Structural Development Study No. 10

Ranney Water System Versus Intake Structure

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Ranney Water System Versus Intake Structure

1.0 Introduction

The purpose of this study is to evaluate two types of water supply systems which could be used for the project. One type is a surface (raw) water intake system, and the second type is a Ranney Collector well (ground) water system. This system could be either radial collectors or Infiltration Galleries, see Appendix I. Fluor has completed a construction cost estimate for a surface (raw) water intake system. A similar estimate is provided by the Ranney Company for their systems.

2.0 Summary

It is determined that the Ranney collector well (ground) water system is the most economical system for the project. This conclusion holds for a required flow rate of either 19,000 or 11,000 gallons per minute (gpm).

3.0 Design Basis

A comparison is made between the two water supply systems and their respective treatment processes necessary for supplying boiler feedwater makeup to the steam plant. See Figures A or B for respective treatment of raw water from an intake structure or ground water from a Ranney Well. See appendix III for water analysis reports.

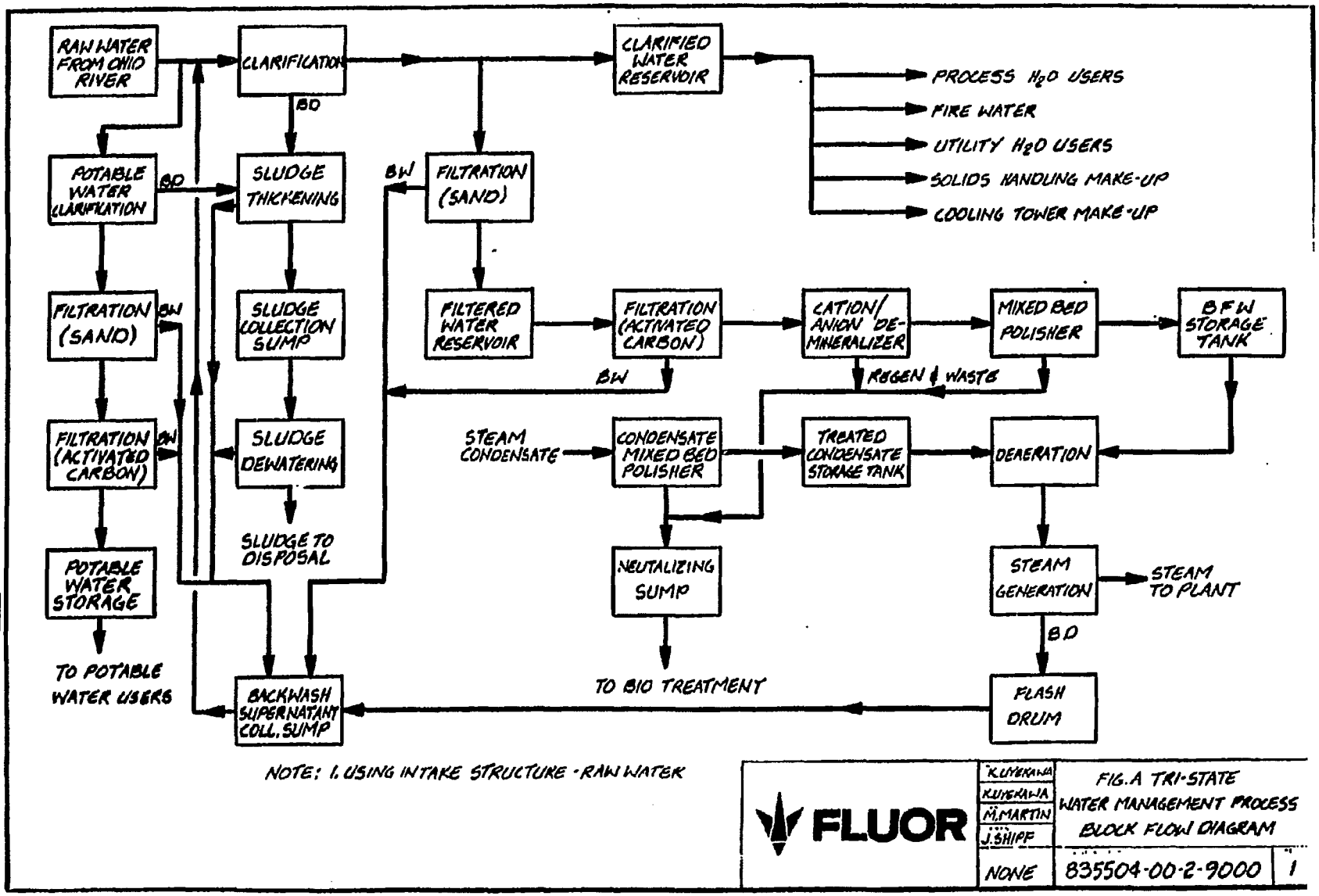
The primary differences between the two treatment processes is in the clarification and demineralization treatment requirements. Raw water requires clarification due to a high suspended solids content, ground water does not require clarification. Raw water requires less demineralization treatment than ground water due to higher dissolved solids content in ground water. For additional information, see appendix II.

4.0 Cost Estimate

A cost comparison between a surface (raw) water intake system and a Ranney collector well (ground) water system is presented in Tables 1 and 2 for two water flowrate requirements. These cost estimates do not include units common to both treatment processes unless there is a difference in sizes. Table 3 lists the units included in each process treatment and Table 4 summarizies those units that are included.

5.0 Recommendation

It is determined that the estimated cost of the Ranney collector well (ground) water system and process treatment is $55.3 MM for a required flowrate of 19 M gpm; within the limitation defined in the cost estimate above. Similary the estimated cost of an alternate surface (raw) water intake system is $69.9 MM. For a required flowrate of 11 M gpm the respective estimated cost are $35.4 MM and $45.6 MM. On the basis of relative cost Fluor recommends the use of the Ranney collector well (ground) water system for this project.

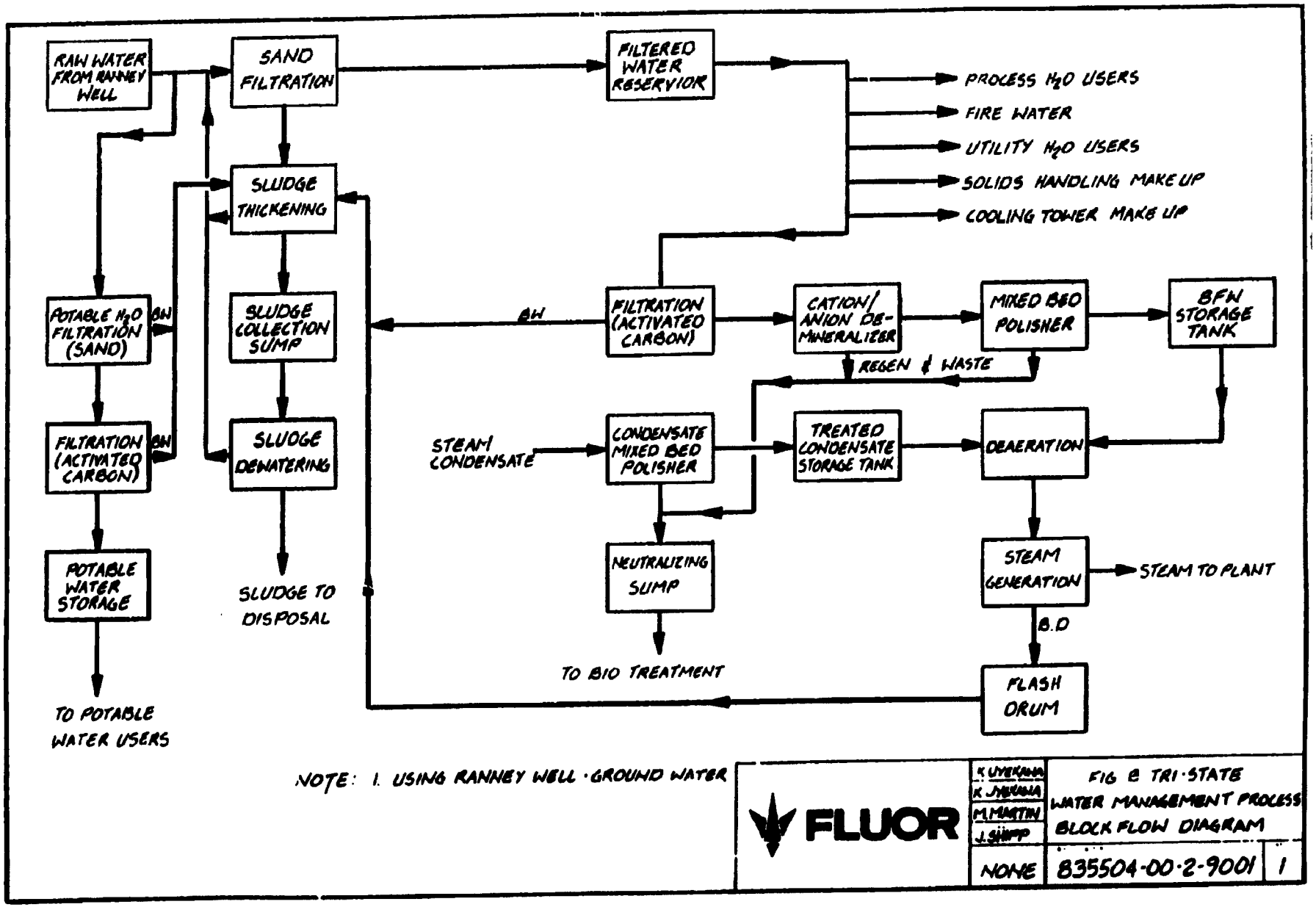


NOTE: 1. USING INTAKE STRUCTURE - RAW WATER

USE OR DISCLOSURE OF PROPRIETARY DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

FLUOR

K.UYEKAWA	FIG. A TRI-STATE WATER MANAGEMENT PROCESS BLOCK FLOW DIAGRAM
K.UYEKAWA	
M.MARTIN	
J.SHIPP	
NONE	835504-00-2-9000 | 1



NOTE: 1. USING RANNEY WELL - GROUND WATER

FLUOR

K UYEKAWA K JHAVERI M. MARTIN J. SIMP	FIG 8 TRI-STATE WATER MANAGEMENT PROCESS BLOCK FLOW DIAGRAM	
NONE	835504-00-2-9001	1

