3½"

POCKET PENETROMETER 1/2 SPT: 1.0

*NUMBER OF BLOWS TO DRIVE STANDARD SPLIT SPOON (2" O.D.) ONE FOOT WITH 140 LB. HAMMER AND 30 INCH DROP

20 NATURAL MOISTURE CONTENT IN PERCENT DRY WEIGHT

LOCATION OF BORING
DATE OF BORING

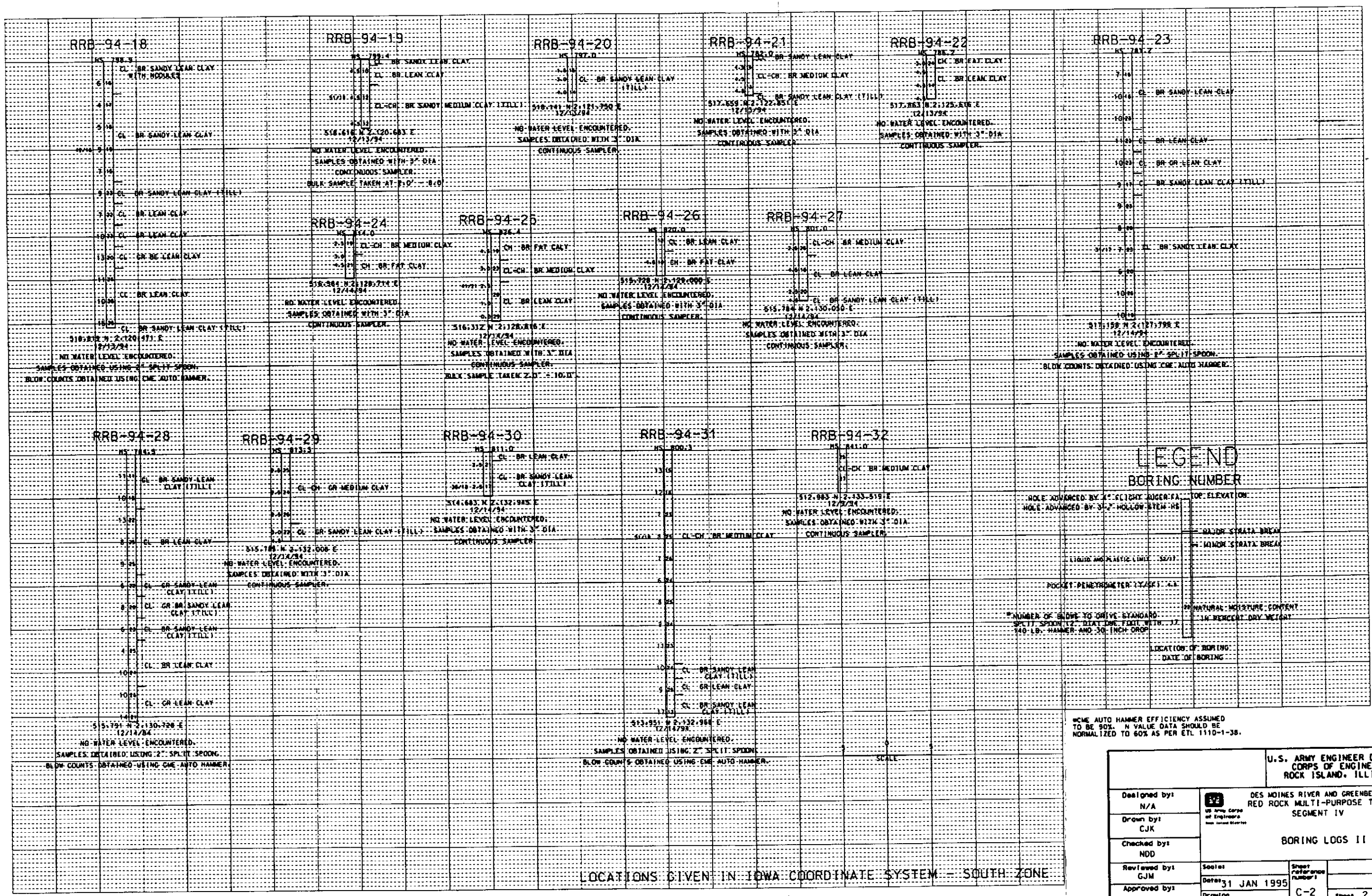
eCME AUTO HAMMER EFFICIENCY ASSUMED TO BE 90%. N VALUE DATA SHOULD BE NORMALIZED TO 60% AS PER ETL 1110-1-38.

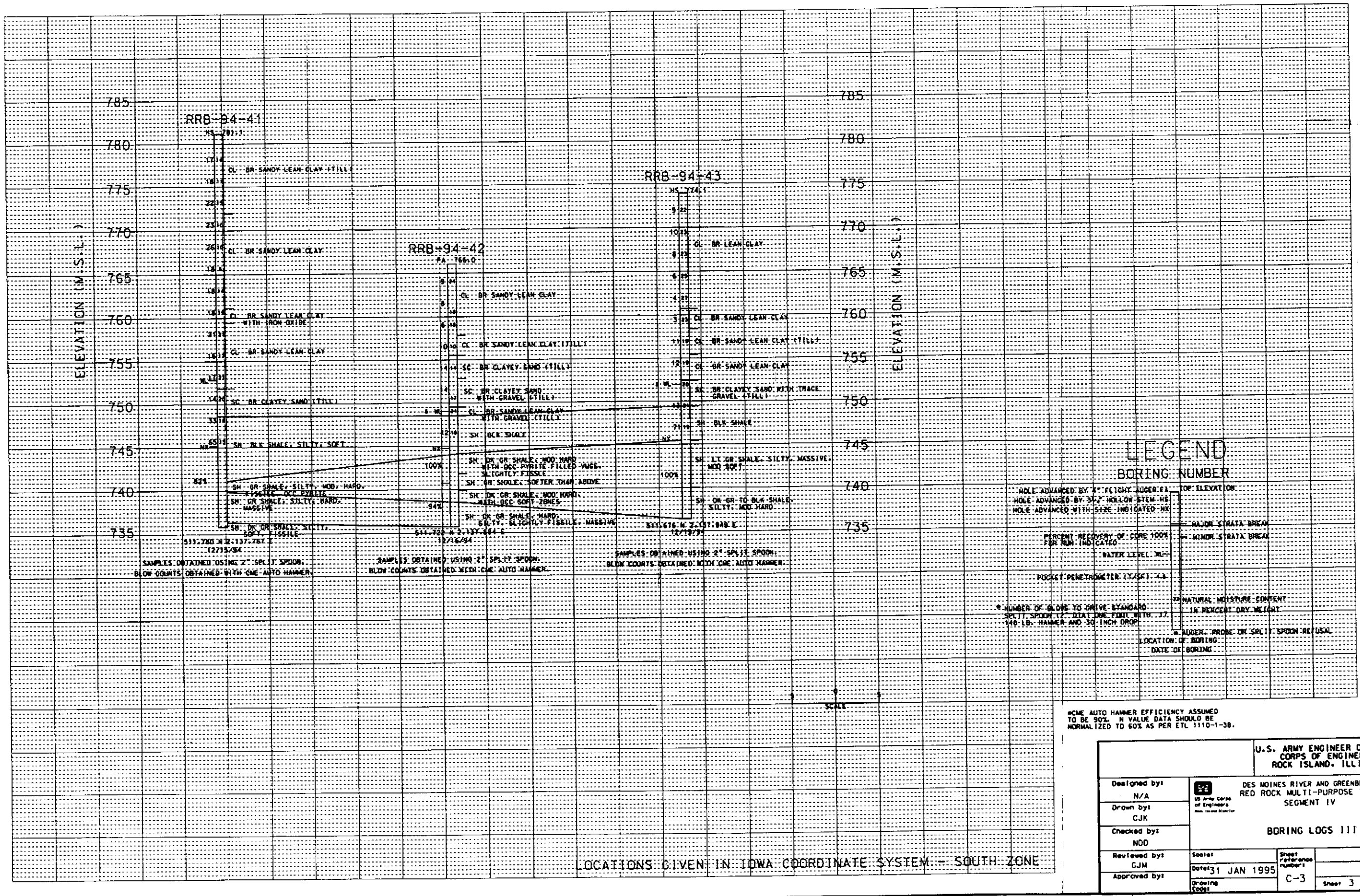
SCALE 0 1"

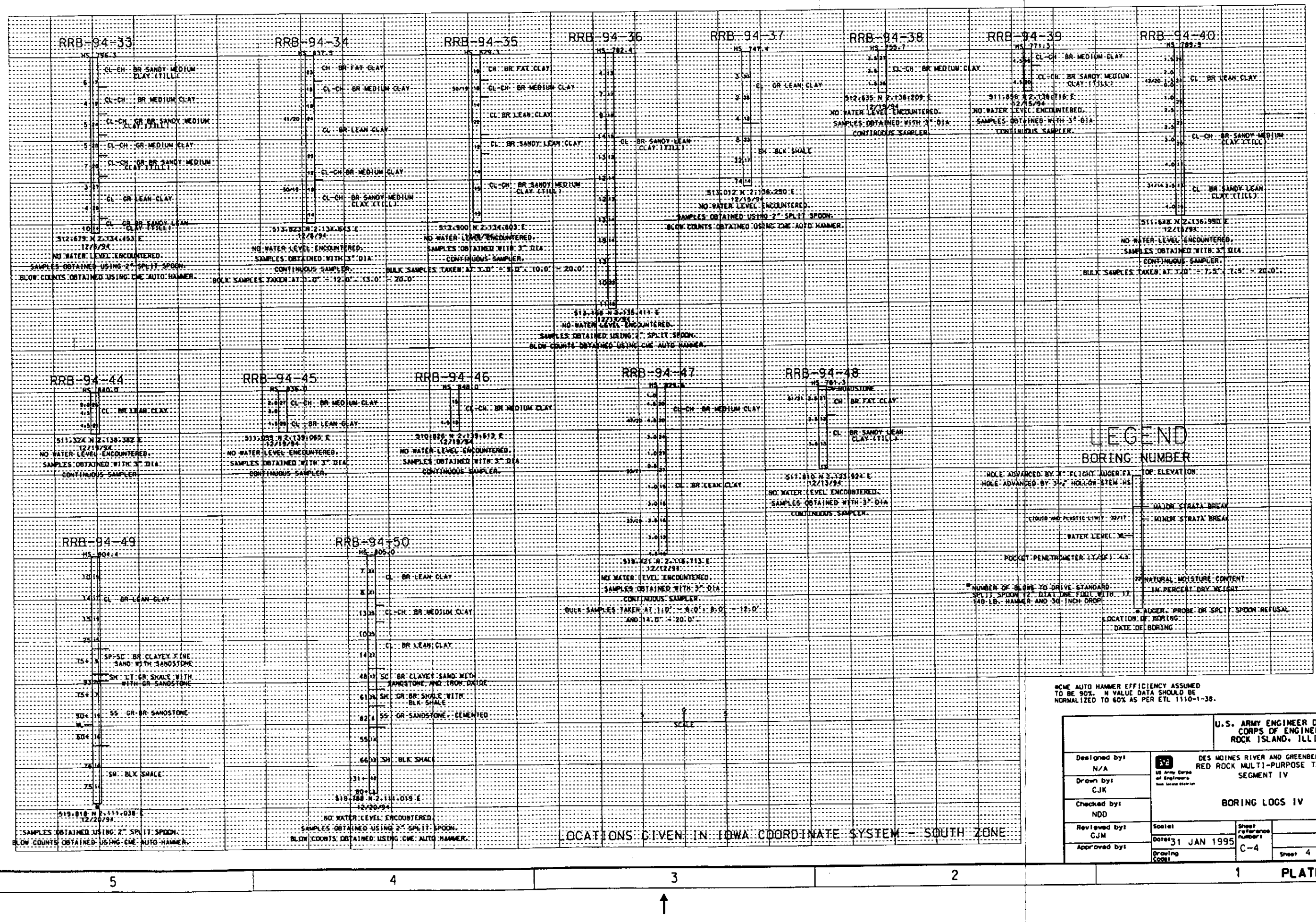
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

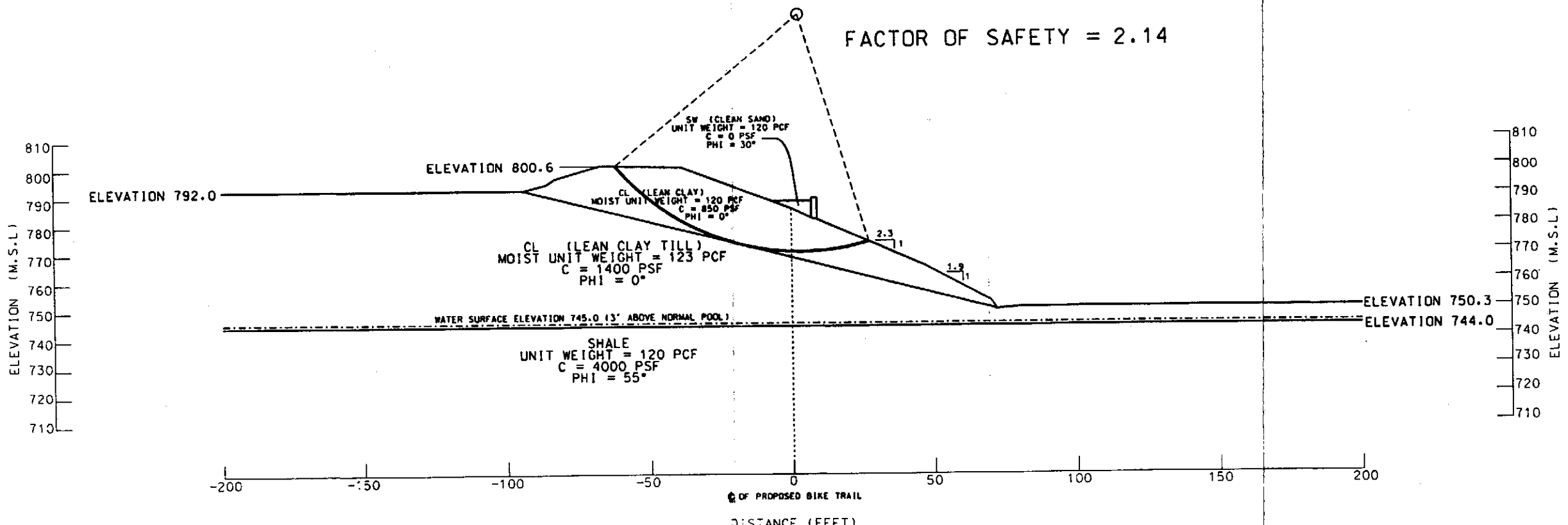
Designed by: N/A	DES MOINES RIVER AND GREENBELT RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Drawn by: CJK	BORING LOGS I
Checked by: NDD	
Reviewed by: GJM	Scale:
Approved by:	Date: 31 JAN 1995
	Drawing Code:
	Sheet reference number: C-1
	Sheet 1 of 7

PLATE C-1


RRB-94-18
HS 788.5
CL BR SANDY LEAN CLAY WITH NODULES
CL BR SANDY LEAN CLAY
CL GR SANDY LEAN CLAY (TILL)
CL BR LEAN CLAY
CL GR BR LEAN CLAY
CL GR BR LEAN CLAY
CL BR LEAN CLAY
CL BR SANDY LEAN CLAY (TILL)
518,812 N 2,120,473 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-19
HS 799.4
CL BR SANDY LEAN CLAY
CL BR LEAN CLAY
CL-CH BR SANDY MEDIUM CLAY (TILL)
518,618 N 2,120,683 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
BULK SAMPLE TAKEN AT 2.0' - 8.0'
RRB-94-20
HS 797.0
CL BR SANDY LEAN CLAY (TILL)
518,141 N 2,121,750 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-21
HS 795.0
CL BR SANDY LEAN CLAY
CL-CH BR MEDIUM CLAY
CL BR SANDY LEAN CLAY (TILL)
517,659 N 2,122,851 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-22
HS 795.7
CH BR FAT CLAY
CL BR LEAN CLAY
517,863 N 2,125,535 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-23
HS 781.2
CL BR SANDY LEAN CLAY
CL BR LEAN CLAY
CL BR GR LEAN CLAY
CL BR SANDY LEAN CLAY (TILL)
CL BR SANDY LEAN CLAY
317,159 N 2,127,798 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-24
HS 814.0
CL-CH BR MEDIUM CLAY
CH BR FAT CLAY
518,586 N 2,128,714 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-25
HS 826.4
CH BR FAT CLAY
CL-CH BR MEDIUM CLAY
CL BR LEAN CLAY
516,332 N 2,128,816 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
BULK SAMPLE TAKEN 2.0' - 10.0'
RRB-94-26
HS 820.0
CL BR LEAN CLAY
CH BR FAT CLAY
515,728 N 2,129,000 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-27
HS 801.0
CL-CH BR MEDIUM CLAY
CL BR LEAN CLAY
CL BR SANDY LEAN CLAY (TILL)
515,784 N 2,130,030 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-28
HS 786.9
CL BR SANDY LEAN CLAY (TILL)
CL BR LEAN CLAY
CL GR SANDY LEAN CLAY (TILL)
CL BR SANDY LEAN CLAY (TILL)
CL BR LEAN CLAY
CL GR LEAN CLAY
515,791 N 2,130,728 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-29
HS 813.3
CL-CH GR MEDIUM CLAY
CL GR SANDY LEAN CLAY (TILL)
515,788 N 2,132,008 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-30
HS 811.0
CL BR LEAN CLAY
CL BR SANDY LEAN CLAY (TILL)
514,683 N 2,132,985 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
RRB-94-31
HS 800.3
CL-CH BR MEDIUM CLAY
CL BR SANDY LEAN CLAY (TILL)
CL GR LEAN CLAY
CL BR SANDY LEAN CLAY (TILL)
513,951 N 2,132,968 E
12/14/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-32
HS 841.0
CL-CH BR MEDIUM CLAY
512,983 N 2,133,519 E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA CONTINUOUS SAMPLER.
LEGEND
BORING NUMBER
HOLE ADVANCED BY 4" FLIGHT AUGER
HOLE ADVANCED BY 3½" HOLLOW STEM AS
TOP ELEVATION
MAJOR STRATA BREAK
MINOR STRATA BREAK
LIQUID AND PLASTIC LIMIT
POCKET PENETROMETER (T/SF)
NATURAL MOISTURE CONTENT IN PERCENT DRY WEIGHT
NUMBER OF BLOWS TO DRIVE STANDARD SPLIT SPOON 12" DIAT ONE FOOT WITH 140-LB. HAMMER AND 30 INCH DROP
LOCATION OF BORING
DATE OF BORING
#CME AUTO HAMMER EFFICIENCY ASSUMED TO BE 90%. N VALUE DATA SHOULD BE NORMALIZED TO 60% AS PER ETL 1110-1-38.
SCALE
LOCATIONS GIVEN IN IOWA COORDINATE SYSTEM - SOUTH ZONE
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS
Designed by: N/A
Drawn by: CJK
Checked by: NDD
Reviewed by: GJM
Approved by:
DES MOINES RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV
BORING LOGS II
Scale:
Date: 31 JAN 1995
Drawing Code:
Sheet reference number: C-2
Sheet 2 of 7
PLATE C-2


RRB-94-41
RRB-94-42
RRB-94-43
ELEVATION (M.S.L.)
785
780
775
770
765
760
755
750
745
740
735
CL BR SANDY LEAN CLAY (TILL)
CL BR SANDY LEAN CLAY
CL BR SANDY LEAN CLAY WITH IRON OXIDE
SC BR CLAYEY SAND (TILL)
SH BLK SHALE; SILTY; SOFT
SH GR SHALE; SILTY; MOD. HARD; FISSILE; OCC PYRITE
SH GR SHALE; SILTY; HARD; MASSIVE
SH DK GR SHALE; SILTY; SOFT; FISSILE
SAMPLES OBTAINED USING 2" SPLIT SPOON;
BLOW COUNTS OBTAINED WITH CME AUTO HAMMER.
CL BR SANDY LEAN CLAY (TILL)
SC BR CLAYEY SAND (TILL)
SC BR CLAYEY SAND WITH GRAVEL (TILL)
CL BR SANDY LEAN CLAY WITH GRAVEL (TILL)
SH BLK SHALE
SH DK GR SHALE; MOD HARD WITH OCC PYRITE FILLED VUGS; SLIGHTLY FISSILE
SH GR SHALE; SOFTER THAN ABOVE
SH DK GR SHALE; MOD HARD; WITH OCC SOFT ZONES
SH DK GR SHALE; HARD; SILTY; SLIGHTLY FISSILE; MASSIVE
SAMPLES OBTAINED USING 2" SPLIT SPOON;
BLOW COUNTS OBTAINED WITH CME AUTO HAMMER.
CL BR LEAN CLAY
CL BR SANDY LEAN CLAY (TILL)
SC BR CLAYEY SAND WITH TRACE GRAVEL (TILL)
SH BLK SHALE
SH LT GR SHALE; SILTY; MASSIVE; MOD SOFT
SH DK GR TO BLK SHALE; SILTY; MOD HARD
SAMPLES OBTAINED USING 2" SPLIT SPOON;
BLOW COUNTS OBTAINED WITH CME AUTO HAMMER.
LEGEND
BORING NUMBER
HOLE ADVANCED BY 4" FLIGHT AUGER
HOLE ADVANCED BY 3 1/2" HOLLOW-STEM
HOLE ADVANCED WITH SIZE INDICATED
TOP ELEVATION
MAJOR STRATA BREAK
MINOR STRATA BREAK
PERCENT RECOVERY OF CORE FOR RUN INDICATED
WATER LEVEL
POCKET PENETROMETER (TONS/SQ. FT.)
NATURAL MOISTURE CONTENT IN PERCENT DRY WEIGHT
AUGER PROBE OR SPLIT SPOON REFUSAL
LOCATION OF BORING
DATE OF BORING
* NUMBER OF BLOWS TO DRIVE STANDARD SPLIT SPOON (2" O.D.) 24 INCHES WITH 140 LB. HAMMER AND 30 INCH DROP
SCALE
0
1
LOCATIONS GIVEN IN IOWA COORDINATE SYSTEM - SOUTH ZONE
*CME AUTO HAMMER EFFICIENCY ASSUMED TO BE 90%. N VALUE DATA SHOULD BE NORMALIZED TO 60% AS PER ETL 1110-1-38.
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed by: N/A
Drawn by: CJK
Checked by: NDD
Reviewed by: GJM
Approved by:
DES MOINES RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV
BORING LOGS III
Scale:
Date: 31 JAN 1995
Sheet reference number: C-3
Drawing Code:
Sheet 3 of 7
PLATE C-3


RRB-94-33
HS 796.3
CL-CH: BR SANDY MEDIUM CLAY (TILL)
CL-CH: BR MEDIUM CLAY
CL-CH: GR BR SANDY MEDIUM CLAY (TILL)
CL-CH: GR MEDIUM CLAY
CL-CH: GR BR SANDY MEDIUM CLAY (TILL)
CL: GR LEAN CLAY
CL: GR BR SANDY LEAN CLAY (TILL)
513,679.N 2,134,493.E
12/7/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-34
HS 837.5
CH: BR FAT CLAY
CL-CH: BR MEDIUM CLAY
CL: BR LEAN CLAY
CL-CH: BR MEDIUM CLAY
CL-CH: BR SANDY MEDIUM CLAY (TILL)
513,823.N 2,136,643.E
12/8/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
BULK SAMPLES TAKEN AT 3.0' - 12.0' - 13.0' - 20.0'
RRB-94-35
HS 829.1
CH: BR FAT CLAY
CL-CH: BR MEDIUM CLAY
CL: BR LEAN CLAY
CL: BR SANDY LEAN CLAY
CL-CH: BR SANDY MEDIUM CLAY (TILL)
513,800.N 2,134,603.E
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
BULK SAMPLES TAKEN AT 3.0' - 5.0' - 10.0' - 20.0'
RRB-94-36
HS 782.4
CL: BR SANDY LEAN CLAY (TILL)
513,456.N 2,135,411.E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-37
HS 747.4
CL: GR LEAN CLAY
SH: BLK SHALE
513,032.N 2,136,250.E
12/15/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-38
HS 755.7
CL-CH: BR MEDIUM CLAY
512,635.N 2,136,209.E
12/19/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
RRB-94-39
HS 771.3
CL-CH: BR MEDIUM CLAY
CL-CH: BR SANDY MEDIUM CLAY (TILL)
511,858.N 2,136,716.E
12/15/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
RRB-94-40
HS 789.9
CL: BR LEAN CLAY
CL-CH: GR SANDY MEDIUM CLAY (TILL)
CL: BR SANDY LEAN CLAY (TILL)
511,648.N 2,136,980.E
12/19/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
BULK SAMPLES TAKEN AT 3.0' - 7.5' - 7.5' - 20.0'
RRB-94-44
HS 840.0
CL: BR LEAN CLAY
511,326.N 2,138,382.E
12/19/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
RRB-94-45
HS 836.0
CL-CH: BR MEDIUM CLAY
CL: BR LEAN CLAY
511,055.N 2,139,065.E
12/19/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
RRB-94-46
HS 848.0
CL-CH: BR MEDIUM CLAY
510,826.N 2,139,612.E
12/19/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
RRB-94-47
HS 825.5
CL-CH: BR MEDIUM CLAY
CL: BR LEAN CLAY
511,810.N 2,133,624.E
12/13/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED WITH 3" DIA
CONTINUOUS SAMPLER.
RRB-94-48
HS 781.3
CH: BR FAT CLAY
CL: BR SANDY LEAN CLAY (TILL)
RRB-94-49
HS 804.4
CL: BR LEAN CLAY
SP-SC: BR CLAYEY FINE SAND WITH SANDSTONE
SH: LT GR SHALE WITH WITH GR SANDSTONE
SS: GR-BR SANDSTONE
SH: BLK SHALE
519,810.N 2,133,038.E
12/20/94
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
RRB-94-50
HS 805.0
CL: BR LEAN CLAY
CL-CH: BR MEDIUM CLAY
CL: BR LEAN CLAY
SC: BR CLAYEY SAND WITH SANDSTONE AND IRON OXIDE
SH: GR-BR SHALE WITH BLK SHALE
SS: GR-SANDSTONE, CEMENTED
SH: BLK SHALE
519,188.N 2,133,019.E
12/20/94
NO WATER LEVEL ENCOUNTERED.
SAMPLES OBTAINED USING 2" SPLIT SPOON.
BLOW COUNTS OBTAINED USING CME AUTO HAMMER.
LOCATIONS GIVEN IN IOWA COORDINATE SYSTEM - SOUTH ZONE
SCALE
LEGEND
BORING NUMBER
TOP ELEVATION
MAJOR STRATA BREAK
MINOR STRATA BREAK
HOLE ADVANCED BY 4" FLIGHT AUGER
HOLE ADVANCED BY 3 1/4" HOLLOW STEM HS
LIQUID AND PLASTIC LIMIT
WATER LEVEL
POCKET PENETROMETER (T/SF)
NATURAL MOISTURE CONTENT IN PERCENT DRY WEIGHT
AUGER, PROBE OR SPLIT SPOON REFUSAL
LOCATION OF BORING
DATE OF BORING
NUMBER OF BLOWS TO DRIVE STANDARD SPLIT SPOON 12" DIA 1 FOOT WITH 1 1/2 140-LB. HAMMER AND 30-INCH DROP
*CME AUTO HAMMER EFFICIENCY ASSUMED TO BE 90%. N VALUE DATA SHOULD BE NORMALIZED TO 60% AS PER ETL 1110-1-38.
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed by: N/A
Drawn by: CJK
Checked by: NDD
Reviewed by: GJM
Approved by:
DES MOINES RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV
BORING LOGS IV
Scale:
Date: 31 JAN 1995
Drawing Code:
Sheet reference number: C-4
Sheet 4 of 7
PLATE C-4



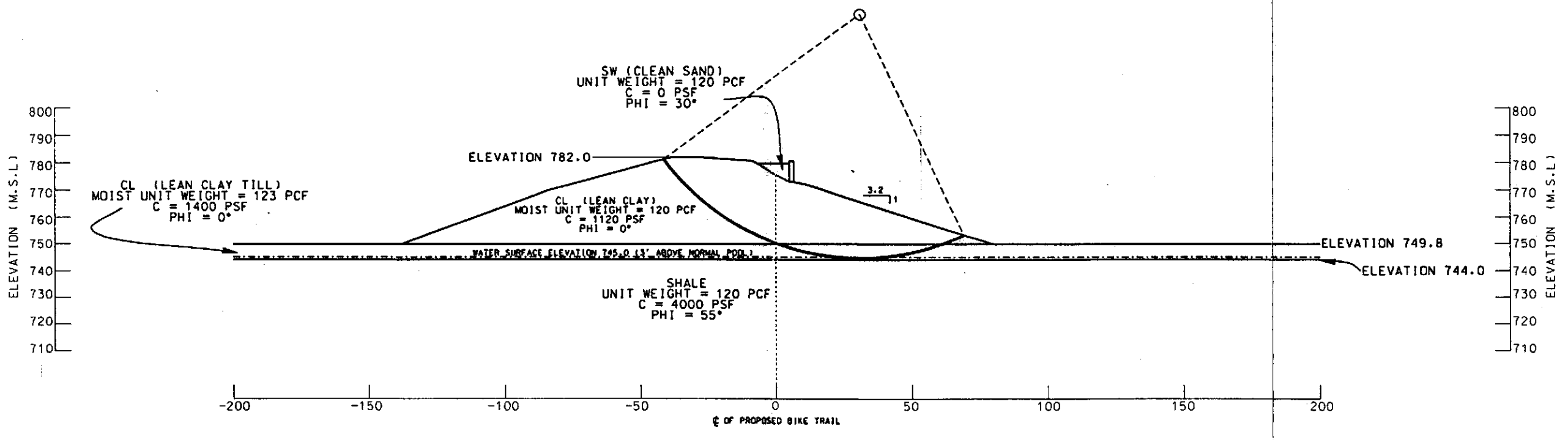
STA 208+90

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: NDD	DES MOINES RECREATIONAL RIVER AND GREENBELT
Drawn by: CJK	RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Checked by: N/A	SLOPE STABILTY ANALYSIS END OF CONSTRUCTION CONDITION STATION 208+90
Reviewed by: GJM	Scale:
Approved by:	Date: 02 FEB 1995
	Drawing Code:
	Sheet reference number: C-5
	Sheet 5 of 7

PLATE C-5

FACTOR OF SAFETY = 2.7



STA 289+00

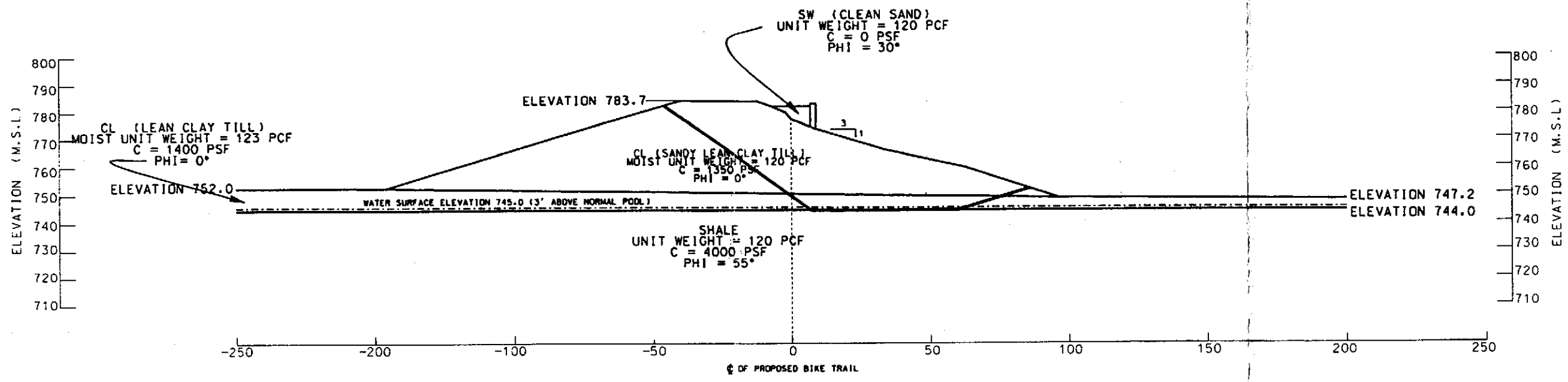
WATER SURFACE

20' 0 20'

	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed by: NDD	DES MOINES RECREATIONAL RIVER AND GREENBELT RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Drawn by: CJK	SLOPE STABILTY ANALYSIS END OF CONSTRUCTION CONDITION STATION 289+00
Checked by: N/A	
Reviewed by: GJM	Scale:
Approved by:	Date: 30 JAN 1995
	Drawing Code:
	Sheet reference number: C-6
	Sheet 6 of 7

PLATE C-6

FACTOR OF SAFETY = 2.87



STA 421+60

	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS ROCK ISLAND, ILLINOIS
Designed by: NDD	DES MOINES RECREATIONAL RIVER AND GREENBELT RED ROCK MULTI-PURPOSE TRAIL SEGMENT IV
Drawn by: CJK	SLOPE STABILTY ANALYSIS END OF CONSTRUCTION CONDITION STATION 421+00
Checked by: N/A	
Reviewed by: GJM	Scales:
Approved by:	Dates: 31 JAN 1995
	Drawing Code:
	Sheet reference number: C-7
	Sheet 7 of 7

PLATE C-7

RED ROCK BIKE TRAIL STAGE IV

Proctor Sample #1 (Moisture-Density Relationship)

Hole Number:	RRB-94-34,35	**Date Sample Taken:**	12/8/94
Standard Proctor Compaction		**Sample Depth (34):**	1.0-12.0 ft
Curve. Automatic (Rainhart)		**Sample Depth (35):**	1.0-9.0 ft
Hammer Used. (ASTM D-698)		**Max Dry Density:**	104.2 pcf
Atterberg Test Results:		**Optimum Moisture:**	20.0%
LL:	46	**Soil Class.:** CL-CH Br. Med. Clay (Alluvium)	
PL:	17	**Retained on #4 Sieve(gravel):**	0.0%
PI:	29	**Retained on #200 Sieve(sand):**	1.5%

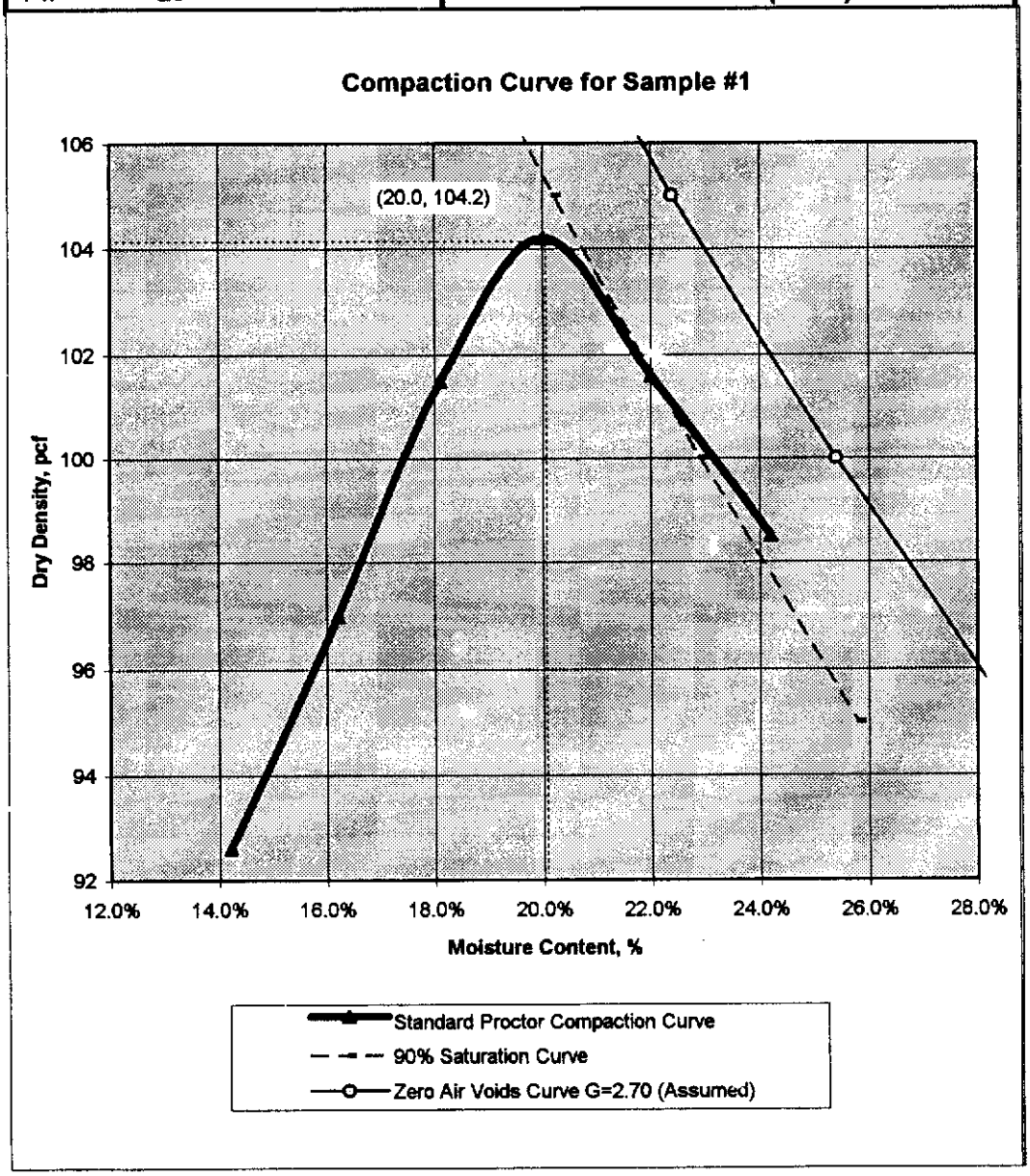


PLATE C-8

RED ROCK BIKE TRAIL STAGE IV

Proctor Sample #2 (Moisture-Density Relationship)

Hole Number:	RRB-94-34, 35	**Date Sample Taken:**	12/8/94
Standard Proctor Compaction Curve. Automatic (Rainhart) Hammer Used. (ASTM D-698)		**Sample Depth (34):**	13.0-20.0 ft
		Sample Depth (35):	10.0-20.0 ft
		Max Dry Density:	112.8 pcf
Atterberg Test Results:		**Optimum Moisture:**	15.0%
LL:	39	**Soil Class.:** CL Br. Sandy Lean Clay (Till)	
PL:	14	**Retained on #4 Sieve(gravel):**	0.1%
PI:	25	**Retained on #200 Sieve(sand):**	30.2%

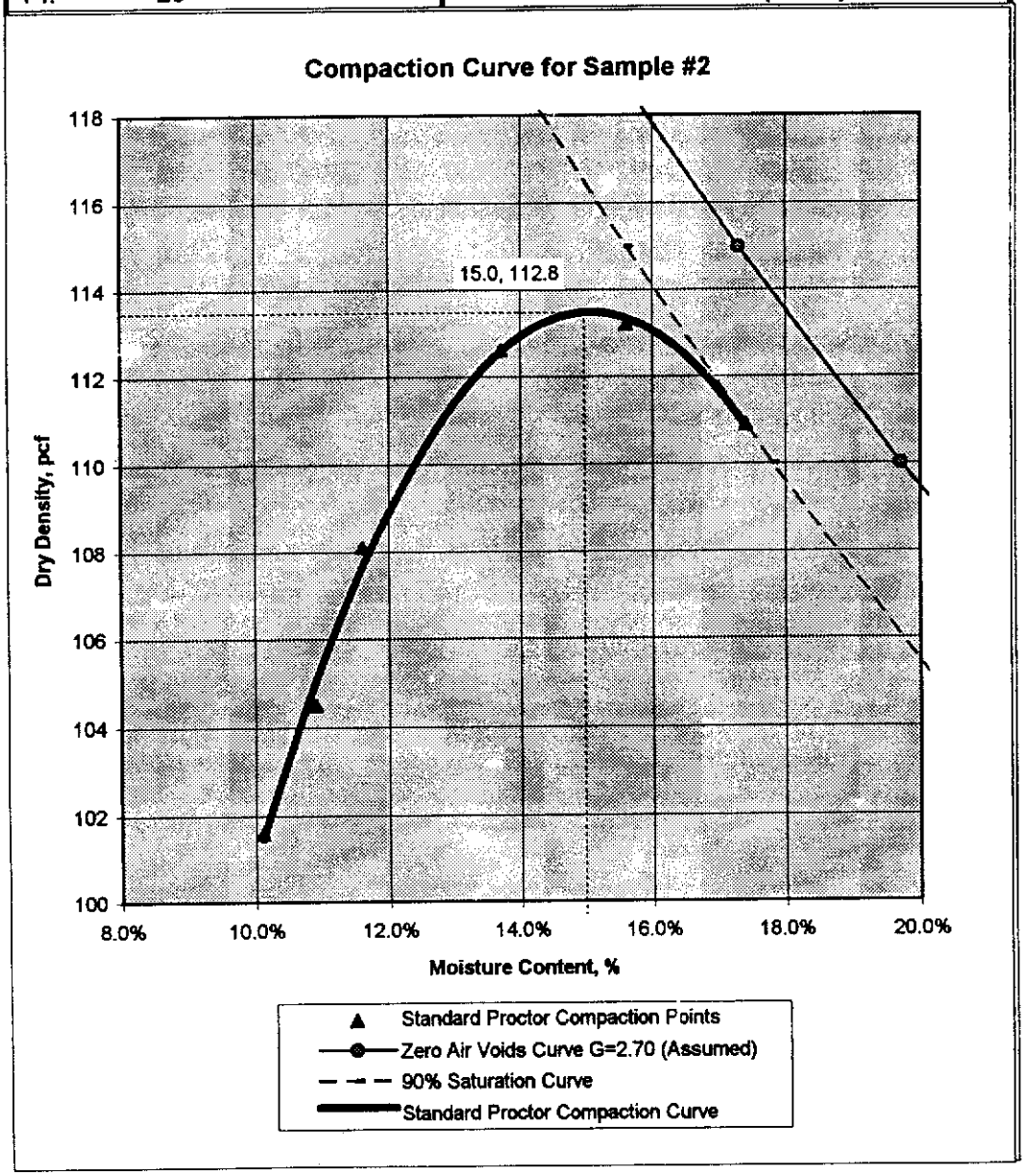


PLATE C-9

RED ROCK BIKE TRAIL STAGE IV

Proctor Sample #3 (Moisture-Density Relationship)

Hole Number:	RRB-94-16	**Date Sample Taken:**	12/13/94
Standard Proctor Compaction Curve. Automatic (Rainhart) Hammer Used. (ASTM D-698)		**Sample Depth:**	7.0-12.0 ft
		Max Dry Density:	106.1 pcf
		Optimum Moisture:	19.8%
Atterberg Test Results:		**Soil Classification:**	
LL:	38	CL Brown Lean Clay (Alluvium)	
PL:	20	**Retained on #4 Sieve(gravel):**	0.0%
PI:	18	**Retained on #200 Sieve(sand):**	0.6%

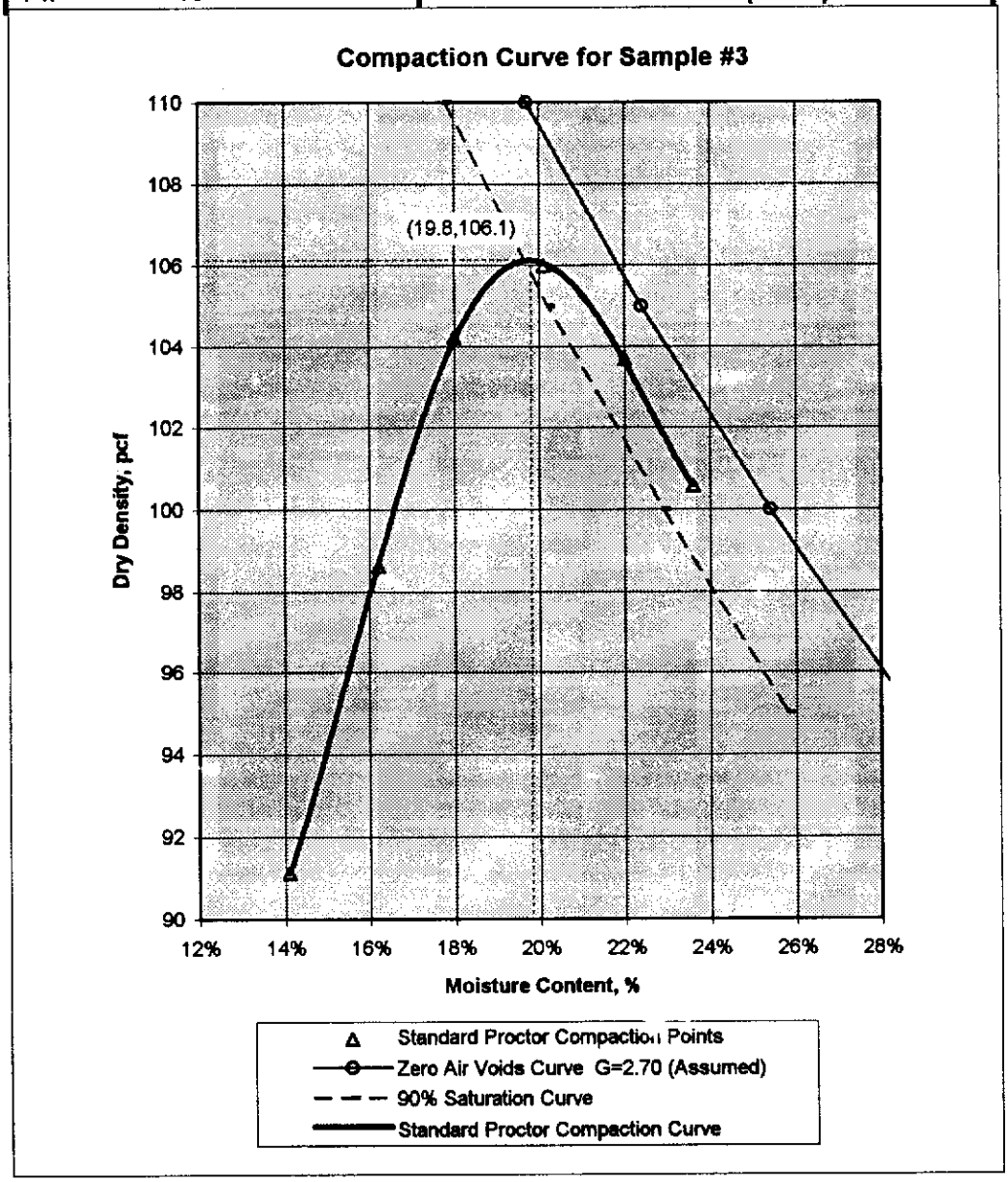
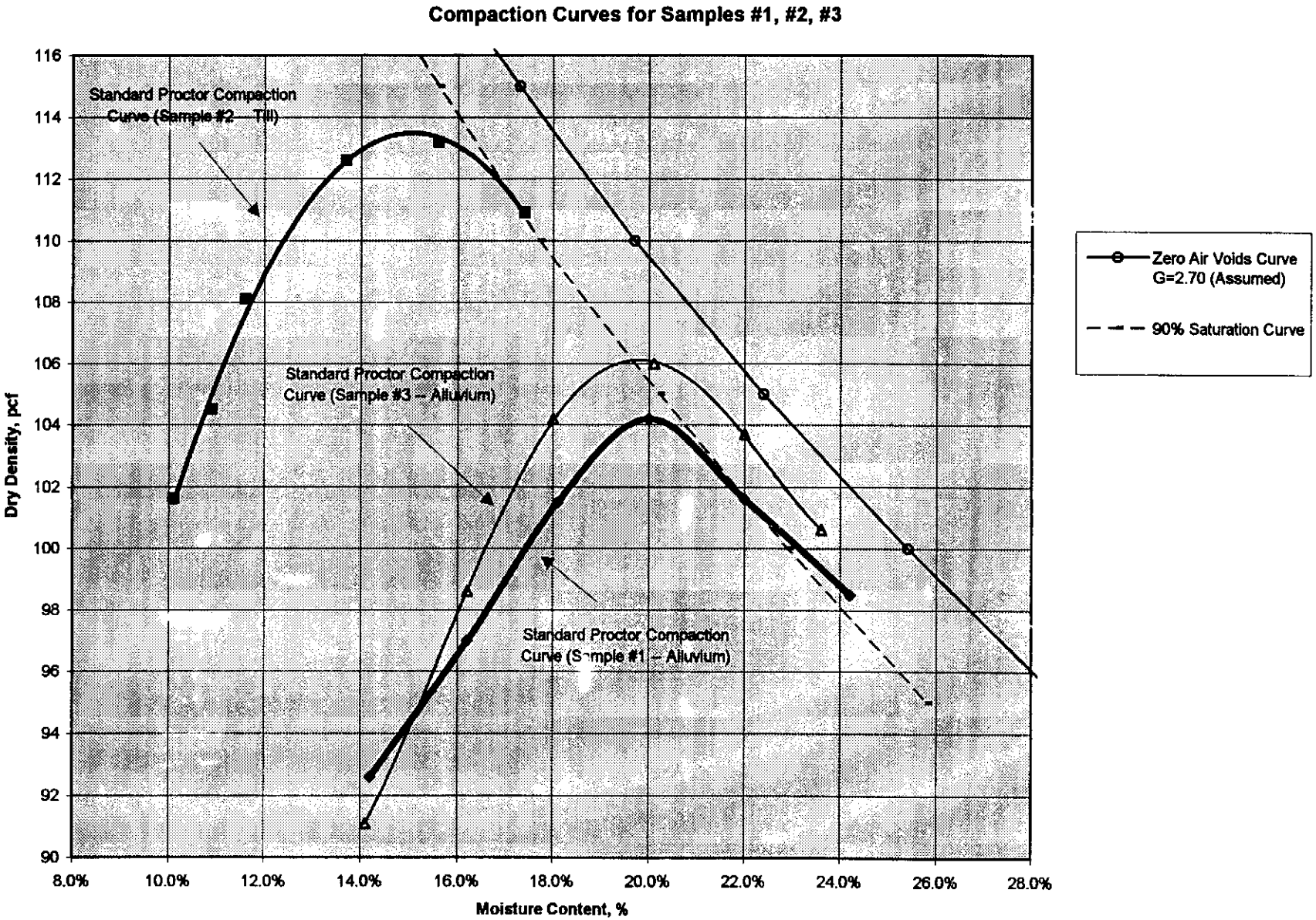


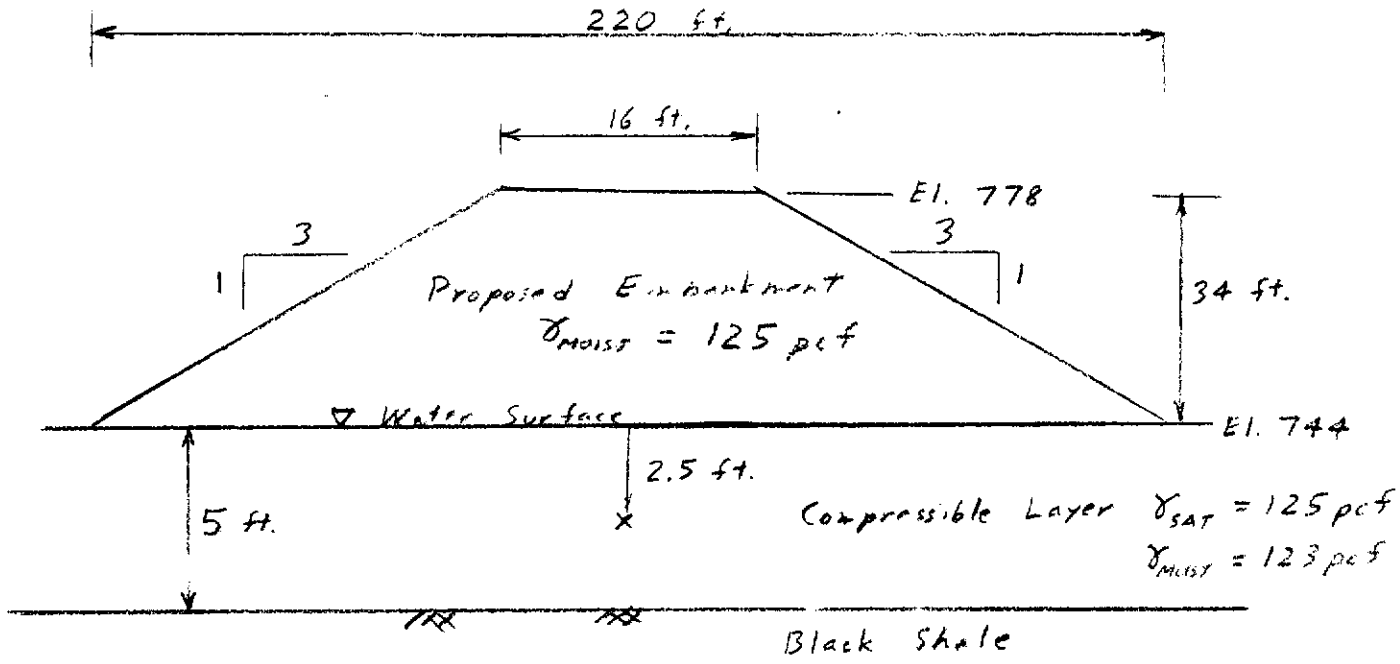
PLATE C-10

RED ROCK BIKE TRAIL STAGE IV



Subject: Des Moines Recreational River and Greenbelt Multi-Purpose Trail, Seg. IV			
Date: Feb 95	Computed By: ND	Checked By: SZ	Sheet 1 of 3

Settlement Analysis
Station 432+50



Assumptions:

Ave. Moisture Content of Comp. Layer (W_n) = 25%
Ave. LL (WL) = 42
Ave. PL (WP) = 20
Specific Gravity = 2.67
$e_o = WG_s$ = (.25)(2.67) = .668

Compression Index, C_c:
C_c = .009(LL-10) = .288
C_c = .37(e_o + .003WL + .0004W_n - .34) = .172
C_c = .30(e_o - .27) = .119
Use C_c = 0.172 as recommended by Joseph E. Bowles, which has a reported 86% reliability

Reference:

(1) Soil Mechanics in Engineering Practice by Karl Terzaghi and Ralph Peck
(2) Foundation Analysis and Design, 3rd Edition by Joseph E. Bowles
(3) Physical and Geotechnical Properties Soils by Joseph E. Bowles

Subject: Des Moines Recreational River and Greenbelt Multi-Purpose Trail, Seg. IV			
Date: Feb 95	Computed By: ND	Checked By: SZ	Sheet 2 of 3

Po:

@ mid depth of layer No. 1 = 2.5 (125-62.4) = 157 psf

ΔP @ layer 1 Boussinesq coefficient * h * m
(.991) * (34) * (125) = 4,212

$$\Delta S = \frac{C_c}{1 + e_o} \quad H \log 10 \quad \frac{P_o + P}{P_o}$$

Depth (feet)	P_o (p.s.f)	ΔP (p.s.f.)	H (feet)	ΔS (feet)
0				
2.5	157	4,212	5	0.74
5				

Total Settlement = .74 feet = 9 inches

Subject:	Des Moines Recreational River and Greenbelt Multi-Purpose Trail, Seg. IV		
Date: Feb 95	Computed By: ND	Checked By: SZ	Sheet 3 of 3

$$t_{80} = \frac{T_v}{C_v} H^2$$

t_{80}= time to reach 80% primary consolidation

T_v = time factor = 0.57 *

C_v = Coefficient of consolidation
= 0.22 ft^2/day (PLATE C-15)

H = thickness of consolidating clay layer, single drainage

$$t_{80} = \frac{0.57}{0.22\ ft^2/day}(5\ ft)^2 = 65\ days$$

Allow three months for 80% of primary consolidation

* From Soils and Foundations by Cheng Liu and Jack B. Evett, p.179

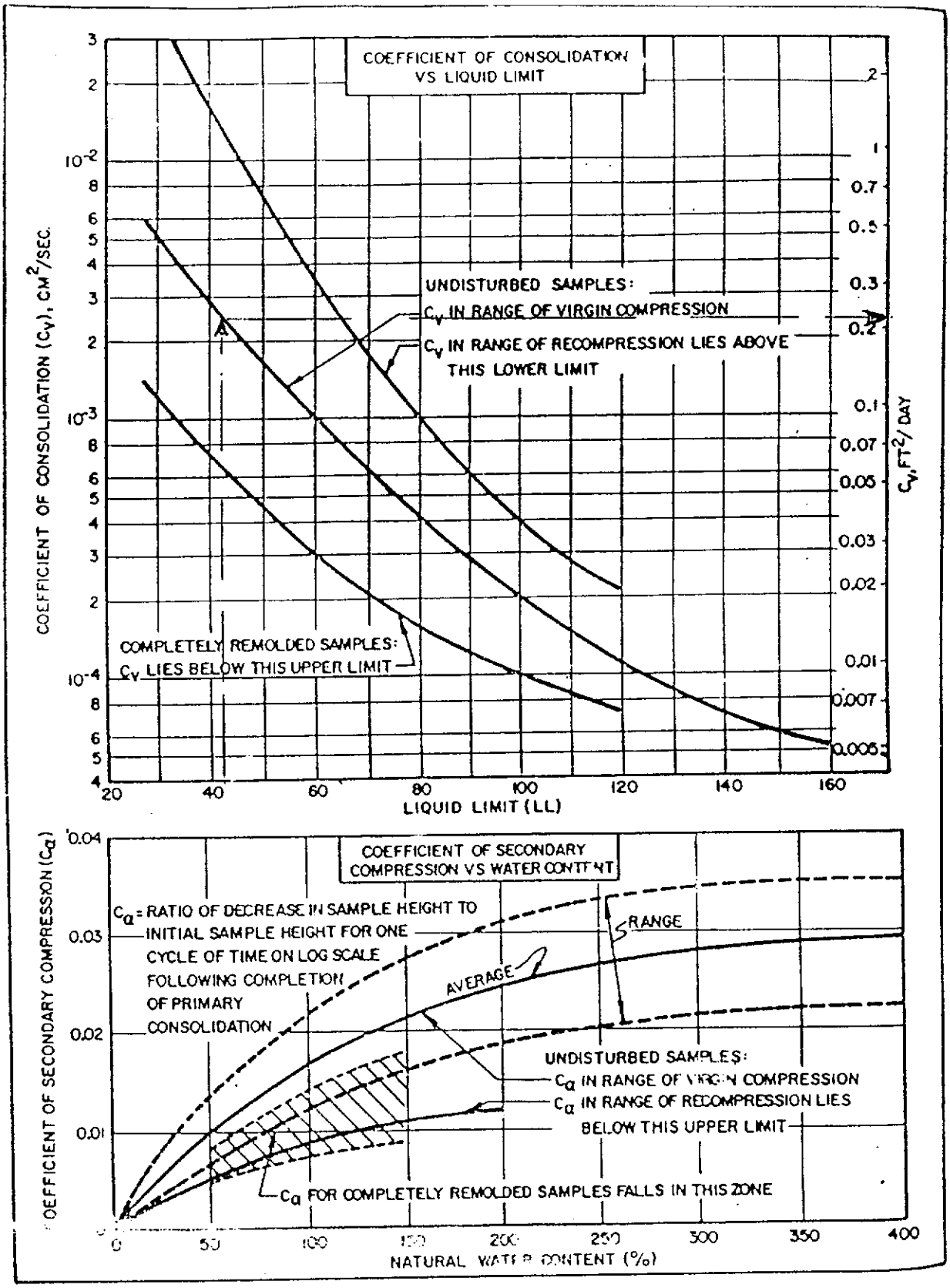


FIGURE 4
Approximate Correlations for Consolidation Characteristics of Silts and Clays

APPENDIX D

ECONOMIC ANALYSIS

U.S. ARMY CORPS OF ENGINEERS
ROCK ISLAND DISTRICT

DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM #9
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

APPENDIX D
ECONOMIC ANALYSIS

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DES MOINES RECREATIONAL RIVER AND GREENBELT
FEATURE DESIGN MEMORANDUM #9
WITH ENVIRONMENTAL ASSESSMENT

RED ROCK MULTI-PURPOSE TRAIL
SEGMENT IV

APPENDIX D
ECONOMIC ANALYSIS

1. Introduction

This analysis examines the economic feasibility of construction of an additional 8.6 miles of multi-purpose trail to extend the existing trail at Lake Red Rock, Marion County, Iowa. The proposed trail will enhance the recreation experience afforded at the federally owned and managed park complex. In addition, the trail segment will help fulfill current and future demand for trail facilities in central Iowa.

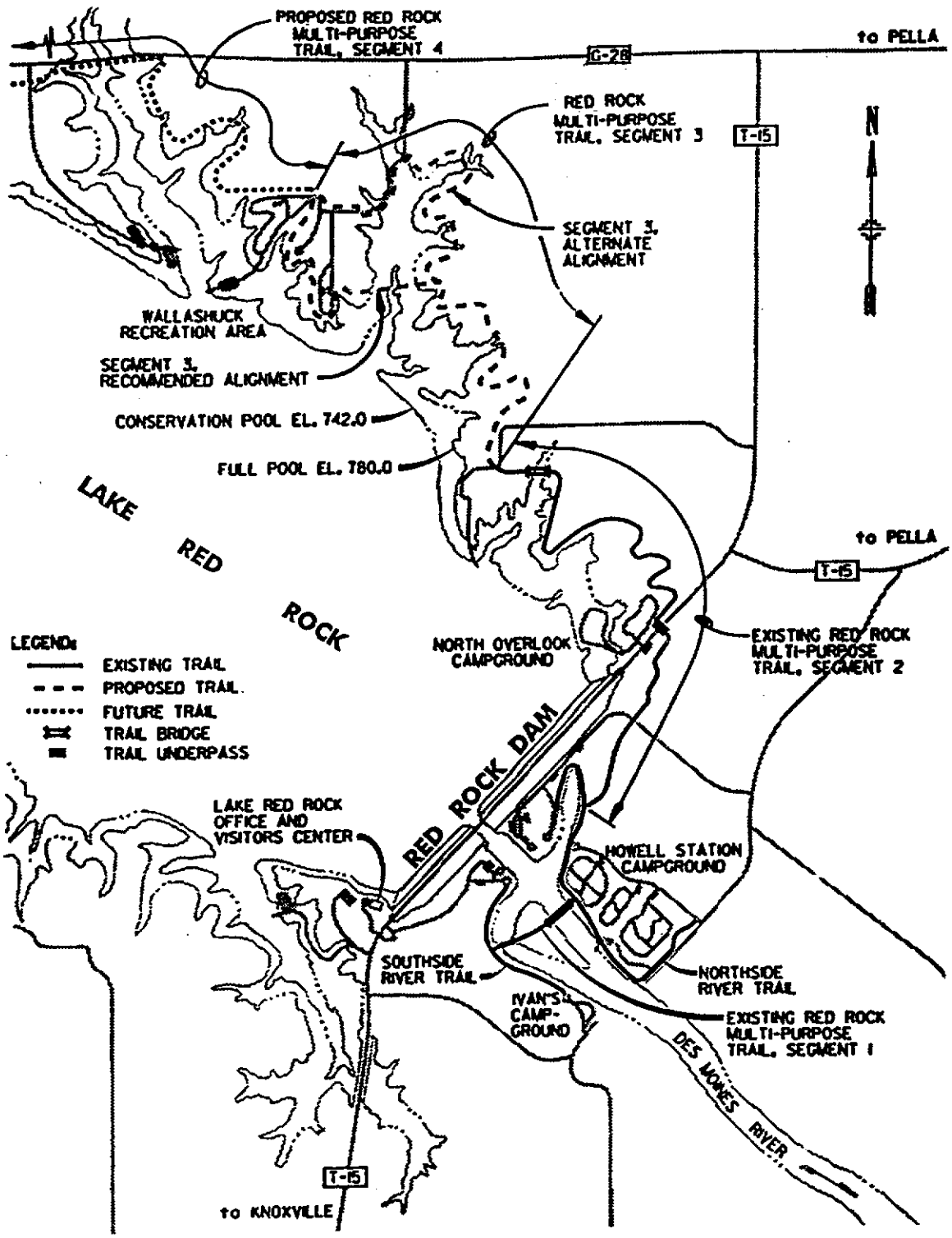
2. Existing Conditions

Existing recreational facilities at Lake Red Rock include various multi-purpose trails which have been linked through the construction of Segments I, II, and III of the Greenbelt project. Segments I. II and III provide a total of 13.4 miles of trail at the Lake Red Rock recreational complex. This 13.4 mile trail system connects four multi-purpose day use and overnight recreation areas, and is heavily used by walkers, cyclists, skaters, nature observers, and others.

3. Trail System Improvements

(a) Segment IV of the Red Rock multi-purpose trail is estimated to be approximately 8.6 miles long, beginning at the Wallashuck Recreation Area and running along the north shore of Lake Red Rock to Iowa State Highway 14 (see Figure 1). It will provide access to the 0.5 mile Robert's Creek Nature Trail at Robert's Creek County Park and the 1 mile Cordova Nature Trail at North Elk Rock State Park. This new trail segment will provide ease of access and increase safety for those recreationists who had previously driven from Robert's Creek and Cordova Nature Trail or walked along Marion County Road G-28 to reach the multi-purpose trail.

(b) A total of 22.0 miles of continuous trail will now be accessible at the Lake Red Rock recreation complex. In addition, the City of Pella has constructed a 3-mile bicycle trail from Pella to connect with the Federal Boundary Trail at Howell Station, making the Lake Red Rock recreation complex accessible to additional recreationists.



PROJECT LOCATION PLAN

2000 0 2000 4000 6000

APPROXIMATE SCALE IN FEET

LAKE RED ROCK TRAIL SYSTEM

Plate D-1

(c) Construction of the new trail would help fulfill current and forecasted public demand for recreation trails suitable for hiking, walking, and cycling. The need for additional miles of trail is supported by the market analysis provided in the Des Moines Recreational River and Greenbelt General Design Memorandum (GDM). The GDM reported that because of the increasing popularity of trail recreation over 500 additional miles of trail would be required to fulfill Greenbelt market area demand through 1995. The proposed multi-purpose trail would enhance recreation opportunities for trail users at Lake Red Rock and within the Des Moines Recreational River and Greenbelt boundaries. The project makes areas of publicly owned land which are presently accessible only to hikers, accessible to bicyclists, skaters, cross county skiers, and disabled individuals.

4. Benefit Computation

(a) The criteria to be used for selecting an appropriate procedure for evaluating recreation projects is detailed in Figure 6.7 of the Guidelines for Conducting Civil Works Planning Studies (ER 1105-2-1200). The steps indicated in the Guidelines result in selection of the Unit Day Value Method for determining the benefits associated with the proposed trail at Lake Red Rock. This criteria is shown in table D-1.

Table D-1
Selection Criteria
for Evaluating Recreation Improvements
Lake Red Rock

Criteria	Answer
Is a regional model available?	No
If "No", do uses affected involve specialized recreation activities?	No
If "No", do expected recreation costs exceed 25-percent of expended total project costs?	Yes
If "Yes", do specific annual Federal recreation costs exceed $1,750,000 FY91 ($1,000,000 FY82)?	No
If "No", then use Unit Day Values for evaluating recreation benefits resulting from the proposed project.	

(b) The Guidelines selection criteria detailed in table D-1 allow consideration for the size of the recreation benefit created and the nature of the activities affected. Selection of a specific evaluation procedure is based on these components as well as the relative importance of any specialized recreation activity, the advantages of the respective methods, and cost considerations. Following the decision criteria and considering the small scale of the proposed project, the Unit Day Value Method is the preferred evaluation procedure for this analysis.

(c) Judgment factor points were used to determined both the existing "without project" and the proposed "with project" conditions. There is no existing trail connecting the main camping, recreation area of the federal complexes at Lake Red Rock to the Robert's Creek or Cordova Nature Center trails. Access to these areas from the existing trail, which ends at the Wallashuck Recreation Area, is by walking along County Highway G-28.

(d) Table D-2 presents the summary for the Unit Day Value Method Assessment of the recreation experience on Segment IV multi-purpose trail for biking, hiking, or walking usage.

Table D-2
Unit Day Value Assessment

Criteria	Judgment Factor Points Without Proj.	With Proj.	Comments
Recreation Experience	5.0	10.0	New trail would enhance recreation experience for bikers, hikers, and sightseers by linking multi-purpose trail allowing access from the Corps of Engineers recreation facilities to the self-guided interpretive trails at Robert's Creek County Park and the recreation facilities and trails at North Elk Rock State Park. The new trail would provide a safer recreation experience by eliminating the use of the county highway or road shoulder to connect with other segments of existing trail.
Availability of Opportunity	2.0	6.0	New trail would provide an additional recreation experience in central Iowa with its rolling topography that is mainly along a bluffline on Lake Red Rock, and create an excellent outdoor opportunity for users based on length of total trail network and connections to unique recreation areas.
Carrying Capacity	2.0	10.0	New trail would be 8.6-miles long and would connect to the existing Lake Red Rock Trail system at Wallashuck Recreation Area, creating optimum facilities for users and fulfilling a small portion of latent demand.
Accessibility	6.0	15.0	New trail would connect and link existing recreation amenities at the eastern edge of the

			reservoir by continuing the existing trail from the Wallashuck Recreation Area to the county and state trails, providing safe and good quality access roads to the site, and good access within the Lake Red Rock recreation complex. Good access roads to the site will make the trail easily accessible to disabled visitors. Use of a county highway or road shoulder as the existing trail for access between these sites would be eliminated. The new trail also provides a vital link for the new trail from Pella, Iowa, to the Lake Red Rock complex.
Environ-mental	3.0	11.0	New trail has a high aesthetic quality as it affords unlimited lake viewing from an elevated position on the north shore bluffline overlooking Lake Red Rock. Eliminates problem of traffic and traffic noise while using the state highway to go from one recreation site to another.

Total Points:			
Without Project	18.0	With Project	52.0
Point Value	$3.19		$5.32

Net increase in value per Cyclist/Hiker = $2.13

(e) As indicated in table D-2, the proposed trail improvement would provide an enhanced recreation experience, increased opportunity for use of a longer multi-purpose trail, increased trail carrying capacity, improved accessibility to and between Lake Red Rock recreation amenities, and increased opportunity to view the environmental features of the area. These benefits are detailed in the Guidelines, Section VIII, paragraph 6-115 Unit Day Value Method.

(f) Based on ER 1105-2-100, Revised Table 6-28 (FY95), the Unit Day Value of one user on the existing trail network at Lake Red Rock is $3.19. Following completion of the proposed 8.6-mile extension from Wallashuck Recreation Area, this value for cyclists/hikers would increase by $2.13 to $5.32 per recreationist.

5. Anticipated Use of New Trail

(a) The Des Moines Recreational River and Greenbelt General Design Memorandum (GDM) reported that a minimum of 500 additional miles of multi-purpose trail within the Greenbelt boundaries would be required to fulfill demand through 1995. The 1990 SCORP, conducted by the State of Iowa, reflected state recreational needs on a county and regional basis, and indicated demand for an additional 77 miles of foot trail in

the area. Based on the GDM market analysis, it was assumed that the Segment IV proposed 8.6-mile trail at Lake Red Rock would be fully utilized during the peak summer months of cycling/hiking season. Using the design criteria detailed in the GDM, a total of 24,200 walkers, hikers, and cyclists would use the trail on a prime weekend day without overcrowding the trail.

(b) Survey data for Rock Island District managed recreation areas indicate that 80-percent of all recreation takes place on weekends. Following the methodology in the GDM, the maximum daily recreation use of the proposed new trail segment, without overcrowding, was converted to peak monthly use:

Cyclists/Hikers:

(24,200	x	2	x	4.3)	-:-	.8	=	260,150
peak daily use of new trail		number of days per weekend		weeks per month		80% of recreation occurs on weekends		peak monthly use of proposed trail

(c) Attendance for fiscal years 1992, 1993 and 1994 was used to determine the average monthly usage by percent of total usage. Peak monthly use was converted to estimated annual new trail use by applying monthly recreation attendance trends at the Lake Red Rock complex. Expected monthly trail use of the proposed 8.6-miles segment of trail is summarized in table D-3.

Table D-3
Expected Monthly Use of Proposed Trail

Month	Recreationists	Percent
January	11,908	0.9
February	18,778	1.4
March	40,305	2.9
April	73,282	5.3
May	176,792	12.9
June	248,242	18.1
July	260,150	18.9
August	260,150	18.9
September	151,601	11.0
October	79,236	5.8
November	35,267	2.6
December	18,778	1.4
Total	1,374,490	100.0

(e) Based on the data in table D-3, the annual number of recreationists using for the proposed 8.6-mile trail would be approximately 1,374,500. This figure is a conservative estimate of annual use, and was adjusted to reflect recreation activity in the Greenbelt area based on prior years' surveys. This figure assumes no overcrowding of facilities and does not include recreationists from adjoining non-federal recreational areas who would use this trail. It should be noted that winter use of the trail would include hiking, sightseeing, and general winter activities.

6. Average Annual Benefit

(a) Approximately once every five years, a 1900-foot section of trail may be inundated for about 6 weeks between 15 April and 15 October. Allowing time for closure and clean up, this would reduced benefits by 2.8 percent annually.

(b) Assuming no change in annual visitation or use of the new trail, 1,374,500 hikers and cyclists would benefit from the 8.6-mile trail addition for the life of the project (50 years). Based on the new increase in value per recreationist, the average annual benefits for the trail improvement are $2,845,700 [1,374,500 x $2.13 less $82,000 ($2,927,700 x 2.8% for inundation)].

7. Average Annual Cost

Construction, operation, and maintenance costs detailed in this report are presents at January 1995 price levels. Interest during construction is not calculated as project benefits accrue as each phase of the trail construction is completed. A detailed cost estimate is shown in the main report. Operation and maintenance costs include additional costs incurred due to inundation. Replacement costs for asphalt overlay on the trail are estimated at $500,000, and will be incurred once every 20 years during the life of the project. These costs were discounted to the base year and annualized over the 50-year planning period. A summary of annual costs, computed at a 7-3/4 percent discount rate and a 50-year project life, is presented in table D-4.

Table D-4
Summary of Annual Costs
Red Rock Trail Segment IV
March 1995 Price Levels

Estimated Project Cost	$ 928,000
Annualized First Cost	$ 542,100
Annual Operation and Maintenance	$ 50,000
Replacement Costs	$ 9,300
Total Annual Cost	$ 601,400

8. Economic Summary

Table D-5 presents a summary economic analysis for the proposed recreation enhancement project. As indicated, the project is economically justified with net annual benefits totaling $2,245,200 and a benefit-to-cost ratio of 4.7.

Table D-5
Benefit and Cost Summary
(7-3/4 Percent Discount Rate
March 1995 Price Levels)

Total First Cost	$6,828,000	
Annual Benefit		$2,845,700
Annual Cost	$ 601,400	
Average Annual Cost	542,100	
Annual Operation/Maintenance	50,000	
Replacement Costs	9,300	
Net Annual Benefit		$2,244,300
Benefit-to-Cost Ratio		4.7

9. Sensitivity Analysis

To determine the effect of lower and higher usage on the project, the benefit-to-cost determination was developed using a plus or minus 20 percent in user estimates from table D-3. As shown below, a reduction in the projected future usage of the trail would not significantly affect the benefit-to-cost ratio.

Table D-6
Comparison Summary
(7-3/4 discount rate-March 1995 price levels)

	-20%	+20%
Estimated Users:	1,099,600	1,649,400
8.6 mile trail @$2.13	$2,342,100	$3,513,200
less inundation	(65,600)	(98,400)
Estimated Annual Benefit	$2,276,500	$3,414,800
Total Annual Cost	$ 601,400	$ 601,400
Net Benefit	$1,675,100	$2,813,400
Benefit-to Cost Ratio	3.8	5.7

APPENDIX E

HYDROLOGY AND HYDRAULIC ANALYSIS

HANSON ENGINEERS, INCORPORATED

HYDROLOGY AND HYDRAULIC ANALYSIS

TABLE OF CONTENTS

HYDROLOGY AND HYDRAULIC ANALYSIS SUMMARY

Drainage areas were determined using USGS quad maps. For drainage areas greater than 25 acres, the Iowa regression equation for hydrologic region 3 was used to calculate the discharge. For drainage areas less than 25 acres, the Soil Conservation Service TR-55 method was used to calculate the discharge.

The minimum pipe size for this project is 18 inch diameter. At steep drainage basin slopes, an 18 inch pipe was determined to be adequate for drainage areas up to 1.5 acres. Flatter drainage basin slopes produce lower discharges, therefore, for drainage areas less than 1.5 acres an 18 inch pipe was assumed and no further computations were performed.

The bike path is to be constructed adjacent to County Highway 28 and cross several existing culverts. These culverts will need to be extended underneath the bike path and will have no increase in drainage area.

A spreadsheet was assembled that requires input of the drainage area, the drainage basin length, and the basin slope between the 10 percent and 85 percent points in the basin length. With this information, the spreadsheet determines which discharge method to use and calculates the discharge. Knowing the discharge and inputting the upstream and downstream flowline elevations and the downstream channel slope, width, and sideslope the culverts were sized using HY8, Version 4.0.

The Rational Method, Q=CIA, was used to determine ditch capacity. Ditch drainage areas and rainfall intensities were calculated to determine the discharge in the ditch. The actual discharge was then compared to the ditch capacity.

LAKE RED ROCK MULTI PURPOSE TRAIL - SEGMENT IV
MARION COUNTY, IOWA
CONTRACT NO DACW25-93-D-0011 0004
HEI #94S2044
16-Feb-95