TABLE 1
EVALUATED COST ESTIMATE: SURFACE (RAW) WATER INTAKE SYSTEM

UNIT	FLOWRATE = 19000 GPM					FLOWRATE = 11,000 GPM				
	EQUIPMENT COST, $	LABOR COST, $	POWER COST, $	CHEMICAL COST, $	TOTAL $	EQUIPMENT COST, $	LABOR COST, $	POWER COST, $	CHEMICAL COST, $	TOTAL $
SURFACE H_2O INTAKE STRUCTURE	—	—	—	—	2,640,000	—	—	—	—	2,640,00
POTABLE H_2O CLARIFIER	51,340	34,200	—	—		21,200	14,100	—	—	
RAW WATER CLARIFIER	2,400,000	1,600,000	460,000	181,820		1,515,500	1,010,300	381,920	104,900	
CLARIFIED WATER RBS	7,247,500	9,644,300	89,600	—		4,945,600	6,581,100	48,100	—	
SAND FILTER	377,600	251,700	24,200	—		230,400	158,900	11,440	—	
FILTERED WATER RESERVOIR	3,336,700	4,466,700	474,760	—		2,060,400	2,741,700	267,960	—	
BACKWASH SUPERNATANT COLLECTION SUMP	150,000	100,000	3,520	—		150,000	100,000	8,800	—	
BFW TREATMENT [1]	—	—	—	93,420		—	—	—	54,090	
TOTAL, $	13,583,140	16,096,900	1,246,080	275,240		8,931,100	10,606,100	718,520	158,990	
TOTAL DIRECT FIELD COST (DFC)	29,680,040					19,537,200				
TOTAL PROJECT COST (PC) = 1.94 (DFC)	57,579,278					37,902,168				
TOTAL ANNUAL COST (AC)			1,521,320					877,510		
EVALUATED ANNUAL COST (EAC) = 5.77 (AC)			8,778,016					5,063,233		
TOTAL COST = PC + EAC + INTAKE					68,961,294					45,605,401

NOTE: 1. BOILER FEEDWATER TREATMENT UNITS HAVE NOT BEEN INCLUDED IN COST SUMMARIES FOR EQUIPMENT, LABOR OR POWER BECAUSE THEY WILL BE EQUIVALENT FOR BOTH THE SURFACE (RAW) WATER INTAKE SYSTEM AND THE RANNEY WELL (GROUND) WATER SYSTEM.

FLUOR

KUMEKAWA	TRI-STATE COST ESTIMATE TABLE 1
KUMEKAWA	
M. MARTIN	
J. SHIPP	
NONE	835504-00-2-9002 1

TABLE 2

EVALUATED COST ESTIMATE: RANNEY COLLECTOR WELL (GROUND) WATER SYSTEM

UNIT	FLOWRATE: 19,000 GPM EQUIPMENT COST $	LABOR COST $	POWER COST $	CHEMICAL COST $	TOTAL $	EQUIPMENT COST $	LABOR COST $	POWER COST $	CHEMICAL COST $	TOTAL $
RANNEY WELL STRUCTURE					7,830,000					4,698,00
SAND FILTER	1,132,800	755,200	660,000	114,830		718,900	476,900	381,920	66,250	
FILTERED H_2O RESERVOIR	7,267,500	9,644,300	972,520			4,945,600	6,681,100	512,160		
BFW TREATMENT [1]				157,200					91,030	
TOTALS, $	8,380,900	10,399,500	1,632,520	272,030		5,660,900	7,058,000	894,080	157,280	
TOTAL DIRECT FIELD COST (DFC)	18,779,800					12,718,900				
TOTAL PROJECT COST (PC) = 1.94 (DFC)	36,432,812					24,674,666				
TOTAL ANNUAL COST (AC)			1,904,550					1,051,960		
EVALVATED ANNUAL COST (EAC) = 5.71 (AC)			10,989,254					6,006,347		
TOTAL COST = PC + EAC + WELL					55,292,066					35,139,01

NOTE: 1. BOILER FEEDWATER TREATMENT UNITS HAVE NOT BEEN INCLUDED IN COST SUMMARIES FOR EQUIPMENT, LABOR OR POWER BECAUSE THEY WILL BE EQUIVALENT FOR BOTH THE SURFACE (RAW) WATER INTAKE SYSTEM AND THE RANNEY

FLUOR

CONTRACT NUMBER	NONE
TRI-STATE COST ESTIMATE TABLE 2	
6955O4-00-E-9002	1

Table 3

Units Lists: Raw Water Intake Versus Ground Water System

Units	Ground Water System	Raw Water Intake
Raw water potable H_2O clarifier		X
Sand Filter (Potable)	X	X
A.C. Filter (Potable)	X	X
Potable H_2O Storage	X	X
Raw Water Clarifier		X
Sand Filter	X	X *
Sludge Thickener	X	X
Sludge Collection Sump	X	X
Sludge Dewatering	X	X
Backwash Supernatant Collection Sump		
Clarified H_2O Revservior		X
Filtered H_2O Reservior	X	X *
A.C. Filter	X	X
Demineralizer	X	X
Mixed Bed Polisher	X	X
BFW Storage Tank	X	X
Condensate Mixed Bed Polisher	X	X
Treated Condensate Storage Tank	X	X
Neutralizing Sump	X	X
Steam Generator	X	X

*Unit sizes differ between the two systems

Table 4

Units Included In Cost Estimate

Cost estimate for:

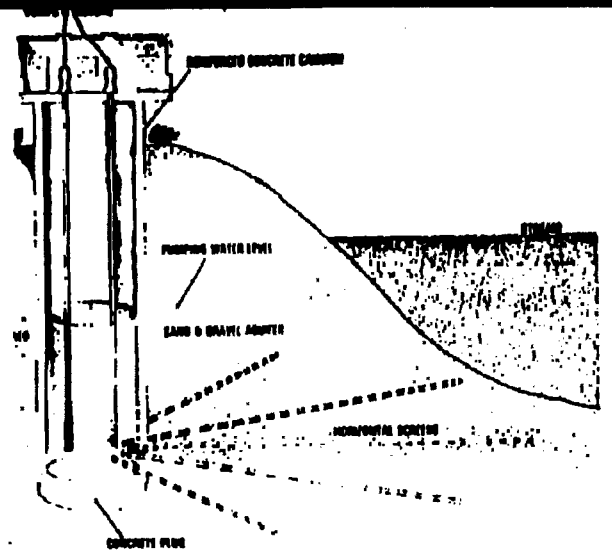
- Ranney Well
- Intake Structure
- Raw Water Clarifier
- Sand Filter (Diff. Sizes)
- Back Wash Supernatant Collection Sump
- Clarified Water Reservior
- Filtered Water Reservior
- Potable Water Clarifier
- BFW Treatment

Cost estimates for units is provided for two flowrates:

- 19,000 GPM - Raw Water Required
- 11,000 GPM - Raw Water Required

APPENDIX I

Water Supply Systems



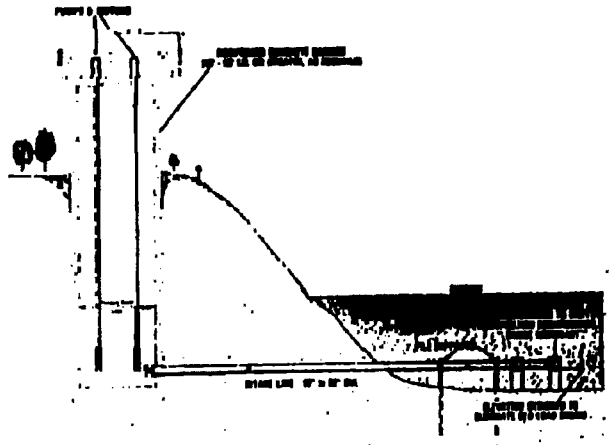
RANNEY

Radial Collectors

Proven by hundreds of installations around the world, the Ranney Radial Collector is the outstanding engineering development of modern day ground water acquisition. Horizontal screens radiate from the central caisson collecting water from the surrounding strata, utilizing either induced infiltration or ground water storage as the source of supply. Yields from existing installations range from 700 gpm to 20,000 gpm, depending upon the aquifer characteristics.

A single unit exceeds the yield of several conventional vertical wells. This improves pumping efficiency and requires less maintenance, pumping equipment, pipeline and overall land acquisition. Ranney's methods of construction and flexibility of design have made this type of installation superior in all environmental applications.

Ranney Collectors develop a supply of water from a given site, of a quality and quantity often not economically obtainable by conventional methods.



RANNEY

Raw Water Intakes

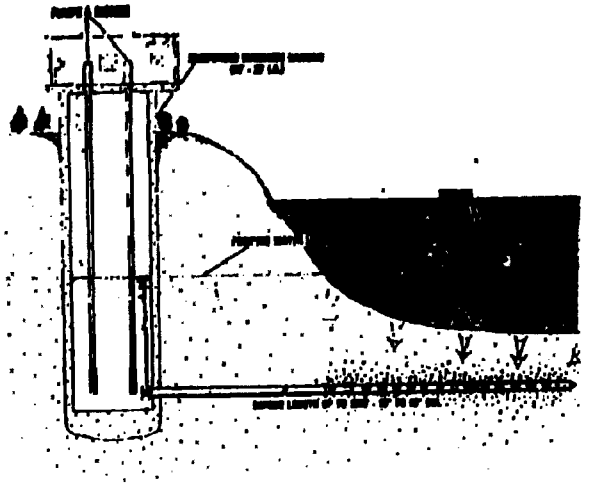
The Ranney Raw Water Intake features an onshore pumping station, utilizing Ranney's proven caisson design. The onshore caisson is gravity-fed through one or more intake lines which are supplied by one or more intake screens located in the surface water source. Except for the pumping facility, this complete intake system has NO MOVING PARTS.

The intake screens can be equipped with an air or water backwash system, if necessary, and the screens can be easily replaced. Therefore the amount of required maintenance to a Ranney unit is negligible.

The Environmental Protection Agency in its "Development document for best technology available for the location, design, construction and capacity of cooling water intake structures for minimizing adverse environmental impact", dated April, 1976, page 77, describes this type of "fixed-screen intake" as follows:

"In this manner large quantities of water may be handled at what may be substantially less cost and greater fish protection effectiveness than presently used conventional screens".

Intake capacities vary from a few hundred gallons per minute to hundreds of thousands of gallons per minute. This intake offers low capital cost, low operating cost, maximum dependability and security, ease and convenience of operation, as well as being environmentally sound.