	Plan Station	Study Station for Drainage Study	Drainage Area # (Acres)	Adjacent CH-28 Culvert: Highway Station	Adjacent CH-28 Culvert: Size	Adjacent CH-28 Culvert: Drainage Area	Adjacent CH-28 Culvert: USFL	Adjacent CH-28 Culvert: DSFL	Discharge Method	Drainage Area (Acres)	Drainage Area (sq mi)	Drainage Length (ft)	Equiv. Drainage Area (Acres)	Shape Factor	Peak Q (cfs/in)	Slope S 10/85 (%)	Slope Factor	Q (50yr) (cfs)	USFL Elevation	DSFL Elevation	Skew Fwd	Prop. Culvert Slope	Channel Slope (%)	Channel Width (ft)	Channel Side (__:1)	Tw 50 (ft)	No. Barrels	Pipe Diam (in)	Box Size Span (ft)	Box Size Rise (ft)	Hw/D (50)	Hw Elevation	Inlet/ Outlet Control	Prop road Elevation	Prop Elev - Hw	Prop Elev - DSFL	Proposed Length	Extend, or New (E,N)	Comments	MIN DIA SUCH THAT Vfull < 8 fps	CLEARANCE PGL-DIA-.5(USFL+DSFL)
2	45+95	44+80	0.459						S.C.S.	0.459	0.001								798.0	792.0	0	0.2366					1	18			1.00			796.6		4.6	25	N	18" CMP BY INSPECTION	0	
3	49+65	48+30	4.986						S.C.S.	4.986	0.008	800	9.37	0.53	15.3	8.00	0.92	25.3	801.0	797.0	0	0.0625	6.60	10	5	0.43	1	24			1.89	804.8	Inlet	807.0	2.2	10.0	64	N		24	6.0
4	51+45	50+10	1.285						S.C.S.	1.285	0.002								815.5	810.0	0	0.1218					1	18			1.20	817.3		817.6	0.3	7.6	45	N	18" CMP BY INSPECTION	0	3.4
[illegible]	54+15	52+70	0.523						S.C.S.	0.523	0.001								818.0	812.0	0	0.1252					1	18			1.00	819.5		820.3	0.8	8.3	48	N	18" CMP BY INSPECTION, DROP INLET	0	3.8
[illegible]	58+50	57+00	1.191						S.C.S.	1.191	0.002								804.0	802.0	0	-					1	18			1.20	805.8		806.6	0.8	4.6	38	N	18" CMP BY INSPECTION	0	2.1
[illegible]	59+85	58+30	3.780						S.C.S.	3.780	0.006	1700	32.90	0.11	27.0	2.75	0.92	9.6																					BRIDGE		
87	68+40	68+40	0.940						S.C.S.	0.940	0.001	1300	21.04	0.04				0.0	820.5	820.3	0	0.0068						18			1.00	822.0		822.6	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
8	85+20	82+90	1.561						S.C.S.	1.561	0.002	350	2.36	0.66	2.5	2.28	1.21	6.7	850.0	847.0	0	0.0698	8.00	50	10	0.07	1	18			1.01	851.5	Inlet	853.0	1.5	6.0	43	N		12	3.0
9	95+55	92+98	4.683	37+20	30"	4	834.9	830	S.C.S.	8.683	0.014	480	4.00	2.17	5.5	4.72	1.03	41.1	826.0	824.0	0	0.0476	2.00	10	5	0.78	1	36			1.08	829.2	Inlet	829.3	0.1	5.3	42	N		31	1.3
10	97+70	95+10	1.011						S.C.S.	1.011	0.002								825.0	823.0	0	0.0542					1	18			1.20	826.8		827.5	0.7	4.5	37	N	18" CMP BY INSPECTION	0	2.0
11	100+55	98+00	1.193						S.C.S.	1.193	0.002								824.0	820.0	0	0.1028					1	18			1.20	825.8		825.8	0.0	5.8	39	N	18" CMP BY INSPECTION	0	2.3
12	105+95	104+00	3.489	2+05	30"	18	830	814	S.C.S.	21.489	0.034	900	11.40	1.89	12.1	6.07	1.07	82.3	804.0	800.0	20	0.0458	5.00	2	3	1.59	1	48			1.05	808.2	Inlet	813.0	4.8	13.0	87	N		43	7.0
13	114+20	112+00	4.315						S.C.S.	4.315	0.007	650	6.63	0.65	11.1	10.45	0.96	23.4	786.0	781.0	0	0.0777	12.00	4	5	0.65	1	30			1.68	790.2	Inlet	791.6	1.4	10.6	64	N		23	5.6
14	117+35	115+10	1.191						S.C.S.	1.191	0.002								786.0	778.0	45	0.0985					1	24			1.20	788.4		788.9	0.5	10.9	81	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	4.9
15	120+70	118+50	7.713	10+44	30"	5	825.1	814	S.C.S.	12.713	0.020	1500	26.70	0.48	23.1	6.04	1.10	40.8	779.0	771.0	60	0.0637	6.20	4	3	0.90	1	36			1.07	782.2	Inlet	782.8	0.6	11.8	126	N		31	4.8
16	123+25	121+10	4.224						S.C.S.	4.224	0.007	400	2.95	1.43	6.4	7.67	0.93	28.7	778.0	776.0	0	0.0485	5.00	0	40	0.09	1	30			1.17	780.9	Inlet	781.2	0.3	5.2	41	N		26	1.7
17	128+55	125+98	0.918						S.C.S.	0.918	0.001								780.0	774.0	30	0.1140					1	18			1.00	781.5		781.9	0.4	7.9	53	N	18" CMP BY INSPECTION	0	3.4
18	130+80	128+90		24+50	48"	200		742	U.S.G.S.	200.000	0.313							370.9	-	740.0	0	-					1	48				-		780.0	-		80	E		92	406.0
19	134+20	132+30	0.735						S.C.S.	0.735	0.001								778.0	772.0	45	0.0877					1	24			1.00	780.0		780.4	0.4	6.4	66	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	3.4
20	137+50	135+50	2.157	30+57	24"	5		785	S.C.S.	7.157	0.011	700	7.50	0.95	12.9	11.60	0.97	40.3	781.0	780.0	0	0.0250	6.60	70	8	0.18	1	36			1.07	784.2	Inlet	784.5	0.3	4.5	40	N		30	1.0
21	141+00	139+10	2.294						S.C.S.	2.294	0.004	400	2.95	0.78	6.5	8.00	0.92	15.7	786.0	785.0	0	0.0292	8.50	0	35	0.06	1	24			0.85	787.7	Inlet	788.6	0.8	3.5	34	N		19	1.0
88	146+00	146+00	0.460						S.C.S.	0.460	0.001	270	1.53	0.30				0.0	788.1	787.9	0	0.0068						18			1.00	789.6		790.2	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
22	149+40	148+10		38+36	36"	19		770	S.C.S.	19.000	0.030	1000	13.59	1.40	20.2	8.00	0.91	86.6	-	770.0	0	-					1	36				-		791.0	-		90	E		45	403.0
23	150+00	149+10	1.469						S.C.S.	1.469	0.002								789.6	782.0	40	0.1094					1	24			1.20	792.0		792.0	0.0	10.0	69	N	18" CMP BY INSPECTION, REGRADE CH DITCH, DEEPEN TRAIL DITCH,INCREASED TO 24"	0	4.2
24	154+00	153+10	5.417						S.C.S.	5.417	0.008	700	7.50	0.72	8.8	2.86	0.93	19.9	786.0	781.0	0	0.0909	8.50	35	5	0.17	1	24			1.37	788.7	Inlet	790.0	1.3	9.0	55	N		21	4.5
25	156+50	155+50	3.305						S.C.S.	3.305	0.005	750	8.41	0.39	9.5	5.86	1.06	13.3	791.0	787.5	10	0.0579	9.20	5	5	0.38	1	24			0.98	793.0	Inlet	796.5	3.5	9.0	60	N		17	5.3
26	158+35	157+50	0.989						S.C.S.	0.989	0.002	350	2.36	0.42	3.3	5.70	1.06	4.9	796.0	792.0	0	0.0964	11.00	10	5	0.24	1	18			1.00	797.5	Inlet	798.3	0.8	6.3	42	N	DROP IN DITCH UPSTREAM	11	2.8
89	161+00	161+00	0.460						S.C.S.	0.460	0.001	200	0.93	0.50				0.0	799.4	799.2	0	0.0068						18			1.00	800.9		801.5	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
90	164+00	164+00	0.690						S.C.S.	0.690	0.001	210	1.01	0.68				0.0	797.7	797.4	0	0.0068						18			1.00	799.2		799.8	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
91	166+00	166+00	0.340						S.C.S.	0.340	0.001	180	0.78	0.44				0.0	799.3	799.1	0	0.0068						18			1.00	800.8		801.5	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
27	168+75	167+90	0.478						S.C.S.	0.478	0.001								807.0	803.0	0	0.1039					1	18			1.00	808.5		808.8	0.3	5.8	39	N	18" CMP BY INSPECTION, DEEPEN DITCH UPSTREAM	0	2.3
28	171+60	170+80	0.918						S.C.S.	0.918	0.001								805.0	804.0	0	0.0299					1	18			1.00	806.5		807.4	0.9	3.4	33	N	18" CMP BY INSPECTION, DEEPEN DITCH UPSTREAM	0	1.4
30	178+30	177+40	2.203						S.C.S.	2.203	0.003	200	0.93	2.37	2.8	14.67	0.99	22.1	783.0	782.0	20	0.0119	12.00	10	3	0.34	1	30			0.91	785.3	Inlet	793.0	7.7	11.0	84	N	CHECK CLEARANCE OVER PIPE	23	8.0
31	179+10	178+30		51+17	48"	37		753	U.S.G.S.	37.000	0.058							149.1	-	752.0	10	-					1	48				-		790.6	-		10	E		58	410.6
32	180+70	179+80	1.652						S.C.S.	1.652	0.003	400	2.95	0.56	6.5	12.67	0.97	11.9	786.0	786.0	0	0.0559	5.50	2	7	0.52	1	24			0.93	789.9	Inlet	790.3	0.4	4.3	36	N	DROP INLET	17	1.3
33	184+95	184+05	1.285						S.C.S.	1.285	0.002								792.0	788.0	0	0.0979					1	18			1.20	793.8		794.1	0.3	6.1	41	N	18" CMP BY INSPECTION	0	2.6
34	189+05	188+10	3.031						S.C.S.	3.031	0.005	750	8.41	0.36	9.5	4.44	1.02	11.8	786.0	782.0	0	0.0670	2.50	4	4	0.57	1	24			0.89	787.8	Inlet	789.0	1.2	7.0	46	N	EXTEND OR REPLACE? (EXIST SIZE ?). ROAD EMBANK (EL 790.3) WILL CONTAIN BACKWAT	16	3.0
35	189+65	188+80	1.285						S.C.S.	1.285	0.002								786.0	782.0	0	0.0787					1	18			1.20	787.8		789.8	2.0	7.8	51	N	18" CMP BY INSPECTION	0	4.3
36	192+40	191+50	1.744						S.C.S.	1.744	0.003	350	2.36	0.74	5.0	15.21	0.99	12.3	784.0	782.0	0	0.0599	21.00	0	100	0.02	1	24			0.90	785.8	Inlet	785.9	0.1	3.9	33	N	CHECK CLEARANCE OVER PIPE, DROP INLET	17	0.9
37	198+20	197+10	2.479						S.C.S.	2.479	0.004	600	5.80	0.43	7.5	3.78	1.00	10.8	783.0	780.0	20	0.0575	20.00	0	2	0.18	1	24			0.84	784.7	Inlet	787.0	2.3	7.0	52	N	CHECK CLEARANCE OVER PIPE	16	3.5
38	199+45	198+50		65+48	48"	19		756	S.C.S.	19.000	0.030	1100	15.92	1.19	22.7	7.88	0.90	82.1	-	756.0	20	-					1	48				-		788.0	-				EXTENSION NOT REQUIRED	43	406.0
39	200+45	199+80	0.826						S.C.S.	0.826	0.001								786.0	782.0	0	0.0870					1	18			1.00	787.5		789.0	1.5	7.0	46	N	18" CMP BY INSPECTION	0	3.5
40	203+25	202+80	1.193						S.C.S.	1.193	0.002								782.0	778.0	0	0.1255					1	18			1.20	783.8		784.3	0.5	8.3	48	N	18" CMP BY INSPECTION	0	3.8
41	207+95	207+00	1.285						S.C.S.	1.285	0.002								783.0	776.0	20	0.1154					1	24			1.20	785.4		786.3	0.9	10.3	61	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	4.8
42	208+70	208+20		72+49	30"	10		754	S.C.S.	10.000	0.016	650	6.63	1.51	11.8	12.30	0.97	58.2	-	754.0	10	-					1	30				-		787.0	-				EXTENSION NOT REQUIRED	37	407.5
43	211+30	210+95	0.826						S.C.S.	0.826	0.001								786.0	780.0	50	0.0551					1	24			1.00	788.0		792.0	4.0	12.0	109	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	7.0
44	215+00	213+70	1.101						S.C.S.	1.101	0.002								795.0	790.0	0	0.0633					1	24			1.20	797.4		803.0	5.6	13.0	79	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	8.5
45	217+40	217+50		81+00	24"	3	800.4	800	S.C.S.	3.000	0.005	250	1.35	2.23	3.5	13.30	0.97	25.5	800.0	796.0	0	-					1	24				800.0		808.0	8.0				EXTENSION NOT REQUIRED - RETAINING WALL	24	8.0
46	225+50	225+60		88+75	30"	3			S.C.S.	3.000	0.005	300	1.83	1.64	2.1	2.22	1.21	14.1	-	786.0	60	-					1	30				-		797.6	-		70	E		18	402.1
47	232+10	232+05	1.101	98+00	36"	5	784	780	S.C.S.	6.101	0.010	550	5.02	1.22	9.6	9.69	0.96	37.8	778.0	773.0	30	0.0670	8.00	4	4	0.77	1	36			0.99	781.0	Inlet	783.6	2.6	10.6	75	N	UPSTREAM CULVERT UNDER C.H. IS 36"	29	5.1
48	235+00	235+00	1.101						S.C.S.	1.101	0.002								778.0	770.0	20	0.1112					1	24			1.20	780.4		782.6	2.2	12.6	72	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	6.6
49	241+95	242+00	1.101						S.C.S.	1.101	0.002								778.0	774.0	30	0.0637					1	24			1.20	780.4		782.4	2.0	8.4	63	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	4.4
50	250+00	250+00		111+00	10' x 10'	8132		734	U.S.G.S.	8132	12.706							2742.5	-	733.0	0	-					1		10	10		-		782.2	-		-		EXTENSION NOT REQUIRED	251	415.7
51	265+50	265+00	1.561						S.C.S.	1.561	0.002	1000	13.59	0.11	16.0	1.07	1.02	6.3	778.0	773.0	45	0.0657	6.70	0	100	0.02	1	24			0.96	779.9	Inlet	781.8	1.9	8.8	76	N	INCREASED TO 24" BECAUSE OF LONG LENGTH	12	4.3
92	274+80	274+40																																793.2				N			
53	289+60	289+20		150+40	6' x 6'	238		744	U.S.G.S.	238.000	0.372							407.4	-	750.0	0						1		6	6		-		780.6	-	30.6			EXTENSION NOT REQUIRED - RETAINING WALL	97	405.6
54	293+25	292+90	5.000						S.C.S.	5.000	0.008	1550	28.20	0.18	15.1	1.81	1.20	10.8	779.3	774.0	45		7.3	6	3	0.34	1	24			1.55	782.4	Inlet	788.0	5.6		119	N	INCREASED TO 24" BECAUSE OF LONG LENGTH	16	9.4
55	302+20	302+00	0.735						S.C.S.	0.735	0.001								812.0	810.0	0	0.0550					1	18			1.00	813.5		814.4	0.9	4.4	36	N	18" CMP BY INSPECTION	0	1.9
56	305+30	305+00	0.826						S.C.S.	0.826	0.001								814.0	810.0	0	0.1072					1	18			1.00	815.5		815.6	0.0	5.5	37	N	18" CMP BY INSPECTION	0	2.0
57	308+50	308+00	0.700						S.C.S.	0.700	0.001								810.0	802.0	0	0.1216					1	24			1.00	812.0		814.3	2.3	12.3	66	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	6.3
58	315+15	314+90	0.918						S.C.S.	0.918	0.001								802.0	798.0	30	0.0623					1	24			1.00	804.0		806.6	2.6	8.6	64	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	4.6
59	319+00	318+90	4.040						S.C.S.	4.040	0.006	500	4.28	0.94	5.8	5.87	1.07	19.7	796.0	794.0	10	0.0340	10.00	2	3	0.70	1	24			1.42	798.8	Inlet	802.0	3.2	8.0	59	N		21	5.0
60	321+40	321+50	3.581						S.C.S.	3.581	0.006	350	2.36	1.52	5.5	12.17	0.97	27.3	797.0	795.0	20	0.0409	5.00	4	4	0.74	1	30			1.14	799.9	Inlet	801.0	1.1	6.0	49	N		25	2.5
93	325+40	325+00	0.750						S.C.S.	0.750	0.001	220	1.09	0.69				0.0	805.9	805.7	0	0.0068						18			1.00	807.4		808.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
63	331+10	334+00	1.561						S.C.S.	1.561	0.002	300	1.83	0.85	4.3	12.44	0.97	12.0	808.0	804.0	0	0.0526	8.00	2	2	0.62	1	24			1.73	811.5	Inlet	816.0	4.5	12.0	76	N	INCREASED TO 24" BECAUSE OF LONG LENGTH	17	8.0
64	335+30	336+50	2.938						S.C.S.	2.938	0.005	850	10.36	0.28	11.0	5.02	1.04	10.9	788.0	779.0	0	0.0746	5.70	4	2	0.47	1	24			1.53	791.1	Inlet	800.9	9.9	21.9	121	N	INCREASED TO 24" BECAUSE OF LONG LENGTH	16	15.4
94	339+40	339+00	0.320						S.C.S.	0.320	0.001	300	1.83	0.18				0.0	784.1	783.9		0.0068						18			1.00	785.6		786.3	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
65	341+40	344+60		182+55	5' x 5'	150		746	U.S.G.S.	150.000	0.234							317.5	-	750.0	0	ERR					1		5	5		-		783.0	-	33.0			EXTENSION NOT REQUIRED - RETAINING WALL	85	408.0
95	344+40	344+00	0.710						S.C.S.	0.710	0.001	450	3.59	0.20				0.0	783.9	783.7		0.0068						18			1.00	786.4		786.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
96	347+40	347+00	0.280						S.C.S.	0.280	0.000	270	1.53	0.18				0.0	789.9	789.7		0.0068						18			1.00	791.4		792.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
97	350+40	350+00	0.280						S.C.S.	0.280	0.000	260	1.44	0.19				0.0	799.9	799.7		0.0068						18			1.00	801.4		802.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
66	353+20	356+40		194+33	24"	6	806.9	804	S.C.S.	6.000	0.009	750	8.41	0.71	15.0	8.89	0.94	33.9	-	802.0	45	-12.3385					1	24				-		812.0	-	10.0	65	E		28	409.0
98	356+40	356+00	0.280						S.C.S.	0.280	0.000	270	1.53	0.18				0.0	825.9	825.7		0.0068						18			1.00	827.4		828.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
99	359+40	359+00	0.320						S.C.S.	0.320	0.001	300	1.83	0.18				0.0	837.9	837.7		0.0068						18			1.00	839.4		840.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
100	365+30	365+00	0.230						S.C.S.	0.230	0.000	300	1.83	0.13				0.0	837.9	837.7		0.0068						18			1.00	839.4		840.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
101	368+30	368+00	0.240						S.C.S.	0.240	0.000	250	1.35	0.18				0.0	825.9	825.7		0.0068						18			1.00	827.4		828.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
102	369+80	369+50	3.830						S.C.S.	3.830	0.006	670	6.97	0.55				0.0	823.5	823.0		0.0286						30				823.5		823.5	0.0	0.5	18	N	UNDER CROSS ROAD	0	-2.3
103	371+30	371+00	0.210						S.C.S.	0.210	0.000	270	1.53	0.14				0.0	813.9	813.7		0.0068						18			1.00	815.4		816.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
104	374+30	374+00	0.280						S.C.S.	0.280	0.000	270	1.53	0.18				0.0	800.9	800.7		0.0068						18			1.00	802.4		803.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
105	376+30	376+00	0.620						S.C.S.	0.620	0.001	400	2.95	0.21				0.0	796.9	796.7		0.0068						18			1.00	798.4		799.0	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
67	379+50	382+75		65+00	3' X 4'	50		756	U.S.G.S.	50.000	0.078							175.4	-	756.0	0	ERR					1		4	3		-		802.7	-	46.7			EXTENSION NOT REQUIRED - RETAINING WALL	63	424.7
68	381+30	384+75	0.225						S.C.S.	0.225	0.000								804.0	796.0	60	0.0769					1	24			1.00	806.0		806.0	0.0	10.0	104	N	18" CMP BY INSPECTION BUT INCREASED TO 24" BECAUSE OF LONG LENGTH	0	4.0
106	384+30	384+00	0.240						S.C.S.	0.240	0.000	270	1.53	0.16				0.0	815.3	815.1		0.0068						18			1.00	816.8		817.4	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
107	387+30	387+00	0.270						S.C.S.	0.270	0.000	230	1.17	0.23				0.0	826.0	825.8		0.0068						18			1.00	827.5		828.2	0.6	2.4	30	N	18" CMP BY INSPECTION	0	0.8
69	390+80	393+80	1.101						S.C.S.	1.101	0.002								838.0	836.0	30	0.0509					1	18			1.20	839.8		840.0	0.2	4.0	39	N	18" CMP BY INSPECTION, DEEPEN DITCH	0	1.5
70	395+00	396+70	0.918						S.C.S.	0.918	0.001								838.0	834.0	10	0.0890					1	18			1.00	839.5		840.7	1.2	6.7	45	N	18" CMP BY INSPECTION	0	3.2
71	397+60	401+10	1.010						S.C.S.	1.010	0.002								836.0	835.0	0	0.0323					1	18			1.00	837.5		838.0	0.5	3.0	31	N	18" CMP BY INSPECTION, LOWER DITCH FLOWLINE	0	1.0
72	402+30	406+00	1.377						S.C.S.	1.377	0.002								812.0	806.0	0	0.1034					1	18			1.20	813.8		816.0	2.2	10.0	58	N	18" CMP BY INSPECTION	0	5.5
73	403+95	409+00	1.010						S.C.S.	1.010	0.002								810.0	805.0	0	0.1150					1	18			1.20	811.8		812.1	0.3	7.1	43	N	18" CMP BY INSPECTION	0	3.1
74	407+60	414+00	11.018						S.C.S.	11.018	0.017	800	9.37	1.18	15.3	7.83	0.92	55.8	794.0	790.0	0	0.0735	5.00	6	3	0.96	1	36			1.41	798.2	Inlet	798.4	0.2	8.4	54	N	REPLACE EXISTING	36	3.4
75	411+50	418+00	4.958						S.C.S.	4.958	0.008	950	12.47	0.40	12.3	5.19	1.04	17.1	792.0	778.0	0		10	10	5	0.30	1	24			1.15	794.3	Inlet	796.0	1.7		82	N		20	9.0
76	412+30	418+50	0.500						S.C.S.	0.500	0.001								791.0	786.0	0						1	18			1.00	792.5		793.5	1.0		46	N	18" CMP BY INSPECTION	0	3.5
77	424+60	431+00		12+00	(2) 5' X 10'	2600		732	U.S.G.S.	2600	4.063							1481.6	-	732.0	0						2		10	5		-		781.6	-	49.6			EXTENSION NOT REQUIRED - RETAINING WALL	184	415.6
78	432+50	438+50	17.573						S.C.S.	17.573	0.027	1700	32.90	0.53	27.0	6.43	1.12	54.4	748.0	740.0	30	0.0433	2.20	25	2	0.57	1	36			1.43	752.3	Inlet	768.0	15.7	28.0	185	N		35	21.0
110	437+00	437+00	7.05						S.C.S.	7.050	0.011	1000	13.59	0.52	13.8	10.13	0.95	22.9	757.0	755.0	0	0.0500	10.00	15	20	0.27	1	30			0.98	759.5	Inlet	760.0	0.5	5.0	40	N		23	1.5
79	443+60	449+99	19.270						S.C.S.	19.270	0.030	1300	21.04	0.92	19.3	8.21	0.89	53.0	760.0	756.0	0	0.0683	5.00	0	10	0.28	1	36			1.37	764.1	Inlet	765.1	1.0	9.1	59	N		35	4.1
80	456+40	463+40	10.100						S.C.S.	10.100	0.016	1000	13.59	0.74	20.7	8.27	0.91	47.2	778.0	770.0	10	0.0908	4.00	15	1	0.60	1	36			1.19	781.6	Inlet	785.8	4.2	15.8	88	N		33	8.8
81	459+30	466+50	65.000						U.S.G.S.	65.000	0.102							202.1									1					0.0			0.0		16	N	BRIDGE	68	0.0
82	466+30	466+30	3.100						S.C.S.	3.100	0.005	500	4.28	0.72	8.5	9.60	0.92	19.0	809.5	808.0	0	0.0407	8.50	10	6	0.34	1	24			1.37	812.2		812.2	0.0	4.2	37	N		21	1.5
83	470+85	470+90	0.340						S.C.S.	0.340	0.001								824.0	822.0	0	0.0364					1	18			1.00	825.5		829.5	4.0	7.5	55	N	18" CMP BY INSPECTION	0	5.0
84	473+40	473+45	0.830						S.C.S.	0.830	0.001								836.0	832.0	0	0.0769					1	18			1.00	837.5		840.0	2.5	8.0	52	N	18" CMP BY INSPECTION	0	4.5
85	478+95	479+00	4.100						S.C.S.	4.100	0.006	440	3.46	1.19	4.9	5.42	1.05	20.5	836.0	834.0	0	0.0485	7.00	20	7	0.25	1	24			1.45	838.9		839.2	0.3	5.2	41	N		22	2.2
86	482+25	482+35	2.100						S.C.S.	2.100	0.003	420	3.20	0.66	4.6	2.22	1.15	11.7	847.0	842.0	0	0.1224	4.60	0	100	0.03	1	24			0.82	848.6		848.6	0.0	6.6	41	N	DROP INLET	16	2.1
108	489+95	490+00	1.000						S.C.S.	1.000	0.002								828.0	826.0	0	0.0263					1	24			1.00	830.0		837.0	7.0	11.0	76	N	18" BY INSPECTION, INCREASED TO 24" BECAUSE OF LONG LENGTH	0	8.0
[illegible]	497+80	497+75	1.600						S.C.S.	1.600	0.003	570	5.32	0.30	6.8	4.68	1.01	6.9	804.0	800.0	0	0.0743	10.00	10	4	0.25	1	18			1.00	805.5		808.3	2.8	8.3	54	N		13	4.8
[illegible]																																									
61																																									
62																																									
110	384+40	384+40	3						S.C.S.	3.000	0.005	500	4.28	0.70	5.7	3.73	1.00	13.6	808.0	800.0	0	0.1379	26.00	5	3	0.25	1	24			1.20	810.4		811.0	0.6	11.0	58	N	ALTERNATIVE #2 - DROP INLET	18	5.0
111	390+60	390+60	2						S.C.S.	2.000	0.003	250	1.35	1.48	2.4	9.60	0.94	11.2	814.0	811.0	0	0.0380	0.50	10	5	0.25	1	24			1.20	816.4		823.0	6.6	12.0	79	N	ALTERNATIVE #2	18	8.5
112	380+80	380+80	3						S.C.S.	3.000	0.005	800	9.37	0.32	10.4	5.00	1.04	11.7	794.0	780.0	0	0.1129	0.50	10	5	0.25	1	24			1.20	796.4		805.0	8.6	25.0	124	N	ALTERNATIVE #2	16	18.0
113	386+75	386+75	3						S.C.S.	3.000	0.005	400	2.95	1.02	4.3	10.00	0.96	14.2	796.0	794.0	0	0.0227	0.50	10	5	0.25	1	24			1.20	798.4		807.0	8.6	13.0	88	N	ALTERNATIVE #2	18	10.0

BY NLH DATE 11-17-94
CHKD. BY DLH DATE 1-10-95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

JOB NO. 9452044

Drainage Analysis

Need to submit Q's for trail culverts by Nov 25

Areas determined from Mapping and Quads by planimeter and scaling

For drainage areas > 25 acres use Iowa regression equation to get Q_{50}
see attached (A) ✓

For areas requiring min. pipe size 18" and less →
do not need to calculate Q's

18" pipe works for areas < 1.5 acres

see attached (B) for calculation of 1.5 acres

For areas >1.5 and <25 acres
use TR-55 as outlined by JWM 10-23-94
see attached (C)

Summary of drainage lengths and slope (10% to 85%)
see attached (D)

drainage lengths and slope points on rolled mapping and quads.

JLA planimeter calcs in folder.

Summary of culvert data → see attached (E)

(A)

Table 2. Regional flood-frequency equations

Hydrologic region 1
(19 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 211A^{0.62}$	61
$Q_5 = 502A^{0.60}$	37
$Q_{10} = 757A^{0.60}$	28
$Q_{25} = 1,140A^{0.57}$	24
$Q_{50} = 1,500A^{0.60}$	21
$Q_{100} = 1,880A^{0.60}$	24

Hydrologic region 2
(81 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 196A^{0.57}$	55
$Q_5 = 402A^{0.55}$	39
$Q_{10} = 570A^{0.55}$	34
$Q_{25} = 821A^{0.54}$	32
$Q_{50} = 1,020A^{0.53}$	33
$Q_{100} = 1,230A^{0.53}$	36

Hydrologic region 3
(119 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 129A^{0.62}$	44
$Q_5 = 265A^{0.59}$	36
$Q_{10} = 381A^{0.57}$	35
$Q_{25} = 555A^{0.55}$	37
$Q_{50} = 695A^{0.54}$	39
$Q_{100} = 851A^{0.53}$	41

Hydrologic region 4
(24 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 31A^{0.77}$	40
$Q_5 = 67A^{0.72}$	33
$Q_{10} = 98A^{0.70}$	31
$Q_{25} = 145A^{0.68}$	29
$Q_{50} = 180A^{0.66}$	30
$Q_{100} = 227A^{0.65}$	30

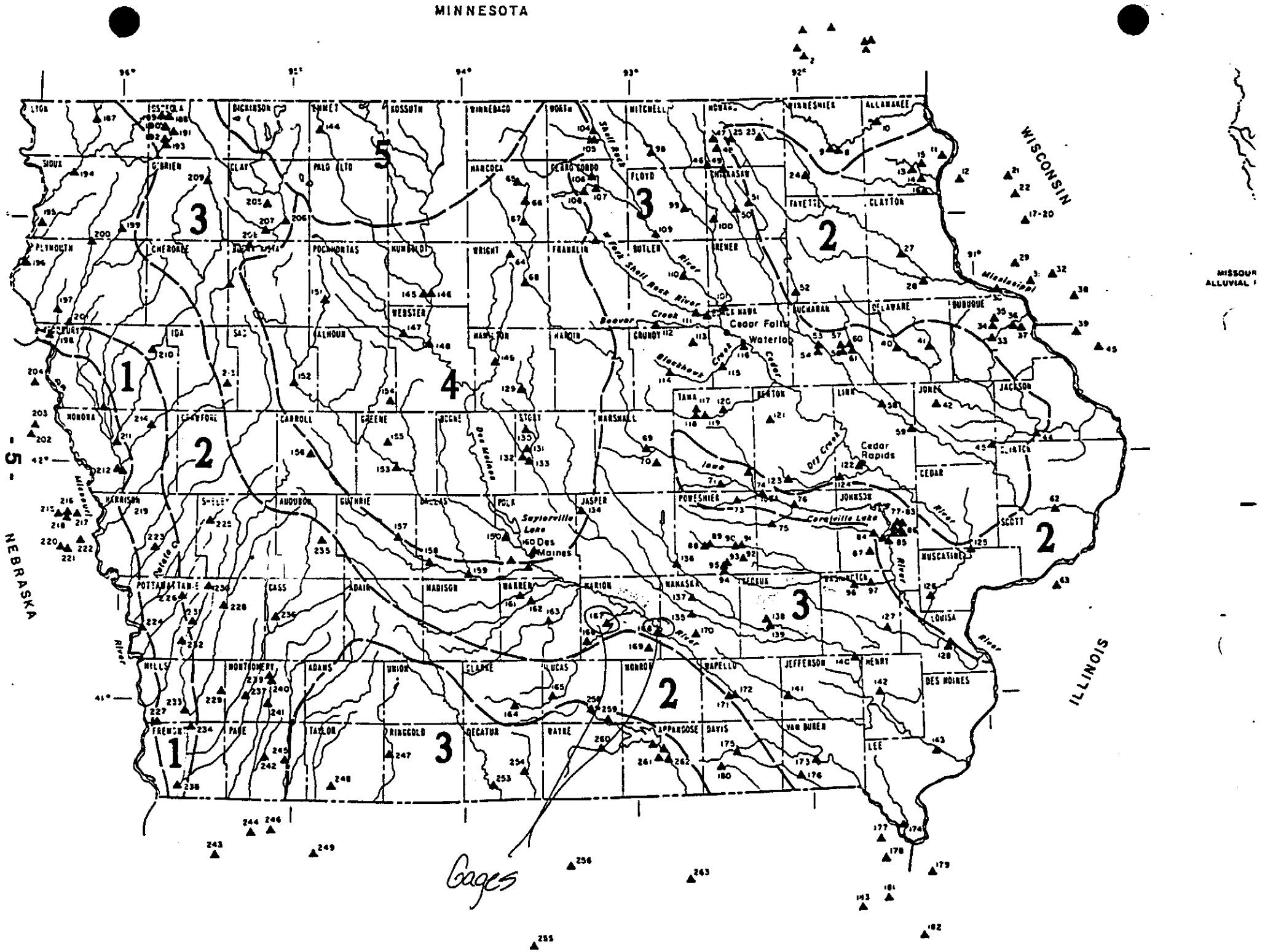
Hydrologic region 5
(8 stations)

Equation for indicated recurrence interval	Standard error (percent)
$Q_2 = 30A^{0.66}$	27
$Q_5 = 37A^{0.71}$	21
$Q_{10} = 41A^{0.74}$	20
$Q_{25} = 45A^{0.77}$	24
$Q_{50} = 47A^{0.79}$	24
$Q_{100} = 50A^{0.80}$	26

SQ MI

CFS

Use for A ≥ 25 acres


MINNESOTA
WISCONSIN
ILLINOIS
NEBRASKA
MISSOURI ALLUVIAL
Cedar Falls
Waterloo
Cedar Rapids
Des Moines
Coralville Lake
Saylorville Lake
Beaver Creek
Shell Rock River
Iowa River
Cedar River
Des Moines River
Missouri River
Big Sioux River
Little Sioux River
Floyd River
Blackhawk Creek
Wapsipinicon River
Maquoketa River
Turkey River
Upper Iowa River
Yellow River
Volga River
Mississippi
Gages

JM 10-23-94
MH 10-25-94

(C)

Discharge By SCS TR-55

1. Use Type II Storm, 24 Hour
2. Assume Hydrologic Soil Group "C". (Sandy Clay Loa
3. 50 year Rainfall = 6.1"/hr
4. Use Runoff Curve No (CN) = 75 (Avg)
   & Runoff Volume = 3.37"
5. Adjust For Watershed Shape.
   A. Determine Length of Watershed
   B. Determine Equivilent Drainage Area From Chart
   C. Shape Factor = $\frac{\text{Actual Area}}{\text{Equivalent Area}}$.
7. Determine Slope S10/85.
8. From Figures D-2 Determine Peak Discharge per Inch of Runoff.
9. Determine Slope Adjustment Factor (Table E-1)
10. Determine Q50

TR-55, APPENDIX "D" PEAK DISCHARGE COMPUTATION SHEET

PROJECT LAKE RED ROCK TRAIL - SEGMENT IV By_____, Date____

_____ Checked_____, Date____

Steps

1. Given: *Drainage Area (DA) = _____ Acres
   Storm Type & Duration = II 24 -Hours
   *Design Frequency = 50 -Years
   *Rainfall Depth (P) = 6.1 Inches
   *Average Watershed Slope = _____ % Sloped
   *Runoff Curve No. (CN) = 74-75

2. Table 2-1: Use RF and CN as input to this or similar table.
   Runoff Volume (Q) = 3.37 Inches

3.** Watershed Shape Adjustment (Figure E-1):
   *Hydraulic Length = _____ Ft.
   Equivalent Drainage Area = _____ Acres
   Watershed Shape Factor = ____ = Actual DA / Equivalent DA

4. Figure D-2:
   Use Equivalent DA if Watershed Shape Adjustment (Step 3) is to be applied.
   (Slopes: Flat < 3%; Moderate 3% to < 8%; Steep 8% and above)
   Peak Discharge per inch of Q = _____ cfs/inch of runoff

5.** Watershed Slope Interpolation (Table E-1):
   Use Equivalent DA if Watershed Shape Adjustment (Step 3) is to be applied.
   Slope Adjustment factor = ____

6.** Ponding & Swamp Storage Adjustment (Tables E-2, E-3, E-4)
   *% of Ponding and Swampy Area = 0 % (Based on Actual DA)
   *Location in Watershed (check one):
   Design Point (E-2)__; Center or Spreadout (E-3)__; Upper Reaches (E-4)__.
   Ponding Adjustment Factor = 1.00

7. Basic Peak Discharge with Watershed Adjustments (q_p):

From Step#	(4)	(2)	(3)**	(5)**	(6)**
q_p =	Peak Discharge per inch of Q	x Q	x [Watershed Shape Factor	x Slope Factor	x Ponding Factor]
q_p =	_____ cfs/in	x 3.37 in	x [____	x ____	x 1.00]

q_p = _____ cfs

*Input Data
**Optional Adjustments. If the adjustment is not used, the Factor = 1.0

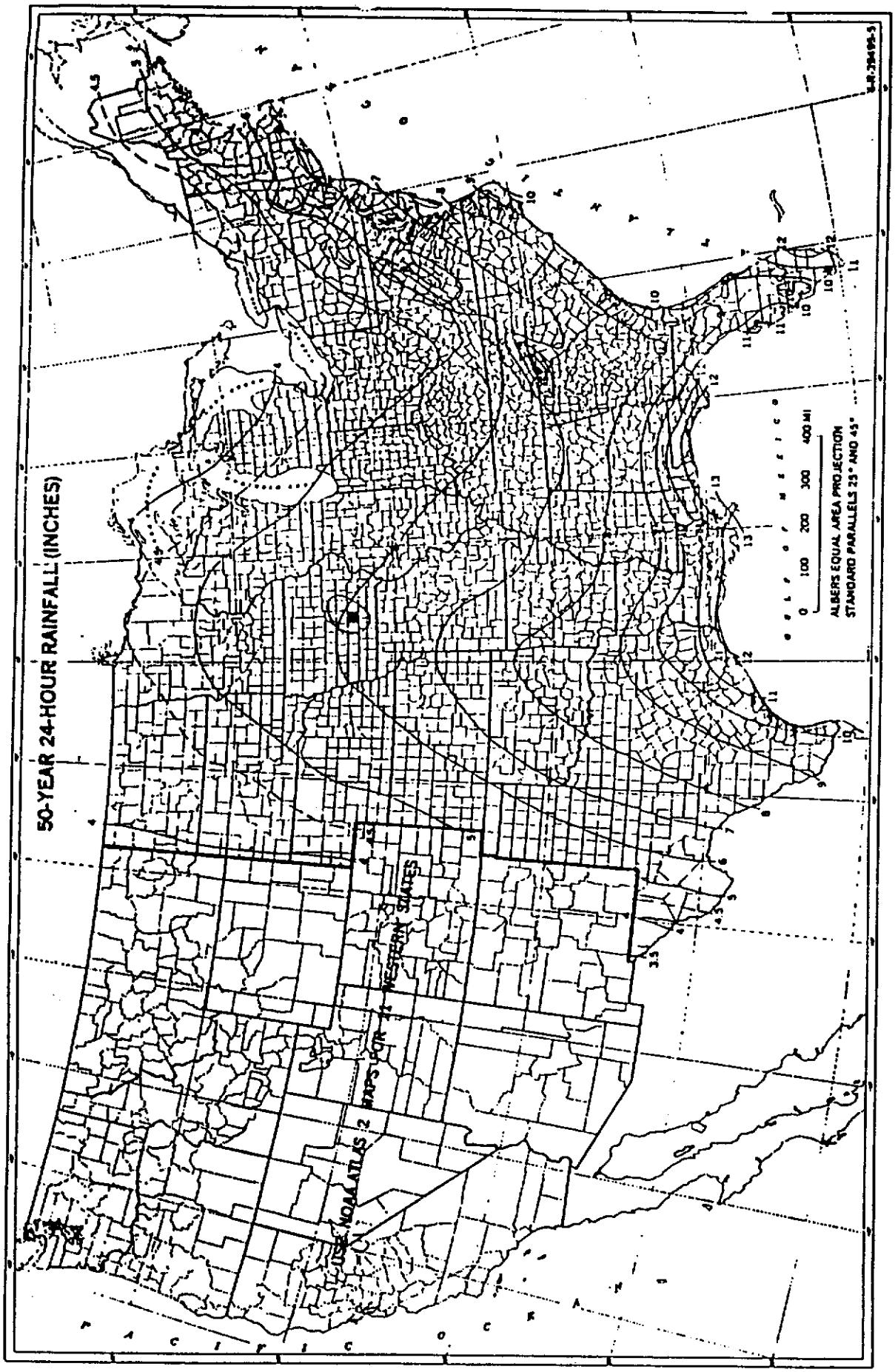


Figure B-7.—Fifty-year, 24-hour rainfall.

Table 2-2.--Runoff curve numbers for selected agricultural, suburban, and urban land use. (Antecedent moisture condition II, and $I_a = 0.2S$)

LAND USE DESCRIPTION	HYDROLOGIC SOIL GROUP			
	A	B	C	D
Cultivated land[1/]: without conservation treatment	72	81	88	91
: with conservation treatment	62	71	78	81
Pasture or range land: poor condition	68	79	86	89
good condition	39	61	74	80
Meadow: good condition	30	58	71	78
Wood or Forest land: thin stand, poor cover, no mulch	45	66	77	83
good cover[2/]	25	55	70	77
Open Spaces, lawns, parks, golf courses, cemeteries, etc.				
good condition: grass cover on 75% or more of the area	39	61	74	80
fair condition: grass cover on 50% to 75% of the area	49	69	79	84
Commercial and business areas (85% impervious)	89	92	94	95
Industrial districts (72% impervious).	81	88	91	93
Residential:[3/]				
Average lot size — Average % Impervious[4/]				
1/8 acre or less — 65	77	85	90	92
1/4 acre — 38	61	75	83	87
1/3 acre — 30	57	72	81	86
1/2 acre — 25	54	70	80	85
1 acre — 20	51	68	79	84
Paved parking lots, roofs, driveways, etc.[5/]	98	98	98	98
Streets and roads:				
paved with curbs and storm sewers[6/]	98	98	98	98
gravel	76	85	89	91
dirt	72	82	87	89

1/ For a more detailed description of agricultural land use curve numbers refer to National Engineering Handbook, Section 4, Hydrology, Chapter 9, Aug. 1972.

2/ Good cover is protected from grazing and litter and brush cover soil.

3/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

4/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

5/ In some warmer climates of the country a curve number of 95 may be used.

Table 2-1.--Runoff depth in inches for selected CN's and rainfall amounts

Rainfall (inches)	Curve Number (CN)[1/]								
	60	65	70	75	80	85	90	95	98
1.0	0	0	0	0.03	0.08	0.17	0.32	0.56	0.79
1.2	0	0	0.03	0.07	0.15	0.28	0.46	0.74	0.99
1.4	0	0.02	0.06	0.13	0.24	0.39	0.61	0.92	1.18
1.6	0.01	0.05	0.11	0.20	0.34	0.52	0.76	1.11	1.38
1.8	0.03	0.09	0.17	0.29	0.44	0.65	0.93	1.29	1.58
2.0	0.06	0.14	0.24	0.38	0.56	0.80	1.09	1.48	1.77
2.5	0.17	0.30	0.46	0.65	0.89	1.18	1.53	1.96	2.27
3.0	0.33	0.51	0.72	0.96	1.25	1.59	1.98	2.45	2.78
4.0	0.76	1.03	1.33	1.67	2.04	2.46	2.92	3.43	3.77
5.0	1.30	1.65	2.04	2.45	2.89	3.37	3.88	4.42	4.76
6.0	1.92	2.35	2.80	3.28	3.78	4.31	4.85	5.41	5.76
7.0	2.60	3.10	3.62	4.15	4.69	5.26	5.82	6.41	6.76
8.0	3.33	3.90	4.47	5.04	5.62	6.22	6.81	7.40	7.76
9.0	4.10	4.72	5.34	5.95	6.57	7.19	7.79	8.40	8.76
10.0	4.90	5.57	6.23	6.88	7.52	8.16	8.78	9.40	9.76
11.0	5.72	6.44	7.13	7.82	8.48	9.14	9.77	10.39	10.76
12.0	6.56	7.32	8.05	8.76	9.45	10.12	10.76	11.39	11.76

[1/] To obtain runoff depths for CN's and other rainfall amounts not shown in this table, use an arithmetic interpolation.

FOR 6.1" RAINFALL
RUNOFF DEPTH = 3.37"

$l = 209\ a^{0.6}$

$(l)^{1/0.6} = 209^{1/0.6}\ l$

$a = \frac{l^{1/0.6}}{209^{1/0.6}} = \left(\frac{l}{209}\right)^{1/0.6}$

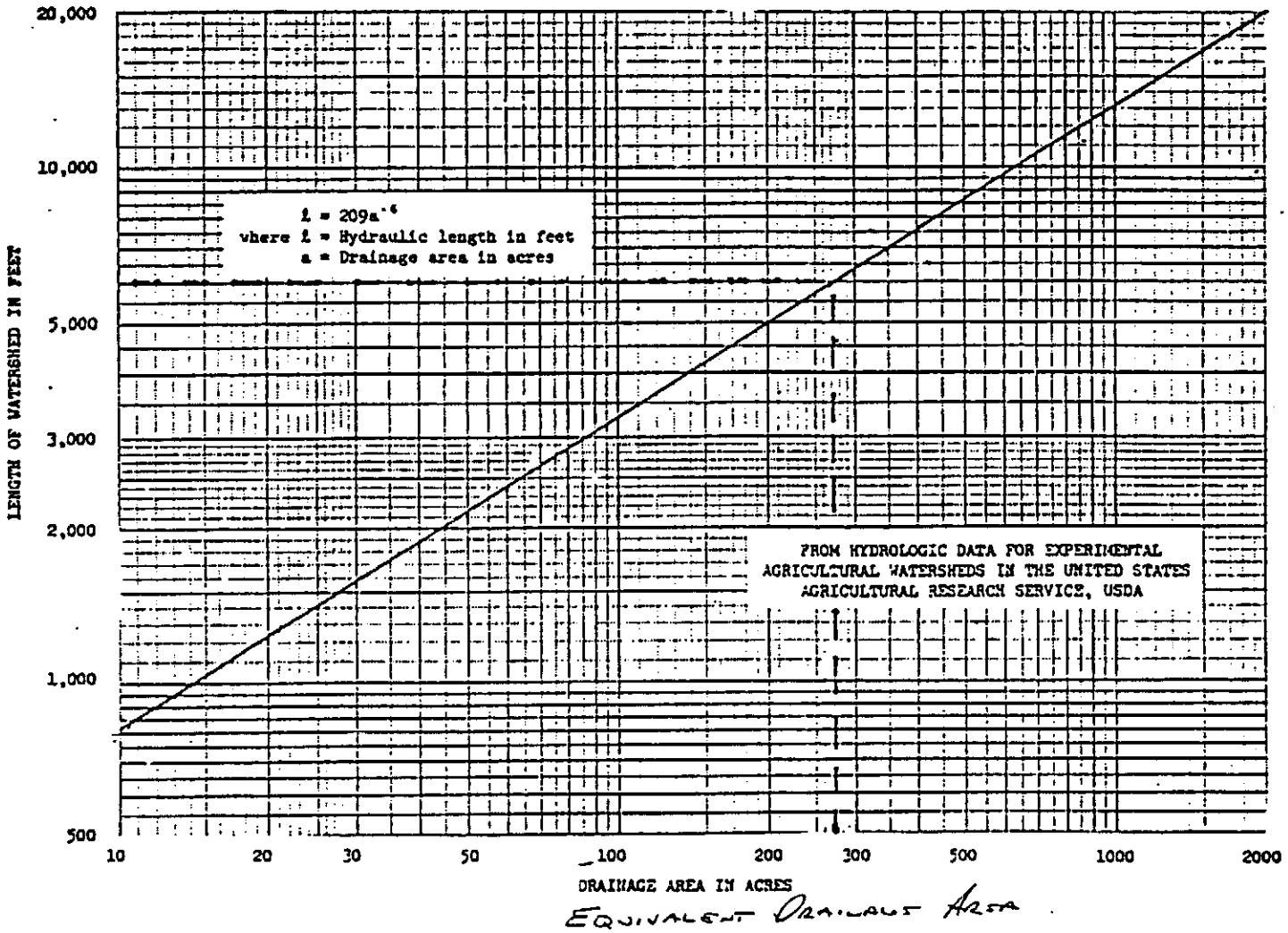


Figure E-1.--Hydraulic length and drainage area relationship.