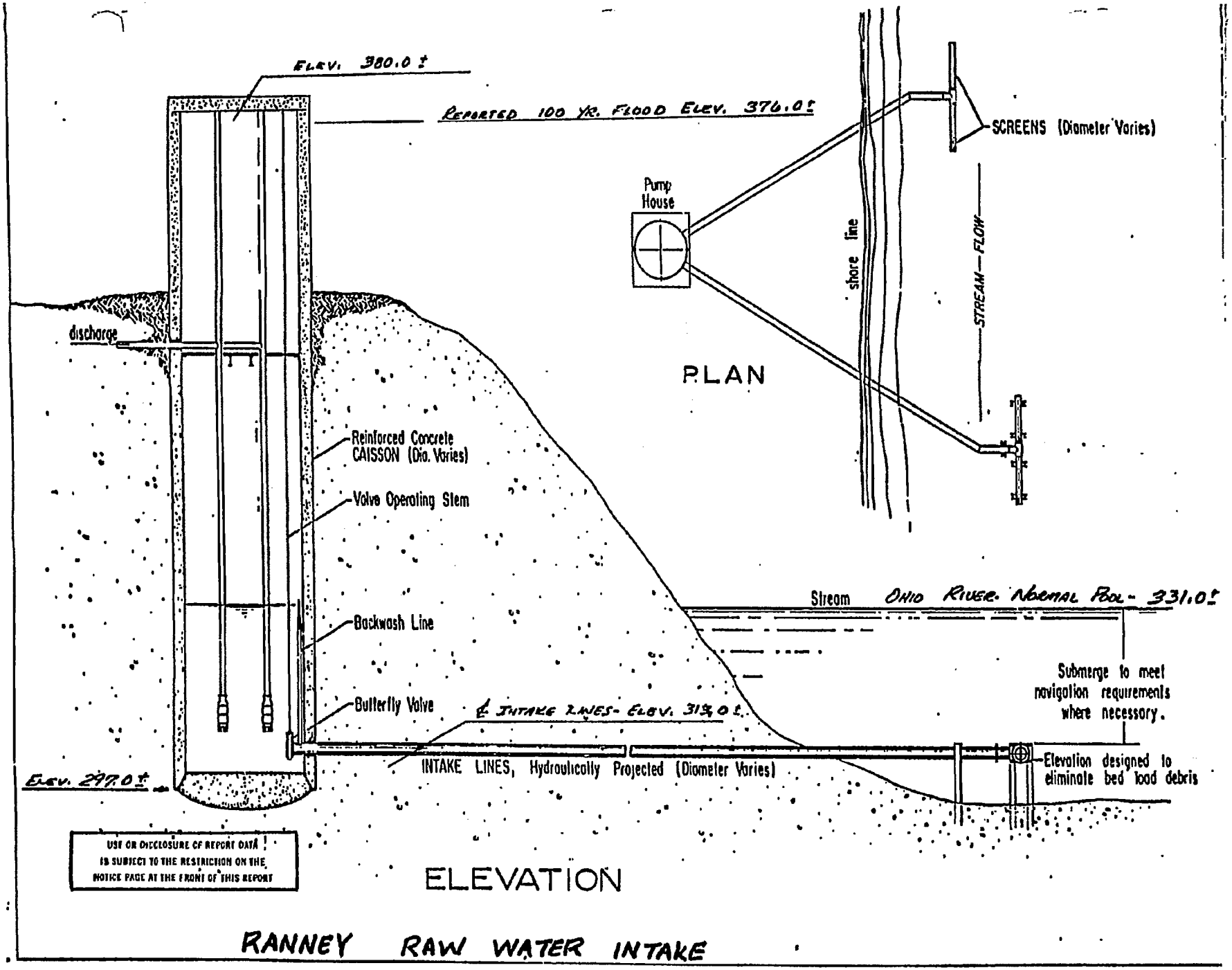
RANNEY

Infiltration Galleries

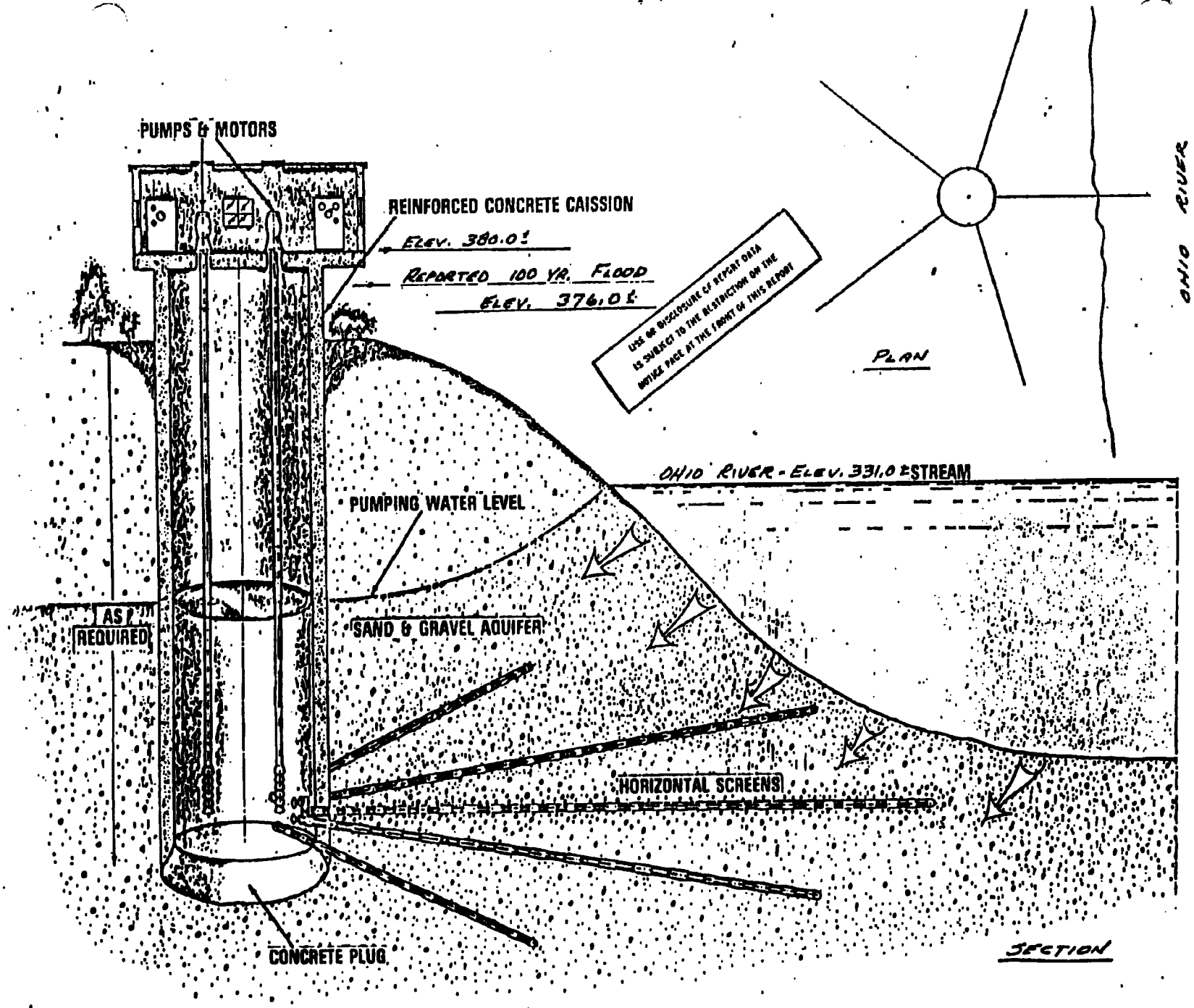
Where ground water and surface water sources are not feasible due to quality or quantity limitations, Ranney Infiltration Galleries have proven most effective.

These infiltration galleries are permeable, horizontal or inclined conduits into which water can infiltrate from an overlying or adjacent source. They are constructed below the water table in an area where there is sufficient recharge to offset the pumping rate, and where the permeability of the natural soils is sufficient to transmit this quantity of water to the gallery under the existing head conditions.

The gallery consists of a typical Ranney caisson with one or more large diameter screens located beneath the adjacent water source. Need for further filtration, in most cases, is eliminated resulting in high capital savings and lower operational expenditures. The Ranney gallery requires only limited area . . . important in crowded industrial centers, and can be installed for only a fraction of the cost of conventional sand filtration plants. Ranney's gallery was engineered to meet special natural conditions and complete Ranney's facilities for all major water development programs.



RANNEY RAW WATER INTAKE



RANNEY COLLECTOR WELL (TYPICAL)

APPENDIX II

Structural Engineering Study

APPENDIX II

TRI-STATE SYNFUELS COMPANY
Indirect Coal Liquefaction Plant
Western Kentucky

FLUOR ENGINEERS AND CONSTRUCTORS, INC.
Contract 835504
May 19, 1981

STRUCTURAL ENGINEERING STUDY

RANNEY WATER SYSTEM VERSUS INTAKE STRUCTURE

1.0 GENERAL

This study will provide a comparison of a Ranney Water System versus an alternate surface water intake structure.

2.0 WORK DEFINITION

2.1 The Ranney Water System shall be one of the following:

2.1.1 Radial Collectors: Horizontal screens radiate from a central caisson collecting water from the surrounding strata, utilizing either induced infiltration or ground water storage as the source of supply.

2.1.2 Raw Water Intakes: The onshore pumping station and caisson is gravity fed through one or more intake lines which are supplied by one or more intake screens located in the surface water source.

2.1.3 Infiltration Galleries: Permeable horizontal or inclined conduits are constructed below the water table in an area where the permeablility of the natural soil is sufficient to transmit this quantity of water to the gallery under the existing head conditions.

The optimum Ranney Water System will be selected and an estimated construction cost provided as part of the Ranney Hydrogeological Survey, Fluor Inquire NO. k003-0-835504-7JB.

2.2 Alternate surface water intake structures to be evaluated by Fluor shall be the following:

2.2.1 Onshore pump-house with deep shaft and tunnel under river to intake structure projecting up thru the river bottom to a velocity cap.

2.2.2 Onshore pump-house with shallow shaft and tunnel through the side of the river bank, and above the river bottom, with intake screens.

2.2.3 Above water tressel and pump platform with submerged pumps suspended in the river.

The optimum alternate surface water intake structure will be selected and a cost comparison made with the optimum Ranney Water System. Final recommendation will be based on total cost and quality of the water.