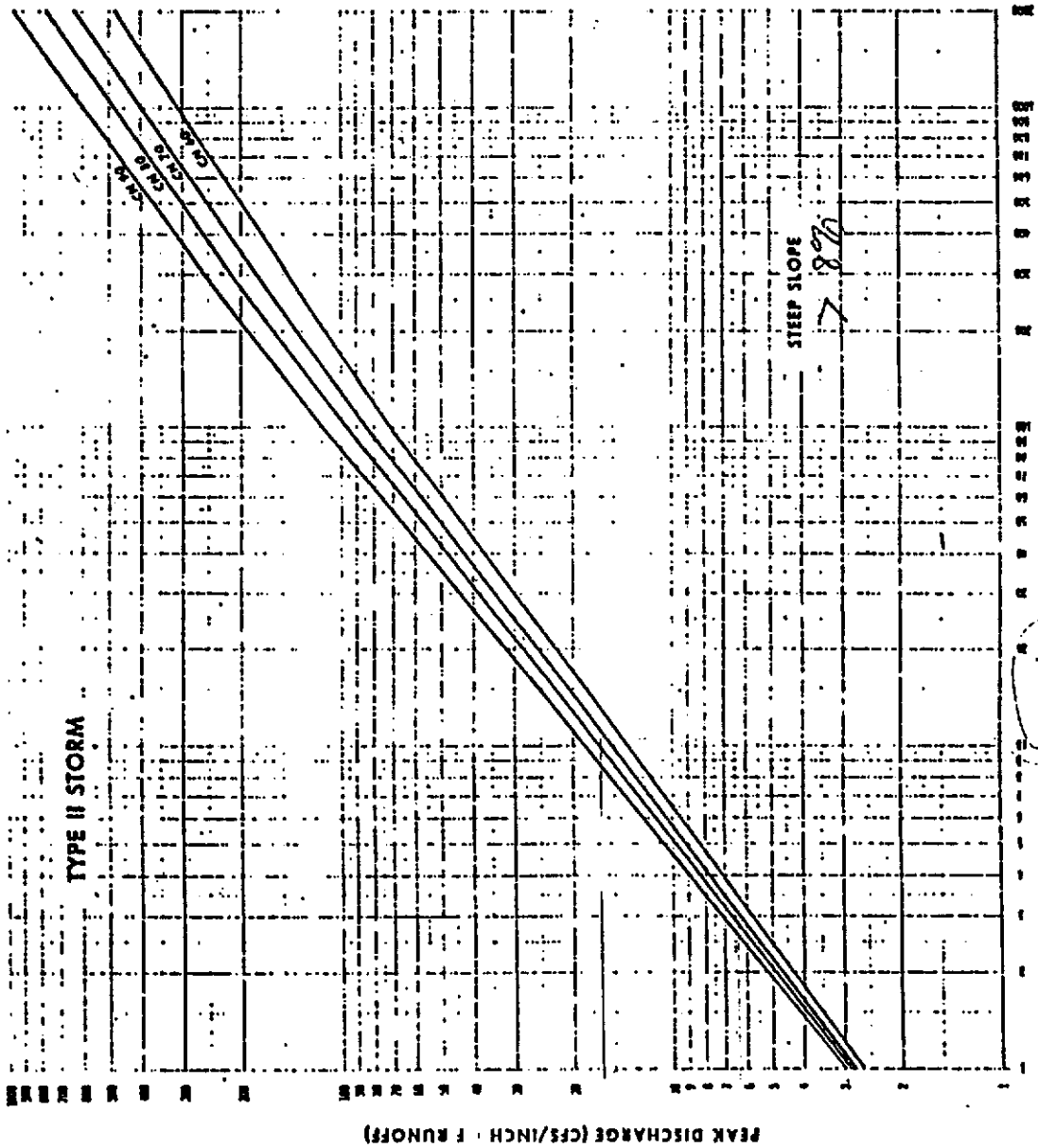
Equivalent

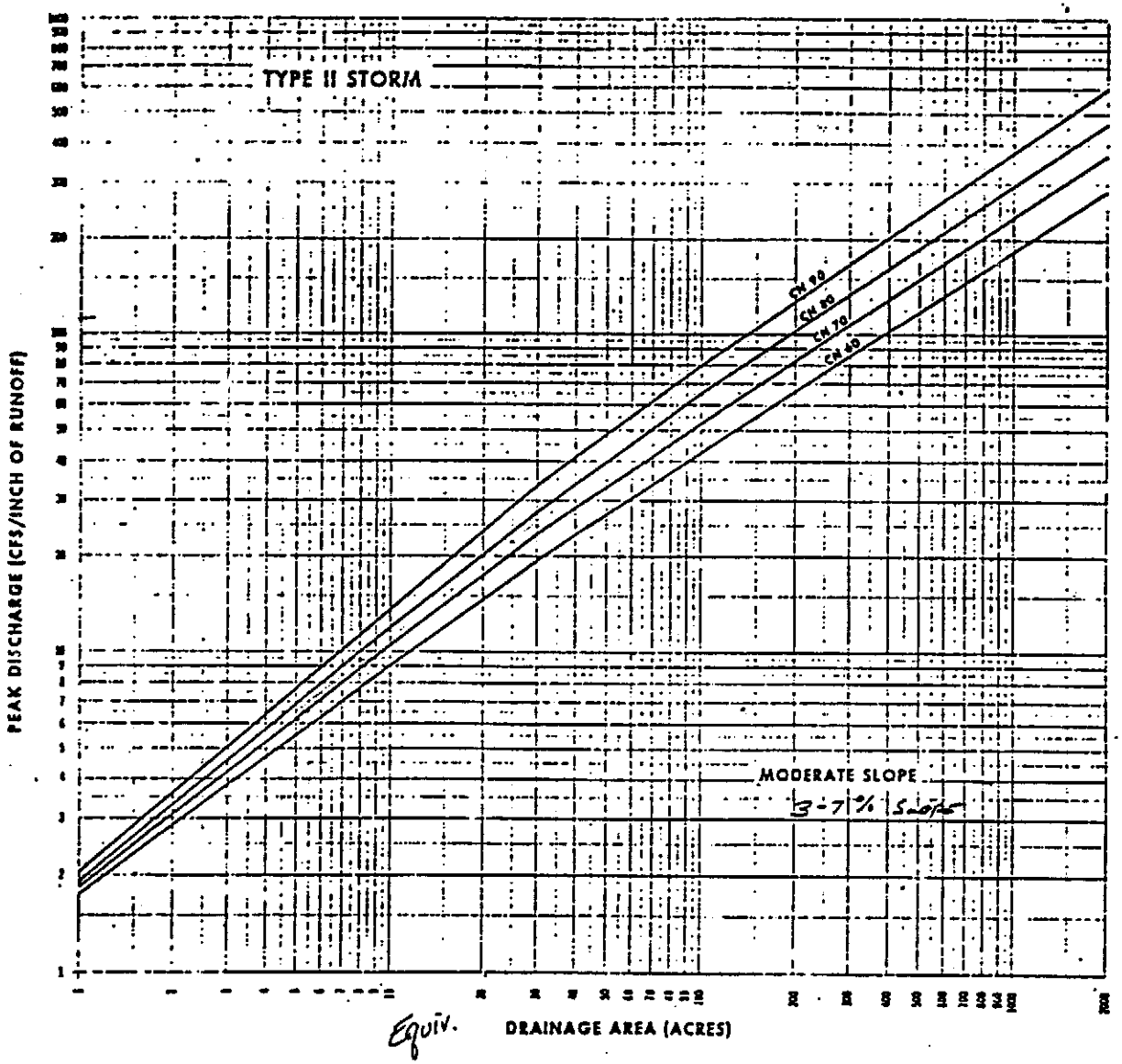
Table E-1.--Slope adjustment factors by drainage areas

Slope (percent)	10 acres	20 acres	50 acres	100 acres	200 acres	500 acres	1,000 acres	2,000 acres
FLAT SLOPES								
0.1	0.49	0.47	0.44	0.43	0.42	0.41	0.41	0.40
0.2	.61	.59	.56	.55	.54	.53	.53	.52
0.3	.69	.67	.65	.64	.63	.62	.62	.61
0.4	.76	.74	.72	.71	.70	.69	.69	.69
0.5	.82	.80	.78	.77	.77	.76	.76	.76
0.7	.90	.89	.88	.87	.87	.87	.87	.87
1.0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.5	1.13	1.14	1.14	1.15	1.16	1.17	1.17	1.17
2.0	1.21	1.24	1.26	1.28	1.29	1.30	1.31	1.31
MODERATE SLOPES								
3	.93	.92	.91	.90	.90	.90	.89	.89
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.04	1.05	1.07	1.08	1.08	1.08	1.09	1.09
6	1.07	1.10	1.12	1.14	1.15	1.16	1.17	1.17
7	1.09	1.13	1.18	1.21	1.22	1.23	1.23	1.24
STEEP SLOPES								
8	.92	.88	.84	.81	.80	.78	.78	.77
9	.94	.90	.86	.84	.83	.82	.81	.81
10	.96	.92	.88	.87	.86	.85	.84	.84
11	.96	.94	.91	.90	.89	.88	.87	.87
12	.97	.95	.93	.92	.91	.90	.90	.90
13	.97	.97	.95	.94	.94	.93	.93	.92
14	.98	.98	.97	.96	.96	.96	.95	.95
15	.99	.99	.99	.98	.98	.98	.98	.98
16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.03	1.04	1.05	1.06	1.07	1.08	1.09	1.10
25	1.06	1.08	1.12	1.14	1.15	1.16	1.17	1.19
30	1.09	1.11	1.14	1.17	1.20	1.22	1.23	1.24
40	1.12	1.16	1.20	1.24	1.29	1.31	1.33	1.35
50	1.17	1.21	1.25	1.29	1.34	1.37	1.40	1.43

For CN 75

$Q = 2.85 A^{0.75}$





Equiv.

Figure D-2.--Peak rates of discharge for small watersheds (24-hour, type-II storm distribution). Sheet 2 of 3

$Q = 1.9 A^{0.76}$

CN = 75

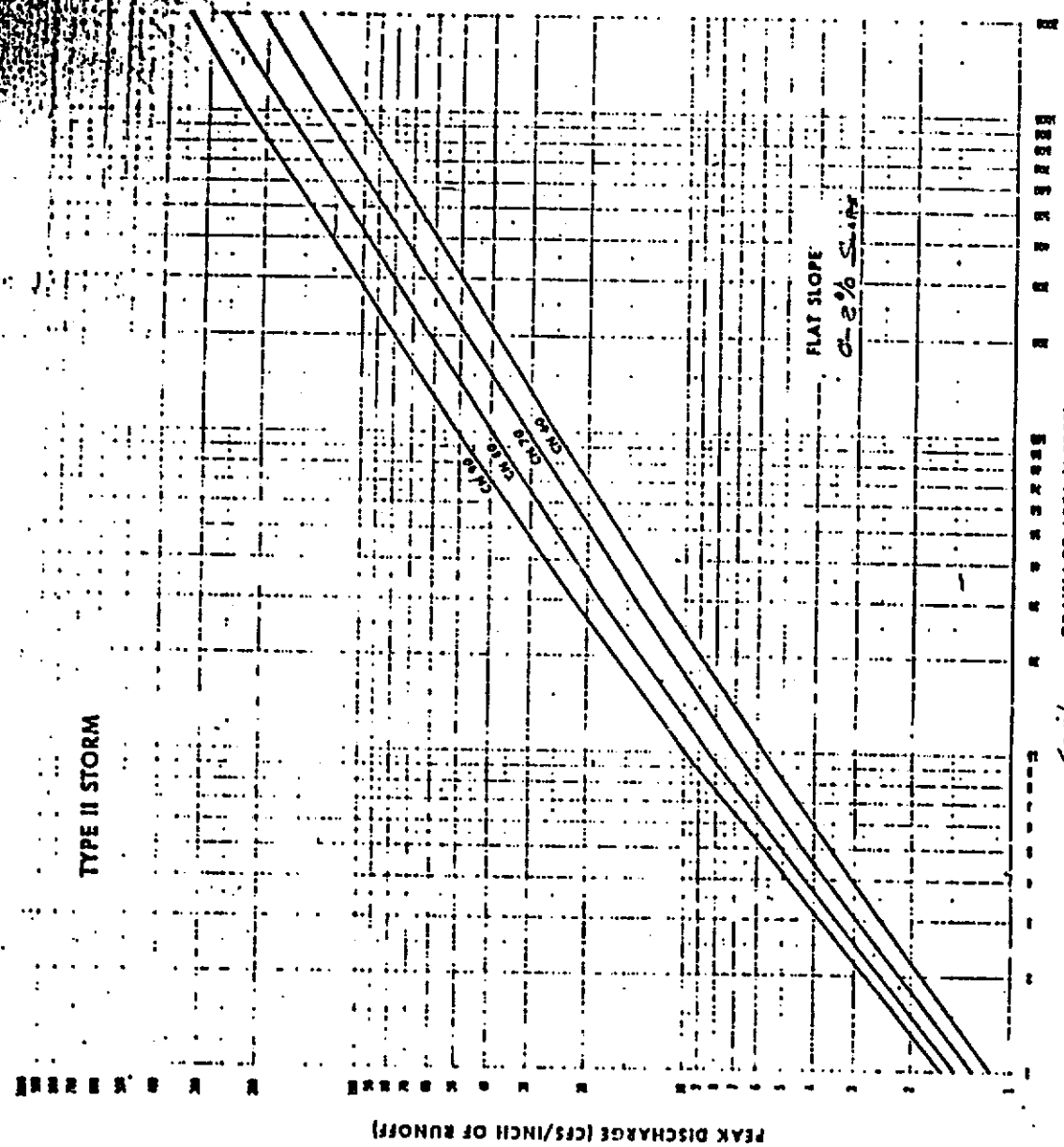


Figure D-2.--Peak rates of discharge for small watersheds (24-hour, type-II storm distribution). Sheet 1 of 3

JAD 12/7/94
TTH 12/10/94

9452044
2070

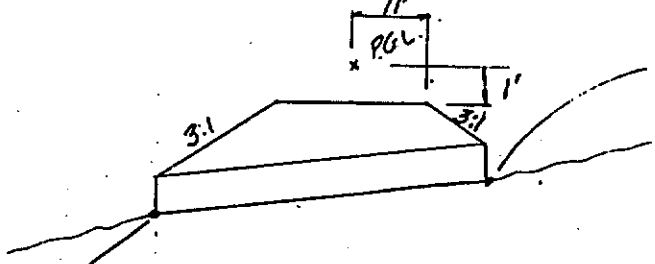
Lake Red Rock
Culvert Size Determination

PROCEDURE

1.) Locate Proposed Culvert on Plan dated 11/8/94 based on Culvert locatio shown on drainage area plots. (Stationing on Culvert Tab. Stationing on P&P).

2.) Calculate Profile Grade Elev. @ ℄ Prop. Culvert

3) Estimate pipe length and USFL & DSFL from contour plot and computed P.G. Elev.



USFL = Natural Channel or PGL - 1 - Pipe ϕ. (whichever is lower)

DSFL = Natural Channel Elev.

To Estimate pipe length & ℄ Elev's assume pipe size = pipe size for existin culverts under CH for simila size drainage area.

4) Determine downstream channel slope and section from contour plo (Assume trapezoidal section). (This will be used to estimate tailwater depth. Most of the pipes & channels are on such steep slopes that TW does not significantly affect pipe size. ∴ Rough approximation of channel section & slope is adeq.

5.) Determine minimum pipe diameter such that pipe flowing full can carry Q_{50} at velocity ≤ 8 ft/s. (Minimum 18" ϕ)

6) Use HY8 to calculate headwater for pipe size determine in Step 5. Adjust pipe size and/or USFL such that HW is 6" (min) below PGL and HW/D ≤ 2.0. See sample HY8 input/output file (attached) for typica data input. (Input/output for each culvert can be reviewed in HY8, but hard copy was not printed).

7) Summarize results in J:\USER\TRAN\9452044\CULVERTS.WK1

EXAMPLE HYD RUN

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF

SUMMARY TABLE

CULV NO.	<S> SITE DATA			<C> CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	747.50	737.00	240.23	1 - CSP	4.00	4.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

Based on Contour plot

Assumed Steel pipe

Vary pipe size to meet design constraints.

PRESS	TO REVIEW	PRESS	TO
<C>	CULVERT DATA	<E>	EDIT CULVERT SIZE
<D>	DISCHARGE DATA	<M>	MINIMIZE CULVERT SPAN
<R>	ROADWAY DATA	<A>	ADD OR DELETE CULVERTS
<S>	SITE DATA	<N>	EDIT NUMBER OF BARRELS
<T>	TAILWATER RATING CURVE		

<ENTER> TO CONTINUE

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

SCI CULVERT DATA

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF

ITEM	SELECTED CULVERT
<1> BARREL SHAPE:	CIRCULAR
<2> BARREL SIZE:	4.00 FT DIAMETER
<3> BARREL MATERIAL:	CORRUGATED STEEL
<4> MANNING'S n:	.024 – selected by program based on pipe material
<5> INLET TYPE:	CONVENTIONAL
<6> INLET EDGE AND WALL:	SQUARE EDGE WITH HEADWALL
<7> INLET DEPRESSION:	NONE

<NUMBER> TO EDIT ITEM
<ENTER> TO CONTINUE DATA LISTING

Inlet options most like Metal End S (See attached pictures from FHWA HDS *

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

* Options are
<1> Thin Edge Projecting
<2> Mitered to Conform to Slope
<3> Square Edge w/ Headwall No Option 4 or 5
<6> Beveled Edge (1:1)
<7> " " (1.5:1)

SDI DISCHARGE DATA

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF

PERFORMANCE CURVE DISCHARGE RANGE
(Minimum to Maximum Discharge)

ENTER DISCHARGES IN CFS

	DISCHARGE	CFS	CMS
65% (≈ 10 Yr Storm) <1>	MINIMUM	45.0	1.27
50 Yr Storm <2>	DESIGN	70.5	2.00
125% (≈ 100 Yr Storm) <3>	MAXIMUM	90.0	2.55

<NUMBER> TO EDIT DISCHARGE
<ENTER> TO CONTINUE
<U> TO CHANGE UNITS

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

<R> ROADWAY DATA

CULVERT FILE: REDRK78
TAILWATER FILE: REGULAR

FHWA CULVERT ANALYSIS
HY-8, VERSION 4.0

DATE: 12-05-1994
CULVERT NO. 1 OF

SELECTED ROADWAY CREST

<1> SHAPE: CONSTANT ROADWAY ELEVATION ~~767.5~~ 0.0 FT

<2> CROSS-SECTION DATA

<3> ROADWAY SURFACE: P

<4> EMBANKMENT TOP WIDTH (FT): 16

<NUMBER> TO EDIT ITEM:
<ENTER> TO CONTINUE
<ESC> FOR LAST MENU

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

NOTE: Roadway Data will not be used if No Overtopping Analysis is selected.
∴ Not necessary to define roadway profile.

<(5) SITE C TA

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF

CULVERT INVERT DATA

NO.	ITEM	VALUE	
<1>	INLET STATION (FT)	0.00	
<2>	INLET ELEVATION (FT)	747.50	USFL
<3>	OUTLET STATION (FT)	240.00	- Pipe Length
<4>	OUTLET ELEVATION (FT)	737.00	DSFL
<5>	ENTER NUMBER OF BARRELS	1	

<NUMBER> TO EDIT ITEM
<ENTER> TO CONTINUE DATA INPUT
<ESC> FOR SITE DATA OPTION MENU

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

USFL, DSFL & Pipe Length estimated from contour plot and Proposed PG Elev (based on Prelim. Profile 11/8/94)

<17 TAILWAT 2 RATING CURVE
<D> DATA

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF

ENTER TAILWATER CHANNEL DATA

NO.	ITEM	VALUE	
<1>	BOTTOM WIDTH (FT)	25	Estimated from Cont.
<2>	SIDE SLOPE H:V __:1	2	
<3>	CHANNEL SLOPE (FT/FT)	.022	
<4>	MANNING'S N (.01-0.1)	.04	From 1001 Drainage M Table 5-301c For Natural Streams
<5>	CHANNEL INVERT ELEVATION (FT)	737	
	CULVERT INVERT ELEVATION (FT) (CULVERT NO. 1 OUTLET)	737.00	

<NUMBER> TO EDIT ITEM
<ENTER> TO CONTINUE DATA INPUT
<ESC> FOR CHANNEL SHAPE MENU

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF 1

TAILWATER RATING CURVE

NO.	FLOW(CFS)	T.W.E.(FT)	DEPTH (FT)	VEL.(FPS)	SHEAR(PSF)
1	45.00	737.51	0.51	3.40	0.70
2	49.50	737.54	0.54	3.53	0.74
3	54.00	737.57	0.57	3.64	0.78
4	58.50	737.59	0.59	3.76	0.82
5	63.00	737.62	0.62	3.86	0.85
6	67.50	737.65	0.65	3.96	0.89
7	70.50	737.66	0.66	4.03	0.91
8	76.50	737.70	0.70	4.15	0.96
9	81.00	737.72	0.72	4.24	0.99
10	85.50	737.75	0.75	4.33	1.02
11	90.00	737.77	0.77	4.41	1.05

PRESS:
<D> FOR DATA
<P> TO PLOT RATING CURVE
<ESC> FOR CHANNEL SHAPE MENU
<ENTER> TO CONTINUE

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

CULVERT FILE: REDRK78 FHWA CULVERT ANALYSIS DATE: 12-05-1994
TAILWATER FILE: REGULAR HY-8, VERSION 4.0 CULVERT NO. 1 OF

CULVERT PROGRAM OPTIONS

PRESS LETTER OF DESIRED OPTION

<O> OVERTOPPING ANALYSIS
Inlet Control - HDS5 Nomographs
Outlet Control - Water Surface Profiles
Overtopping - Weir Equation

Select <N>

<N> NO OVERTOPPING ANALYSIS (CULVERT NUMBER 1)
Inlet Control - HDS5 Nomographs
Outlet Control - Water Surface Profiles

<B> OUTLET CONTROL METHOD - Toggles outlet control loss comp. between water surface profile (default) & full barrel,
<S> SAVE MENU
<D> DATA SUMMARY
<F> FILE MENU SAVE FILE BEFORE <F> OR <M>
<M> MAIN MENU OR FILE WILL BE LOST

1-Help 2-Progr 3 4 5-End 6 7 8 9-DOS 10

If toggled to "full barrel - flow" output heading will show "FULL FLOW HD

Tried both methods o outlet control. (See attac output printouts).

Use water surface profile (default) computation method.

, OUTLET CONTROL METHOD = WATER SURFACE PROFILE (DEFAULT)

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (4 BY 4) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	ANALYSIS ASSUMES NO OVERTOPPING NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	OUTLET DEPTH (ft)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
45	750.31	2.81	2.81	1-S2n	1.43	2.01	11.15	1.43	3.40	0.51
50	750.49	2.99	2.99	1-S2n	1.51	2.10	11.42	1.51	3.53	0.54
54	750.66	3.16	3.16	1-S2n	1.58	2.20	11.66	1.58	3.64	0.57
59	750.84	3.34	3.34	1-S2n	1.65	2.30	11.92	1.65	3.76	0.59
63	751.01	3.51	3.51	1-S2n	1.72	2.39	12.17	1.72	3.86	0.62
68	751.18	3.68	3.68	1-S2n	1.79	2.48	12.40	1.79	3.96	0.65
71	751.30	3.80	3.80	1-S2n	1.83	2.53	12.54	1.83	4.03	0.66
77	751.54	4.04	4.04	5-S2n	1.92	2.64	12.79	1.92	4.15	0.70
81	751.73	4.23	4.23	5-S2n	1.99	2.72	12.96	1.99	4.24	0.72
86	751.92	4.42	4.42	5-S2n	2.06	2.80	13.14	2.06	4.33	0.75
90	752.12	4.62	4.62	5-S2n	2.12	2.87	13.31	2.12	4.41	0.77

INVERT ELEVATIONS--> Inlet - 747.50 ft Crest - 0.00 ft
Outlet - 737.00 ft Throat - 0.00 ft

PRESS: <KEY> TO RETURN

1 2 3 4 5-End 6 7 8 9 10

Inlet Control unless Outlet Control Depth > Inlet Control Depth

Check that HW Elev ≤ PGL - 0.5

and HW < Pipe ϕ × 2 (HW/D ≤ 2.0)

OUTLET CONTROL METHOD + FULL BARREL FLO

Do Not U

PERFORMANCE CURVE FOR CULVERT # 1 - 1 (4 BY 4) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FULL FLOW HDS5 <F4>	ANALYSIS ASSUMES NO OVERTOPPING NORMAL DEPTH (ft)	CRITICAL DEPTH (ft)	OUTLET VEL. (fps)	OUTLET DEPTH (ft)	TAILWATER VEL. (fps)	TAILWATER DEPTH (ft)
45	750.31	2.81	-6.40	6-FFc	1.43	2.01	7.13	2.01	3.40	0.51
50	750.49	2.99	-6.12	6-FFc	1.51	2.10	7.39	2.10	3.53	0.54
54	750.66	3.16	-5.82	6-FFc	1.58	2.20	7.63	2.20	3.64	0.57
59	750.84	3.34	-5.50	6-FFc	1.65	2.30	7.84	2.30	3.76	0.59
63	751.01	3.51	-5.15	6-FFc	1.72	2.39	8.03	2.39	3.86	0.62
68	751.18	3.68	-4.79	6-FFc	1.79	2.48	8.27	2.48	3.96	0.65
71	751.30	3.80	-4.54	6-FFc	1.83	2.53	8.42	2.53	4.03	0.66
77	751.54	4.04	-4.01	6-FFc	1.92	2.64	8.71	2.64	4.15	0.70
81	751.73	4.23	-3.58	6-FFc	1.99	2.72	8.91	2.72	4.24	0.72
86	751.92	4.42	-3.14	6-FFc	2.06	2.80	9.09	2.80	4.33	0.75
90	752.12	4.62	-2.67	6-FFc	2.12	2.87	9.34	2.87	4.41	0.77

INVERT ELEVATIONS--> Inlet - 747.50 ft Crest - 0.00 ft
Outlet - 737.00 ft Throat - 0.00 ft

PRESS: <KEY> TO RETURN

1 2 3 4 5-End 6 7 8 9 10

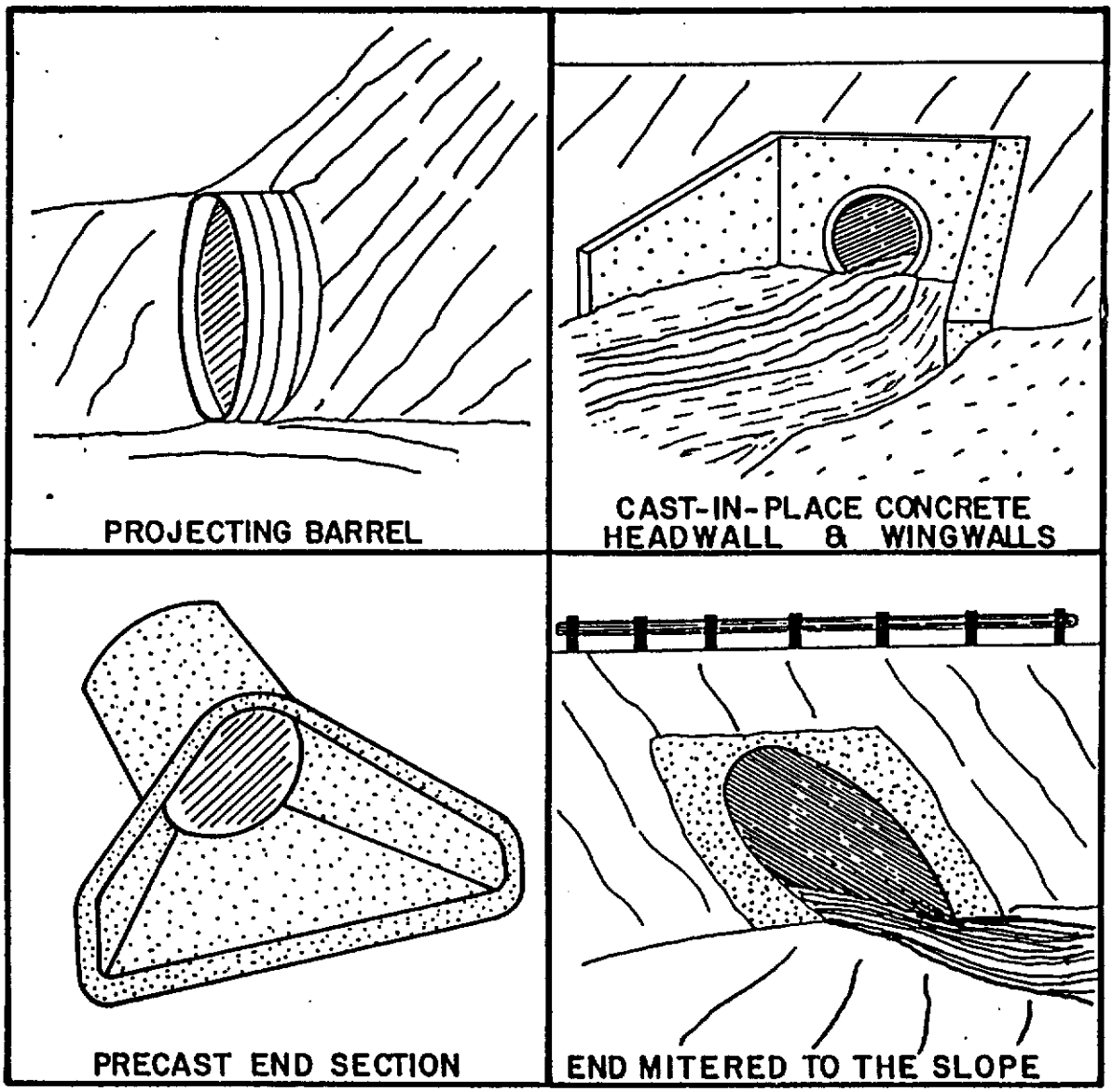


Figure I-7--Four standard inlet types (schematic).

water surface elevation may also produce full flow. (figure I-11) Regardless of the cause, the capacity of a culvert operating under pressure flow is affected by upstream and downstream conditions and by the hydraulic characteristics of the culvert.

b. Partly Full (Free Surface) Flow. Free surface flow or open channel flow may be categorized as subcritical, critical, or supercritical. A determination of the appropriate flow regime is accomplished by evaluating the dimensionless number, F_r, called the Froude number:

$$F_r = V/(gy_h)^{0.5}$$

In this equation, V is the average velocity of flow, g is the gravitational acceleration, and y_h is the hydraulic depth. The hydraulic depth is calculated by dividing the cross-sectional flow area by the width of the free water surface. When $F_r > 1.0$, the flow is supercritical and is characterized as swift. When $F_r < 1.0$, the flow is subcritical and characterized as smooth and

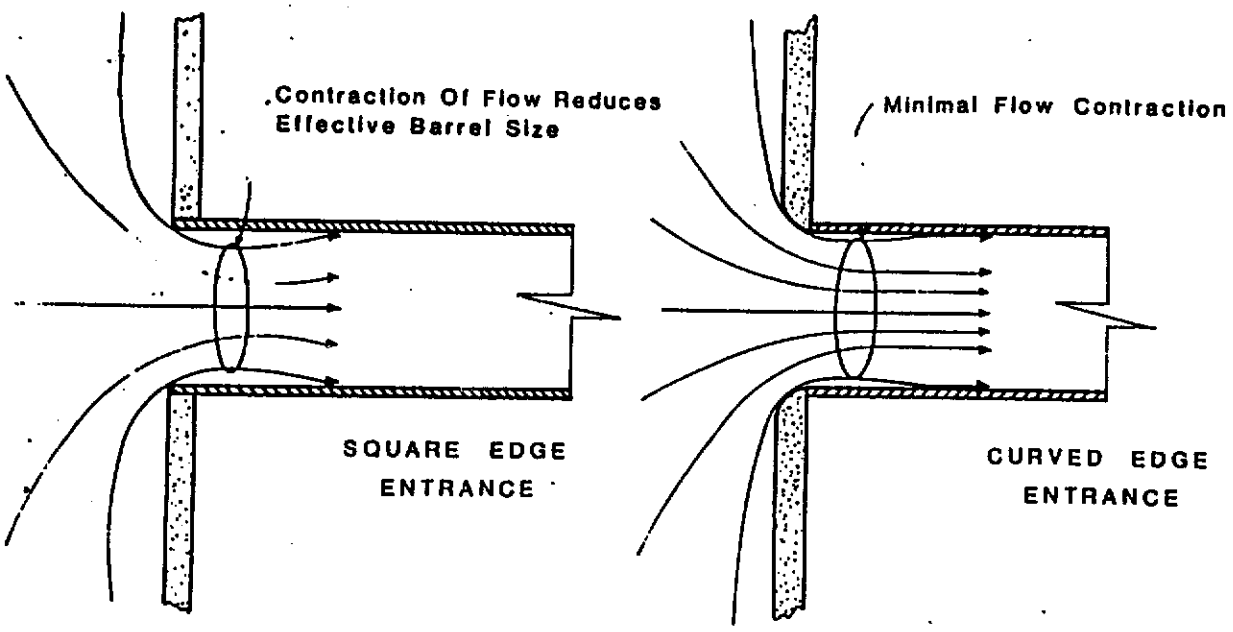
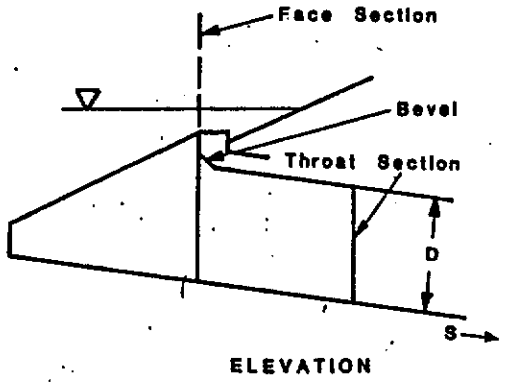
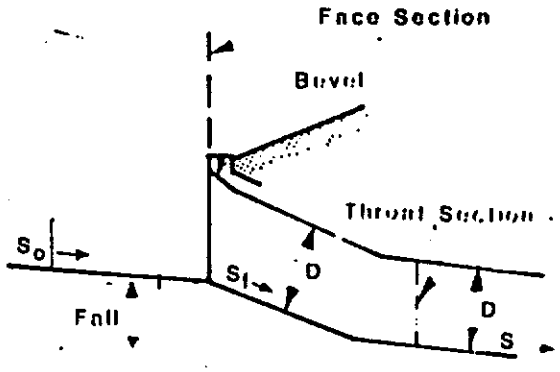


Figure I-8--Entrance contraction (schematic).





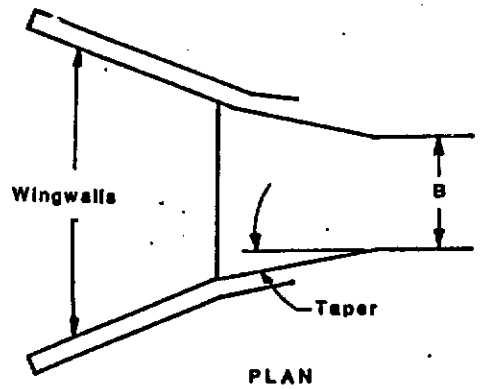


Figure I-9--Side-tapered inlet.

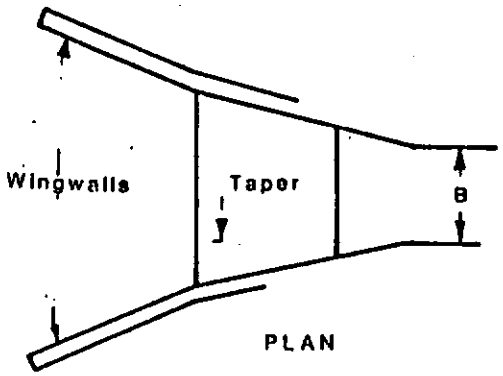


Figure I-10--Slope-tapered inlet.

DLH 1-11-95

TTH 1-13-95

$Q = C I A \rightarrow C = 0.25$

- Determine Duration (minutes) using OVERLAND FLOW TIME CHART

INPUTS ARE — LENGTH OF DRAINAGE AREA
DITCH SLOPE (GROUND SLOPE)

Use Average Grass Surface for Character of Ground

- TAKE the Duration into the RAINFALL INTENSITY VS. DURATION Chart FOR A RECURRANCE INTERVAL = 25 YEARS TO DETERMINE RAINFALL INTENSITY (INCHES/HOUR)

- WITH A KNOWN Q DETERMINE A

$$A = \frac{Q}{I C}$$

IF THE DRAINAGE AREA FOR THE DITCH IS GREATER THAN THIS VALUE OF A THEN DITCH NEEDS MORE CAPACITY

DITCH SECTION

SLOPE	Q
1%	9.04 cfs
2%	12.78 cfs
3%	15.65 cfs
4%	18.08 cfs
5%	20.21 cfs

VALUES DETERMINED USING CIVIL TOOLS

MAN-MADE CHANNELS

VARIABLES LIST:

Y - FLOW DEPTH	B - CHANNEL BOTTOM WIDTH	S - CHANNEL SLOPE
Q - FLOWRATE	M - CHANNEL SIDE SLOPE	N - CHANNEL ROUGHNES

VARIABLE TO BE SOLVED (Y,Q,B,M,S OR N) ? Q

```
Y (FT)      ? 1
B (FT)      ? 0
M (FT/FT)   ? 3
S (FT/FT)   ? .01
N (FT^1/6)  ? .03
```

RESULTS

```
Q=      9.04 CFS
A=      3.00 SF
P=      6.32 FT
V=      3.01 FPS
F=      0.75      SUB-CRITICAL FLOW
```

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to men

---

MAN-MADE CHANNELS

VARIABLES LIST:

Y - FLOW DEPTH	B - CHANNEL BOTTOM WIDTH	S - CHANNEL SLOPE
Q - FLOWRATE	M - CHANNEL SIDE SLOPE	N - CHANNEL ROUGHNES

VARIABLE TO BE SOLVED (Y,Q,B,M,S OR N) ? Q

```
Y (FT)      ? 1
B (FT)      ? 0
M (FT/FT)   ? 3
S (FT/FT)   ? .02
N (FT^1/6)  ? .03
```

RESULTS

```
Q=     12.78 CFS
A=      3.00 SF
P=      6.32 FT
V=      4.26 FPS
F=      1.06      SUPER-CRITICAL FLOW
```

<Shift> <Prt Sc> print <Return> repeat <Space Bar> back to menu

---

MAN-MADE CHANNELS

VARIABLES LIST:

Y - FLOW DEPTH	B - CHANNEL BOTTOM WIDTH	S - CHANNEL SLOPE
Q - FLOWRATE	M - CHANNEL SIDE SLOPE	N - CHANNEL ROUGHNESS

```
VARIABLE TO BE SOLVED (Y,Q,B,M,S OR N) ? Q

Y (FT)      ? 1
B (FT)      ? 0
M (FT/FT)   ? 3
S (FT/FT)   ? .03
N (FT^1/6)  ? .03

                RESULTS
            ================
            Q=      15.65 CFS
            A=       3.00 SF
            P=       6.32 FT
            V=       5.22 FPS
            F=       1.30       SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print        <Return> repeat        <Space Bar> back to menu
```

MAN-MADE CHANNELS

```
VARIABLES LIST:
        Y - FLOW DEPTH        B - CHANNEL BOTTOM WIDTH      S - CHANNEL SLOPE
        Q - FLOWRATE          M - CHANNEL SIDE SLOPE        N - CHANNEL ROUGHNESS

VARIABLE TO BE SOLVED (Y,Q,B,M,S OR N) ? Q

Y (FT)      ? 1
B (FT)      ? 0
M (FT/FT)   ? 3
S (FT/FT)   ? .04
N (FT^1/6)  ? .03

                RESULTS
            ================
            Q=      18.08 CFS
            A=       3.00 SF
            P=       6.32 FT
            V=       6.03 FPS
            F=       1.50       SUPER-CRITICAL FLOW

<Shift> <Prt Sc> print        <Return> repeat        <Space Bar> back to menu
```

TABLE 6.8

Typical C Coefficients for 5- to 10-yr Frequency Design*

DESCRIPTION OF AREA	RUNOFF COEFFICIENTS
Business	
Downtown areas	0.70–0.95
Neighborhood areas	0.50–0.70
Residential	
Single-family areas	0.30–0.50
Multiunits, detached	0.40–0.60
Multiunits, attached	0.60–0.75
Residential (suburban)	0.25–0.40
Apartment dwelling areas	0.50–0.70
Industrial	
Light areas	0.50–0.80
Heavy areas	0.60–0.90
Parks, cemeteries	0.10–0.25
Playgrounds	0.20–0.35
Railroad yard areas	0.20–0.40
Unimproved areas	0.10–0.30
Streets	
Asphalt	0.70–0.95
Concrete	0.80–0.95
Brick	0.70–0.85
Drives and walks	0.75–0.85
Roofs	0.75–0.95
Lawns, Sandy Soil	
Flat, 2%	0.05–0.10
Average, 2–7%	0.10–0.15
Steep, 7%	0.15–0.20
Lawns, Heavy Soil	
Flat, 2%	0.13–0.17
Average, 2–7%	0.18–0.22
Steep, 7%	0.25–0.35

* Viessman et al., 1977.

To avoid the complications of an iterative process, constant overland flow inlet times are often used to approximate the time of concentration. These vary from 5 to 30 min with 5 to 15 min most commonly used (American Society of Civil Engineers and Water Pollution Control Feder-

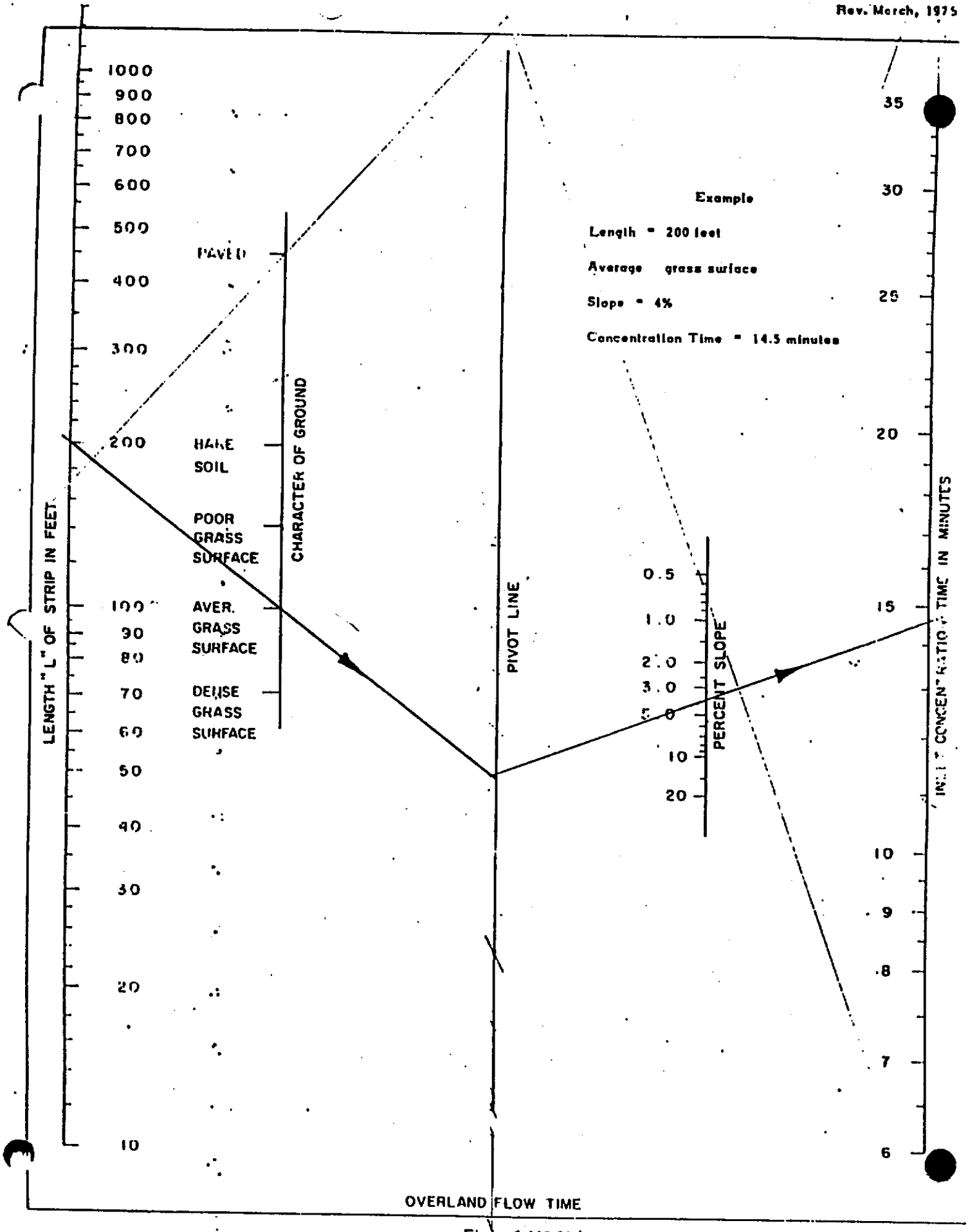
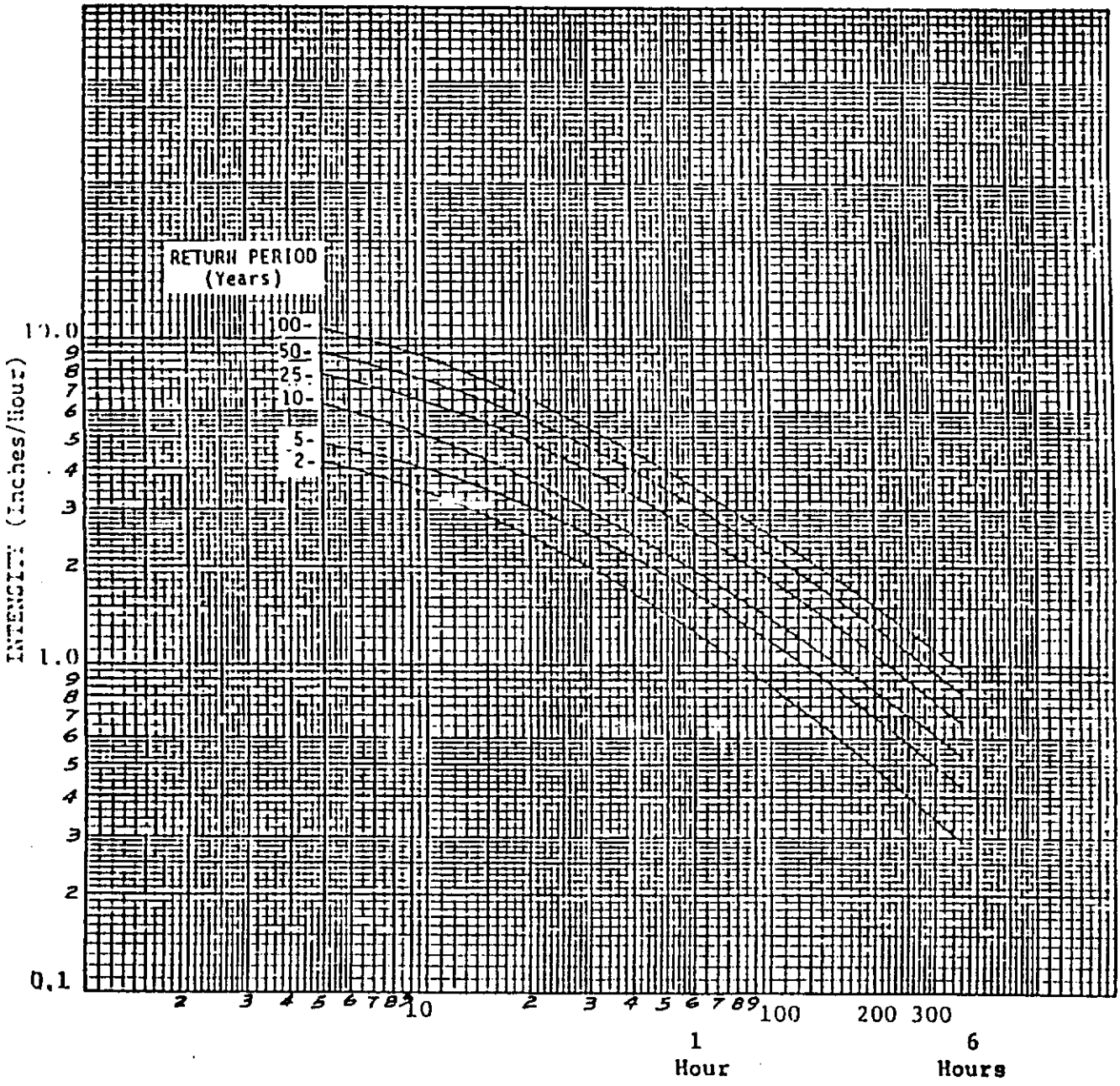


Figure 6-110.01 I

RAINFALL INTENSITY vs. DURATION

NORTH WESTERN ILLINOIS



DURATION (Minutes)

Figure 4-103f

DLH 1-11-95

TRH 1-13-95

AREAS CHECKED

CORRESPOND TO CULVERT DRAINAGE AREAS

④ $\left(\frac{320+200}{2}\right) * 100 * \frac{1}{43560} = 0.60$ ACRES

$L = 250'$ SLOPE = 4% $D = 16$ minutes $I = 5.3$ "/hr.

$A = 13.64 > 0.6$ OK

$450 * 700 * \frac{1}{3} * \frac{1}{43560} = 2.41$ ACRES

⑤ $L = 750$ $S = 4\%$ $D = 25.5$ minutes, $I = 4.2$

$A = 17.2$ acres > 2.41 ∴ OK

①

$L = 1300$ $S = 0.8\%$ $D = \pm 45$ minutes $I = 3$"/hr.

$A = \frac{Q}{CI} = \frac{8.08}{3*(.25)} = 10.8$ ACRES $> \pm 2$ ACRES OK

$L = 900'$ $S = 2.33\%$ $D = 30$ minutes $I = 4$

⑥ $A = \frac{Q}{CI} = \frac{12.78}{.25(4)} = 12.78$ AC. $> \frac{400 \times 400}{43560} = 3.7$ ACRES OK

⑪ $L = 800$ $S = 2.33$ $D = 29$ minutes $I = 4$

$A = \frac{Q}{CI} = \frac{12.78}{.25(4)}$ (for $S = 2.00$) $= 12.78 > \left(5 + \frac{750 \times 450}{43560}\right) = 12.75$ ACRES OK

STA. 218+80 TO STA. 224+30 $L = 550$ $S = 1.52$ $D = 22$ $I = 4.1$

$A = \frac{Q}{CI} = \frac{9.04}{.25(4.1)} = 8.82$ ACRES > 1.4 acres OK

STA. 397+80 TO STA. 402+50 $L = 330$ $S = 4\%$ $D = 18$ $I = 5$

$\frac{18.09}{.25(5)} = 14.5$ A = LESS THAN 4 acres OK

APPENDIX F

STRUCTURAL ANALYSIS

HANSON ENGINEERS, INCORPORATED

BY MEA DATE 2/12/95
CHKD. BY GLL DATE 2:16:95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 1 OF 24
JOB NO. 945 2044 - 1000

Lake Red Rock - Covered Bridge - Piles

LOADS (to piles)

Dead Loads (Loads based on drawings w/loads provided by K. Wilson 1/9/95 - copy attached) ✓

Truss DL $145 plf (39.92')(2 trusses) = 11,577 \#$ ✓

Column DL $608\#$ (6 cols.) + $304\#$ (4 cols) + $70\#$ (2 cols) $= 5,004\ \#$ ✓

Floor load $14.625'(102 plf (3 beams) + 51 plf (2 beams) + 12 plf) = 6,143\ \#$ ✓

(assume W24x55) 3 stringers $3(55 plf)(39.92') = 6,587$ ✓

6 floor beams $16.458'\left(\frac{8 * 11.75}{144}\right)(50 pcf)(6 beams) = 3,223\ \#$ ✓

TOTAL = 32,534 # say 32.5 ⇒ $\frac{32.5}{2} = \boxed{16.25\ k}$ per abutment ✓

Abutment Cap $(16.33)(2.5)(2.5)$ (brg seat) + $16.33(1)(4.5)$ (backwall) + $7(7)(1) - 3.0(1)(1)$ (wings) ✓ $= 221$ C.F. $(.15) = \boxed{33.16\ k}$ ✓

Live Load 85 psf or 10,000# vehicle ld.

$\frac{85 psf (39.92')(14.625')}{2} = 24,813\ \# \Rightarrow \boxed{24.81\ k}$ per abutment ✓

Snow load $2(9.67)(39.92)(30 psf) = 23,162\# \Rightarrow \boxed{11.58\ k}$ per abutment ✓

Wind load

50 psf wind load (AASHTO 3.15.1)

Structure height $4'2\frac{1}{2}" + \frac{5.4375}{.375} = 18.7083 \Rightarrow 18'8\frac{1}{2}"$

Wind load to each abutment = $18.7083\left(\frac{39.92}{2}\right)(50 psf) = 18.67\ k$ ✓

Moment from wind = $18.67\left(\frac{18.708}{2}\right) = 174.64\ 'k.$ ✓

Overturning moment from 20 psf load = $.02(16.458)\left(\frac{39.92}{2}\right)\left(\frac{16.458}{4}\right) = 27.03\ 'k$ ✓

- from 6 psf load = $27.03\left(\frac{6}{20}\right) = 8.11\ 'k$ ✓

16.25
33.16
24.81
+11.58
85.81 k

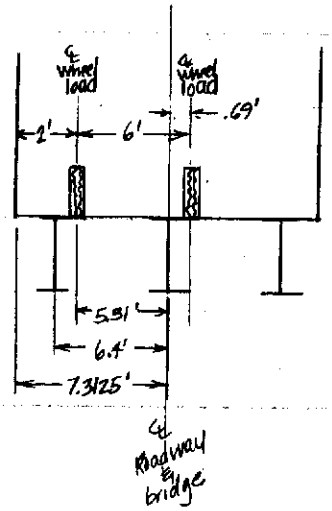
Longitudinal Force (from braking of 10,00 lb vehicles) Assumed to be resisted by passive earth pressure at back of abutment. ✓

BY MEA DATE 2/14/95
CHKD. BY GLC DATE 2-16-95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 2 OF 24
JOB NO.

Lake Red Rock - Covered Bridge - Piles



Moment from LL
(10k vehicle, 2' from wall)

$M_{LL} = 5k(5.31) - 5(.69)$
$= 23.1$ 'k ✓

Load Combinations for Piles

Group 1: DL + LL + Snow ✓ $P = 16.25 + 33.16 + 24.81 + 11.58 = 85.8$ ✓ (for 85 psf LL)
0
0

$P = 33.16 + 16.25 + 10$ (conservative) $+ 11.58 = 70.99$k ✓ (for 10 k vehicle ld)
$M_x = 0$
$M_y = 23.1$ 'k ✓

Group 2: DL + Wind + Overturning (@ 20psf) ✓ (with allowance for 1.25 overstress)

$P = 16.25 + 33.16 = 49.41$ ✓
$M_x = 0$
$M_y = 174.64 + 27.03 = 201.7$ 'k ✓

Group 3: DL + LL + Snow + .3(Wind + Overturning (@ 6psf)) (1.25 overstress)

$P = 85.8$ k ✓ (for 85 psf LL)
$M_x = 0$
$M_y = .3(174.64 + 8.11) = 54.8$ 'k ✓

$P = 70.99$ ✓ (for 10 k vehicle LL)
$M_x = 0$
$M_y = 54.8 + 23.1 = 77.9$ 'k ✓

BY MEA DATE 2/14/95
CHKD. BY GLC DATE 2·16·95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 3 OF 24
JOB NO.

Lake Red Rock - Covered Bridge - Piles

Try 3 piles @ 6'8" spacing

$I_{pile\ group} = 2(6.67^2) = 88.89$ ✓

Loads on Piles

Group 1 $\frac{85.8}{3} = 28.6$

$P_{MAX} = 28.6$ k ✓
$P_{MIN} = 28.6$ k ✓

$\frac{70.99}{3} \pm \frac{23.1(6.67)}{88.89}$

$P_{MAX} = 25.4$ k ✓
$P_{MIN} = 21.9$ k ✓

Group 2 $\frac{42.9}{3} \pm \frac{201.7(6.67)}{88.89}$ ✓

$P_{MAX} = 31.6$ k ✓
$P_{MIN} = 1.3$ k ✓

Group 3 $\frac{85.8}{3} \pm \frac{54.8(6.67)}{88.89}$

$P_{MAX} = 32.7$ k ✓
$P_{MIN} = 24.5$ k ✓

$\frac{70.99}{3} \pm \frac{77.9(6.67)}{88.89}$

$P_{MAX} = 29.5$ k ✓
$P_{MIN} = 17.8$ k ✓

Capacity of HP 8x36
$= 9\ ksi\ (10.6\ in^2) = 95.4$ k/pile

(for 1.25 overstress, → 119.25)

- Check capacity of outer pile to resist horizontal wind
  Batter must resist horizontal wind of 18.67 k (assume 2:12 batter)

$119.25 \cos(\tan^{-1}\frac{12}{2}) = 19.6$ k > 18.67 ✓ OK.

Use 3 piles, HP 8x36, point-bearing, approx 6'8" spacing, outer piles battered @ 2:12. ✓

Lake Red Rock – Covered Bridge

Estimate Pile Length

Abut at Sta 59+60

el. top of pile ≈ 802.5 } 3' fill
el. existing ground ≈ 799.5 }
el. of shale layer = 804.4 - 14 = 790.4 (From boring RRB-94-49 (attached)) (see page 7)

length of pile (estimated) = (802.5 - 790.4) + 2' = 14.1 ⇒ 15'
(2' into shale layer)

Abut @ Sta 60+00.00

el. top of pile ≈ 802.5'
el. existing ground ≈ 802'

elev. of shale layer = 805 - 16 = 789.0 (boring log RRB-94-50 (attached))

length of pile = (802.5 - 789) + 2' = 15.5'

~~Investigate capacity of HP8x36 @ 2:12 batter to resist uplift~~

~~$(250_{psf})\left(\frac{32}{12}\right)(14')$~~ = 9.3 k

~~pile NG~~

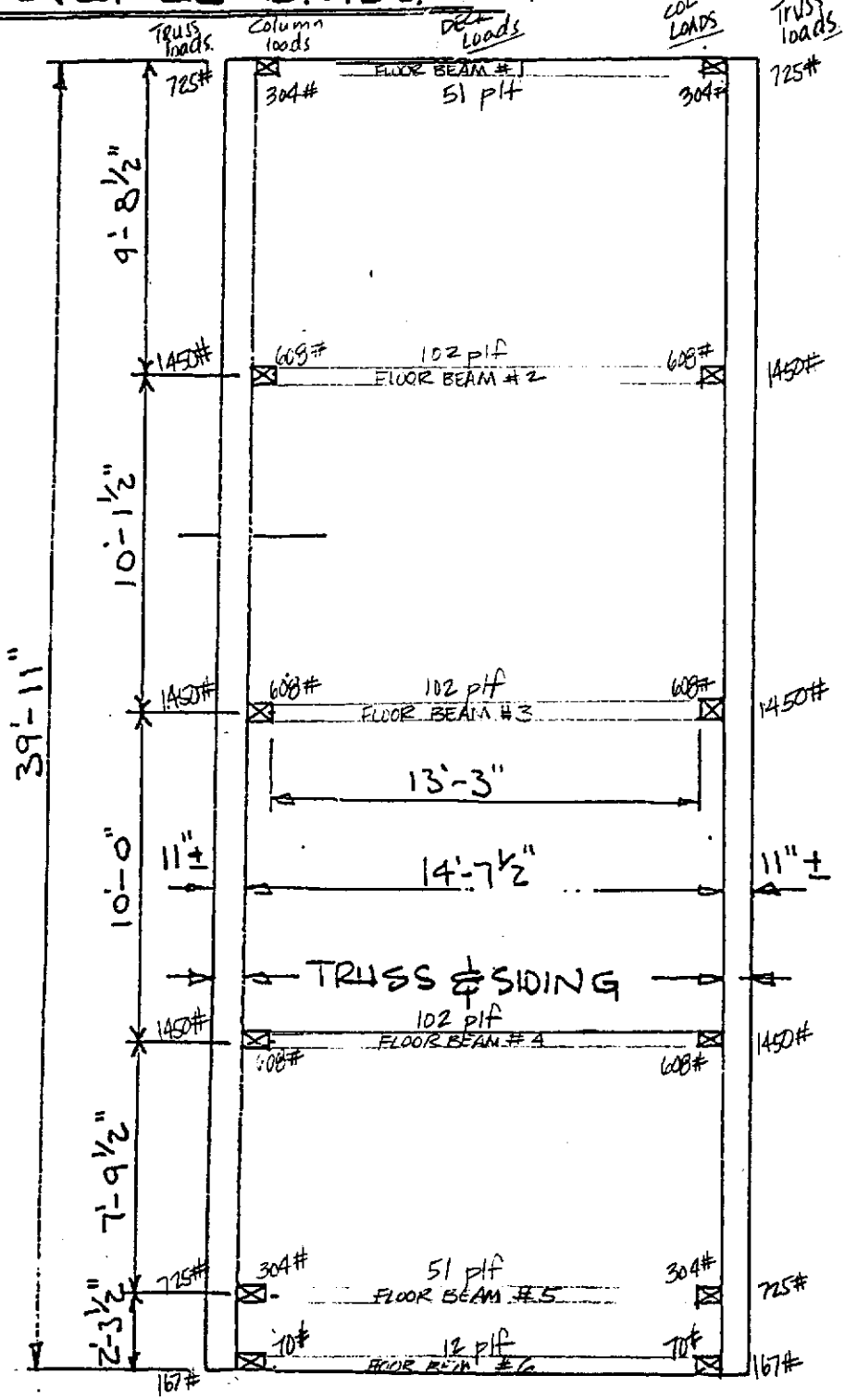
✓

Use 3 piles, 16' estimated length, HP 8x36 (point-bearing), approx. 6'8" spacing, outer piles battered @ 2:12.

Subject: RED ROCK TRAILS - SEGMENT IV Date 1-9-95

Computed by: K WILSON Checked by: Sheet 1 of

COVERED BRIDGE



PLAN

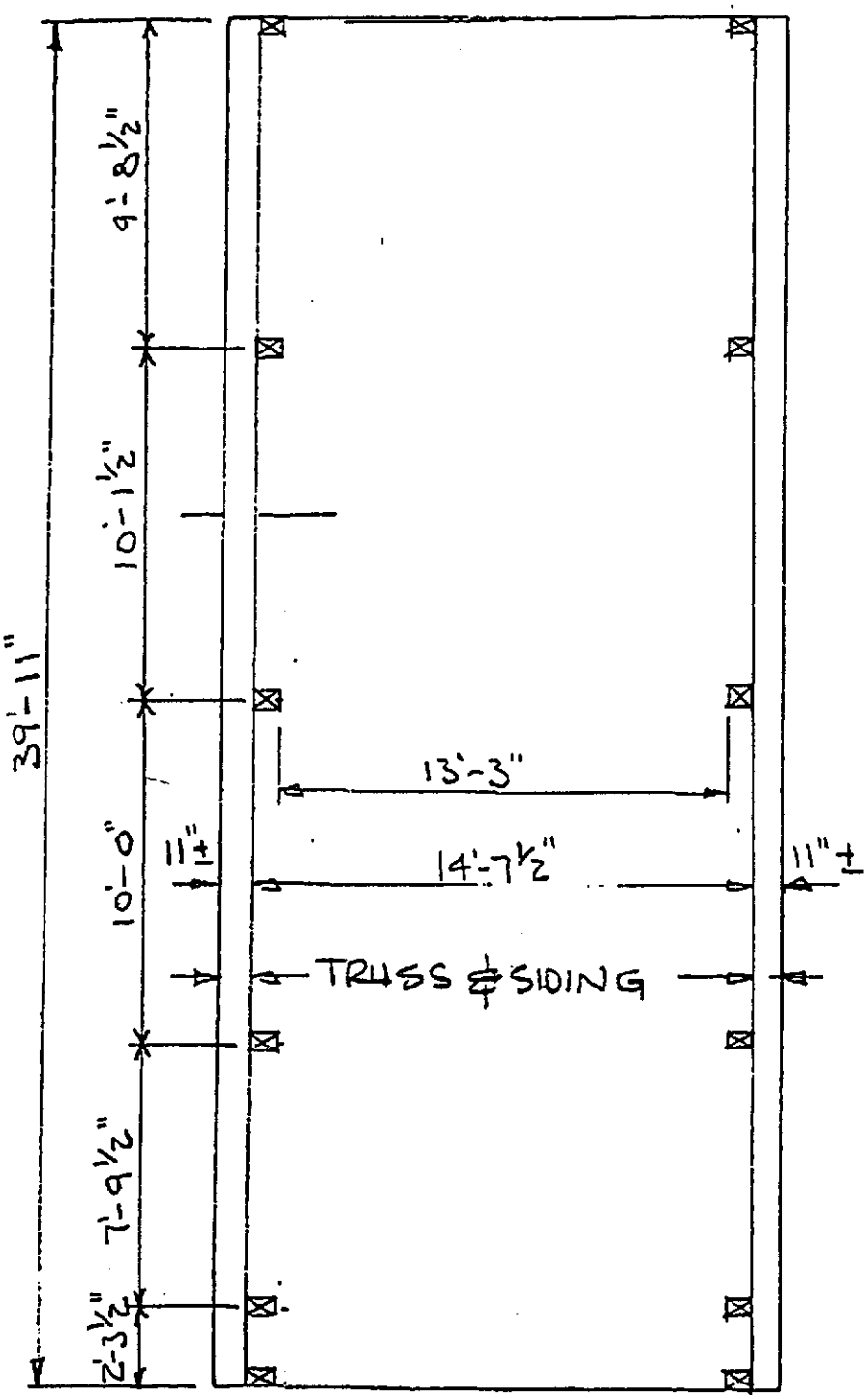
SCALE: 3/16" = 1'-0"

NOR Form 88-15
1 Aug 80

Subject: RED ROCK TRAILS - SEGMENT IV Date 1-9-95

Computed by: K WILSON Checked by: Sheet 1 of

COVERED BRIDGE



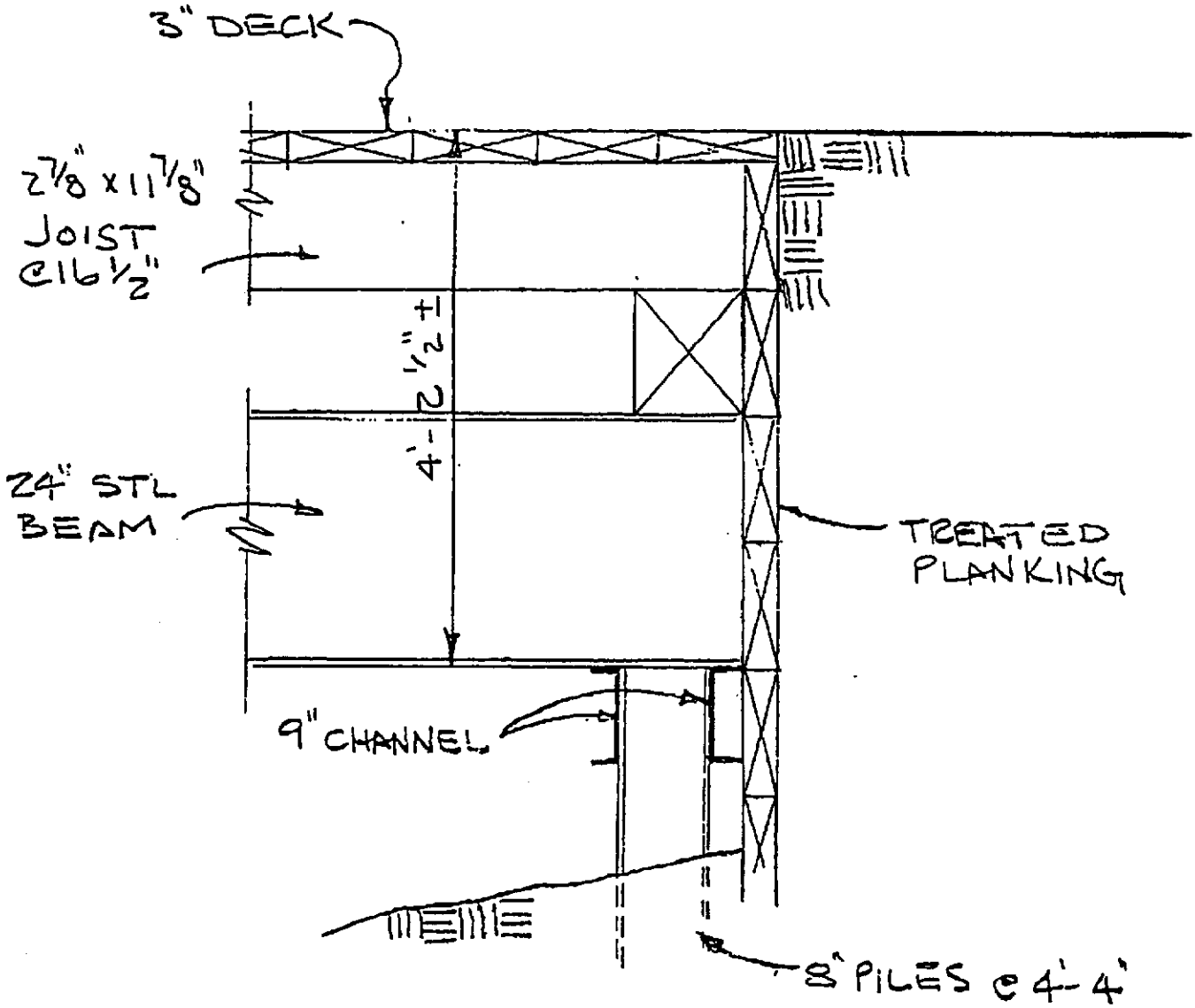
PLAN

SCALE: 3/16" = 1'-0"

Subject RED ROCK TRAILS - SEGMENT IV Date 1-9-95

Computed by K. WILSON Checked by Sheet 2 of

COVERED BRIDGE



EXISTING ABUTMENT

SCALE: 3/4" = 1'-0"

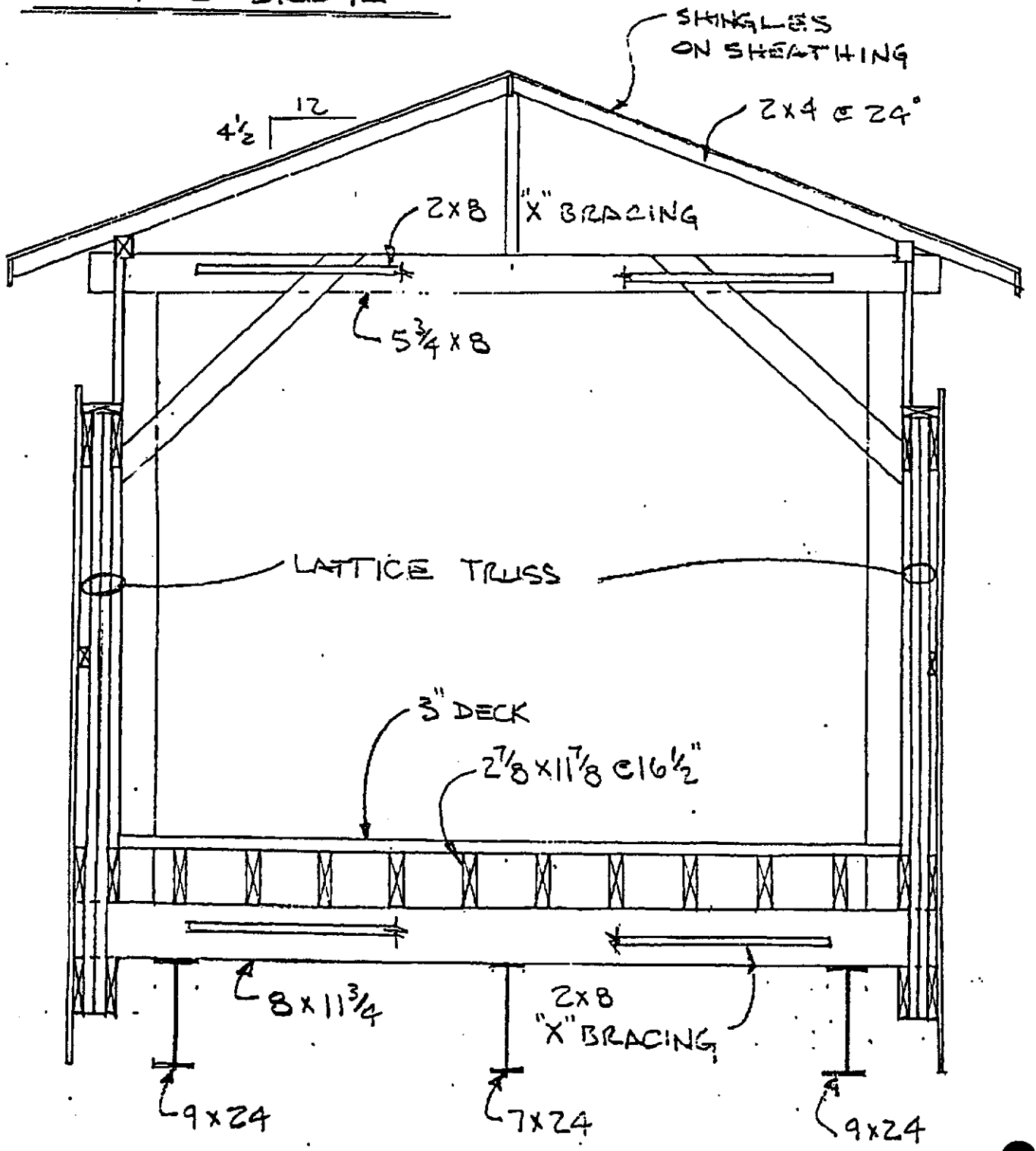
Project: RED ROCK TRAILS - SEGMENT IV

Date: 1-9-95

Drawn by: K. WILSON

Sheet: 3

COVERED BRIDGE



CROSS-SECTION

SCALE: ⅜" = 1'-0"

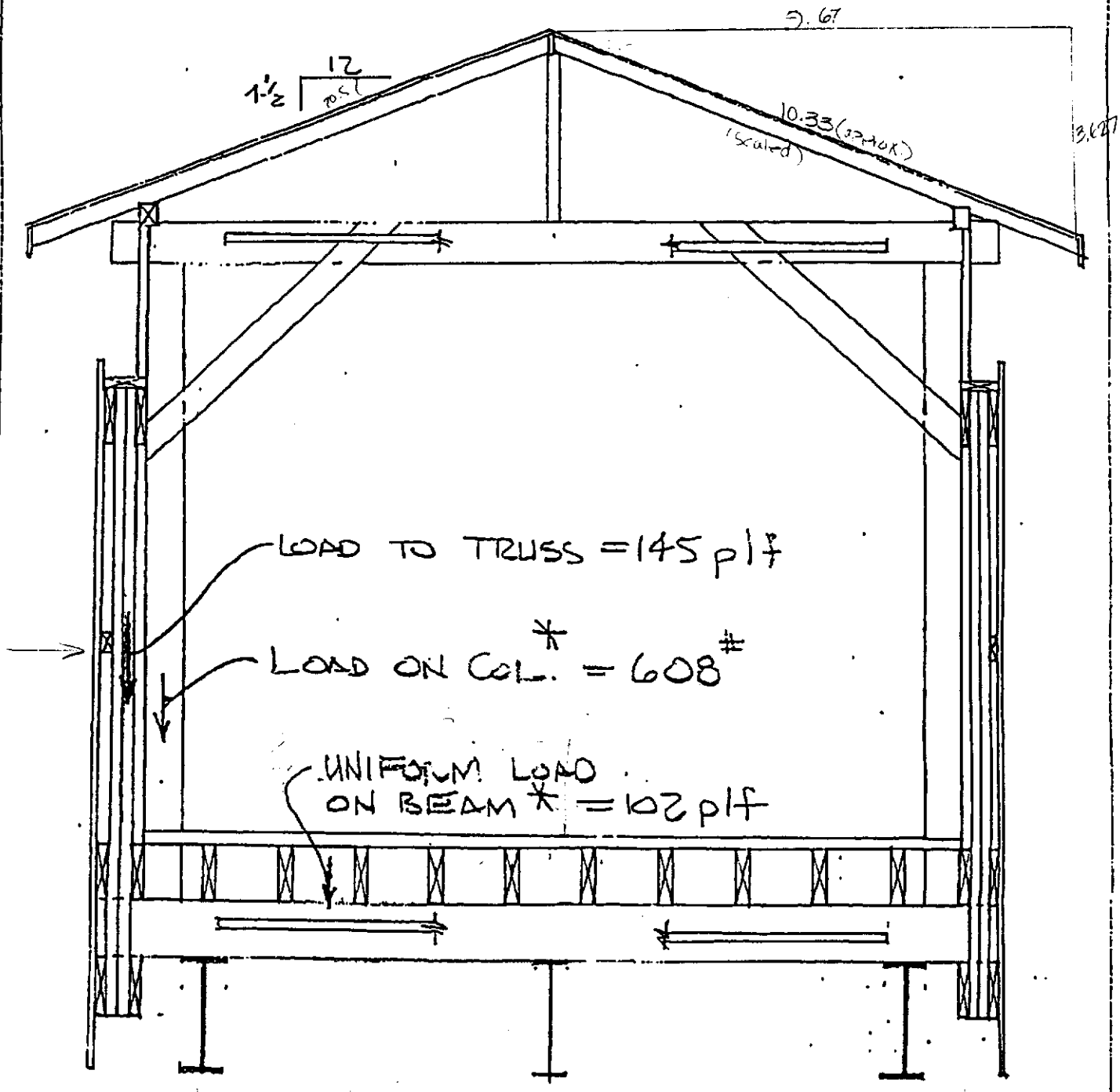
NCR Form 391b
1 Aug 88

RED ROCK TRAILS - SEGMENT VI

K. WILSON

1-9-95

4



*ASSUMED SPACING = 10'-0"

NCR Form 381b
1 Aug 80

NUMBER SYSTEM	ELEV (ft)	ST PLANE COORD SYS (N)	ST PLANE COORD SYS (E)	STATIONING (100 feet)	OFFST (ft)	DEPTH (feet)	STRUCTURE	COMMENTS
RRB-94-36	782.4	513,168	2,135,411	421.60		30	EMBANKMENT	N=11 @ 30' depth SLOUGH AREA!! (PROP RET WALL)
RRB-94-37	747.4	513,012	2,136,250	432.54		16	EMBANKMENT	N=74 @ 16' depth
38	755.7	512,635	2,136,209	436.00	35 RT	5	BORROW SITE	
39	771.3	511,856	2,136,716	445.00	35 RT	5	BORROW SITE	
40	789.9	511,648	2,136,990	450.00	50 lT	20	BORROW SITE	
41	781.1	511,780	2,137,767	458.35		45.3	BRDGE ABUTMENT	32.5' + shale. N=65 @ 35' DEPTH
42	766.0	511,722	2,137,884	459.55		30.3	BRDGE PIER	17.5' + shale. N=42 @ 19' depth
43	774.1	511,676	2,137,949	460.30		37.5	BRDGE ABUTMENT	24.5' + shale N=71 @ 27' depth
44*	840.0	511,324	2,138,382	465.20	240 RT	5	CUT	
45*	836.0	511,055	2,139,065	475.15		5		
46*	848.0	510,826	2,139,613	482.20		5		
47	829.6	519,421	2,116,713	148.50	300 LT	20	BORROW SITE	
48*	781.3	517,810	2,123,924	249.00		10		POSSIBLE 3' RET WALL
49	804.4	519,818	2,111,038	59.65		29.5	WD BRDGE ABUTMENT	14' + shale. N>70 in shale
50	805.0	519,788	2,111,019	60.05		28.5	WD BRDGE ABUTMENT	16' + shale. N>55 in shale

NOTE: ALL THE BORES WERE LOCATED BY THE COE SURVEY BRANCH. THE BORE ELEVATIONS WERE ALSO TAKEN BY THE COE SURVEY BRANCH WITH THE EXCEPTION OF THE BORES WITH AN ASTERISK (*). THE ELEVATIONS FOR THESE WERE DETERMINED FROM A 2' CONTOUR MAP.

Lake Red Rock - Covered Bridge Analysis

Floor beam loads (see following page) For an 85 psf Live Load.

INTERIOR FLOOR BEAMS (assume 10' tributary length) ✓

deck load = 102 plf ✓
column load + snow load = 608# + 9.67(10)(30 psf) = 3509# ✓
truss load = 145plf (10') = 1450# ✓
floor beam self wt = $\frac{8(11.75)}{144}$ (50 pcf) = 32.6 plf. ✓
live load = 85psf(10') = 850 plf along floor beam. ✓

FLOOR BEAMS #1 and #5 (assume 5' tributary length)

deck load = 51 plf ✓
column + snow = 1755 # ✓
truss load = 725# ✓
fl. bm weight = 32.6 plf ✓
Live Load = 425 plf. ✓

FLOOR BEAM # 6 (1.15' tributary length)

deck load = 11.8 plf ✓
column + snow = 404 # ✓
truss load = 167# ✓
fl. beam wt. = 32.6 plf ✓
Live Load = 98 plf ✓

Use RISA program to find reactions from these loads at supports (3 steel stringers)

RISA coordinates

Node #	Coordinates	Description
①	(-8.23, 0) ✓	End of floor beam
②	(-7.77, 0) ✓	Pt. of application of truss load (estimated)
③	(-7.31, 0) ✓	Inner wall of truss, extent of deck load.
④	(-7.10, 0) ✓	Pt of application of column load & snow load
⑤	(-6.4, 0) ✓	Support (Girder #1)
⑥	(-.69, 0) ✓	application of wheel load (used only for 10k vehicle LL)
⑦	(0, 0) ✓	Center of bridge, Support (Girder #2)
⑧	(5.31, 0) ✓	application of wheel load (for 10k vehicle)
⑨	(6.4, 0) ✓	Support (Girder #3)
⑩	(7.10, 0) ✓	
⑪	(7.31, 0) ✓	
⑫	(7.77, 0) ✓	
⑬	(8.23, 0) ✓	

BY MEA DATE 2/15/95
CHKD. BY GLC DATE 2·16·95

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SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 9 OF 24
JOB NO. 9452044-1000

Lake Red Rock - Covered Bridge Analysis

SUMMARY OF RISA RUNS.	(k) Reaction at Center Girder	(k) Max. reaction at Ext. girder
1. INTERIOR FLOOR BEAM - DEAD LOADS	-1.05 ✓ (↓)	6.50 ✓
2. FLOOR BEAMS 1 & 5 - DL	-0.41 ✓ (↓)	3.33 ✓
3. FLOOR BEAM #6 - DL	0.09 ✓	0.88 ✓
4. 85 PSF LL ON INTERIOR BMS	6.64 ✓	2.90 ✓
5. 85 PSF LL ON FLOOR BMS 1 & 5	3.32 ✓	1.45 ✓
6. 85 PSF LL ON FLOOR BM #6	0.76 ✓	0.33 ✓
7. 10k-Vehicle front axle loads	4.94 ✓	2.97 ✓
8. 10 k-vehicle back axle loads.	1.24 ✓	0.74 ✓

Impact = $\frac{50}{99.92+125} = .3$
Multiply these values by 1.3.

At each floor beam, there is an additional load from the wind + overturning Moment

Wind load = 50 psf Moment arm = $\frac{18.7083}{2} - 2' = 7.35$ ✓

Overturning = 20 psf Moment arm = $\frac{16.458}{4} = 4.11$ ✓

at interior floor beams $M_{W+OT} = .05(10)(18.7083)(7.35) + .02(10)(16.458)(4.11) = 82.28$ ft-k
additional ld = $\frac{82.28}{2(6.4)} = 6.43$ k ✓

at floor beams #1, and #5 $P_{W+OT} = 6.43\left(\frac{5}{10}\right) = 3.22$ k ✓

at floor beam #6 $P_{W+OT} = 6.43\left(\frac{1.15}{10}\right) = 0.74$ ✓

These loads will be used in RISA analysis of steel girders ✓

BY MEA DATE 2/15/95
CHKD. BY GLC DATE 2:16:95

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SHEET NO. 10 OF 24
JOB NO. 945204A-1000

Lake Red Rock - Covered Bridge Analysis

RISA COORDINATES for analysis of steel girder

Node #

1 (0,0) ✓ End of girder, pt of application of load from floor beam #1; Supports
2 (9.7083,0) ✓ Floor beam #2
3 (19.833,0) ✓ Floor beam #3
4 (29.833,0) ✓ Floor beam #4
5 (37.625,0) ✓ Floor beam #5
6 (39.917,0) ✓ Floor beam #6, End of girder; support

CENTER W24 X 55

Node #	Load Combination #1 85 psf; center girder		
1	↑ .41 DL	− 3.32 LL	
2.	↑ 1.05 DL	− 6.64 LL	
3.	↑ 1.05 DL	− 6.64 LL	
4.	↑ 1.05 DL	− 6.64 LL	
5	↑ .41 DL	− 3.32 LL	
6	− 0.09 DL	− 0.76 LL	

Node #	Load Combination #2 10 k vehicle; center girder		
1	+ .41 DL		
2	+ 1.05 DL		
3	+ 1.05 DL	− 4.94 LL	
4	+ 1.05 DL	− 1.24 LL	
5	+ .41 DL		
6	− 0.09 DL		

W C E FORM 186

EXTERIOR GIRDER (W24 X 68)

	Load Combination #1 85 psf; exterior girder		
1	− 3.33 DL	− 1.45 LL	− 3.22 W
2	− 6.5 DL	− 2.90 LL	− 6.43 W
3	− 6.5 DL	− 2.90 LL	− 6.43 W
4	− 6.5 DL	− 2.90 LL	− 6.43 W
5	− 3.33 DL	− 1.45 LL	− 3.22 W
6	− 0.88 DL	− 0.33 LL	− 0.74 W

	Load Combination #2 10 k vehicle, exterior girder		
1	− 3.33 DL		− 3.22 W
2	− 6.5 DL		− 6.43 W
3	− 6.5 DL	− 2.97 LL	− 6.43 W
4	− 6.5 DL	− 0.74 LL	− 6.43 W
5	− 3.33 DL		− 3.22 W
6	− 0.88 DL		− 0.74 W

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Lake Red Rock - Covered Bridge Analysis

Results of RISA Analysis

36 ksi Steel assumed.