STRUCTURAL ENGINEERING STUDY (Continued)

3.0 DELIVERABLE TO TRI-STATE

A formal report that contains the following:

3.1 Capital cost estimates.

3.2 Operating cost estimates

3.3 General descriptions of proposed intake structure.

4.0 SCHEDULE

It is estimated that the proposed work will be completed as follows:

4.1 Ranney Water System: 3 months after award of contract (NO. k003-0-835504-7JB).

4.2 Alternate Surface water intake structures: 4 months after authorization to proceed.

APPENDIX III

Surface (Raw) Water and Ranney Collector Well
(Ground) Water Analysis Reports

WATER QUALITY

During the initial constant rate test in January, 1982, two water samples were taken from the pumping well (PW), one after 3 hours and one after 24 hours of pumping, and sent to an independent laboratory for analysis. In addition, a water sample was obtained from observation wells installed above the clay separating layer (R-2 shallow) and below the clay (R-2 deep), to observe any differences in water quality. In general, the water above this clay layer appeared to be of a slightly better quality with regard to Total Dissolved Solids and, particularly the iron and manganese concentrations. For this reason, and others previously discussed, it was decided to re-install the observation wells and pumping well above the clay layer and perform a second test of the aquifer.

During the second constant rate test, in April, 1982, three water samples were taken from the pumping well at one hour, thirty-one hours and seventy-four hours after pumping began. These samples and one obtained from the Ohio River were submitted to an independent testing laboratory for analysis. The results of these analyses and those conducted during the first test pumping are included in Appendix C for reference. The water quality appears of the calcium-magnesium-bicarbonate type which is fairly typical of ground water along the Ohio River with moderate amounts of iron and manganese. The saturation index of +0.12 indicates a tendency for the water to deposit calcium carbonate, rather than be corrosive. This is further indicated by a generally neutral pH. Past experience has indicated that under long-term pumping at increased pumping rates it is anticipated that concentrations of

some constituents, such as Hardness and Dissolved Solids, can be expected to decrease as increased infiltration is induced from the Ohio River.

Development of a ground water system has many advantages over a surface water supply, some of which include:

1. More uniform physical and chemical water quality with time causing less variance in treatment procedures.

2. Very low in suspended solids generally requiring no filtration or clarification.

3. Warmer water temperature in winter possibly leading to less problems with water line breakages.

4. Cooler water temperatures in the summer.

5. A more protected supply, less susceptible to pollution or contamination.

6. Very low or no harmful bacterial levels in ground water.

7. Because of the adsorptive, ion exchange capacities and slow filtration characteristics of the aquifer, levels of organic chemicals are generally less in ground water than in surface water.

Considering all of the ramifications, a ground water supply appears to be more advantageous especially from an overall quality aspect for the proposed plant. It appears that the ground water supply may require slight additional softening to reduce hardness, however it is anticipated that continued pumping at higher pumping rates may reduce the levels of hardness and several other constituents observed here. Although less softening may be required in treatment of the surface water, extensive clarification processes will be required, especially during periods of high flow in the river with greater sediment loads.

SURFACE (RAW) WATER

ANALYSIS REPORTS

Attachment 5

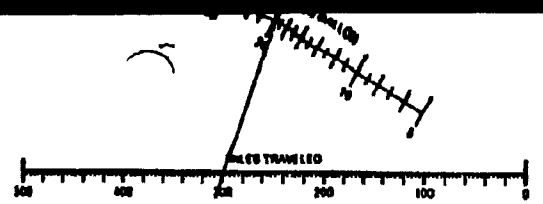
OHIO RIVER
WATER QUALITY AT SELECTED LOCATIONS

SITE.....	A	B	C	D	E	F	G
SAMPLE DATE....	10/26/79	10/9/81	2/5/81	3/3/78	11/6/78	6/79	6/1/78
Calculated CO_2	13	6	1	10	3	19	12
Phenol Alkalinity as $CaCO_3$	0	0	0	0	0	0	
Total Alkalinity as $CaCO_3$	60	90	38	94	82	84	75
Total Hardness as $CaCO_3$	166	156	216	420	210	220	135
Carbonate " " "	60	90	38	94	82	84	
Non-Carbonate " " "	106	66	178	326	128	136	
Calcium Hardness as $CaCO_3$	106	100	110	160	138	100	
Calcium as Ca	42	40	44	64	55	40	
Magnesium Hardness as $CaCO_3$	124	56	106	260	72	120	
Magnesium as Mg	36	16	30	75	21	35	
Chlorides as Cl	23	56	28	55	36	27	20.5
Total Iron as Fe	4.36	.17	2.85	2.30	.11	2.24	
Manganese as Mn	0.11			.67	0.0	.03	
Sulfates as SO_4	205	95			85		
Zinc as Zn	.03						
Total Dissolved Solids	318				204		
pH	6.87	7.4	7.67	7.21	7.69	6.88	
Carbonate as CO_3	0		0			0	
Bicarbonate as HCO_3	90		38			84	
Hydroxides as OH	0		0			0	
Specific Conductance (umhos/cm)	360			345			
Stability Index	7.14	6.81			7.16		

• See attachment 6 for locations

• From Ranney see "Ranney Collector well (Ground) Water analysis Report dated March 8, 1982

Attachment 6

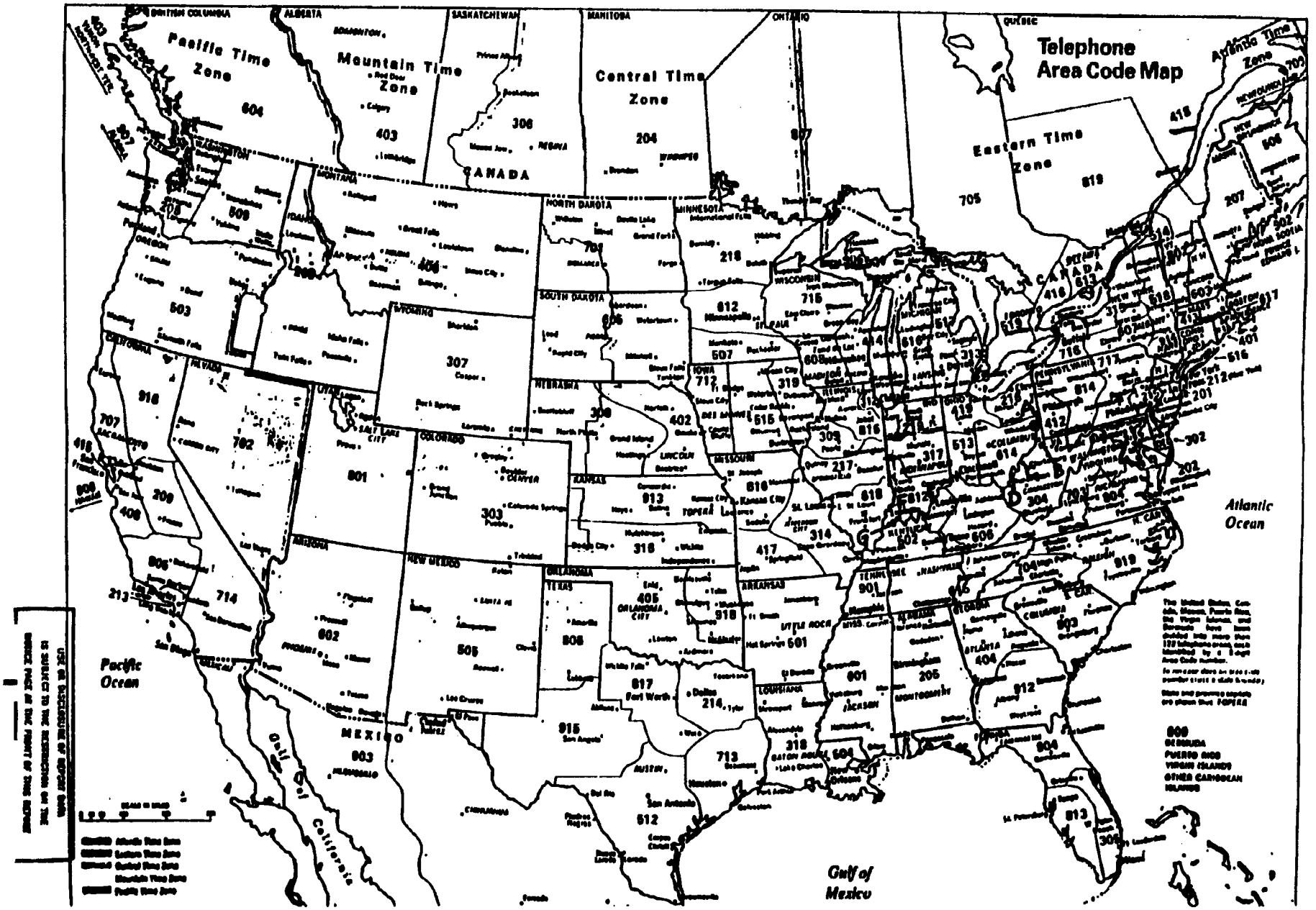


Directions for use of the computer:

A Determine the total miles traveled and the gallons of gas needed to refill tank.

B Use a straight-edge and line-up (connect) both of these figures on the appropriate upper and lower horizontal scales. (The red line illustrates the procedure.)

C Read off the miles per gallon where the straight-edge line intersects the center diagonal scale.



THE RANNEY COMPANY
DIVISION OF Layne-NEW YORK COMPANY, INC.

2 NORTH STATE STREET • P. O. BOX 72 • WESTERVILLE, OHIO 43081 • (614) 882-3104

November 13, 1981

Fluor Engineers and Constructors, Inc.
3333 Michelson Drive
Irvine, California 92730

Attention: Mr. John Shipp

RE: RANNEY HYDROGEOLOGICAL SURVEY
FLUOR CONTRACT NO. 835504-0-K003

Dear John:

We have listed below the results of a water analysis on a sample taken from the Ohio River in the vicinity of Henderson. We are in the process of having a water sample analyzed that was taken from TW-5 at the test drilling site. More representative samples of the local ground water will be obtained and analyzed during the test pumping procedures. The sample was taken June, 1979.

PARAMETER	OHIO RIVER
Calculated CO_2	19.
Phenol Alkalinity as $CaCO_3$	0.
Total Alkalinity as $CaCO_3$	84.
Caustic Alkalinity as $CaCO_3$	0.0
Carbonate as CO_3	0.
Bicarbonate as HCO_3	84.
Hydroxide as OH	0.
Total Hardness as $CaCO_3$	220.
Carbonate Hardness as $CaCO_3$	84.
Non-Carbonate Hardness as $CaCO_3$	136.
Calcium Hardness as $CaCO_3$	100.
Calcium as Ca	40.
Magnesium Hardness as $CaCO_3$	120.
Magnesium as Mg	35.
Chlorides as Cl	27.
Total Iron as Fe	2.24
Manganese as Mn	0.03
pH Value	6.88

The above results are expressed as mg/l except pH.

I hope this information is helpful. We will have more representative samples analyzed as they become available.

Please let us know if you have any further questions or require any additional information.

Very truly yours,

THE RANNEY COMPANY

Henry C. Hunt

Henry C. Hunt

HCH/blw

RANNEY COLLECTOR WELL (GROUND)

WATER ANALYSIS REPORTS

THE RANNEY COMPANY
DIVISION OF Layne-NEW YORK COMPANY, INC.

2 NORTH STATE STREET · P. O. BOX 72 · WESTERVILLE, OHIO 43081 · (614) 882-3104

May 12, 1982

Fluor Engineers and Constructors, Inc.
Advanced Technology Division
Post Office Box C11944
Santa Ana, California 92711

Attention: Mr. W. Jack Buckamier
Senior Contracts Engineer

REFERENCE: PRELIMINARY REPORT
DETAILED PUMP TESTING
FLUOR CONTRACT NO. 835504-O-K004

Gentlemen:

The test pumping procedures at Site 6 have been completed and some preliminary observations presented herein. The survey area tested indicated a very good potential for ground water development and Site 6, in particular, indicated a higher yield under test conditions than most sites along the Ohio River.

In order to develop the preliminary design for a Collector well system in the study area to produce long term reliable yields of 12,000 or 18,000 gallons per minute (gpm), the yield determinations were based on anticipated minimum conditions of low river stage, water temperature and took into account the effect that well interference would have in the system. Utilizing minimum condition values is critical to ensure that the minimum yield requirements can be satisfied at all times.

Under test conditions, the yield from a Collector well at Site 6 would approximate 6,000 gpm. However, under minimum conditions, this yield would be reduced somewhat. The anticipated yields from Collector wells located at the other sites can only be approximated at this time, and are estimated to be slightly less than 6,000 gpm. These yields will be more closely determined following test pumping at each site as construction plans progress.

Based upon these determinations, it appears that a yield of 12,000 gpm can be developed from a system of three Ranney Collector wells. Correspondingly, it appears that a yield of 18,000 gpm can be obtained from a series of five Collector wells. As further testing at the individual sites is accomplished, there exists a possibility that each of these systems can be reduced by one Collector

well, as results dictate. For the purpose of system cost comparison, three and five Collector wells should be used and prospective sites (in order of preference) would be: Sites 6, 2, 5, 1 and 4.

* The estimated cost to design and construct a system to produce 18,056 gpm consisting of five Ranney Collector wells is about $6,200,000.00, and for a system to produce 12,000 gpm from three Ranney Collector wells, is about $3,720,000.00. Detailed test pumping at prospective Collector sites is estimated to cost $65,000.00 per site.

In our previous correspondence of December 18, 1981, we outlined the preliminary design for an intake to produce 18,056 gpm. From present indications, there appears to be sufficient river water depth in the vicinity of Site 3 to retain that site as the tentative Intake location. The estimated cost to design and construct a Ranney Surface Water Intake to produce up to 18,500 gpm is about $2,200,000.00.

Please find attached copies of the water quality analyses from the samples collected during the recent test pumping procedures. More detailed comments pertaining to these analyses and the anticipated water quality from a Collector well system will be provided in the final report. It is anticipated, from past experiences, that the water produced from a Collector well system can be of a more consistent temperature and quality, potentially resulting in a more simplified water treatment design.

Should you have any questions in this regard, please do not hesitate to contact us. We hope that the information supplied is sufficient for your project planning at this point. More detailed determinations will be included in the final report.

Thank you for this opportunity to be of service.

Very truly yours,

THE RANNEY COMPANY

Henry C. Hunt

Henry C. Hunt

HCH/blw

Enclosures

* 18,056 : 6,200,000 + 5(65,000) = 6,525,000
12,000 : 3,720,000 + 3(65,000) = 3,915,000

TOTAL PROJECT COST = 1.2 (2,200,000) = 2,640,000
= 1.2 (6,525,000) = 7,830,000
= 1.2 (3,915,000) = 4,698,000

AQUA ASSOCIATES INC.
Analytical Chemistry and Bacteriology
1275 Bloomfield Avenue
Building 1
P.O. Box 1251
Fairfield, N.J. 07006
(201) 227-0422

N.J. DEP. CERTIFIED LABORATORY #07066

ANALYSIS REPORT:

Date 5/5/82
Laboratory No. 81592W
Date Sampled 4/27/82
Location Tri State Synfuels
Henderson, Kentucky
Source Pumping well after
74 hours pumping

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Attn: Henry Hunt

pH	7.1 Units	Total Hardness, $CaCO_3$	360 mg/l
Color	0 Units	Calcium Hardness $CaCO_3$	244 mg/l
Turbidity	10 Units	Magnesium Hardness $CaCO_3$	116 mg/l
Conductivity	642 Micromhos/cm.	Iron, as Fe	0.56 mg/l
Total Dissolved Solids	513.6 mg/l	Manganese, as Mn	<0.01 mg/l
Total Alkalinity, $CaCO_3$	324 mg/l	Copper, as Cu	0.16 mg/l
Carbonate Alkalinity $CaCO_3$	0 mg/l	Silica, as SiO_2	11.3 mg/l
Bicarbonate Alkalinity $CaCO_3$	324 mg/l	Nitrate, as N	0.9 mg/l
Hydroxide Alkalinity $CaCO_3$	0 mg/l	Saturation Index	+0.12
Chloride, as Cl	6 mg/l		
Sulfate, as SO_4	54 mg/l		
Fluoride as F	0.22 mg/l		
Phosphate, as PO_4	0.21 mg/l		

Director

AQUA ASSOCIATES INC.
Analytical Chemistry and Bacteriology
1275 Bloomfield Avenue
Building 1
P.O. Box 1251
Fairfield, N.J. 07006
(201) 227-0422

N.J. DEP. CERTIFIED LABORATORY #07066

ANALYSIS REPORT:

Date 5/6/82
Laboratory No. 81611W
Date Sampled 4/24/82
Location Tri State Synfuels
Henderson, Kentucky
Source Pumping Well @ 1 Hour

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Attn: Henry Hunt

pH	7.3 Units	Total Hardness, $CaCO_3$	298 mg/l
Color	0 Units	Calcium Hardness $CaCO_3$	170 mg/l
Turbidity	11 Units	Magnesium Hardness $CaCO_3$	128 mg/l
Conductivity	640 Micromhos/cm.	Iron, as Fe	1.24 mg/l
Total Dissolved Solids	512 mg/l	Manganese, as Mn	<0.01 mg/l
Total Alkalinity, $CaCO_3$	164 mg/l	Copper, as Cu	0.2 mg/l
Carbonate Alkalinity $CaCO_3$	0 mg/l	Silica, as SiO_2	8.4 mg/l
Bicarbonate Alkalinity $CaCO_3$	164 mg/l	Nitrate, as N	2.3 mg/l
Hydroxide Alkalinity $CaCO_3$	0 mg/l		
Chloride, as Cl	12 mg/l		
Sulfate, as SO_4	44 mg/l		
Fluoride as F	0.15 mg/l		
Phosphate, as PO_4	0.26 mg/l		

Andrew Pappano Director

Andrew Pappano M.S. (Chemistry) M.S. (Civil Engineering)

AQUA ASSOCIATES INC.
Analytical Chemistry and Bacteriology
1275 Bloomfield Avenue
Building 1
P.O. Box 1251
Fairfield, N.J. 07006
(201) 227-0422

N.J. DEP. CERTIFIED LABORATORY #07066

ANALYSIS REPORT:

Date 5/6/82
Laboratory No. 81594A
Date Sampled 4/24/82
Location Tri State Synfuels
Henderson, Kentucky
Source Ohio River @ 1 hour

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Attn: Henry Hunt

pH	7.3	Units	Total Hardness, $CaCO_3$	150	mg/l
Color	35	Units	Calcium Hardness $CaCO_3$	80	mg/l
Turbidity	54	Units	Magnesium Hardness $CaCO_3$	70	mg/l
Conductivity	331	Micromhos/cm.	Iron, as Fe	0.12	mg/l
			Manganese, as Mn	0.3	mg/l
Total Dissolved Solids	265	mg/l	Copper, as Cu	0.19	mg/l
Total Alkalinity, $CaCO_3$	120	mg/l	Silica, as SiO_2	6.3	mg/l
Carbonate Alkalinity $CaCO_3$	0	mg/l	Nitrate, as N	3.4	mg/l
Bicarbonate Alkalinity $CaCO_3$	120	mg/l			
Hydroxide Alkalinity $CaCO_3$	0	mg/l			
Chloride, as Cl	22	mg/l			
Sulfate, as SO_4	65	mg/l			
Fluoride as F	0.05	mg/l			
Phosphate, as PO_4	0.26	mg/l			

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Andrew Pappachen Director

Andrew Pappachen, M.S. (Chemistry) M.S. (Civil Engineering)

AQUA ASSOCIATES INC.
Analytical Chemistry and Bacteriology
1275 Bloomfield Avenue
Building 1
P.O. Box 1251
Fairfield, N.J. 07006
(201) 227-0422

N.J. DEP. CERTIFIED LABORATORY #07066

ANALYSIS REPORT:

Date 5/5/82
Laboratory No. 81593W
Date Sampled 4/25/82
Location Tri State Synfuels
Henderson Kentucky
Source Pumping Well @ 31 Hrs
7:00 pm

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Attn: Henry Hunt

pH	7.1 Units	Total Hardness, $CaCO_3$	376 mg/l
Color	0 Units	Calcium Hardness $CaCO_3$	232 mg/l
Turbidity	11 Units	Magnesium Hardness $CaCO_3$	144 mg/l
Conductivity	634 Micromhos/cm.	Iron, as Fe	0.3 mg/l
Total Dissolved Solids	507 mg/l	Manganese, as Mn	<0.01 mg/l
Total Alkalinity, $CaCO_3$	332 mg/l	Copper, as Cu	<0.01 mg/l
Carbonate Alkalinity $CaCO_3$	0 mg/l	Silica, as SiO_2	10 mg/l
Bicarbonate Alkalinity $CaCO_3$	332 mg/l	Nitrate, as N	1.0 mg/l
Hydroxide Alkalinity $CaCO_3$	0 mg/l		
Chloride, as Cl	10 mg/l		
Sulfate, as SO_4	50 mg/l		
Fluoride as F	0.22 mg/l		
Phosphate, as PO_4	0.34 mg/l		

Andrew Pappano Director

THE RANNEY COMPANY

DIVISION OF Layne-NEW YORK COMPANY, INC.