EXTERIOR GIRDER, W24 x 68 assumed (this is the smallest 9" x 24" section)

M_{max} = 361.53 ✓ k-ft (factored, group 2 loading: DL + Wind)

S = 154 in^3 ✓

$\frac{M}{S} = \frac{361.53(12)}{154} = 28.2$ ksi ✓ < 36 ksi OK

SHEAR: V_{max} = 34.6 k ✓

$V_p = 0.58 F_y D t_w$

$= 0.58(36)(21\text{ in})(.415\text{ in})$ [AASHTO sec 10.48.8.1]

$= 181.96$ k ✓

$\frac{D}{t_w} = \frac{21}{.415} = 50.6$ $\quad k = 5$ for unstiffened beams $\quad \frac{\sqrt{k}}{\sqrt{F_y}} = \frac{\sqrt{5}}{\sqrt{36{,}000}} = .011785$

$6000(.011785) = 70.7$
$7500(.011785) = 88.4$

$\therefore \frac{D}{t_w} < \frac{6000\sqrt{k}}{\sqrt{F_y}}$

$50.6 < 70.7 \Rightarrow C = 1.0$

$V_n = CV_p = 1.0(181.96) = 182$ k ✓ > 34.6 ✓ O.K.

Max Deflection (under service LL) = .31" $\quad \frac{39.92}{(31/12)} = 1545$

Max deflection = $\ell/1545$ ✓ OK

∴ The Exterior girders are adequate to support the given loads.

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Red Rock Lake - Covered Bridge

CENTER GIRDER W24 X 55 (Smallest 7" X 24" section)

$M_{max} = 281.15$

$S = 114$ ✓

$\frac{M}{S} = \frac{281.15(12)}{114} = 29.6$ ksi ✓ < 36 ksi ✓ OK

SHEAR: $V_{max} = 26.95 \Rightarrow 27$ k

$V_p = 0.58(36)(21)(.395)$

$V_p = 173.2$ k

$\frac{D}{t_w} = \frac{21}{.395} = 53.2 < 70.7 \Rightarrow C = 1.0$

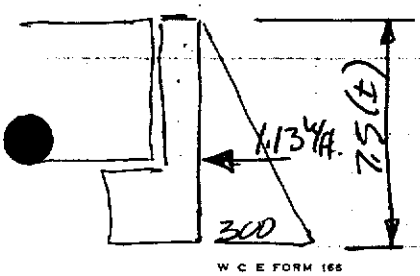
$V_u = \phi V_p = 173.2 > 27$ k ✓ OK

Max Service LL Defl = .9521" $\frac{39.92'}{.9521/12} = 503$

Max defl = $\ell/503$

AASHTO recommends defl. from serv. LL + IMP be limited to $\ell/800$ or preferably $\ell/1000$ for pedestrian bridges.

Compression & Moment in beams due to fixity @ abutments:



W C E FORM 166

Axial Load / Beam = 1.13 k/ft × 23/3 = 8.7 k

$f_a = 8.7^k / 16.2 in^2 = .5$ ksi (negligible)

$M = 8.7^k \times 2' = 17.4$ k-ft (opposite w.r.t. gravity)

ok

Lake Red Rock - Covered Bridge Analysis

Thermal Forces from girders (AASHTO 3.16)

Assume 50° initially, cold climate 50° - (-30°) = 80° F

$\Delta L = \alpha \Delta T L$

$\Delta L = 6.5 \times 10^{-6}/°F \; (80°)(39.92') = .02076$

$\Delta L = .02076 * 12 = .249$ in

W24 x 55 $\quad \Delta = \frac{PL}{AE} \qquad P = \frac{\Delta AE}{L} = \frac{.2491 \; (16.2 \text{ in}^2)(29 \times 10^3 \text{ ksi})}{(39.92 * 12)} = 244.3 \text{ k}$

$F_T = 15.1$ ksi

W24 x 68 $\quad P = \frac{.2491 \; (20.1 \text{ in}^2)(29 \times 10^3)}{39.92 * 12} = 303.1 \text{ k}$

According to Illinois Bridge Manual, Analysis of Thermal Forces is not required in this case because the bridge is significantly less than 200' in length, the girder supports are fixed and the piles are not battered in the longitudinal direction. (Sec. 3.6.12) Therefore the piles will deflect, relieving the axial stress in the beams. ✓

by MEA

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LAKE RED ROCK

[redacted]

✓GLC
2-16-95

Node No	X-Coord (ft)	Y-Coord (ft)	Boundary Conditions X-dof (in,K/in)	Y-dof (in,K/in)	Rotation (r,K-ft/r)	Temp. (F)
1	-8.23	0.00				0.00
2	-7.77	0.00				0.00
3	-7.31	0.00				0.00
4	-7.10	0.00				0.00
5	-6.40	0.00	R	R		0.00
6	-0.69	0.00				0.00
7	0.00	0.00		R		0.00
8	5.31	0.00				0.00
9	6.40	0.00		R		0.00
10	7.10	0.00				0.00
11	7.31	0.00				0.00
12	7.77	0.00				0.00
13	8.23	0.00				0.00

	I Node	J Node	Section	I Releases x	y	z	J Releases x	y	z	Sec	Sway	End Offsets I (in)	J (in)	Length (ft)
1	1	2	MEMBER											0.46
2	2	3	MEMBER											0.46
3	3	4	MEMBER											0.21
4	4	5	MEMBER											0.70
5	5	6	MEMBER											5.71
6	6	7	MEMBER											0.69
7	7	8	MEMBER											5.31
8	8	9	MEMBER											1.09
9	9	10	MEMBER											0.70
10	10	11	MEMBER											0.21
11	11	12	MEMBER											0.46
12	12	13	MEMBER											0.46

BLC No.	Basic Load Case Description	Load Totals Nodal Point	Dist.
✓1	FLOOR BEAM SELF WEIGHT		12
✓2	COL,SNOW,TRUSS LDS AT INT FL BM	4	
✓3	DECK LOAD AT INT FL BM		8
✓4	LL AT INTERIOR FLOOR BEAM		8
✓5	COL, SNOW, TRUSS LDS @ FL BM 1&5	4	
✓6	DECK LOAD AT FLOOR BEAMS 1 AND 5		8
✓7	LL AT FLOOR BEAMS 1 AND 5		8
✓8	COL,SNOW,TRUSS LDS AT FL BM #6	4	
✓9	DECK LOAD AT FLOOR BEAM #6		8
✓10	LL AT FLOOR BEAM #6		8

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by MEA

LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

11	FRONT AXLE OF 10 K VEHICLE	2
12	BACK AXLE OF 10 K VEHICLE	2

Member Distributed Loads,BLC 1: FLOOR BEAM SELF WEIGHT

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
1	1	2	Y	-0.033	-0.033	0.000	0.459
2	2	3	Y	-0.033	-0.033	0.000	0.460
3	3	4	Y	-0.033	-0.033	0.000	0.210
4	4	5	Y	-0.033	-0.033	0.000	0.699
5	5	6	Y	-0.033	-0.033	0.000	5.710
6	6	7	Y	-0.033	-0.033	0.000	0.689
7	7	8	Y	-0.033	-0.033	0.000	5.309
8	8	9	Y	-0.033	-0.033	0.000	1.090
9	9	10	Y	-0.033	-0.033	0.000	0.699
10	10	11	Y	-0.033	-0.033	0.000	0.210
11	11	12	Y	-0.033	-0.033	0.000	0.460
12	12	13	Y	-0.033	-0.033	0.000	0.459

Nodal Loads, BLC 2: COL,SNOW,TRUSS LDS AT INT FL BM

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
2	0.000	-1.450	0.000
4	0.000	-3.510	0.000
10	0.000	-3.510	0.000
12	0.000	-1.450	0.000

Member Distributed Loads,BLC 3: DECK LOAD AT INT FL BM

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
3	3	4	Y	-0.102	-0.102	0.000	0.210
4	4	5	Y	-0.102	-0.102	0.000	0.699
5	5	6	Y	-0.102	-0.102	0.000	5.710
6	6	7	Y	-0.102	-0.102	0.000	0.689
7	7	8	Y	-0.102	-0.102	0.000	5.309
8	8	9	Y	-0.102	-0.102	0.000	1.090
9	9	10	Y	-0.102	-0.102	0.000	0.699
10	10	11	Y	-0.102	-0.102	0.000	0.210

Member Distributed Loads,BLC 4: LL AT INTERIOR FLOOR BEAM

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by MEA
Job 9452044-1000
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LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
3	3	4	Y	-0.850	-0.850	0.000	0.210
4	4	5	Y	-0.850	-0.850	0.000	0.699
5	5	6	Y	-0.850	-0.850	0.000	5.710
6	6	7	Y	-0.850	-0.850	0.000	0.689
7	7	8	Y	-0.850	-0.850	0.000	5.309
8	8	9	Y	-0.850	-0.850	0.000	1.090
9	9	10	Y	-0.850	-0.850	0.000	0.699
10	10	11	Y	-0.850	-0.850	0.000	0.210

Nodal Loads, BLC 5: COL, SNOW, TRUSS LDS @ FL BM 1&5

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
2	0.000	-0.725	0.000
4	0.000	-1.755	0.000
10	0.000	-1.755	0.000
12	0.000	-0.725	0.000

Member Distributed Loads,BLC 6: DECK LOAD AT FLOOR BEAMS 1 AND 5

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
3	3	4	Y	-0.051	-0.051	0.000	0.210
4	4	5	Y	-0.051	-0.051	0.000	0.699
5	5	6	Y	-0.051	-0.051	0.000	5.710
6	6	7	Y	-0.051	-0.051	0.000	0.689
7	7	8	Y	-0.051	-0.051	0.000	5.309
8	8	9	Y	-0.051	-0.051	0.000	1.090
9	9	10	Y	-0.051	-0.051	0.000	0.699
10	10	11	Y	-0.051	-0.051	0.000	0.210

Member Distributed Loads,BLC 7: LL AT FLOOR BEAMS 1 AND 5

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
3	3	4	Y	-0.425	-0.425	0.000	0.210
4	4	5	Y	-0.425	-0.425	0.000	0.699
5	5	6	Y	-0.425	-0.425	0.000	5.710
6	6	7	Y	-0.425	-0.425	0.000	0.689
7	7	8	Y	-0.425	-0.425	0.000	5.309
8	8	9	Y	-0.425	-0.425	0.000	1.090
9	9	10	Y	-0.425	-0.425	0.000	0.699

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by MEA
Job 94S2044-1000
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LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
10	10 -	11	Y	-0.425	-0.425 ✓	0.000	0.210

Nodal Loads, BLC 8: COL,SNOW,TRUSS LDS AT FL BM #6

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
2	0.000	-0.167 ✓	0.000
4	0.000	-0.404 ✓	0.000
10	0.000	-0.404 ✓	0.000
12	0.000	-0.167 ✓	0.000

Member Distributed Loads,BLC 9: DECK LOAD AT FLOOR BEAM #6

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
3	3 -	4	Y	-0.012	-0.012	0.000	0.210
4	4 -	5	Y	-0.012	-0.012	0.000	0.699
5	5 -	6	Y	-0.012	-0.012	0.000	5.710
6	6 -	7	Y	-0.012	-0.012	0.000	0.689
7	7 -	8	Y	-0.012	-0.012	0.000	5.309
8	8 -	9	Y	-0.012	-0.012	0.000	1.090
9	9 -	10	Y	-0.012	-0.012	0.000	0.699
10	10 -	11	Y	-0.012	-0.012 ✓	0.000	0.210

Member Distributed Loads,BLC 10: LL AT FLOOR BEAM #6

Memb No	I Node	J Node	Dir	Start Magnitude (K/ft,F)	End Magnitude (K/ft,F)	Start Location (ft)	End Location (ft)
3	3 -	4	Y	-0.098	-0.098	0.000	0.210
4	4 -	5	Y	-0.098	-0.098	0.000	0.699
5	5 -	6	Y	-0.098	-0.098	0.000	5.710
6	6 -	7	Y	-0.098	-0.098	0.000	0.689
7	7 -	8	Y	-0.098	-0.098	0.000	5.309
8	8 -	9	Y	-0.098	-0.098	0.000	1.090
9	9 -	10	Y	-0.098	-0.098	0.000	0.699
10	10 -	11	Y	-0.098	-0.098 ✓	0.000	0.210

Nodal Loads, BLC 11: FRONT AXLE OF 10 K VEHICLE

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LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
6	0.000	-4.000 ✓	0.000
8	0.000	-4.000 ✓	0.000

Nodal Loads, BLC 12: BACK AXLE OF 10 K VEHICLE

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
6	0.000	-1.000 ✓	0.000
8	0.000	-1.000 ✓	0.000

Load Combination No.	Description	Self Wt Dir	Fac	BLC	Fac	BLC	Fac	BLC	Fac	BLC	Fac	DYNA	W S	E V
1	INT BMS - DL			1	1	2	1	3	1 ✓					
2	BMS 1&5 - DL			1	1	5	1	6	1 ✓					
3	BM 6 - DL			1	1	8	1	9	1 ✓					
4	INT BMS - LL			4	1 ✓									
5	BMS 1&5 - LL			7	1 ✓									
6	BM 6 - LL			101 ✓										
7	BM 3 - VEHICLE LD			111 ✓										
8	BM 4 - VEHICLE LD			121 ✓										

Pedestrian

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LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

Load Combination is ① : INT BMS - DL
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	6.50036	0.00000
6	0.00000	-1.05001	0.00000
7	0.00000	6.50091	0.00000
Totals	0.00000	11.95127	0.00000

Load Combination is ② : BMS 1&5 - DL
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	3.32588	0.00000
6	0.00000	-0.40676	0.00000
7	0.00000	3.32646	0.00000
Totals	0.00000	6.24565	0.00000

Load Combination is ③ : BM 6 - DL
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	0.88251	0.00000
6	0.00000	-0.08895	0.00000
7	0.00000	0.88309	0.00000
Totals	0.00000	1.85454	0.00000

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LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

Load Combination is 4 : INT BMS - LL
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	2.89599	0.00000
6	0.00000	6.63504	0.00000
7	0.00000	2.89599	0.00000
Totals	0.00000	12.42700	0.00000

Load Combination is 5 : BMS 1&5 - LL
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	1.44799	0.00000
6	0.00000	3.31751	0.00000
7	0.00000	1.44799	0.00000
Totals	0.00000	6.21350	0.00000

Load Combination is 6 : BM 6 - LL
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	0.33389	0.00000
6	0.00000	0.76498	0.00000
7	0.00000	0.33389	0.00000
Totals	0.00000	1.43276	0.00000

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LAKE RED ROCK
DETERMINATION OF LOADS TO STEEL GIRDERS

Load Combination is 7 : BM 3 - VEHICLE LD
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	0.08387	0.00000
7	0.00000	4.94476	0.00000
9	0.00000	2.97137	0.00000
Totals	0.00000	8.00000	0.00000

Load Combination is 8 : BM 4 - VEHICLE LD
Reactions

Node	Global X (K)	Global Y (K)	Moment (K-ft)
5	0.00000	0.02097	0.00000
7	0.00000	1.23619	0.00000
9	0.00000	0.74284	0.00000
Totals	0.00000	2.00000	0.00000

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF EXTERIOR STEEL GIRDERS

Node No	X-Coord (ft)	Y-Coord (ft)	Boundary Conditions X-dof (in,K/in)	Y-dof (in,K/in)	Rotation (r,K-ft/r)	Temp. (F)
1	0.00 ✓	0.00	R	R		0.00
2	9.71 ✓	0.00				0.00
3	19.83 ✓	0.00				0.00
4	29.83 ✓	0.00				0.00
5	37.63 ✓	0.00				0.00
6	39.92 ✓	0.00		R		0.00

Material Label	Elastic Modulus (Ksi)	Poisson's Ratio	Thermal Coefficient (F)	Weight Density (K/ft3)	Yield Stress (Fy) (Ksi)
STEEL	29000.00	0.30000	0.65000	0.490	36.000

Section Label	Database Shape	Matl. Set	Area (in^2)	Moment of Inertia (in^4)	As Coef	y/y
W 24 X 68		STEEL	20.10	1830.000	1.20	

No	I Node	J Node	Section	I Releases x y z	J Releases x y z	Sec	Sway	End Offsets I (in)	End Offsets J (in)	Length (ft)
1	1	2	W 24 X 68	assumed						9.71
2	2	3	W 24 X 68							10.12
3	3	4	W 24 X 68							10.00
4	4	5	W 24 X 68							7.80
5	5	6	W 24 X 68							2.29

BLC No.	Basic Load Case Description	Load Totals Nodal	Point	Dist.
1	FLOOR BEAM DL - CENTER GIRDER	6 ✓		
2	FLOOR BEAM LL - 85 PSF	6 ✓		
3	FLOOR BEAM LL - 10 K VEHICL	2 ✓		
4	WIND	6 ✓		

Nodal Loads, BLC 1: FLOOR BEAM DL - CENTER GIRDER

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
1	0.000	-3.330 ✓	0.000
2	0.000	-6.500 ✓	0.000

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF EXTERIOR STEEL GIRDER

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
3	0.000	-6.500	0.000
4	0.000	-6.500	0.000
5	0.000	-3.330	0.000
6	0.000	-0.880	0.000

Nodal Loads, BLC 2: FLOOR BEAM LL - 85 PSF

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
1	0.000	-1.450	0.000
2	0.000	-2.900	0.000
3	0.000	-2.900	0.000
4	0.000	-2.900	0.000
5	0.000	-1.450	0.000
6	0.000	-0.330	0.000

Nodal Loads, BLC 3: FLOOR BEAM LL - 10 K VEHICLE

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
3	0.000	-2.970	0.000
4	0.000	-0.740	0.000

Nodal Loads, BLC 4: WIND

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
1	0.000	-3.220	0.000
2	0.000	-6.430	0.000
3	0.000	-6.430	0.000
4	0.000	-6.430	0.000
5	0.000	-3.220	0.000
6	0.000	-0.740	0.000

Load Combination No.	Description	Self Wt Dir	Fac	BLC	Fac	BLC	Fac	BLC	Fac	BLC	Fac	BLC	Fac	DYNA	W S	E V
1	GR 1: 85 PSF LL	Y	-1.3	1	1.3	2	2.17									
2	GR 1:10K VEH +IMP	Y	-1.3	1	1.3	3	2.82									
3	GROUP 2: DL + W	Y	-1.3	1	1.3	4	1.3									
4	GR 3: 85 PSF LL	Y	-1.3	1	1.3	2	1.3	4	.39							

LOAD FACTOR
impact included

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF EXTERIOR STEEL GIRDER

Load Combination No.	Description	Self Wt Dir	Fac	BLC	Fac	BLC	Fac	BLC	Fac	BLC	Fac	DYNA	W S	E V
5	GR 3:10K VEH +IMP	Y	-1.3	1	1.3	3	2.82	4	.39					
6	SERVICE 85PSF LL			2	1									
7	SERVICE VEH + IMP			3	1.3									

} for computation of Δ Deflection

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF EXTERIOR STEEL GIRDER

Load Combination is 1 : GR 1: 85 PSF LL
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	24.51	0.00	0.00	-23.64	233.77
2	2-	3	0.00	8.90	-233.77	0.00	-8.00	319.28
3	3-	4	0.00	-6.74	-319.28	0.00	7.63	247.41
4	4-	5	0.00	-22.37	-247.41	0.00	23.07	70.18
5	5-	6	0.00	-30.54	-70.18	0.00	30.75	0.00

Load Combination is 2 : GR 1:10K VEH +IMP
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	19.55	0.00	0.00	-18.69	185.62
2	2-	3	0.00	10.24	-185.62	0.00	-9.34	284.65
3	3-	4	0.00	-7.49	-284.65	0.00	8.38	205.30
4	4-	5	0.00	-18.92	-205.30	0.00	19.61	55.05
5	5-	6	0.00	-23.94	-55.05	0.00	24.14	0.00

Load Combination is 3 : GROUP 2: DL + W
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	27.69	-0.00	0.00	-26.83	264.69
2	2-	3	0.00	10.02	-264.69	0.00	-9.12	361.53
3	3-	4	0.00	-7.69	[illegible]	0.00	8.58	280.19
4	4-	5	0.00	-25.39	-280.19	0.00	26.08	79.46
5	5-	6	0.00	[illegible]	-79.46	0.00	34.80	-0.00

Load Combination is 4 : GR 3: 85 PSF LL
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	24.48	0.00	0.00	-23.62	233.54
2	2-	3	0.00	8.89	-233.54	0.00	-7.99	318.97
3	3-	4	0.00	-6.74	-318.97	0.00	7.62	247.17
4	4-	5	0.00	-22.35	-247.17	0.00	23.05	70.11
5	5-	6	0.00	-30.52	-70.11	0.00	30.72	0

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF EXTERIOR STEEL GIRDER

Load Combination is 5 : GR 3:10K VEH +IMP
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	23.41	0.00	0.00	-22.55	223.16
2	2-	3	0.00	11.59	-223.16	0.00	-10.69	335.93
3	3-	4	0.00	-8.64	-335.93	0.00	9.53	245.08
4	4-	5	0.00	-22.57	-245.08	0.00	23.27	66.30
5	5-	6	0.00	-28.85	-66.30	0.00	29.06	0.00

Load Combination is 6 : SERVICE 85 PSF LL
Nodal Displacements

Node	Global X (in)	Global Y (in)	Rotation (rad)
1	0.00000	-0.00000	-0.00202
2	0.00000	-0.21264	-0.00144
3	0.00000	-0.30675	-0.00003
4	0.00000	-0.22147	0.00139
5	0.00000	-0.05623	0.00202
6	0.00000	-0.00000	0.00206

Load Combination is 7 : SERVICE 10K +IMP
Nodal Displacements

Node	Global X (in)	Global Y (in)	Rotation (rad)
1	0.00000	-0.00000	-0.00121
2	0.00000	-0.13009	-0.00093
3	0.00000	-0.19535	-0.00004
4	0.00000	-0.13906	0.00091
5	0.00000	-0.03473	0.00125
6	0.00000	-0.00000	0.00127

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF [redacted]

Node No	X-Coord (ft)	Y-Coord (ft)	Boundary Conditions X-dof (in,K/in)	Y-dof (in,K/in)	Rotation (r,K-ft/r)	Temp. (F)
1	0.00	0.00	R	R		0.00
2	9.71	0.00				0.00
3	19.83	0.00				0.00
4	29.83	0.00				0.00
5	37.63	0.00				0.00
6	39.92	0.00		R		0.00

Material Label	Elastic Modulus (Ksi)	Poisson's Ratio	Thermal Coefficient (F)	Weight Density (K/ft3)	Yield Stress (Fy) (Ksi)
STEEL	29000.00	0.30000	0.65000	0.490	36.000

Section Label	Database Shape	Matl. Set	Area (in^2)	Moment of Inertia (in^4)	As Coef	y/y
W 24 X 55		STEEL	16.20	1350.000	1.20	

No	I Node	J Node	Section	I Releases x y z	J x y z	Sec	Sway	End Offsets I (in)	J (in)	Length (ft)
1	1	2	W 24 X 55							9.71
2	2	3	W 24 X 55							10.12
3	3	4	W 24 X 55							10.00
4	4	5	W 24 X 55							7.80
5	5	6	W 24 X 55							2.29

BLC No.	Basic Load Case Description	Load Totals Nodal	Point	Dist.
1	FLOOR BEAM DL - CENTER GIRDER	6		
2	FLOOR BEAM LL - 85 PSF	6		
3	FLOOR BEAM LL - 10 K VEHICLE	2		

Nodal Loads, BLC 1: FLOOR BEAM DL - CENTER GIRDER

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
1	0.000	0.410	0.000
2	0.000	1.050	0.000
3	0.000	1.050	0.000

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF CENTER STEEL GIRDER

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
4	0.000	1.050 ✓	0.000
5	0.000	0.410 ✓	0.000
6	0.000	-0.090 ✓	0.000

Nodal Loads, BLC 2: FLOOR BEAM LL - 85 PSF

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
1	0.000	-3.320 ✓	0.000
2	0.000	-6.640 ✓	0.000
3	0.000	-6.640 ✓	0.000
4	0.000	-6.640 ✓	0.000
5	0.000	-3.320 ✓	0.000
6	0.000	-0.760 ✓	0.000

Nodal Loads, BLC 3: FLOOR BEAM LL - 10 K VEHICLE

Node Number	Global X (K)	Global Y (K)	Moment (K-ft)
3	0.000	-4.940 ✓	0.000
4	0.000	-1.240 ✓	0.000

Load Combination No.	Description	Self Wt Dir	Self Wt Fac	BLC	Fac	BLC	Fac	BLC	Fac	BLC	Fac	DYNA	W S	E V
1	WITH 85PSF LL	Y	-1.3	1	1.3	2	2.17 ✓							
2	WITH 10K VEHICLE	Y	-1.3	1	1.3	3	2.82 ✓							
3	W/85 PSF LL-SRVC			2	1									
4	W/ 10K VEH -SRVC			3	1.3									

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LAKE RED ROCK - COVERED BRIDGE
ANALYSIS OF CENTER STEEL GIRDER

Load Combination is 1 : WITH 85PSF LL
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	21.55	-0.00	0.00	-20.85	205.83
2	2-	3	0.00	7.81	-205.83	0.00	-7.08	281.15
3	3-	4	0.00	-5.96	-281.15	0.00	6.68	217.94
4	4-	5	0.00	-19.72	-217.94	0.00	20.28	61.91
5	5-	6	0.00	-26.95	-61.91	0.00	27.12	0.00

Load Combination is 2 : WITH 10K VEHICLE
Member End Forces

No	Nodes I	J	I-End Axial (K)	I-End Shear (K)	I-End Moment (K-ft)	J-End Axial (K)	J-End Shear (K)	J-End Moment (K-ft)
1	1-	2	0.00	7.23	-0.00	0.00	-6.53	66.82
2	2-	3	0.00	7.90	-66.82	0.00	-7.17	143.08
3	3-	4	0.00	-5.39	-143.08	0.00	6.11	85.58
4	4-	5	0.00	-8.24	-85.58	0.00	8.80	19.12
5	5-	6	0.00	-8.27	-19.12	0.00	8.43	0.00

Load Combination is 3 : W/85 PSF LL-SRVC
Nodal Displacements

Node	Global X (in)	Global Y (in)	Rotation (rad)
1	0.00000	-0.00000	-0.00626
2	0.00000	-0.65997	-0.00448
3	0.00000	-0.95209	-0.00010
4	0.00000	-0.68738	0.00433
5	0.00000	-0.17453	0.00627
6	0.00000	-0.00000	0.00639

Load Combination is 4 : W/ 10K VEH -SRVC
Nodal Displacements

Node	Global X (in)	Global Y (in)	Rotation (rad)
1	0.00000	-0.00000	-0.00273
2	0.00000	-0.29362	-0.00210
3	0.00000	-0.44094	-0.00010
4	0.00000	-0.31395	0.00204
5	0.00000	-0.07840	0.00282
6	0.00000	-0.00000	0.00287

BY MEA DATE 2/15/95
CHKD. BY GLL DATE 2:15:95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 17 OF 24
JOB NO. 9452044-1000

Lake Red Rock - Continental Bridge - piles

Estimate length of piles.

West abutment

elev. of top of pile = 779' ✓
elev. of top of shale layer = 781 - 32.5 = 748.5' (boring RRB-94-41)
estimated length of pile = 779 - 748.5 + 2' = 32.5'
say 33' ✓

East abutment

elev of top of pile = 782 ✓
elev of top of shale layer = 774.1 - 24.5 = 749.6' (boring RRB-94-43)
estimated length of pile = 782 - 749.6 + 2 = 34.4'
say 35' ✓

Pier

elev of top of pile = 759 ✓
elev of top of shale layer = 766 - 17.5 = 748.5' (boring RRB-94-42)
estimated length of pile = 759 - 748.5 + 2 = 12.5'
say 13' ✓

W C E FORM 165

HANSON ENGINEERS, INC.
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Lake Red Rock - Continental Bridge

Determine batter of piles at pier

Lateral Wind Force at pier

For 0° skew ∠ on superstr. ℄ $P_W = 0.075(96.5)(3) =$ 21.71 k ✓
on superstr. ∠ $P_W = 0.1(96.5) =$ 9.65 k ✓
on Pier stem $P_W = 0.04(2.5)(17) =$ 1.70 k ✓

TOTAL = 33 k ✓

Longitudinal Forces at pier

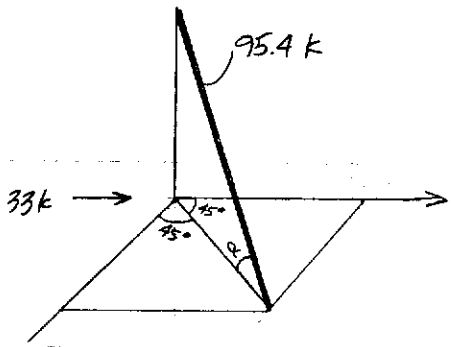
From braking of 10k vehicle $P = .05(10) = 0.5$ k ✓

Wind @ 60° skew ∠ on superstr ℄ $P = .05(193)(3) =$ 28.95 k ✓
on superstr ∠ $P = .038(193) =$ 7.33 k ✓
on pier stem $P = .04 \sin 60° (14.5)(17) =$ 8.54 k ✓

TOTAL = 45.3 k.

Capacity of HP8x36 = 9ksi(10.6) = 95.4 k ✓

Try 2:12 batter at 45°



In transverse direction

$\alpha = \tan^{-1}\frac{12}{2} = 80.54°$ ✓

95.4 (cos 80.54°) = 15.68 k/pile ✓

15.6k (cos 45°) = 11.09 k/pile

11.09 k/pile (2 piles)(1.25 overstress factor) = 27.7 k < 33k N.G.

Try 2:12 batter at 30°

15.68 k (cos 30°) = 13.58 k/pile ✓
13.58 k/pile (2 piles)(1.25) = 33.96 k > 33 k OK ✓

In longitudinal direction

capacity = [15.68(sin 30°)(2) + 15.68 k/pile(2)](1.25) = 58.8 k > 45.3 OK. ✓

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CHKD. BY GLC DATE 2:15:95

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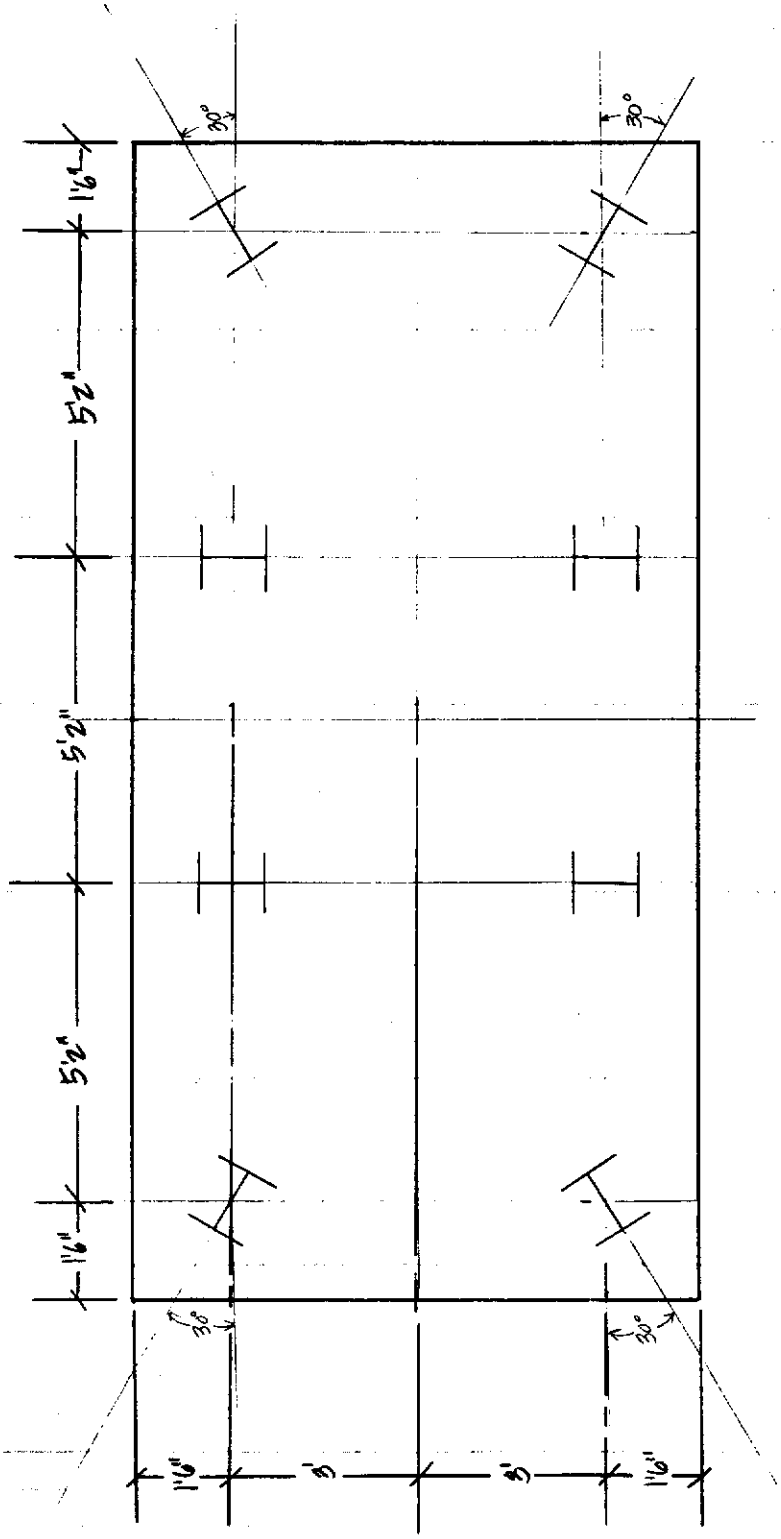
SHEET NO. 19 OF 24
JOB NO. 94S2049-1000

Continental Bridge - Lake Red Rock

PILE LAYOUT
at Pier Footing



Piles:

HP 8 x 36
Number: 8
Est. Length = 13' ✓

all piles battered at 2:12. ✓

BY MEA DATE 2/15/95
CHKD. BY GLC DATE 2:16:95

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SHEET NO. 20 OF 24
JOB NO. 9452044-1000

Lake Red Rock - Continental Bridge

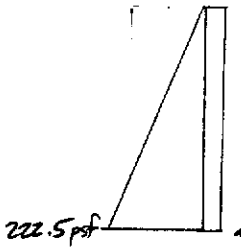
Determine batter of piles at abutments

Lateral Wind Force at Abutments

For 0° skew angle
on Superstr. Dn $0.075\left(\frac{110}{2}\right)(3) = 12.375$ k ✓
on Superstr. Lt $.1(55') = 5.5$ k ✓
TOTAL = 17.875 k ✓

Longitudinal Forces on Abutments

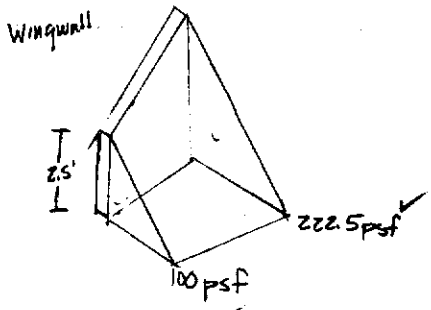
Lateral Earth Pressure on backwall (dimensions as show on following page, from continental Bridge, Segment IIB of Lake Red Rock Multi-Purpose Trail)
Use E.F.P. = 40pcf



main part of backwall $F = .5(222.5)(5.5625)(17.333) = 10.73$ k ✓

Wingwall

$F = \frac{[.5(222.5)(5.5625) + .5(25)(100)]}{2} \times 6' \times 2 = 4.46$ k ✓



Total = 15.19 k ✓

Try outer piles battered at 2:12 laterally

Capacity of one pile (to resist wind force) = 95.4 k $(\cos(\tan^{-1}\frac{12}{2}))$ = 15.68 k

15.68 * 1.25 = 19.6 k ✓ > 17.9 ✓ ok

Inner 2 piles battered at 2:12 longitudinally

15.68 (2 piles)(1.25) = 39.2 k ✓ > 15.19 ✓ ok

batter all piles 2:12 ✓

(outer piles to resist lateral forces, inner piles to resist earth pressure)

Pier pile capacity to resist uplift = 250psf(12')$\left(\frac{32}{12}\right)$ + 13'$\left(\frac{10.6}{144}\right)$(490) = 8.47 k > 8.35 ✓ ok

W C E FORM 166

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Red Rock Lake - Load Calculations

Two span bridge with 5" lightweight concrete deck (@50psf), 193' total, spans of 110' and 83'

Information provided by Continental Bridge for superstructure DL:

175' x 10' (w/ Wood Deck) ⇒ 113,000 lb
175' x 10' (w/ Concrete Deck) ⇒ 110,000 lb (W/O concrete)
100' x 10' (w/ Wood Deck) ⇒ 34,900 lb

Diff. in DL (Wood to concrete) $\frac{3000\ lb}{175(10)} = 1.71$ psf

DL (100x10' conc. deck) = 34,900 − 1.71(100)(10) = 33,190 ⇒ 33,200 lb

For 110' x 10' span:

Superstructure DL = $33200\left(\frac{110}{100}\right) = 36,520$ ✓

Ltwt. concrete deck = 50 psf (110)(10) = 55,000 ✓

For 83' x 10' span:

Superstr. DL = $33200\left(\frac{83}{100}\right) = 27,556$ ✓

Ltwt. concrete = 50 psf (83)(10) = 41500

Live Load - 85 psf or 10,000 lb vehicle ld.

Abut 1 DL = $\left(\frac{55 + 36.52}{2}\right) = 45.8$ k ✓

LL = $\frac{.085(110)(10)}{2} = 46.8$ k ✓

Est. Abut Cap DL = 311 ft³ (.15) = 46.7 k ✓

[Dimensions of Abuts. and Pier based on drawings for continue bridge at Sta. 5+90 on Segment IIB of Multipurpose Trail. (100' spans)]

TOTAL 139.3 ✓

$\frac{139.3\ k}{[(9\ ksi(10.6\ in^2)) - 25]}$ = 2 piles required (assume HP 8x36, 25k neg. skin friction)

70 k/pile

Use 4 piles with 2 outer piles battered to resist lateral forces, 2 inner piles battered to resist earth pressure ✓

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Red Rock Lake

PIER

Pier stem ht. ≅ 20'
width = 14.5'
thickness = 2.5'

[Loadings according to AASHTO Ch. 3]

$$D = \left[12(2.5) + \frac{\pi}{4}(2.5)^2\right](20)(.15) = 104.7\ k$$

Footing
length = 18.5'
width = ~~7.5'~~ 9'
thickness = 2.5'

$$D = 18.5(\text{~~7.5~~ } 9')(2.5)(.15) = \text{~~58~~ } k \quad 62.4\ k$$

D Span 1 = 45.8 k
L Span 1 = 46.8 (based on 55 psf)

D Span 2 = 34.5 k
L Span 2 = 35.3 (based on 55 psf)

Longitudinal Force (from 10,000 lb vehicle)
$M_x = .05(10\ k)(22.5 + 3.17 + 6) = 15.8\ k'$

Overturning
$M_x \cong 0$
$M_y = 0.02(10')\left(\frac{110}{2} + \frac{55}{2}\right)\left(\frac{10}{4}\right) = 48.3\ k'$ (2 spans)

$M_y = 48.3\left(\frac{55}{96.5}\right) = 27.5$ (ONLY SPAN 1 IN PLACE)

Wind

0° skew angle

ON Superstr. D
$M_x = 0$
$M_y = 0.075(96.5)(3)(22.5 + 3.83) = 571.7\ k\text{-ft.}$

ON Superstr. L
$M_x = 0$
$M_y = 0.1(96.5)(22.5 + 3.17 + 6) = 305.6\ k\text{-ft}$

ON Pier Stem
$M_x = 0$
$M_y = 0.04(2.5)(17)(5.5 + 17/2) = \text{~~67.2~~ } 23.8\ k\text{-ft.}$

- assume 3' of earth over ftg.
- assume height of exposed truss area equivalent to 3' of solid area.]