2 NORTH STATE STREET · P. O. BOX 72 · WESTERVILLE, OHIO 43081 · (614) 882-3104

March 8, 1982

Received

MAR 1 1982

Fluor Engineers and Constructors, Inc.
Advanced Technology Division
Post Office Box C11944
Santa Ana, California 92711

Attention: Mr. John Shipp

REFERENCE: GROUND WATER AND RIVER WATER QUALITY
TRI-STATE SYNFUELS PLANT
GENEVA, KENTUCKY
FLUOR CONTRACT NO. 835504-Q-K004

Dear Mr. Shipp:

Please find enclosed graphs regarding water quality trends at locations along the Ohio and Mississippi Rivers as requested. We have also enclosed information regarding Ohio River quality at seven locations along the Ohio (indicated as A-G on the enclosed map) a price list and analysis schedule from Aqua Associates, Inc., and a schedule of required constituents (Exhibit A) for testing.

The enclosed graphs (Attachments 1-4) illustrate the water quality trends for a Collector well and a test pumping well along the Mississippi River and a series of seven Collector wells along the Ohio River. These graphs depict changes in the ground water quality and the trends indicate that the ground water quality approaches that observed in the adjacent river with time.

The water quality analyses shown in the table as Attachment 5 were obtained from the sites indicated on the location map (Attachment 6), and indicate variations in concentrations of certain parameters; even between stations which are fairly close together. You mentioned that the river water quality data obtained by your Process Department had indicated some variations at sampling stations, both seasonally and otherwise. As we discussed, fluctuations in river water quality have indicated that ground water source can often provide a supply of more consistent quality, facilitating a more fixed treatment system. It is anticipated that levels of turbidity and color observed during preliminary testing will be much lower or eliminated in the final installation.

From the enclosed price list, (Attachment 7) the cost to conduct the complete list

of analyses listed on Fluor Exhibit A would be in excess of $400.00. The parameter analyzed on the samples collected during the previous test pumping are identified on the price list as the "Complete Test Package" for $45.00. These parameters are those generally tested in water sample analyses during similar hydrogeological surveys, and any additional required parameters would be considered an extra to the original contract. Our current schedule for obtaining water samples during the final test pumping is to collect a pumped water sample one hour, twenty-four hours and seventy-two hours after pumping began. One river water sample will also be collected; making a total of four samples to be collected and tested during the final test. Should you desire additional samples to be collected during the test, please advise. We would expect to add a standard fifteen percent mark-up on the cost of additional required analyses to cover our handling costs.

Please let us know if you have any questions in this regard, and please notify us which analyses you would like included during our final testing. We anticipate starting the final test on or before March 17, 1982, site conditions permitting, and completion of field testing procedures by March 26, 1982.

We hope that the weather and river conditions in the next several weeks will be favorable and permit us to complete the field procedures on schedule. We are anxious to complete this phase and prepare our analyses.

Thank you for your assistance in this matter.

Very truly yours,

THE RANNEY COMPANY

Henry C. Hunt

Henry C. Hunt

HCH/blw

Enclosures (Attachments 1-7)

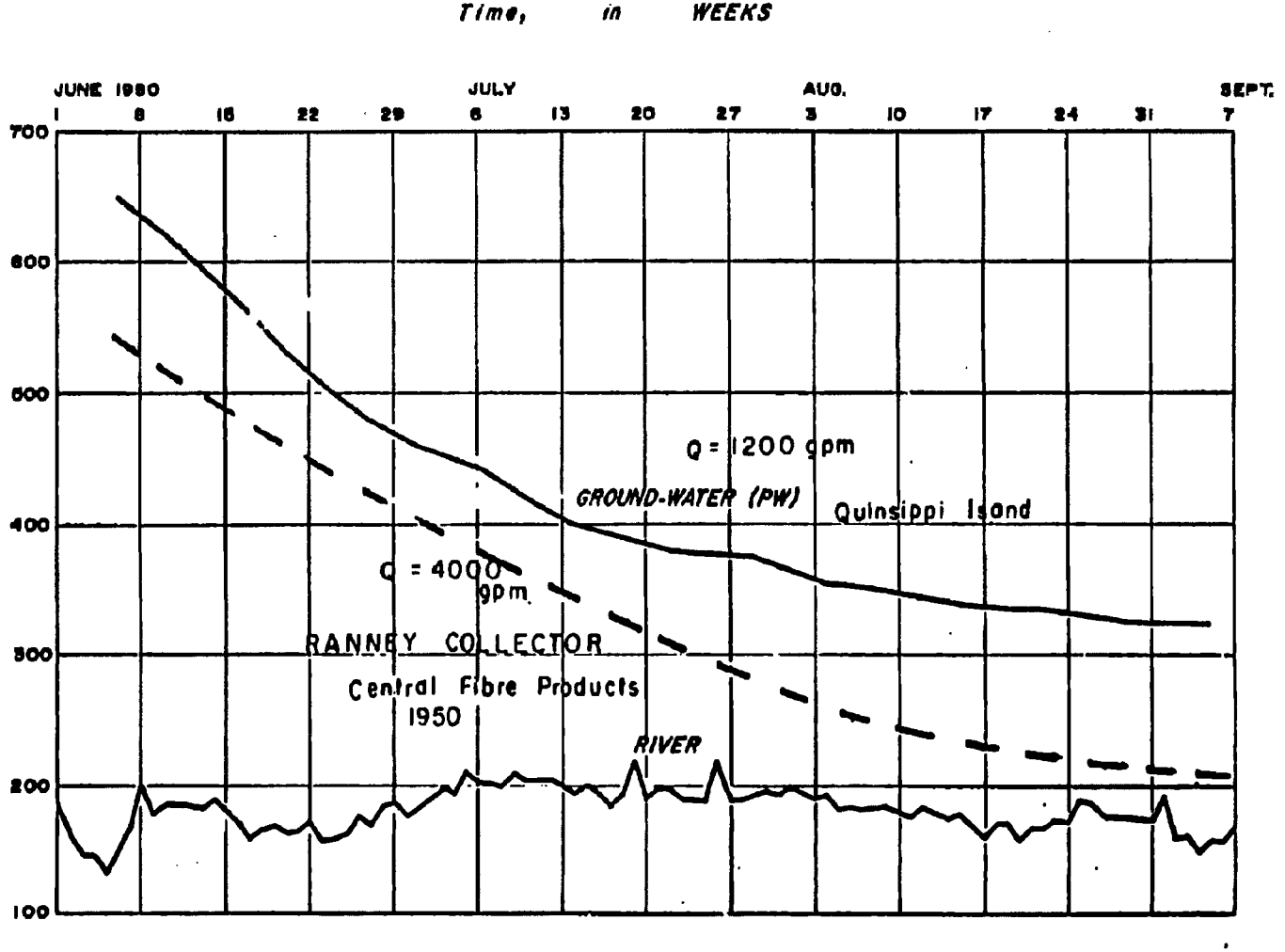
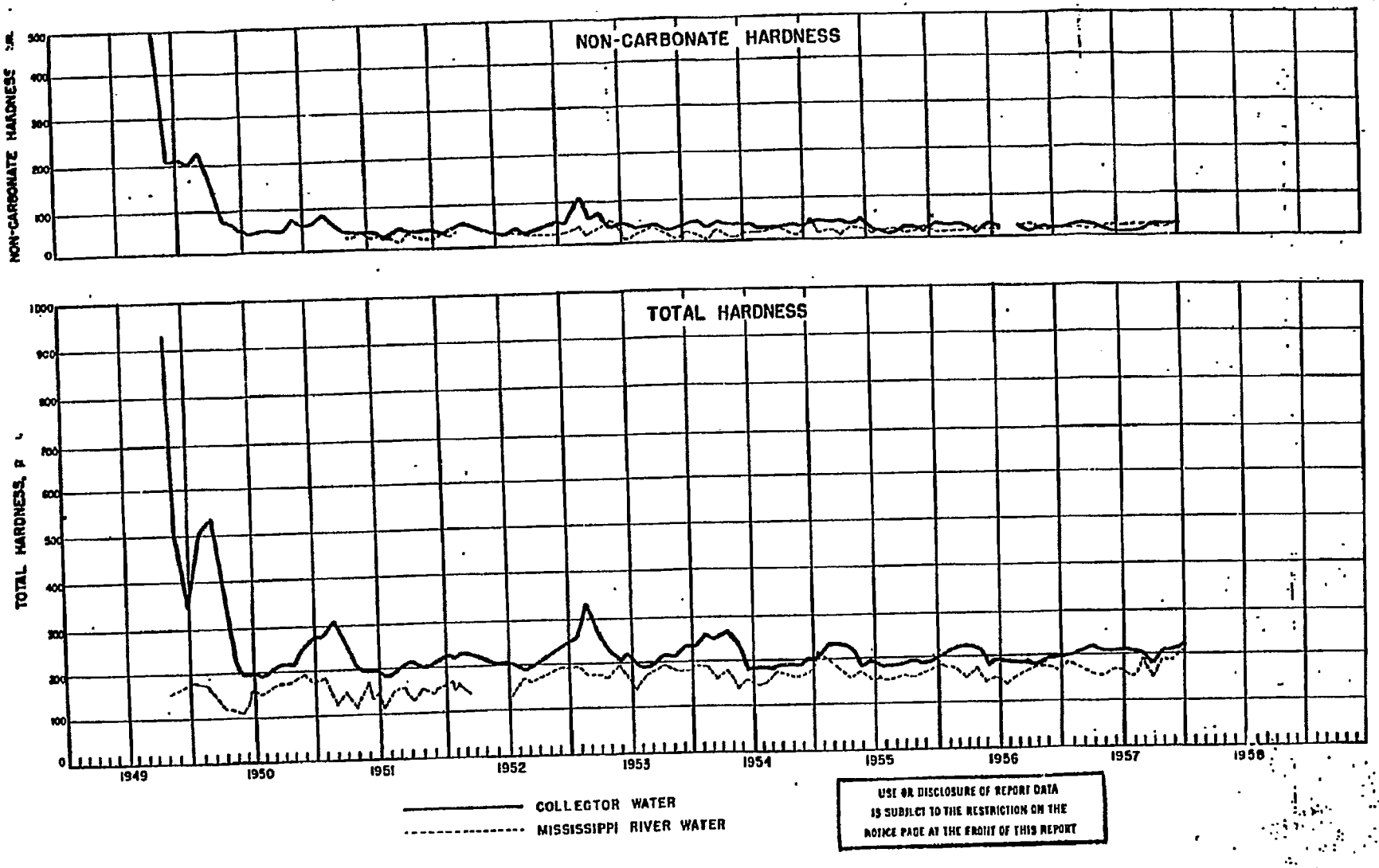


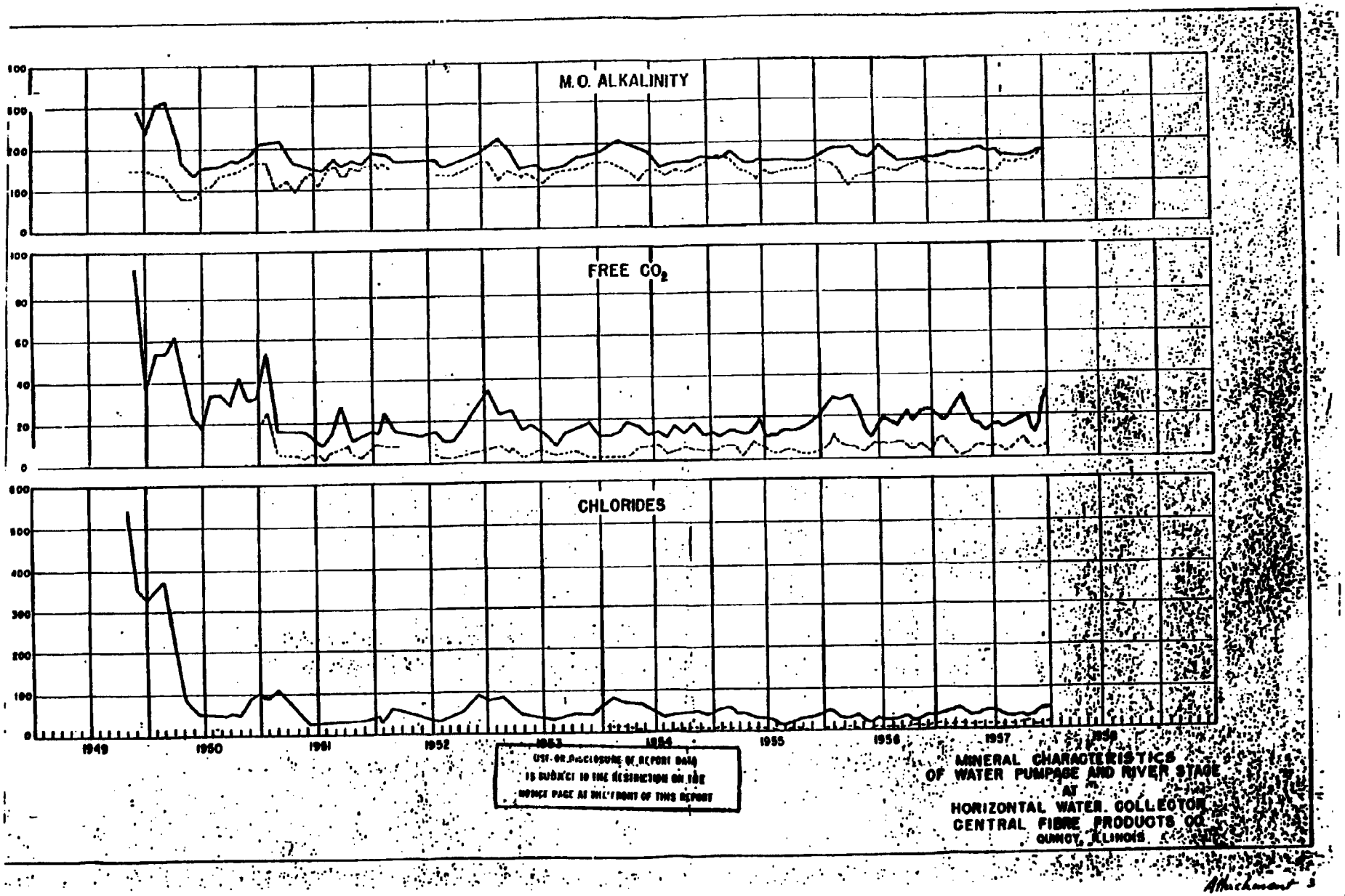
Fig. 16 : RIVER / GROUND-WATER HARDNESS CORRELATION .

City of Quincy, Illinois

Attachment 1



Attachment 2


M.O. ALKALINITY
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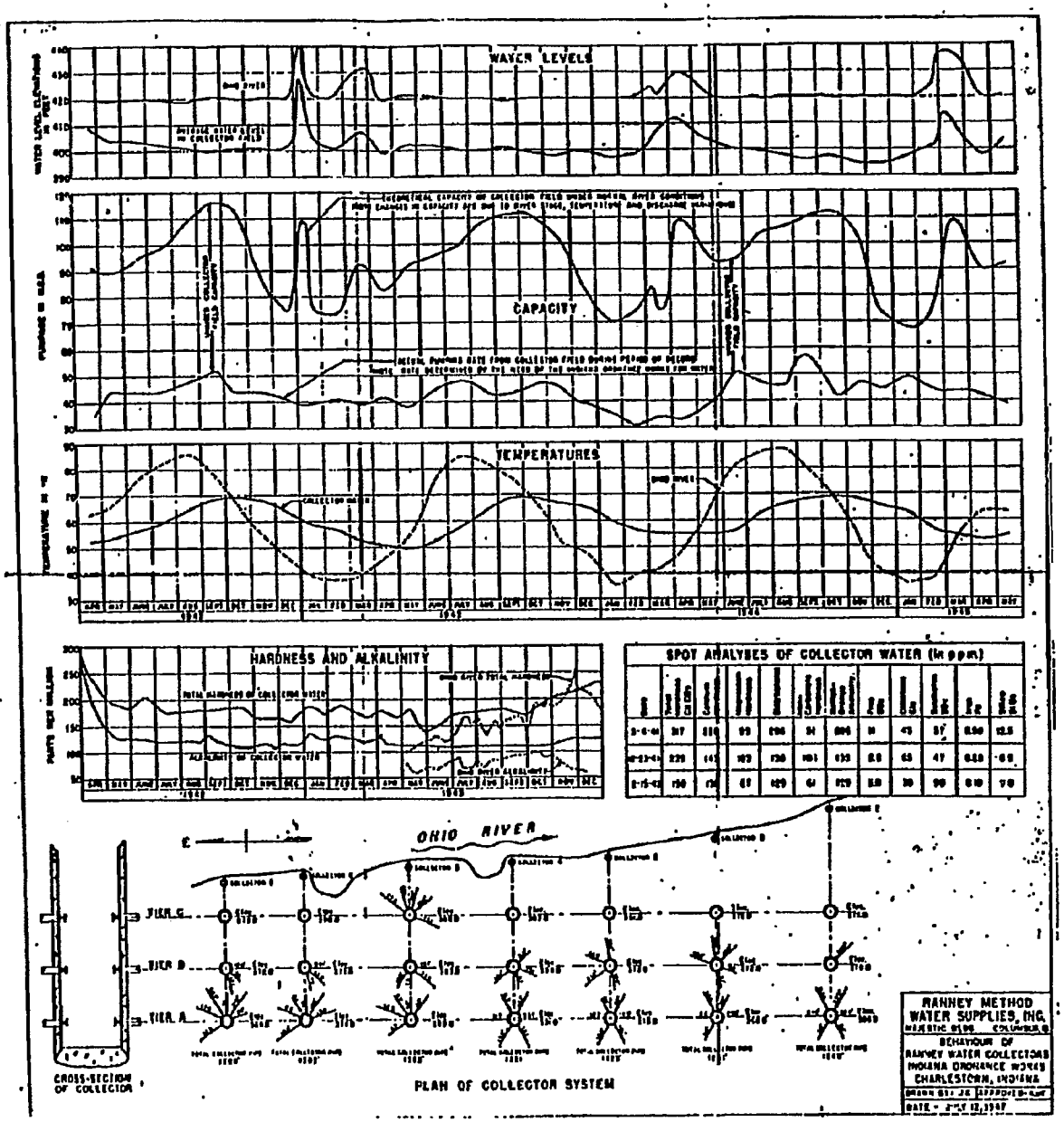
USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT
MINERAL CHARACTERISTICS OF WATER PUMPAGE AND RIVER STAGE AT HORIZONTAL WATER COLLECTOR CENTRAL FIBRE PRODUCTS CO. QUINCY, ILLINOIS



Attachment 4

ATTACHMENTS 5 & 6

See "Surface (raw) Water

Analysis Reports"

Aqua Associates, Inc.
P.O. Box 1251
West Caldwell, New Jersey 07006

(201) 227-0422

Attachment 7

ANALYSES AND PRICE LIST

COMPLETE TEST PACKAGE ($45)

Total Dissolved Solids	Total Hardness, as $CaCO_3$
Total Alkalinity, as $CaCO_3$	Calcium Hardness, as $CaCO_3$
Carbonate Alkalinity, as $CaCO_3$	Magnesium Hardness, as $CaCO_3$
Bicarbonate Alkalinity, as $CaCO_3$	Conductivity
Hydroxides, as OH	Iron, as Fe
Chloride, as Cl ✓	Manganese, as Mn
Sulfate, as SO_4 ✓	Copper, as Cu
Fluoride, as F	Silica, as SiO_2
Phosphate, as PO_4	Color, PCS
pH	Turbidity, NTU

ADDITIONAL ANALYSES AVAILABLE

CHEMICAL

Heavy Metals	Price per Analysis ($)
Aluminum	10.00
Antimony	10.00
Arsenic	15.00
Beryllium	10.00
Barium	10.00
Cadmium	10.00
Calcium	10.00 ✓
Chromium	10.00
Cobalt	10.00
Lead	10.00
Magnesium	10.00 ✓
Mercury	20.00
Molybdenum	10.00
Nickel	10.00
Platinum	20.00
Potassium	10.00
Selenium	20.00
Silver	10.00
Sodium	10.00 ✓
Tin	10.00
Tungsten	15.00
Zinc	10.00

(All metal analyses performed by Atomic Absorption Spectrophotometry.)