60° skew angle

ON Superstr. D
$M_x = .05(\text{~~193~~ } 762)(3)(22.5 + 3.83) = \text{~~39.5~~ } k'$
$M_y = .024(96.5)(3)(22.5 + 3.83) = 182.9\ k'$

ON L
$M_x = .038(\text{~~193~~ } 762)(22.5 + 3.17 + 6) = \text{~~k~~ } 232$
$M_y = .034(96.5)(22.5 + 3.17 + 6) = 103.9\ k'$

ON Pier Stem
$M_x = .04 \sin 60°\,(14.5)(17)(5.5 + 17/2) = 119.6\ k'$
$M_y = .04 \cos 60°\,(2.5)(17)(5.5 + 17/2) = 11.9\ k'$

W C E FORM 166

Earth ≅ $3'((17.5)(7.5) - 34.91) + .12\ kcf = 37.38$ $M_x \cong 0$ $M_y \cong 0$

BY MEA DATE 1/6/95
CHKD. BY GLL DATE 2-16-95

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SHEET NO. 3 OF 9
JOB NO. 94S2044

Red Rock Lake

WIND Lds With only span 1 in place

0°

SUPERSTR. DL $M_X = 0$
$M_y = .075(55)(3)(22.5 + 3.83) = 325.8$ ✓

SUPERSTR L $M_X = 0$
$M_y = 0.1(55)(22.5 + 3.17 + 6) = 174.2$ ✓

ON PIER STEM $M_X = 0$
$M_y = ~~672~~ 23.8$

60°

Superstr DL $M_X = ~~395~~ 762\left(\frac{110}{193}\right) = 434$ ✓
$M_y = 182.9\left(\frac{55}{96.5}\right) = 104.2$ ✓

Superstr L $M_X = ~~78~~ 232\left(\frac{110}{193}\right) = 132$ ✓
$M_y = 103.9\left(\frac{55}{96.5}\right) = 59.2$ ✓

ON pier stem $M_X = 119.6$ ✓
$M_y = 11.9$ ✓

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Red Rock Lake

Dead Loads

	P	Mx	My
Both spans in place			
Superstructure	80.3 ✓	3.8 ✓	—
Pier Stem & ftg	~~157.7~~ 167.1 ✓	—	—
	~~237.0~~ 247.4 ✓		
Span 1 in place			
Superstructure	45.8 ✓	15.3 ✓	—
Pier Stem & ftg	~~157.7~~ 167.1 ✓	—	—
	~~202.5~~ 212.9 ✓		

The span loads are applied at a 4" eccentricity about the X axis (long. axis of pier)
Based on Continental bridge drawings

Live Loads

	P	Mx	My
85psf { Both spans in place	82.1 ✓	3.8 ✓	—
85psf { Span 1 in place	46.8 ✓	15.6 ✓	—
10,000 lb vehicle on span 1	10 ✓	3.3 ✓ } 19.1 ✓	—
Longit. force from 10,000 lb vehicle	—	15.8 ✓ }	

Wind Forces

	P	Mx	My	With Span 1 only in Pl. My	With Span 1 only in Pl. Mx
Wind skew = 0° (Max My)					
on Superstr. DL (both spans)	—	—	571.7 ✓	—	325.8 ✓
on Pier Stem	—	—	~~67.2~~ 23.8 ✓	—	~~67.2~~ 23.8
Overturning (both spans)	—	—	45.3 ✓	—	27.5 ✓
			~~637.2~~ 643.8		~~480.5~~ 377
on LL		—	305.6 ✓	—	174.2 ✓
Wind skew = 60° (Max Mx)		762 ✓		434 ✓	
on Superstr. DL (both spans)	—	~~32.5~~	162.9 ✓	~~32.5~~	104.2
on Pier Stem	—	119.6 ✓	11.9 ✓	119.6 ✓	11.9
Overturning (both)	—	—	48.3 ✓	—	27.5
		~~1001~~ 881.6	243.1 ✓	~~1021~~ 553.6 ✓	143.6
on LL		232 ~~X~~	103.9 ✓	132 ~~X~~ ✓	59.2
Earth	37.4	—	—		

Red Rock Lake

Loadings (85 psf LL)

Group 1 (85psf LL + DL)

Both spans
P = ~~287~~ 291.4 + 82.1 + 37.4 = ~~356.5~~ 366.9 ✓
Mx = 3.8 + 3.8 = 7.6 ✓
My = 0

Span One in place
P = ~~250.5~~ 212.9 + 46.8 + 37.4 = ~~296.7~~ 297.1 ✓
Mx = 15.3 + 15.6 = 30.9
My = 0

Group 2 (DL + WIND)

Both Spans, Wind @ 60°
P = ~~291.4~~ ✓ + 37.4 = ~~214.4~~ 284.8 ✓
Mx = ~~750.1~~ 881.6 + 3.8 = ~~754.9~~ 885.4 ✓
My = 243.1

Span 1, Wind @ 60°
P = ~~292.5~~ 212.9 + 37.4 = ~~250.9~~ 250.3 ✓
Mx = ~~753.1~~ 553.6 + 15.3 = ~~768.4~~ 568.9 ✓
My = 148.6

Both spans, Wind @ 0°
P = ~~214.4~~ 284.8 ✓
Mx = 3.8
My = ~~684.2~~ 643.8

Span 1, Wind @ 0°
P = ~~250.9~~ 250.3
Mx = 15.3
My ~~426.5~~ 377.1

Group 3 (DL, 85psf LL and WIND)

Both spans, Wind @ 60°
P = ~~356.5~~ 366.9 ✓
Mx = ✓.3(~~753.1~~ 881.6) + ~~232~~ 132 + 3.8 3.8 = ~~673~~ 504.1
My = ✓.3(243.1) + 103.9 = 176.8

1 span, Wind @ 60°
P = ~~296.7~~ 297.1
Mx = .3(~~753.1~~ 553.6) + ~~232~~ 132 + 15.3 + 15.6 = ~~498.6~~ 329
My = .3(143.6) + 59.2 = 102.3

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Red Rock Lake

Both spans, Wind @ 0°
P= ~~356~~ 366.9
M_x = 3.8 + 3.8 = 7.6
M_y = .3(~~687.2~~ 643.8) + 305.6 = ~~511.8~~ 498.7

One Span, Wind @ 0°
P= ~~286.7~~ 297.1
M_x = 15.3 + 15.6 = 30.9
M_y = .3(~~429.5~~ 377.1) + 174.2 = ~~300.4~~ 287.3

Group 4 (Same as Group 1) - NO THERMAL LOADS

Group 5 (Same as Group 2) - NO THERVAL LOADS

Group 6 (Same as Group 3) - No Long. Load from 85 psf LL

Group 8 (Same as G1)

Group 9 (Same as G2)

Loadings (10,000 lb vehicle LL)

Group 1 Both Spans
P= ~~237.0~~ 247.4 + 10 + 37.4 = ~~284.4~~ 294.8
M_x = 3.9 + 3.3 = 7.1
M_y = 0

One Span
P= ~~202.5~~ 212.9 + 10 + 37.4 = ~~249.9~~ 260.3
M_x = 15.3 + 3.3 = 18.6
M_y = 0

Group 2 - same as previous group 2

Group 3 Both spans, Wind @ 60°
P= ~~284.4~~ 294.8 881.6 232 +15.8 =
M_x = .3(~~1591~~) + ~~12~~ + 3.8 + 3.3 = ~~66.03~~ 519.4
M_y = 176.8

1 span, Wind @ 60 P= ~~249.9~~ 260.3 553.6 132 +15.8 = 332.5
M_x = .3(~~159.1~~) + ~~12~~ + 15.3 + 3.3 = ~~78.3~~
M_y = 102.3

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Red Rock Lake

Both spans, Wind @ 0°
P = ~~284.4~~ 294.8
Mx = 7.1
My = ~~511.8~~ 498.7

1 span, Wind @ 0°
P = ~~249.9~~ 260.3
Mx = 18.6
My = ~~300.4~~ 287.3

Group 6 longitudinal load included

Both spans Wind @ 60°
P = 284.4
Mx = 66.83 + 15.8 = 82.6
My = 176.8

1 span, Wind @ 60°
P = 249.9
Mx = 78.3 + 15.8 = 94.1
My = 102.3

Both spans, Wind @ 0°
P = 284.4
Mx = 7.1 + 15.8 = 22.9
My = 511.8

1 spans, Wind @ 0°
P = 249.9
Mx = 18.6 + 15.8 = 34.4
My = 300.4

Group 6 - same as group 3.

Also consider case where both spans are in place but only Span 1 nodes w/live load (for Group III loading)

60° P = ~~247~~ 247.4 + 46.8 + 37.4 = ~~331.2~~ 331.6
Mx = 3.8 + 15.6 + .3(~~150~~ ~~881.6~~ 132) + ~~12~~ = ~~79.1~~ 415.9
My = .3(243.1) + ~~102.9~~ 59.2 = ~~176.8~~ 132.1

0° P = ~~321~~ 331.6
Mx = 3.8 + 15.6 = 19.4
My = .3(~~607.2~~ 643.8) + ~~305.6~~ 174.2 = ~~311.8~~ 367.3

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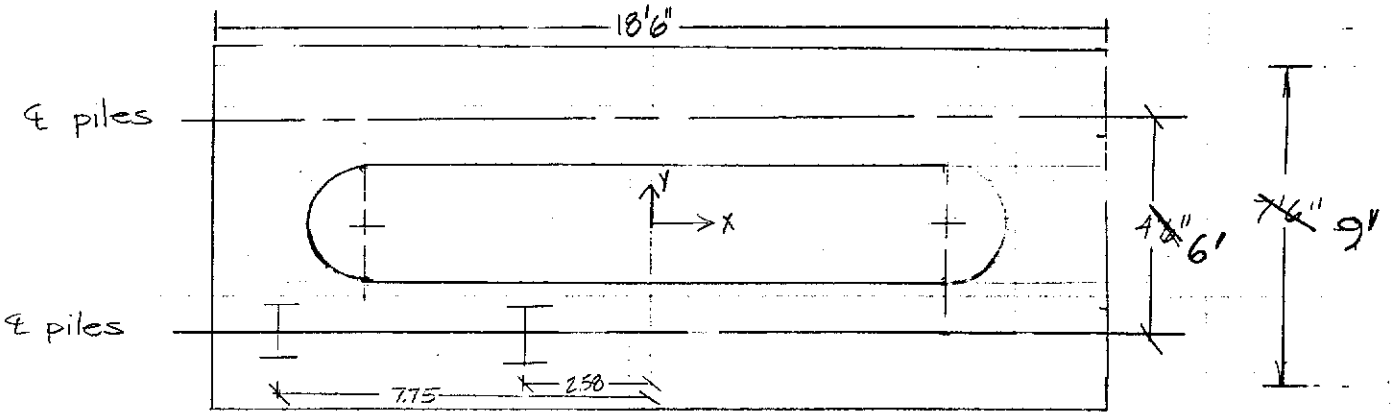
R.R. Lake

Assume 8-HP8x36 piles, 70 k capacity per pile



X Spacing = $\frac{18.5 - 3}{3} = 5.17'$ Y spacing = $\frac{9}{2} - 3 = 2.85'$ ~~3~~

$I_x = 8(2.85)^2 = 40.5$ ~~72~~ pile-ft² ✓

$I_y = 4(2.58^2 + 7.75^2) = 266.9$ pile-ft² ✓

(See Spreadsht, next pg)

Sample Spreadsheet Calc.

(Group 2 Line 1)

$P = \frac{214.4}{8} \pm \frac{162.9(2.85)}{40.5} \pm \frac{243.1(7.75)}{266.9} \Rightarrow P_{max} = 50.41 \quad P_{min} = 18.19$

~~reduced $P_{max} = \frac{50.41}{1.25} = 40.33$ $P_{min} = \frac{18.19}{1.25} = 14.55$~~

Use 8 - HP8x36 piles. ✓

HP 8 X 36 @9 KSI, 85 PSF LIVE LOAD

KIES PILE LOADS

# Piles	IX	IY	P	MX	MY		PMAX	PMIN	REDUCED PMAX	REDUCED PMIN
8	72.00	266.90	366.90	7.60	0.00	GR I	46.18	45.55	46.2	45.5
8	72.00	266.90	297.10	30.90	0.00		38.43	35.85	38.4	35.9
8	72.00	266.90	284.80	885.40	243.10	GR II	79.55	-8.35	63.6	-6.7
8	72.00	266.90	250.30	568.90	143.60		59.16	3.41	47.3	2.7
8	72.00	266.90	284.80	3.80	643.80		54.45	16.75	43.6	13.4
8	72.00	266.90	250.30	15.30	377.10		42.87	19.70	34.3	15.8
8	72.00	266.90	366.90	504.10	176.80	GR III	72.00	19.72	57.6	15.8
8	72.00	266.90	297.10	329.00	102.30		53.82	20.46	43.1	16.4
8	72.00	266.90	366.90	7.60	498.70		60.66	31.07	48.5	24.9
8	72.00	266.90	297.10	30.90	287.30		46.77	27.51	37.4	22.0

HP 8 X 36 @9 KSI, 10000 LB VEHICLE LOAD

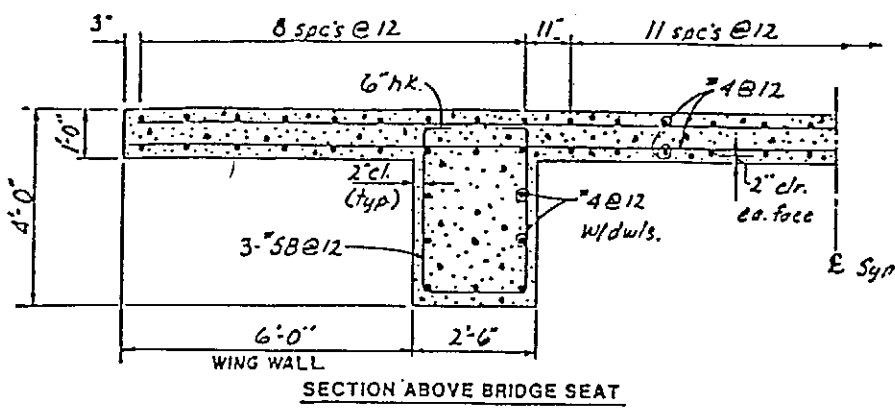
# Piles	IX	IY	P	MX	MY		PMAX	PMIN	PMAX	PMIN
8	72.00	266.90	294.80	7.10	0.00	GR I	37.15	36.55	37.1	36.6
8	72.00	266.90	260.30	18.60	0.00		33.31	31.76	33.3	31.8
8	72.00	266.90	294.80	519.40	176.80	GR III	63.63	10.07	50.9	8.1
8	72.00	266.90	260.30	332.50	102.30		49.36	15.71	39.5	12.6
8	72.00	266.90	294.80	7.10	498.70		51.63	22.07	41.3	17.7
8	72.00	266.90	260.30	18.60	287.30		41.65	23.42	33.3	18.7

8	72.00	266.90	331.60	415.90	132.10		62.61	20.29	50.1	16.2
8	72.00	266.90	331.60	19.40	367.30		52.92	29.98	42.3	24.0

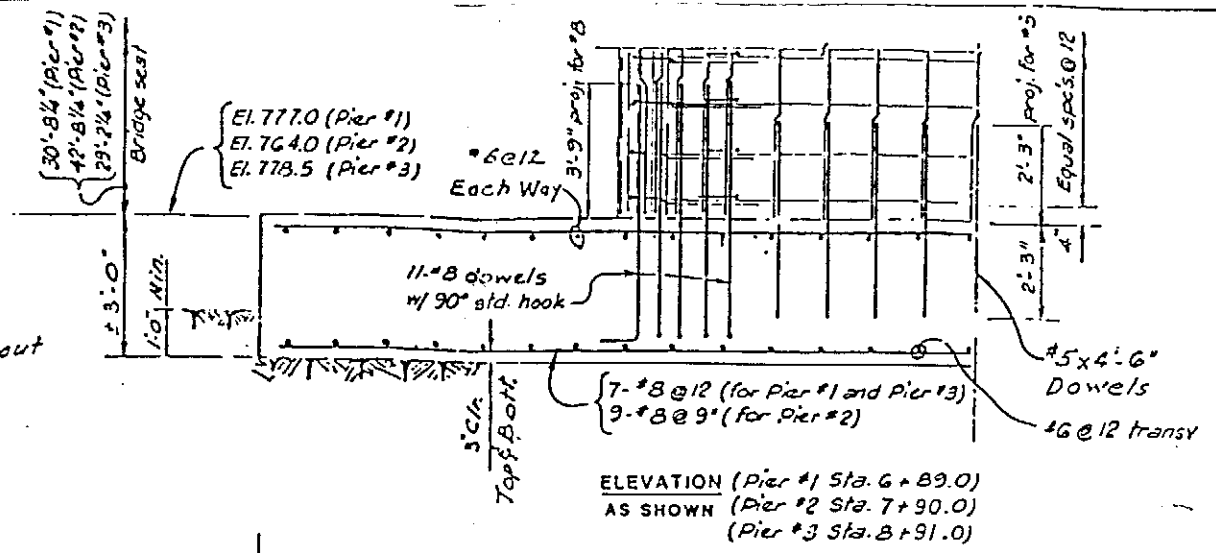
This supersedes the previously submitted pile loads sheet An error in the spreadsheet was corrected. This does not result in any changes in the number or spacing of piles.

pg 1

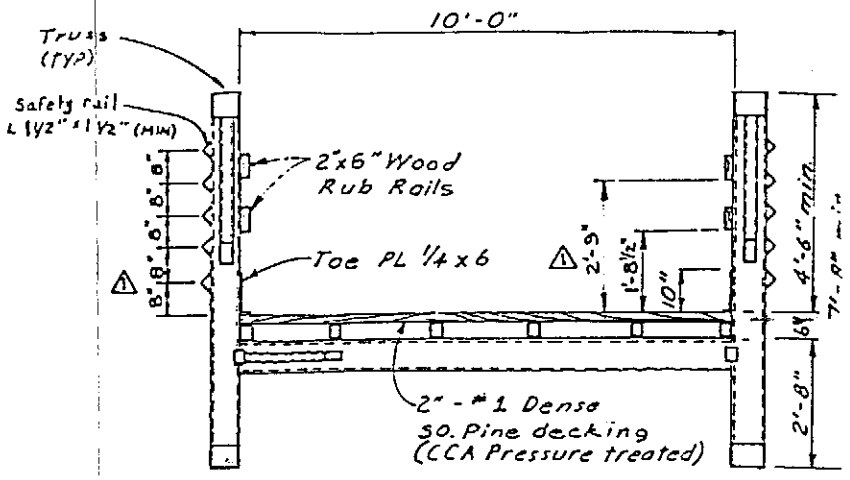
by MEA
2/16/95
9452044-1000



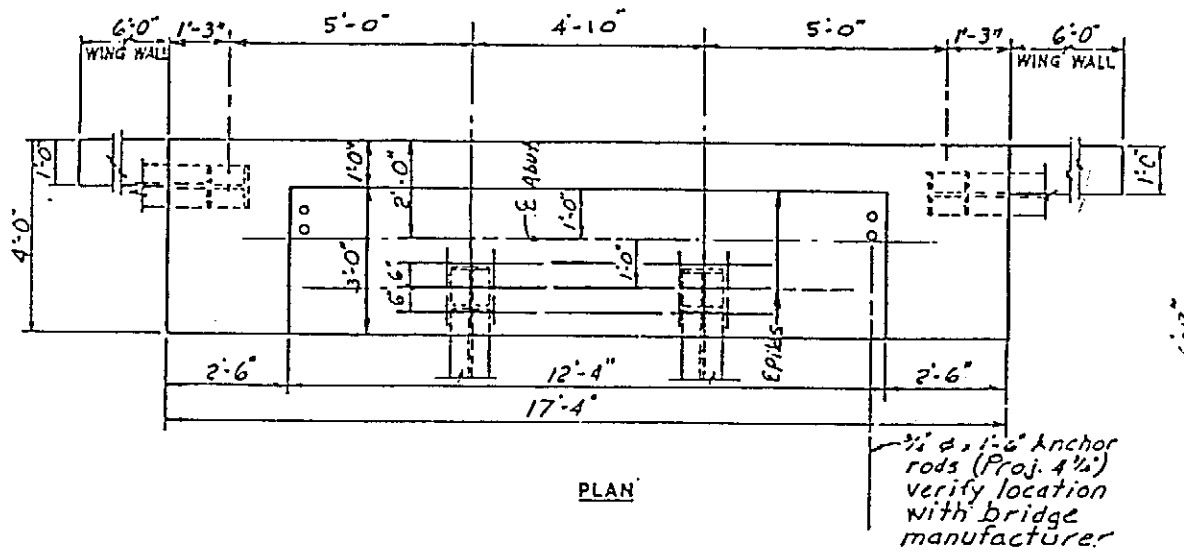
SECTION ABOVE BRIDGE SEAT



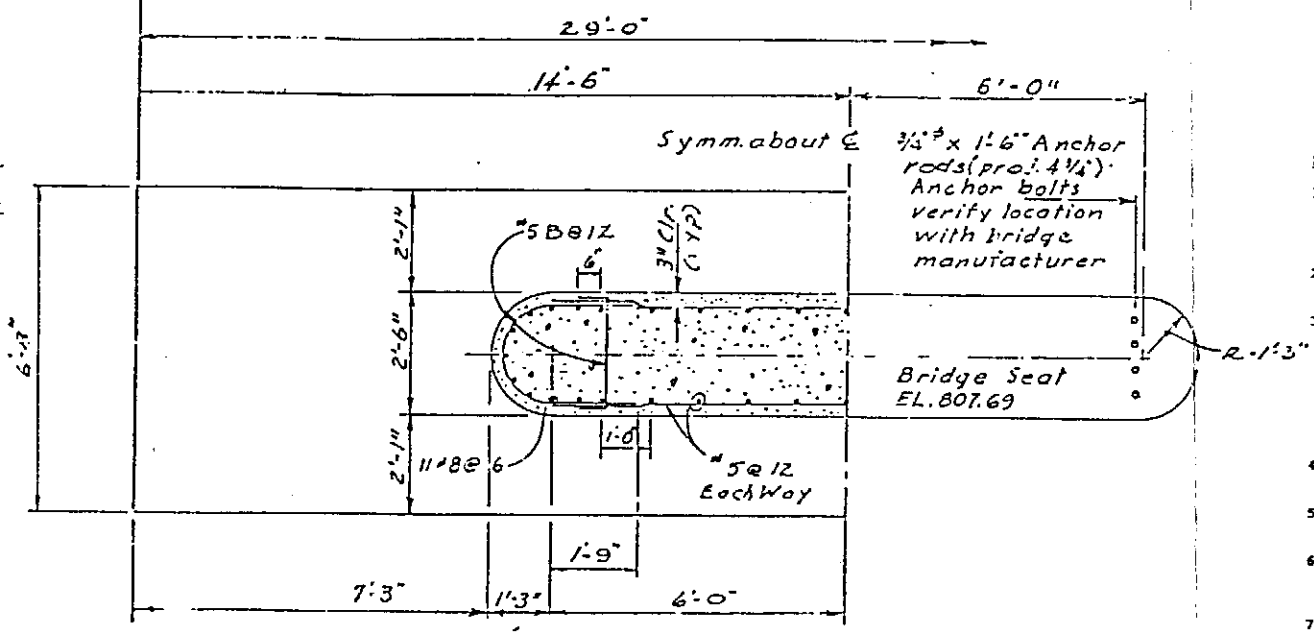
ELEVATION (Pier #1 Sta. 6+89.0)
AS SHOWN (Pier #2 Sta. 7+90.0)
(Pier #3 Sta. 8+91.0)



TYPICAL BRIDGE SECTION

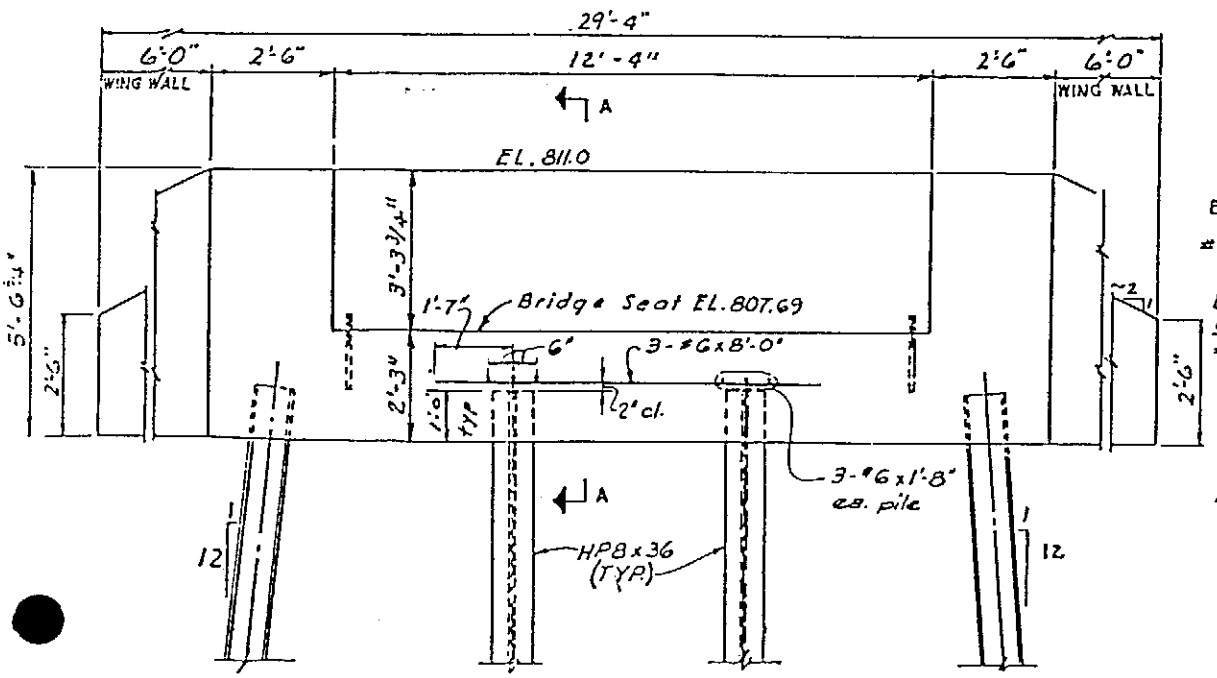


PLAN

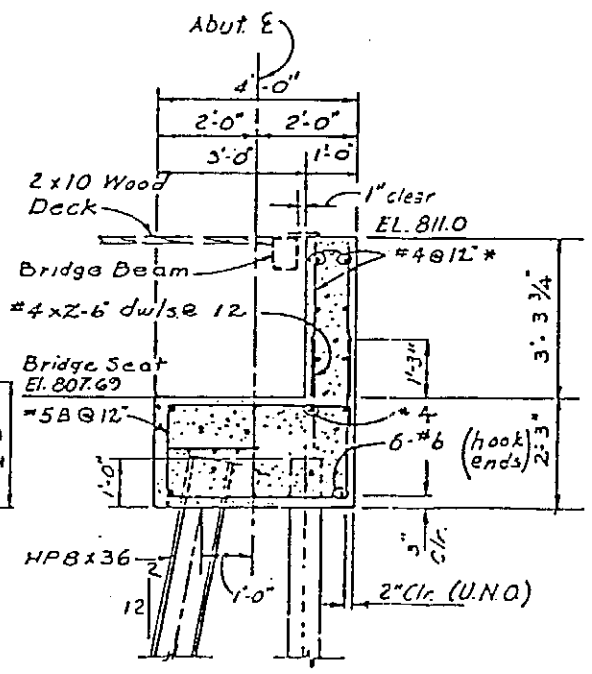


FOOTING PLAN SEAT PLAN.

PIER DETAILS



ELEVATION



* THE TOP TWO HORIZONTAL BARS SHALL EXTEND THE FULL LENGTH OF THE ABUTMENT AND FOLLOW THE SLOPE OF THE TOP OF THE WING WALLS.

SECTION A-A

ABUTMENT DETAILS

SUBSTRUCTURE NOTES:

1. Design Criteria.
   - A. Concrete: F'C (28 Days) = 4,000 psi.
   - B. Reinforcing Steel: ASTM A 615, Gr. 60.
   - C. Anchor Rods: A307, Gr. A, Hot-Dip Galvanized.
2. Provide 3/4" chamfer at all exposed edges of concrete.
3. Backfill for abutments shall be a mixture of compacted sand and gravel.
4. Anchor rods may be preset or installed in resin grout in holes drilled after final positioning of the superstructure provide (2) anchor rods at each bearing point.
5. Each anchor rod shall be provided with double nuts and heavy washer. At fixed bearings both nuts shall be installed wrench tight. At expansion bearings the lower nut shall be installed finger tight and backed off one quarter turn and the upper nut shall be installed wrench tight.
6. Score threads of anchor rods after nuts are tightened to prevent loosening.
7. Bearing plates and bridge anchorage shall be designed and detailed by the bridge manufacturer.

Scale 0 2 4 Feet
½" = 1'-0"

BRIDGE SUPERSTRUCTURE NOTES:

1. BRIDGES SHALL BE PRE-ENGINEERED TRUSS TYPE, FABRICATED FROM HIGH STRENGTH, SELF-WEATHERING, ATMOSPHERIC CORROSION-RESISTANT STEEL CONFORMING TO ASTM A847, A606, A242, OR A588 (Fy=50,000 psi).
2. THE GENERAL DIMENSIONS OF THE BRIDGES ARE INDICATED ON THE SECTION ABOVE AND ON THE PROFILE SHEET.
3. THE MINIMUM DESIGN LOADING FOR THE BRIDGES SHALL BE:
   - a. UNIFORM LIVE LOAD=60 psf.
   - b. VEHICLE LOAD=10,000 lbs. PLUS 30% IMPACT.
   - c. WIND LOAD=30 pfs ON THE VERTICAL PROJECTED SURFACE AS IF ENCLOSED.

   THE LIVE LOAD AND VEHICLE LOAD NEED NOT BE APPLIED AT THE SAME TIME.
4. BRIDGE SPANS SHALL BE CAMBERED FOR 125% OF THE DEAD LOAD DEFLECTION.
5. MAXIMUM LIVE LOAD DEFLECTION SHALL BE THE SPAN LENGTH DIVIDED BY 480.
6. ALL ALLOWABLE DESIGN STRESSES SHALL BE IN ACCORDANCE WITH THE "SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURRAL STEEL FOR BUILDINGS", BY AISC.
7. THE VERTICAL TRUSS MEMBERS, THE FLOOR BEAMS, AND THEIR CONNECTIONS SHALL BE PROPORTIONED TO RESIST A LATERAL FORCE EQUAL TO 2% OF THE COMPRESSIVE FORCE IN THE TOP CHORD OF THE TRUSS AT THE PANEL POINT CONSIDERED, APPLIED LATERALLY AT THE TOP CHORD PANEL POINTS OF THE TRUSS.
8. THE BRIDGE DESIGN SHALL ALSO CONFORM TO THE PROVISIONS OF SECTION 10.16.12 OF THE "STANDARD SPECIFICATIONS FOR HIGHWAY BRIDGES", BY AASHTO.
9. BEARING PLATES AND BRIDGE ANCHORAGE SHALL BE DESIGNED AND DETAILED BY THE BRIDGE MANUFACTURER.
10. EXPANSION BEARINGS SHALL HAVE TEFLON COATED PLATES WITH SLOTTED HOLES TO PERMIT LONGITUDINAL MOVEMENT OF THE SUPERSTRUCTURE.

Revisions		
Symbol	Description	Date Approved
1	ADDED SAFETY & RUB RAILS, CHANGED DIMENSIONS.	10 AUG 92 TGM/S

HARZA ENGINEERING COMPANY
CHICAGO, ILLINOIS

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND, ILLINOIS

Designed by: S.N.
Drawn by: I.P.
Checked by: J.J.
Reviewed by: N.P.
Approved by: [illegible]

DES MOINES RECREATIONAL RIVER AND GREENBELT
RED ROCK MULTI-PURPOSE TRAIL
SEGMENT II B

BRIDGE DETAILS

Scale: 1/2" = 1'-0"
Date: 8 JUNE 1992
Drawing Number: S-2
Contract Number: DACW25-92-R-0020

5 4 3 2 1

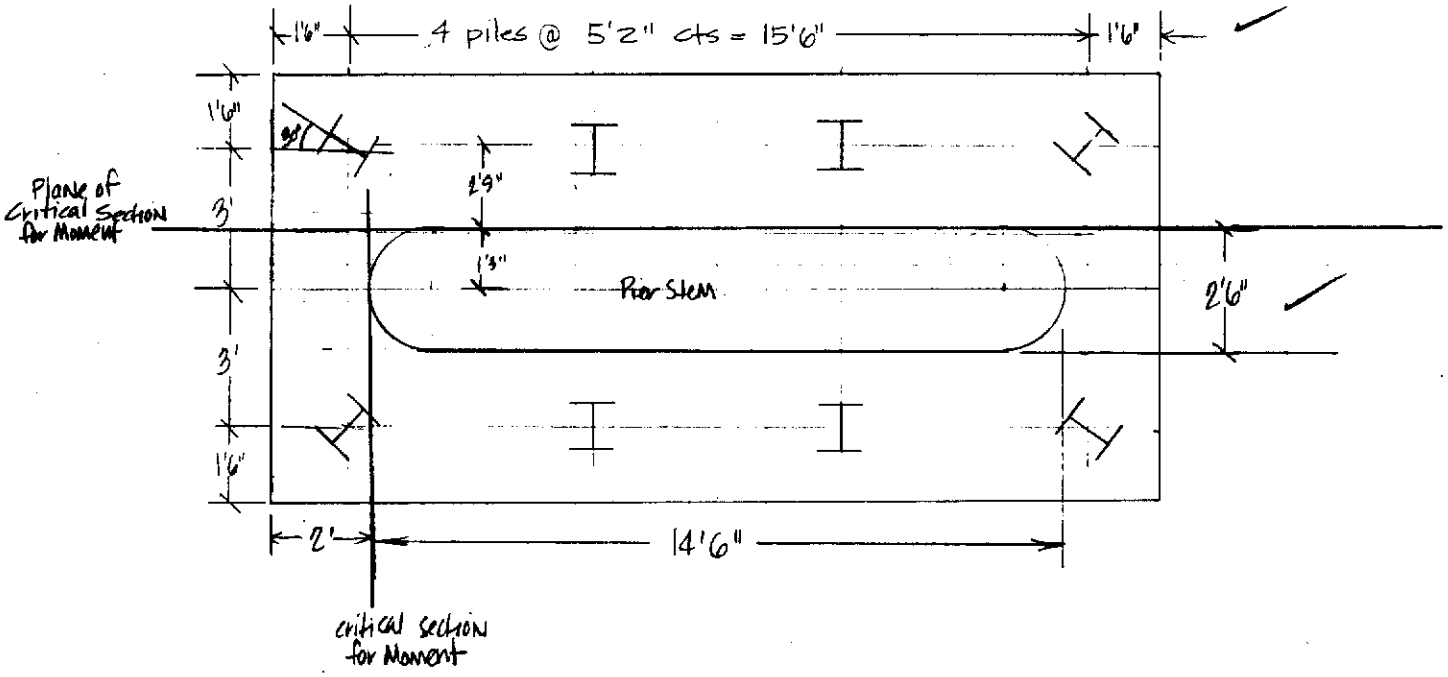
BY MEA DATE 2/16/95
CHKD. BY GLC DATE 2-16-95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 23 OF 24
JOB NO. 9452044-1000

Lake Red Rock - Continental Bridge

Check Pier Footing for bending and shear



Worst case for pile loads - Group 2.

Sum pile loads on one side of stem

pile 1 = 79.55 k

pile 2 = $\underbrace{\frac{284.0}{6}}_{72.49} + \underbrace{\frac{885.4(3)}{72}}_{72.49} + \underbrace{\frac{243.1\,(2.583)}{266.9}}_{2.35} = 74.84$ k

pile 3 = 72.49 − 2.35 = 70.14 k

pile 4 = $72.49 - \frac{243.1(7.75)}{266.9} = 65.43$ k

TOTAL = 290 k

$M_s = 290\text{ k}\,(2.75') = 797.5$ k-ft ✓

BY MEA DATE 1/27/95
CHKD. BY GLC DATE 1-27-95

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

SHEET NO. 2 OF 2
JOB NO. 9452044-1000

Lake Red Rock - revision of cost estimate

Abutments (based on bridge in segment IIB)

$2 * \frac{311\ ft^3}{27} =$ **23.0 CY** ✓

Abutment reinforcing

Reinforcing ratio $\frac{960}{4.5} = \frac{107}{9} = 213$ lb/CY concrete (Based on Sugar Creek Bikeway Abuts)

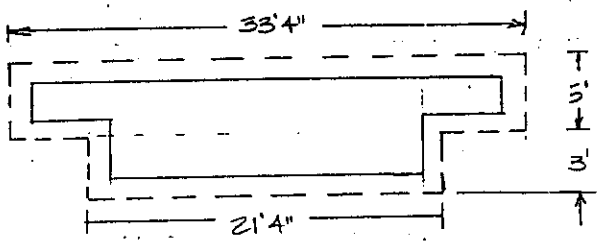
$\frac{107}{215}(23.0\ CY) =$ ~~4899~~ **4890 lb**
2450

Class X concrete encasement

$\left[\frac{\pi}{4}(1.5)^2 * 3\ ft * 8\ piles\right] / 27 =$ **1.6 C.Y.** ✓

Encasement diameter for HP 8x36

Structure Excavation



Abuts. $2 * \frac{[(33.33)(5) + (21.33)(3)](3.5)}{27} = 29.9$

Pier $\frac{(18.5+4)(9+4)(3.5)}{27} = 37.9$ CY.

TOTAL = **67.8 CY.** ✓

Piles

HP 8 x 36

Under pier $8 * 40' = 320$ ft ✓
(piles assumed 40' long under pier)

Under Abutments Assume piles are $40' + 22.4' = 62.4 \rightarrow 62$. (vertical distance from bottom of Abut. to bottom of pier ft)

$62(8) = 496$ ft ✓

W C E FORM 186

HANSON ENGINEERS, INC.
ENGINEERS — CONSULTANTS
SPRINGFIELD, PEORIA & ROCKFORD, ILLINOIS

Lake Red Rock - Continental Bridge

FOOTING ANALYSIS (CONT'D)

$d = 30" - 3" - .5 = 26.5"$ (assume #8's) ✓
$b = 18.5'(12) = 222"$

req'd $A_s = \dfrac{797.5 \text{ k-ft}(12 \text{ "/ft})}{24 \text{ ksi}(.93)(26.5 \text{ in})} = 16.18 \text{ in}^2$ (distributed across length "b")

(24 ksi: allowable grade 60 stl.; .93: estimate j)

for 23 #8 bars $A_s = 18.17 \text{ in}^2$ ✓

$\rho = \dfrac{18.17}{26.5(222)} = .003 \qquad np = .0278$

$k = \sqrt{np^2 + 2np} - np = .2096$

$j = 1 - \dfrac{.2096}{3} = .930$

$M = \dfrac{24 \text{ ksi}(.93)(26.5)(18.17)}{12} = 896 \text{ k-ft}$

This could be provided by 7 - #8 @ 8" cts between piles with one #8 between each outer pile and the edge of the ftg.

Shear

$V_{c,\text{allowable}} = 1.1\sqrt{f'_c} = 1.1\sqrt{4000 \text{ psi}} = 69.57 \text{ psi}$ ✓

applied $V = \dfrac{290{,}000\#}{26.5(222)} = 49.29 \text{ psi} < 69.57$ ✓OK (No shear reinforcement required.)

CONTINENTAL BRIDGE™

8301 State Hwy 29 N. • Alexandria, MN 56308

A subsidiary of Dorian Industries Ltd.

Telephone 612-852-7500
Toll Free 800-[redacted]2047
FAX 612-[redacted]7067

November 28, 1994

John Harms
Hanson Engineering
1525 South 6th Street
Springfield, IL 62703

RE: Pedestrian Bridge, ACOE Bike Trail
Red Rock Lake, IA

Dear Mr. Harms:

Continental Bridge is pleased to offer you the following preliminary budget proposal for the above referenced project. This letter will outline the scope of work that we would provide.

1 only — 175' x 10' Continental H-Section Bridge, one diagonal per panel, fabricated from painted steel, 3" x 12" pressure treated wood decking, safety rails with a maximum opening of 6" , steel toe plate, 85 PSF uniform live load, or a 10,000 lb vehicle load, AASHTO design stresses.
F.O.B. Red Rock Lake, IA.....$110,000.00

1 only — 175' x 10' Continental H-Section Bridge, same specifications as above except utilizing galvanized steel form decking to accept 5" light weight concrete deck material placed by others,
F.O.B. Red Rock Lake, IA.....$105,500.00
These prices do not include any applicable taxes, anchor bolts, unloading or erection costs.

Structural design of the bridge will be by a professional engineer registered in the State of Iowa. Structural steel design will be in accordance with the "Manual of Steel Construction: Allowable Stress Design" by the American Institute of Steel Construction" (AISC - 9th Edition.)

Welded tubular structure design shall be in accordance with the Structural Welding Code (ANSI/AWS D1.1-90) - Chapter 10 Tubular Structures.

All fabrications will be produced from ASTM A500 Grade C structural tubing and/or ASTM A36 structural steel shapes and plates.

All structural steel, after fabrication, will be blast cleaned in accordance with Steel Structures Painting Council Surface Painting Council Surface Preparation Specifications No. 6 Commercial Blast Cleaning, SSPC-SP6, latest Edition. The structural steel will then receive primer and finish coats of paint, shop applied.

The primer coat will consist of Carboline 893 RCP, a 2 part cross-linked epoxy primer, as manufactured by the Carboline Company. The top coat will consist of one (1) coat of Carboline 134 aliphatic acrylic polyurethane paint, as manufactured by the Carboline Company, color to b verified by owner. A nominal amount of touch up paint will be provided to repair any marred surfaces due to transport, unloading, and erection.

The bridge(s) will be delivered in four piece(s) each with the decking in place. The approximat lifting weight is 113,000 lbs for the wood deck bridge with decking in place and 110,000 lbs fo the concrete deck bridge without the concrete in place. The concrete deck bridge is based upon 5" light weight concrete decking at 50psf. Delivery is made to a location nearest the site which accessible to over-the-road trucks. You will need equipment to unload the bridge from our trucks and to set it on your abutments.

Terms of sale will be determined after review of bank and trade references. If this project is no bonded for material suppliers, our credit department will require a deposit prior to fabrication with the balance paid C.O.D. or credit approved. For Approved Credit: Terms of sale are 100 Net 30 days. Payment terms contained in this proposal may not be changed without written authorization from Continental Bridge. Acceptance of any proposal from Continental Bridge constitutes acceptance of these payment terms. Unauthorized retention of payments by Purcha for any reason shall be subject to a service charge of 2% per month on any balance due past 3(days from invoice date.

The following will be the responsibility of others:

1. All construction surveying, including field measurement of abutments and anchor bolts.
2. Design, excavation and construction of Bridge foundations.
3. Provide and install all anchor bolts.
4. Unload all trucks delivering Continental Bridge materials.
5. Erection of bridge.
6. Touch up painting of any marred surfaces due to shipping and erection.
7. Provide and install reinforcing and concrete deck material for that option.

We appreciate the opportunity to provide you with this budget proposal. If you have any questions, please feel free to give me a call. We look forward to working with you to the completion of this project.

Sincerely,
CONTINENTAL BRIDGE

Courtney Smith
Bridge Estimator

C:\WP\QUOTES\JASPRXLK.WPD

CONTINENTAL BRIDGE
8301 State Hwy 29 N. • Alexandria, MN 56308
A subsidiary of Dorian Industries Ltd.

Telephone 6[illegible]52-
Toll Free 800-328-
FAX 612-852-

November 18, 1994

Mr. John Harms
Hanson Engineering
1525 S. 6th Street
Springfield, IL

10 ft Concrete Deck

RE: ACOE Bike Trail
Red Rock Lake, IA

Dear Mr. Harms:

Continental Bridge is pleased to offer you the following preliminary budget proposal for the above referenced project. This letter will outline the scope of work that we would provide.

1 only — 100 x 10 Continental H- Section Bridge, one diagonal per panel, fabricated from atmospheric corrosion resistant steel, 3 x 12 pressure treated wood decking, safety rails with a maximum opening of 4", steel toe plate, rub rail, 85 PSF uniform live load, or a 10,000 lb vehicle load.
F.O.B. Red Rock Lake, IA.....$31,500.00

OR

1 only — 100 x 12 Continental H- Section Bridge, one diagonal per panel, fabricated from atmospheric corrosion resistant steel, 3 x 12 pressure treated wood decking, safety rails with a maximum opening of 4", steel toe plate, rub rail, 85 PSF uniform live load, or a 10,000 lb vehicle load.
F.O.B. Red Rock Lake, IA.....$34,900.00
This price does not include any applicable taxes, anchor bolts, unloading or erection costs.

Bridge applications, shall be designed in accordance with the "Manual of Steel Construction: Allowable Stress Design," as adopted by the American Institute of Steel Construction (AISC) - 9th edition. Shop drawing signed by a professional engineer registered in the State of IA.

Welded tubular structure design shall be in accordance with the Structural Welding Code (ANSI/AWS D1.1) - Chapter 10, Tubular Structures.

All fabrications will be produced from high strength, low alloy, atmospheric corrosion resistant ASTM A847 cold-formed welded square and rectangular tubing, and ASTM A588, ASTM A606, or ASTM A242 plate and structural shapes.

All structural steel, after fabrication, will be blast cleaned in accordance with Steel Structures Painting Council Surface Preparation Specifications No. 6 Commercial Blast Cleaning, SSPC-SP6-latest edition.

Field splices shall be fully bolted with ASTM A325 type 3 high strength bolts in accordance with "Specifications for Structural Joints Using ASTM A325 or A490 bolts."

The bridge will be delivered in two piece(s) with the decking in place. The approximate lifting weight of the 10' wide bridge is 34,900 lbs. and 39,000 lbs. for the 12' wide bridge.. Delivery is made to a location nearest the site which is accessible to over-the-road trucks. You will need equipment to unload the bridge and set on the abutments at the time of arrival.

Terms of sale will be determined after review of bank and trade references. If this project is not bonded for material suppliers, our credit department will require a deposit prior to fabrication with the balance paid C.O.D. or credit approved. For Approved Credit: Terms of sale are 100% Net 30 Days. Payment terms contained in this proposal may not be changed without written authorization from Continental Bridge. Acceptance of any proposal from Continental Bridge constitutes acceptance of these payment terms. Unauthorized retention of payments by Purchaser for any reason shall be subject to a service charge of 2% per month on any balance due past 30 days from invoice date.

The following will be the responsibility of others:

1. All construction surveying, including field measurement of abutments and anchor bolts.
2. Design, excavation and construction of Bridge foundations.
3. Provide and install all anchor bolts.
4. Unload all trucks delivering Continental Bridge materials.
5. Erection of the bridge.

We appreciate the opportunity to provide you with this budget proposal. If you have any questions, please feel free to give me a call. We look forward to working with you to the completion of this project.

Sincerely,
CONTINENTAL BRIDGE

Gordy Vipond
Sales Manager

G:\WP\LARSEDLK.WPD

APPENDIX G

DESIGN PROCESS DOCUMENTATION

HANSON ENGINEERS, INCORPORATED

Design Process Documentation
Lake Red Rock
HEI No. 94S2044

October 1, 1994 — Corps of Engineers provides HEI notice to proceed and preliminary trail centerline sketched on mapping by Jerry Dowell, Lake Red Rock Park Manager.

October 17-22, 1994 — Hanson Engineers Incorporated draws tangents and curves for sketched trail design. Minimum radius is 95 ft based on 20 mph design speed. Some minor adjustments made to provide minimum radius. Hanson Engineers develops typical sections 1-3 and identifies areas where to apply each section.

October 19, 1994 — Coordination meeting held at Rock Island with Hanson Engineers, Inc. Typical sections, safety, stationing, and retaining walls were discussed.

October 25, 1994 — HEI submitted a preliminary alignment and profile.

October 25, 1994 — HEI receives the remainder of the mapping.

October 25-27, 1994 — Field check performed by representatives of Hanson Engineers, Rock Island Corps of Engineers, Lake Red Rock Park, Marion County Conservation Service, and Marion County Highway Engineering Department. Changes to alignments are made during field review and typical sections 4-8 are developed and applied. Alignment and section changes included:

(35% Submittal Stationing)

1. From Station 43+00 to Station 54+00, move alignment to follow contours more closely.
2. Station 54+00 to Station 57+00, change circle drive to one-way vehicle traffic. Use outside pavement lane for trail (joint use facility).
3. From Station 57+00 to Station 83+00, propose new alignment around facilities (increase trail benefit) and follow southeast side of access road.
4. From Station 93+00 to Station 98+00 and Station 103+00 to Station 106+00, move

alignment away from CH G-28 to allow for greater horizontal and vertical separation between road and trail. Also follows contours more closely.

5. From Station 106+00 to Station 120+00, adjust alignment to follow contours more closely.
6. From Station 120+00 to Station 127+00, move alignment north to follow contours more closely and avoid private property at Station 126+00.
7. From Station 127+00 to Station 132+00, develop and use Typical Section No. 4 that places trail on natural bench. Provides greater horizontal and vertical separation between road and trail. Also decreases amount of embankment required.
8. From Station 138+00 to Station 145+00, adjust alignment to follow contours more closely.
9. From Station 162+00 to Station 169+00, adjust alignment to follow contours more closely.
10. From Station 175+00 to Station 185+00, adjust alignment to follow contours more closely. Also, places trail on natural bench to provide greater horizontal and vertical separation between road and trail. Also decreases amount of embankment required.
11. Match road elevation at Station 189+10.
12. From Station 198+00 to Station 201+00 and Station 207+00 to Station 212+00, use Typical Section No. 4 that places trail on natural bench to provide greater horizontal and vertical separation between road and trail. Also decreases amount of embankment required.
13. From Station 216+00 to Station 226+00, develop and use Typical Section No. 6 that places trail on backslope of CH G-28. Decrease existing road ditch to 2 ft bottom. Generate borrow in this area.
14. From Station 242+00 to Station 264+00, develop and use Typical Section No. 8 that places trail close to CH G-28 requiring guardrail and fencing. Minimizes embankment required and avoids existing riprap. Pavement and shoulder widths are decreased to minimums allowed by AASHTO, 8 ft and 2 ft, respectively. CH G-28 existing 7 ft shoulder is decreased to 6 ft.

15. From Station 264+00 to Station 281+00, change from Typical Section No. 3 to Typical Section No. 2 to place trail on CH G-28 backslope. Provides greater horizontal and vertical separation between road and trail. Also minimizes earthwork required.
16. From Station 293+00 to Station 308+00, adjust alignment to follow contours more closely.
17. Match road elevation at Station 309+90.
18. From Station 310+00 to Station 320+00, adjust alignment to the south to decrease grades and avoid Karr Cemetery.
19. From Station 332+00 to Station 339+00, use Typical Section No. 4 that places trail on natural bench to provide greater horizontal and vertical separation between road and trail. Also decreases amount of embankment required.
20. From Station 339+00 to Station 370+00, develop and use Typical Section No. 5 which decreases the pavement and shoulder widths to 8 ft and 2 ft, respectively. The trail is located within road right-of-way which is 50 ft from road centerline. A retaining wall is required along the Dutchman's Landing subdivision.
21. From Station 380+00 to Station 384+00, a retaining wall is required to minimize the amount of embankment required.
22. From Station 384+00 to Station 393+00, develop and use Typical Section No. 7 which provides a shallow ditch between the road and trail.
23. From Station 398+00 to Station 405+00, move alignment south to cross access road at a location that provides improved sight distance.
24. From Station 405+00 to Station 414+00, adjust alignment to use trail road for a longer length and decrease grades.
25. From Station 435+00 to Station 501+00, make minor adjustments to follow contours more closely and avoid private properties and large trees.

November 9, 1994 — Hanson Engineers submits 35% documents. Plans include field check adjustments, typical sections 1-8, and

profile meeting 20 mph design speed. This alignment is staked by survey crew.

November 10, 1994 — Frank Monfelli faxed changes to 35% submittal alignment. Changes were from Sta. 435+00 to Sta. 478+00 and were incorporated into field survey.

November 16, 1994 — Rock Island Corps of Engineers submits comments on the 35% submittal. Recommended changes include:

1. Specify limits and type of retaining walls.
2. Add fence to Typical Section No. 8.
3. Start project at Station 41+50 where a parking lot is planned.
4. From Station 41+50 to Station 60+50, adjust alignment to follow contours more closely and lengthen joint use facility.
5. From Station 109+00 to Station 116+00, move alignment to higher ground to decrease grades.
6. From Station 155+00 to Station 159+00, adjust alignment to follow contours more closely.
7. From Station 216+00 to Station 227+00, shift alignment to south to higher ground.
8. Cut hill at Station 235+00.
9. Provide gaps in fence from Station 242+00 to Station 264+00.
10. From Station 325+00 to Station 338+00, adjust alignment to follow contours more closely.
11. From Station 442+00 to Station 462+00, adjust alignment to higher ground and closer to fence line.
12. From Station 467+00 to Station 477+00, adjust alignment to follow contours more closely.
13. From Station 491+00 to 494+00, straighten alignment to maximize boundary limits.

November 28, 1994 — Coordination meeting held at Hanson Engineers with Rock Island Corps of Engineers. Corps recommends 3:1 as maximum slope due to past failures with steeper slopes.

December 5, 1994 — HEI sends letter to Corps recommending a culvert at Sta. 439+00 and a bridge at Sta. 465+00. Letter included cost estimate and plan sketch at each location.

December 6, 1994	HEI sends letter to Corps recommending lowering the trail profile at three locations to minimize embankment and provide greater separation between the county highway and the trial.
December 9, 1994	Field check performed by HEI and the Corps. Minor alignment changes made at archery access road (Sta. 270+00 to Sta. 280+00) and near Wallashuck (Sta. 470+00 to Sta. 480+00). Corps recommends minimum 10 ft trail width. Joint use facility from Station 54+00 to Station 57+00 is abandoned.
December 14, 1994	Coordination meeting held at Rock Island with HEI. Corps recommends alignment change at archery access road and at picnic area (Sta. 66+00).
December 19, 1994	HEI recommends Sta. 58+40 as a possible location for the Marion County covered bridge. Borings are taken at Sta. 58+20 and Sta. 58+60.
December 23, 1994	Hanson Engineers submits 65% documents. Documents include typical sections, plan and profile, and bridge drawings. HEI highlights three areas still under review (profile at Sta. 460+00, plan and profile from Sta. 462+00 to Sta. 470+00, and plan and profile from Sta. 480+00 to Sta. 492+00).
December 23, 1994	HEI sends letter to Corps recommending retaining walls at certain locations. Letter included worksheet with unit costs, quantities, total costs, and recommendation for each location analyzed.
December 29, 1994	Coordination meeting held at Rock Island with HEI. Corps submits comments on 65% submittal. Corps supplies right-of-way information, ditch capacity storm frequency, and four trail segments.
January 10, 1995	HEI submits 90% documents. Documents include typical sections, plan and profile, bridge drawings, and traverse drawing. HEI highlights one area still under review, Station 480+00 to Station 498+05.
January 12, 1995	HEI corrects profile from Station 480+00 to Station 498+00 to account for errors in mapping. There is new alignment near the Archery Road from Station 265+00

	to Station 275+00 to avoid the archery range. There is new alignment from Station 430+00 to Station 450+00 to pull construction limits away from a property line fence.
January 20, 1995	Corps sends written comments on 90% submittal to HEI by fax.
January 24, 1995	HEI receives the Corps' mark-ups on the 90% submittal.
January 31, 1995	HEI submits final plans. HEI submits written response to Corps' 90% submittal comments.
February 9, 1995	Coordination meeting held at Rock Island with HEI. Corps submits comments on final plans.
February 20, 1995	HEI submits corrected final plans.

APPENDIX H

DESIGN CRITERIA DOCUMENTATION

HANSON ENGINEERS, INCORPORATED

Design Criteria Documentation
Lake Red Rock
HEI No. 94S2044

Design Speed:	From Guide for the Development of Bicycle Facilities August 1991 by AASHTO based on minimum recommended 20 mph (pg. 25). For grades greater than 4%, design speed is 30 mph (pg. 27).
Lanes:	Recommended width is 10 ft Minimum width is 8 ft. (AASHTO, pg. 23) Cross slope is 2% (pg. 26)
Shoulders:	Recommended width is 3 ft Minimum width is 2 ft. (AASHTO, pg. 23) Cross slope is 8% (FDM, Segment III)
Earth Slopes & Ditches:	Maximum slope is 3:1 (Nic Davilla, Corps of Engineers) Minimum ditch depth is 1 ft (FDM Segment III)
Grades:	Maximum grade is 5% Maximum length of 5% grade is 500 ft (AASHTO, pg. 27)
Vertical Alignment:	Sag curves (Corps of Engineers) Crest Curves (AASHTO, pgs. 28-29)
Horizontal Alignment:	Minimum radius for 20 mph is 95 ft Minimum radius for 30 mph is 250 ft (AASTHO, pg. 26)
Vertical Clear Zone:	10 ft (Tim Hess, Corps of Engineers)
Horizontal Clear Zone:	10 ft (FDM, Segment III)
Superelevation:	2% (min.) - 4% (max.) (AASTHO, pg. 26 HEI/Corps)
Roadway Barriers:	4.5 ft height (min.) (AASHTO, pg. 24)
Bridge Width:	10 ft (min.) (AASHTO, pg. 33 - FDM, Segment III)
Drainage, Culverts:	18 in. pipe (min.) (Corps of Engineers)

APPENDIX I

QUANTITIES

HANSON ENGINEERS, INCORPORATED

Lake Red Rock Multipurpose Trail - Segment IV
Marion County, Iowa
Contract No DACW25-93-D-0011 0004
HEI #94s2044

02-Mar-95

SECTION - 4B

Station 43+92 to Station 189+60

ITEM	UNIT	QUANTITY
Bit. Conc. Pav't	Tons	2719
Aggregate Base Course	Tons	5530
Prime Coat	Gal	6070
6' Shoulder	S.Y.	316
6' Shoulder	S.Y.	133
Stabilize 6' CH Shoulder	S.Y.	449
Clearing	Acres	11.7
Seeding	Acres	8.3
Culverts	L.F.	
New Culvert - 18" Dia.	L.F.	25
New Culvert - 18" Dia.	L.F.	45
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	48
New Culvert - 18" Dia.	L.F.	43
New Culvert - 18" Dia.	L.F.	37
New Culvert - 18" Dia.	L.F.	39
New Culvert - 18" Dia.	L.F.	53
New Culvert - 18" Dia.	L.F.	42
New Culvert - 18" Dia.	L.F.	39
New Culvert - 18" Dia.	L.F.	33
New Culvert - 18" Dia.	L.F.	41
Total - (NEW) 18" Dia.	L.F.	595
New Culvert - 24" Dia.	L.F.	64
New Culvert - 24" Dia.	L.F.	81
New Culvert - 24" Dia.	L.F.	68
New Culvert - 24" Dia.	L.F.	69
New Culvert - 24" Dia.	L.F.	34
New Culvert - 24" Dia.	L.F.	55
New Culvert - 24" Dia.	L.F.	60
New Culvert - 24" Dia.	L.F.	36
New Culvert - 24" Dia.	L.F.	46
Total - (NEW) 24" Dia.	L.F.	513
New Culvert - 30" Dia.	L.F.	64
New Culvert - 30" Dia.	L.F.	41
New Culvert - 30" Dia.	L.F.	84
Total - (NEW) 30" Dia.	L.F.	189
New Culvert - 36" Dia.	L.F.	42
New Culvert - 36" Dia.	L.F.	126
New Culvert - 36" Dia.	L.F.	40
Total - (NEW) 36" Dia.	L.F.	208
New Culvert - 48" Dia.	L.F.	87
Ext. Culvert - 18" Dia.	L.F.	38
Ext. Culvert - 36" Dia.	L.F.	90
Ext. Culvert - 48" Dia.	L.F.	80

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SECTION - 4B

Station 43+92 to Station 189+60

ITEM	UNIT	QUANTITY
Ext. Culvert - 48" Dia.	L.F.	10
Total(EXT) - 48" Dia.	L.F.	90
Headwalls	Each	68
Culvert riprap	Tons	367
6" Bedding (CA-6)	S.Y.	544
Barricades	Each	4
Earth Exc.	C.Y.	27386
Borrow Exc.	C.Y.	31421
Ditch Erosion Protection	S.Y.	6466
Bridge (Foundation)	L.S.	1
French Drains	L.F.	474
French Drains	L.F.	200
French Drains (Total)	L.F.	674
Earth Exc for French Drains	C.Y.	70
Earth Exc for French Drains	C.Y.	30
Total Earth Exc for French Drains	C.Y.	100
Granular material for French Drains	Tons	142
Granular material for French Drains	Tons	60
Total Granular material for French Drains	Tons	202
6" Underdrains for French Drains	L.F.	210
6" Underdrains for French Drains	L.F.	100
6" Underdrains for French Drains (Total)	L.F.	310
Erosion Protection Slope	S.Y.	1354
Erosion Protection Slope	S.Y.	2093
Erosion Protection Slope (Total)	S.Y.	3447

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SECTION - Add 2

Station 189+60 to Station 236+00

ITEM	UNIT	QUANTITY
Bit. Conc. Pav't	Tons	866
Aggregate Base Course	Tons	1761
Prime Coat	Gal	1933
Fence	L.F.	276
Fence	L.F.	600
Fence	L.F.	247
Total Fence	L.F.	1123
Ret. Wall	S.F.	3600
Ret. Wall	S.F.	1380
Ret. Wall	S.F.	1482
Ret. Wall (Total)	S.F.	6462
Ret. Wall riprap (Total)	Tons	104
Granular Backfill for Retaining Wall	C.Y.	600
"	C.Y.	192
"	C.Y.	247
Total Granular Backfill for Retaining Wall	C.Y.	1039
6' Shoulder	S.Y.	133
6' Shoulder	S.Y.	146
Stabilize 6' CH Shoulder	S.Y.	279
Clearing	Acres	6.9
Seeding	Acres	5.8
Culverts	L.F.	
New Culvert - 18" Dia.	L.F.	51
New Culvert - 18" Dia.	L.F.	46
New Culvert - 18" Dia.	L.F.	48
Total - (NEW) 18" Dia.	L.F.	145
New Culvert - 24" Dia.	L.F.	33
New Culvert - 24" Dia.	L.F.	40
New Culvert - 24" Dia.	L.F.	109
New Culvert - 24" Dia.	L.F.	79
New Culvert - 24" Dia.	L.F.	72
New Culvert - 24" Dia.	L.F.	50
New Culvert - 24" Dia.	L.F.	61
Total - (NEW) 24" Dia.	L.F.	444
New Culvert - 30" Dia.	L.F.	50
New Culvert - 36" Dia.	L.F.	75
Ext. Culvert - 30" Dia.	L.F.	70
Headwalls	Each	25
Culvert riprap	Tons	135
6" Bedding (CA-6)	S.Y.	491
Barricades	Each	2
Earth Exc.	C.Y.	6010
Borrow Exc.	C.Y.	16218
Ditch Erosion Protection	S.Y.	333
French Drains	L.F.	200
French Drains	L.F.	219

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SECTION - Add 2

Station 189+60 to Station 236+00

ITEM	UNIT	QUANTITY
French Drains (Total)	L.F.	419
Earth Exc for French Drains	C.Y.	30
Earth Exc for French Drains	C.Y.	32
Total Earth Exc for Frencn Drains	C.Y.	62
Granular material for French Drains	Tons	60
Granular material for French Drains	Tons	66
Total Granular material for French Drains	Tons	126
6" Underdrains for French Drains	L.F.	100
6" Underdrains for French Drains	L.F.	108
6" Underdrains for French Drains (Total)	L.F.	208
Erosion Protection Slope	S.Y.	1467
Erosion Protection Slope	S.Y.	1260
Erosion Protection Slope (Total)	S.Y.	2727

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SECTION - Add 1

Station 236+00 to Station 309+79

ITEM	UNIT	QUANTITY
Bit. Conc. Pav't	Tons	1377
Aggregate Base Course	Tons	2801
Prime Coat	Gal	3075
Fence	L.F.	2600
Fence	L.F.	834
Fence	L.F.	2600
Total Fence	L.F.	6034
Guardrail	L.F.	2600
Ret. Wall	S.F.	7800
Ret. Wall	S.F.	7089
Ret. Wall (Total)	S.F.	14889
Ret. Wall riprap	Tons	975
Ret. Wall riprap	Tons	313
Ret. Wall riprap (Total)	Tons	1288
Granular Backfill for Retaining Wall	C.Y.	650
"	C.Y.	1674
Total Granular Backfill for Retaining Wall	C.Y.	2324
Stabilize 6' CH Shoulder	S.Y.	2600
Clearing	Acres	12.4
Seeding	Acres	10.7
Culverts	L.F.	
New Culvert - 18" Dia.	L.F.	36
New Culvert - 18" Dia.	L.F.	37
Total - (NEW) 18" Dia.	L.F.	73
New Culvert - 24" Dia.	L.F.	63
New Culvert - 24" Dia.	L.F.	76
New Culvert - 24" Dia.	L.F.	119
New Culvert - 24" Dia.	L.F.	66
Total - (NEW) 24" Dia.	L.F.	324
Headwalls	Each	12
Culvert riprap	Tons	65
6" Bedding (CA-6)	S.Y.	2004
Barricades	Each	3
Earth Exc.	C.Y.	3998
Borrow Exc.	C.Y.	10248
Ditch Erosion Protection	S.Y.	667
French Drains (Total)	L.F.	2512
Total Earth Exc for French Drains	C.Y.	372
Total Granular material for French Drains	Tons	754
6" Underdrains for French Drains (Total)	L.F.	1025
Erosion Protection Slope (Total)	S.Y.	1479

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SECTION - Add 1

Station 236+00 to Station 309+79

ITEM	UNIT	QUANTITY
Bit. Conc. Pav't	Tons	1377
Aggregate Base Course	Tons	2801
Prime Coat	Gal	3075
Fence	L.F.	2600
Fence	L.F.	834
Fence	L.F.	2600
Total Fence	L.F.	6034
Guardrail	L.F.	2600
Ret. Wall	S.F.	7800
Ret. Wall	S.F.	7089
Ret. Wall (Total)	S.F.	14889
Ret. Wall riprap	Tons	975
Ret. Wall riprap	Tons	313
Ret. Wall riprap (Total)	Tons	1288
Granular Backfill for Retaining Wall	C.Y.	650
"	C.Y.	1674
Total Granular Backfill for Retaining Wall	C.Y.	2324
Stabilize 6' CH Shoulder	S.Y.	2600
Clearing	Acres	12.4
Seeding	Acres	10.7
Culverts	L.F.	
New Culvert - 18" Dia.	L.F.	36
New Culvert - 18" Dia.	L.F.	37
Total - (NEW) 18" Dia.	L.F.	73
New Culvert - 24" Dia.	L.F.	63
New Culvert - 24" Dia.	L.F.	76
New Culvert - 24" Dia.	L.F.	119
New Culvert - 24" Dia.	L.F.	66
Total - (NEW) 24" Dia.	L.F.	324
Headwalls	Each	12
Culvert riprap	Tons	65
6" Bedding (CA-6)	S.Y.	2004
Barricades	Each	3
Earth Exc.	C.Y.	3998
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SECTION - 4A

Station 309+79 to Station 498+28

ITEM	UNIT	QUANTITY
Bit. Conc. Pav't	Tons	3136
P.C.C. Pav't	S.Y.	2278
Aggregate Base Course	Tons	6377
Prime Coat	Gal	7000
Fence	L.F.	400
Fence	L.F.	520
Fence	L.F.	1451
Total Fence	L.F.	2371
Ret. Wall	S.F.	3600
Ret. Wall	S.F.	5200
Ret. Wall	S.F.	10883
Ret. Wall (Total)	S.F.	19683
Ret. Wall riprap	Tons	150
Ret. Wall riprap	Tons	544
Ret. Wall riprap (Total)	Tons	694
Granular Backfill for Retaining Wall	C.Y.	900
"	C.Y.	1444
"	C.Y.	2267
Total Granular Backfill for Retaining Wall	C.Y.	4612
Stabilize 6' CH Shoulder	S.Y.	409
Clearing	Acres	22.1
Seeding	Acres	17.8
Culverts	L.F.	-
New Culvert - 18" Dia.	L.F.	39
New Culvert - 18" Dia.	L.F.	45
New Culvert - 18" Dia.	L.F.	31
New Culvert - 18" Dia.	L.F.	58
New Culvert - 18" Dia.	L.F.	43
New Culvert - 18" Dia.	L.F.	46
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	30
New Culvert - 18" Dia.	L.F.	54
New Culvert - 18" Dia.	L.F.	55
New Culvert - 18" Dia.	L.F.	52

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SECTION - 4A

Station 309+79 to Station 498+28

ITEM	UNIT	QUANTITY
New Culvert - 18" Dia.	L.F.	54
Total - (NEW) 18" Dia.	L.F.	897
New Culvert - 24" Dia.	L.F.	64
New Culvert - 24" Dia.	L.F.	59
New Culvert - 24" Dia.	L.F.	76
New Culvert - 24" Dia.	L.F.	121
New Culvert - 24" Dia.	L.F.	104
New Culvert - 24" Dia.	L.F.	82
New Culvert - 24" Dia.	L.F.	37
New Culvert - 24" Dia.	L.F.	41
New Culvert - 24" Dia.	L.F.	41
New Culvert - 24" Dia.	L.F.	82
New Culvert - 24" Dia.	L.F.	76
Total - (NEW) 24" Dia.	L.F.	783
New Culvert - 30" Dia.	L.F.	49
New Culvert - 30" Dia.	L.F.	18
New Culvert - 30" Dia.	L.F.	40
Total - (NEW) 30" Dia.	L.F.	107
New Culvert - 36" Dia.	L.F.	54
New Culvert - 36" Dia.	L.F.	88
New Culvert - 36" Dia.	L.F.	185
New Culvert - 36" Dia.	L.F.	59
Total - (NEW) 36" Dia.	L.F.	386
Ext. Culvert - 24" Dia.	L.F.	65
Headwalls	Each	85
Culvert riprap	Tons	459
6" Bedding (CA-6)	S.Y.	1708
Barricades	Each	8
Earth Exc.	C.Y.	48679
Borrow Exc.	C.Y.	67924
Bridge	L.S.	1
Sheet Piling	S.F.	2262
Concrete facing on sheet piling	S.F.	1655
Ditch Erosion Protection	S.Y.	10000
French Drains	L.F.	1654
French Drains	L.F.	613
French Drains (Total)	L.F.	2267
Earth Exc for French Drains	C.Y.	245
Earth Exc for French Drains	C.Y.	91
Total Earth Exc for French Drains	C.Y.	336
Granular material for French Drains	Tons	496
Granular material for French Drains	Tons	184
Total Granular material for French Drains	Tons	680

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SECTION - Alt #2

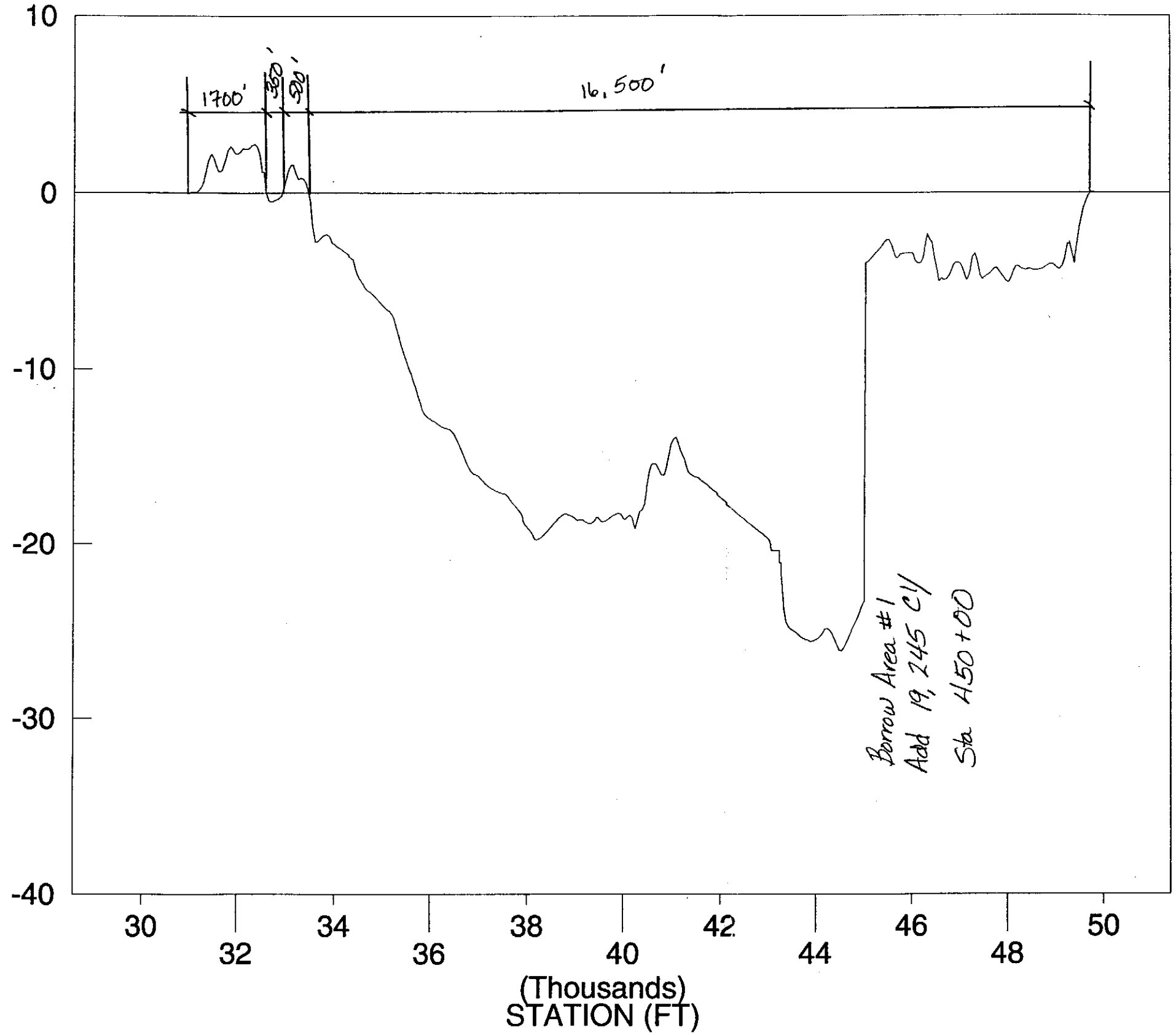
Station 378+89 to Station 394+27

ITEM	UNIT	QUANTITY
Bit. Conc. Pav't	Tons	287
Aggregate Base Course	Tons	584
Prime Coat	Gal	641
Total Fence	L.F.	231
Ret. Wall (Total)	S.F.	2310
Ret. Wall riprap (Total)	Tons	87
Total Granular Backfill for Retaining Wall	C.Y.	642
Clearing	Acres	2.4
Seeding	Acres	2.0
New Culvert - 24" Dia.	L.F.	58
New Culvert - 24" Dia.	L.F.	79
New Culvert - 24" Dia.	L.F.	124
New Culvert - 24" Dia.	L.F.	88
(Total) New Culvert - 24" Dia.	L.F.	349
Headwalls	Each	8
Culvert riprap	Tons	22
6" Bedding (CA-6)	S.Y.	160
Barricades	Each	2
Earth Exc.	C.Y.	232
Borrow Exc.	C.Y.	850
Ditch Erosion Protection	S.Y.	333

APPENDIX J

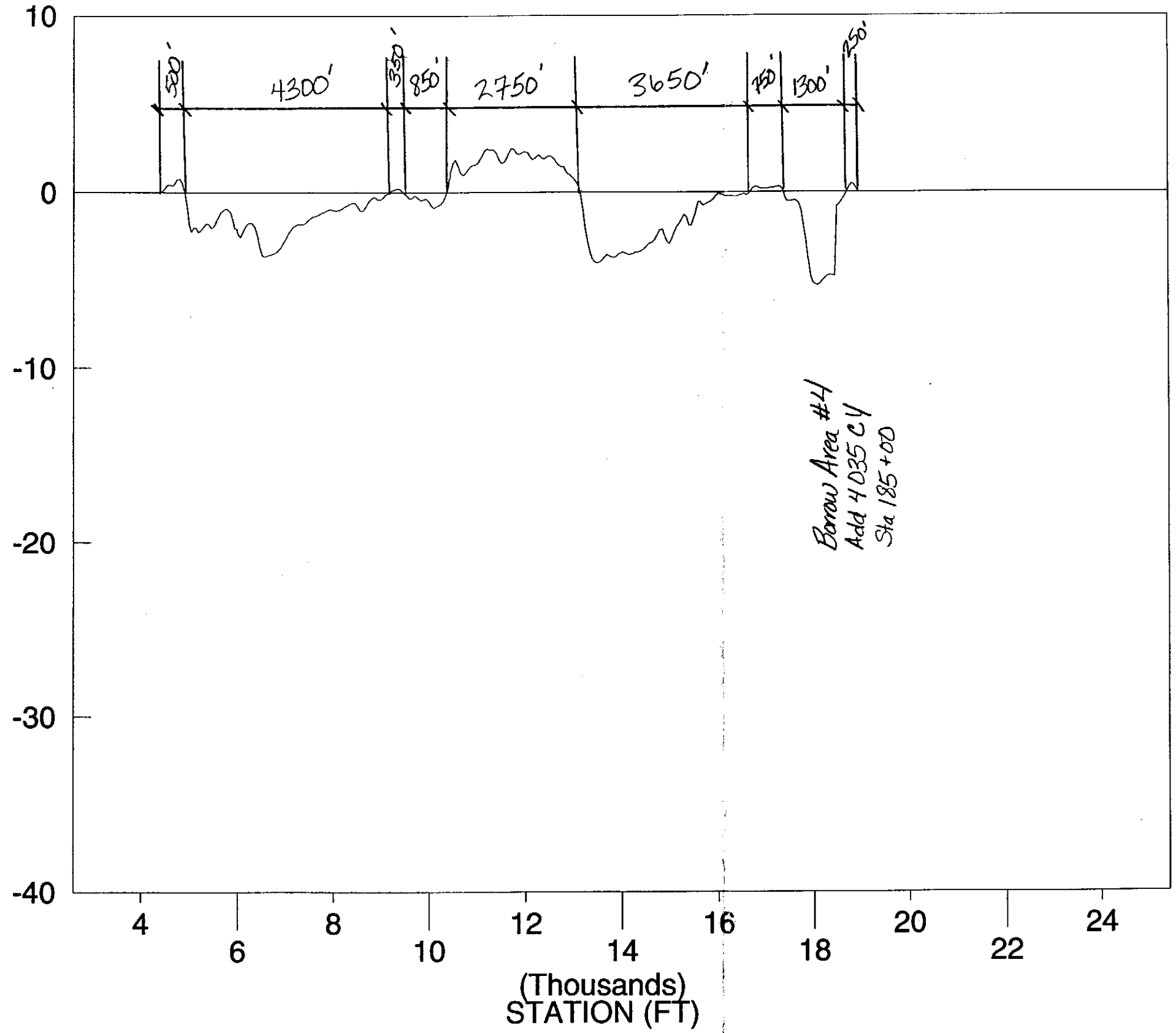
MASS DIAGRAM

HANSON ENGINEERS, INCORPORATED



SEGMENT 4A

2/15/95



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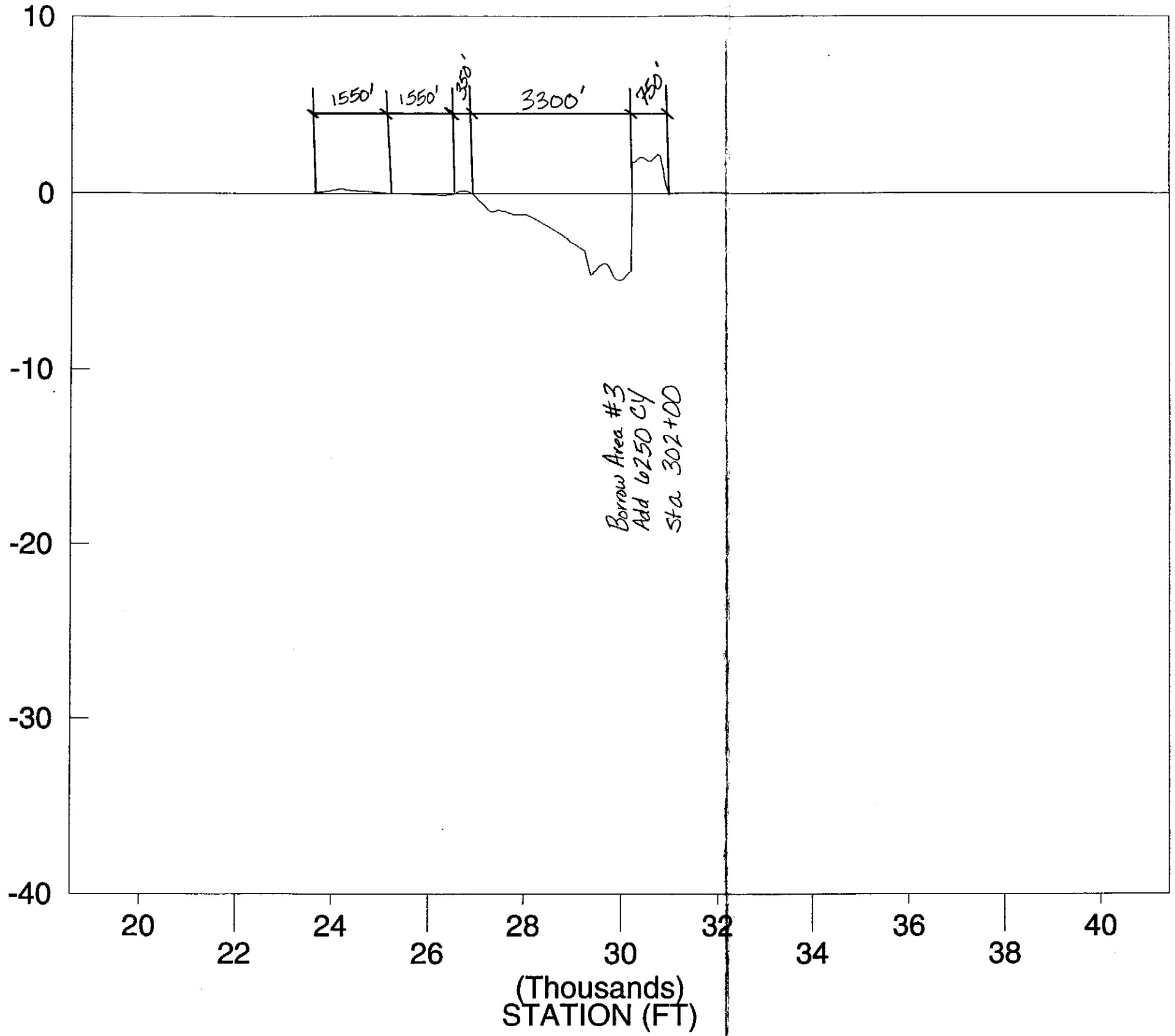
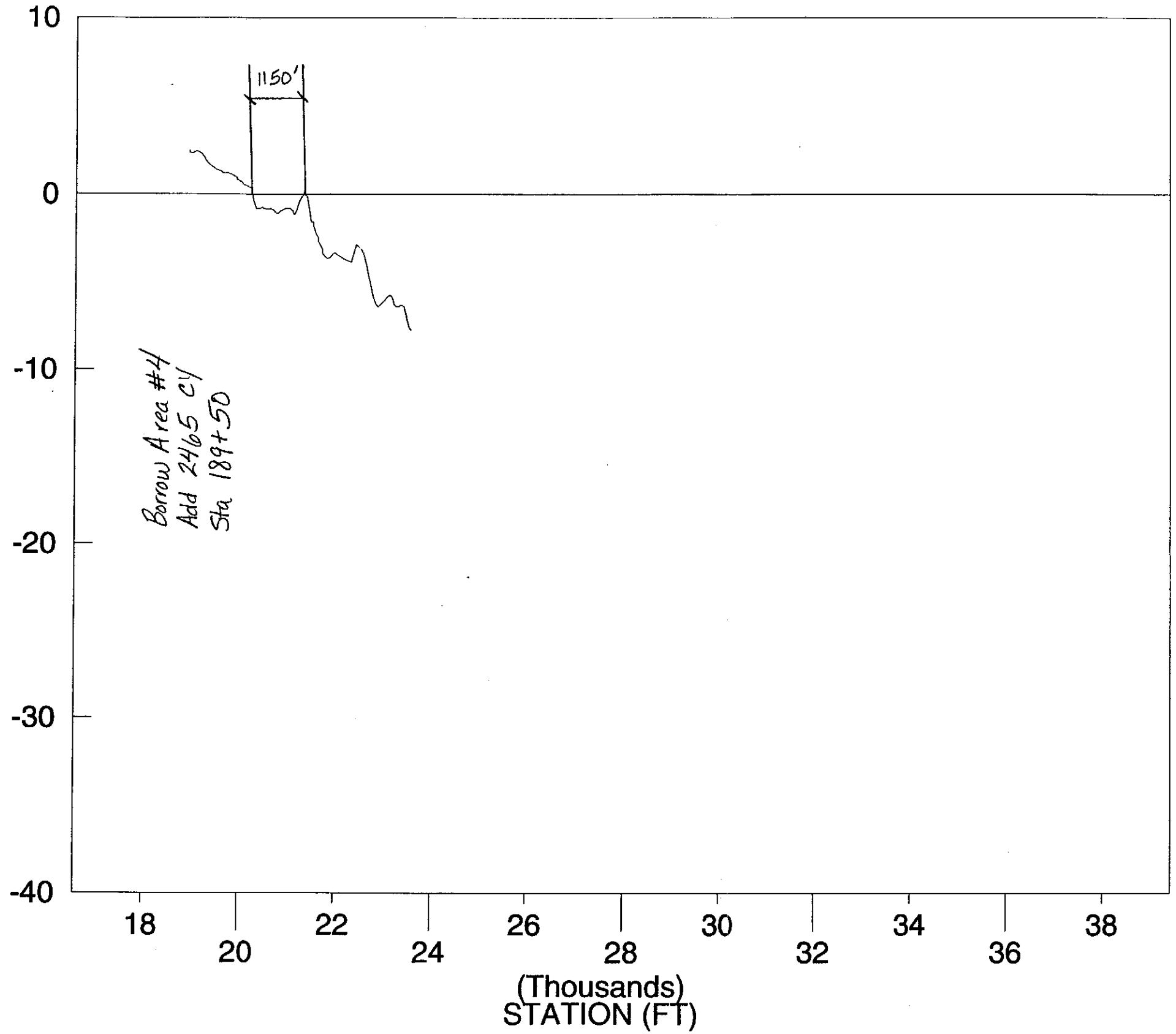
2/15/95



SEGMENT ADD1

2/15/95



SEGMENT ADD2

2/15/95