Aqua Associates, Inc.
P.O. Box 1251
West Caldwell, New Jersey 07006

(201) 227-0422

Physical and Inorganic	Price per Analysis ($)
Saturation Index	15.00
Salinity	5.00
Acidity	5.00
Bromide	10.00
Chlorine Demand	15.00
Cyanide	15.00
Nitrogen, Ammonia	10.00
Nitrogen, Organic	15.00
Nitrite	10.00
Dissolved Oxygen	10.00
Phosphate, Total	10.00
Phosphorous, Total	15.00
Sulfide	10.00
Sulfite	10.00
Organic	
Grease and Oil	20.00
Organic Volatile Acid	20.00
BOD (Biochemical Oxygen Demand)	15.00
COD (Chemical Oxygen Demand)	15.00
Phenol	15.00
Surfactant (Detergent)	15.00
TOC (Total Organic Carbon)	20.00

Minimum order for additional analyses --- $30.00
(Without $45.00 Package Analyses)

THE RANNEY COMPANY

DIVISION OF Layne-NEW YORK COMPANY, INC.

2 NORTH STATE STREET • P. O. BOX 72 • WESTERVILLE, OHIO 43081 • (614) 882-3104

February 4, 1982

Fluor Engineers and Constructors, Inc.
Advanced Technology Division
Post Office Box C11944
Santa Ana, California 92711

Attention: Mr. John Shipp

Received
FEB 8 1982
John G. Shipp

REFERENCE: DETAILED TEST PUMPING
GENEVA, KENTUCKY
FLUOR CONTRACT NO. 835504-0-K004
PROGRESS REPORT

USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT

Dear Mr. Shipp:

Since we are now delayed in the completion of our work by high river conditions, we believe this is an appropriate point to summarize our work to date.

To date, we have constructed one observation well (R-3) at Site 4 and six observation wells at Site 6 plus the conversion of the original test well to an observation well. The pumping well at Site 6 has been installed and a step test and a 24-hour constant rate test run. The site and area appear encouraging from a quantity and quality standpoint, however, the pump test data to date is too inconclusive to accurately compute anticipated well yield at Site 6 (or the other sites) or to finalize design of a Collector well at the site.

The cause of the problem is a geological sequence not previously identified in available investigative reports for the area; whereby the aquifer, while appearing continuous in many holes, is apparently split by a clay layer into two zones. The lower zone, from 106 feet below grade to bedrock, appears less productive and slightly more mineralized, particularly with respect to iron and manganese, than the upper zone, which extends from 60 to 98 feet.

This condition first became apparent as a clay layer observed in logging the test well (R-3) at Site 4. Hoping that the clay layer was site specific, we moved the test to Site 6 and after the installation of two observation wells realized that similar geologic conditions existed at this site. Subsequently, five observation wells and a test pumping well were installed in the lower zone, while a sixth observation well was installed in the upper zone to observe water level differentials between the two zones. Pumping tests were conducted and indicated a differential of over 3 feet between the upper and lower zones. The preliminary indications are that the lower aquifer is of sufficiently low capacity and quality that it should

not be utilized in the final design.

Consequently, this means that the observation and test pumping wells must be reset in the upper zone of materials and a second pump test conducted. We had initiated these procedures when high river conditions flooded the work site and delayed our work. We are prepared to resume the testing procedures as river conditions permit. We should complete the second test approximately two weeks after we can return to the site and we will prepare a preliminary letter report one week after testing is complete and a final report three weeks following. We are following river conditions daily and will restart as soon as the site begins to drain. At this writing, the approximate river elevation at Site 6 is 358 feet, MSL and rising (average site ground elevation is 356.0). Current forecasts by the National Weather Service in that area predict the rising river to crest on or about February 7, 1982. We will keep you advised of conditions and updated scheduling in this regard.

We are enclosing water analyses collected during the initial pumping test. We are sorry about the delay, but feel the steps taken have been necessary to provide a thorough, competent, and professional analysis in view of the unexpected, changed site conditions. We are confident that this is the approach you contemplated when the project was awarded and the quality of analysis necessary for your project design. Except for a few days break over the Christmas holidays, work at the project has been continuous; including some double shift and weekend overtime scheduling during the project in an attempt to avoid the high river conditions.

Thank you for your assistance and patience in this matter. We feel that the modifications made during this survey, based upon our field findings, will facilitate a more accurate and comprehensive analysis at the selected site to be utilized in your system planning.

Please let us know if you have any questions in this regard or if we can be of additional assistance prior to submittal of our reports.

Very truly yours,

THE RANNEY COMPANY

Henry C Hunt

Henry C. Hunt

HCH/blw

Enclosure

Aqua Associates, Inc. P. O. Box 1251, West Caldwell, New Jersey 07006 (201) 227-0422

Complete Water Sampling and Analysis

NEW JERSEY STATE DEPT. HEALTH APPROVED LABORATORY
Licensed: Water Supply System Operators (W-1)
Water Treatment Plant Operators (T-1)
Sewage Treatment Plant Operators (S-1)

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Date: 1/27/82

Laboratory No. 81522W

WATER ANALYSES REPORT

Sample Taken From: Henderson, Ky.

Source: Well R2 Deep Other

Date Sample Taken: 1/20/82

pH	7.3 Units	Total Hardness, $CaCO_3$	312 mg/L
Color	20 Units	Calcium Hardness, $CaCO_3$	196 mg/L
Turbidity	30 Units	Magnesium Hardness, $CaCO_3$	116 mg/L
Conductivity	591 micromhos/cm.	Iron, as Fe	3.25 mg/L
Total Dissolved Solids	473 mg/L	Manganese, as Mn	0.5 mg/L
Total Alkalinity, $CaCO_3$	72 mg/L	Copper as Cu	0.01 mg/L
rbonate Alkalinity, $CaCO_3$	0 mg/L	Silica, as SiO_2	1.7 mg/L
icarbonate Alkalinity, $CaCO_3$	72 mg/L	Nitrate as N	0.8 mg/L
Hydroxide Alkalinity, $CaCO_3$	0 mg/L		
Chloride, as Cl	0 mg/L		
Sulfate, as SO_4	6 mg/L		
Fluoride as F	0.69 mg/L		
Phosphate, as PO_4	0.2 mg/L		

Andrew Pappachen

Andrew Pappachen, Director

Aqua Associates, Inc.

P. O. Box 1251, West Caldwell, New Jersey 07006 (201) 227-0422

Complete Water Sampling and Analysis

NEW JERSEY STATE DEPT. HEALTH APPROVED LABORATORY
Licensed: Water Supply System Operators (W-1)
Water Treatment Plant Operators (T-1)
Sewage Treatment Plant Operators (S-1)

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Date: 1/27/82

Laboratory No. 81523W

WATER ANALYSES REPORT

Sample Taken From: Henderson, Ky.

Source: Well R2 Shallow Other

Date Sample Taken: 1/20/82

pH	7.15 Units	Total Hardness, $CaCO_3$	308 mg/L
Color	10 Units	Calcium Hardness, $CaCO_3$	184 mg/L
Turbidity	23.5 Units	Magnesium Hardness, $CaCO_3$	124 mg/L
Conductivity	570 micromhos/cm.	Iron, as Fe	1.21 mg/L
Total Dissolved Solids	456 mg/L	Manganese, as Mn	0.16 mg/L
Total Alkalinity, $CaCO_3$	64 mg/L	Copper as Cu	0.01 mg/L
rbonate Alkalinity, $CaCO_3$	0 mg/L	Silica, as SiO_2	1.8 mg/L
sicarbonate Alkalinity, $CaCO_3$	64 mg/L	Nitrate as N	0.5 mg/L
Hydroxide Alkalinity, $CaCO_3$	0 mg/L		
Chloride, as Cl	4 mg/L		
Sulfate, as SO_4	11 mg/L		
Fluoride as F	0.7 mg/L		
Phosphate, as PO_4	0.1 mg/L		

Andrew Pappachen.

Andrew Pappachen, Director

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1-29-82

qua Associates, Inc. P. O. Box 1251, West Caldwell, New Jersey 07006 (201) 227-0422

Complete Water Sampling and Analysis

NEW JERSEY STATE DEPT. HEALTH APPROVED LABORATORY
Licensed: Water Supply System Operators (W-1)
Water Treatment Plant Operators (T-1)
Sewage Treatment Plant Operators (S-1)

Date: 1/27/82

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081.

Laboratory No. 81520W

WATER ANALYSES REPORT

mple Taken From: Henerson, Ky.

urce: Well X Other P.W. after 3 Hours pumping

te Sample Taken: 1/18/82

H	6.9 Units	Total Hardness, $CaCO_3$	320 mg/L
olor	10 Units	Calcium Hardness, $CaCO_3$	216 mg/L
urbidity	12 Units	Magnesium Hardness, $CaCO_3$	104 mg/L
onductivity	610 micromhos/cm.	Iron, as Fe	0.86 mg/L
tal Dissolved Solids	488 mg/L	Manganese, as Mn	0.07 mg/L
tal Alkalinity, $CaCO_3$	68 mg/L	Copper as Cu	<0.01 mg/L
rbonate Alkalinity, $CaCO_3$	0 mg/L	Silica, as SiO_2	2.2 mg/L
icarbonate Alkalinity, $CaCO_3$	68 mg/L	Nitrate as N	0.2 mg/L
droxide Alkalinity, $CaCO_3$	0 mg/L		
hloride, as Cl	2 mg/L		
ulfate, as SO_4	23 mg/L		
luoride as F	0.71 mg/L		
hosphate, as PO_4	0.22 mg/L		

Andrew Pappachen

Andrew Pappached, Director

Aqua Associates, Inc. P. O. Box 1251, West Caldwell, New Jersey 07006 (201) 227-8422

Complete Water Sampling and Analysis

NEW JERSEY STATE DEPT. HEALTH APPROVED LABORATORY
Licensed: Water Supply System Operators (W-1)
Water Treatment Plant Operators (T-1)
Sewage Treatment Plant Operators (S-1)

The Ranney Co.
P.O. Box 72
Westerville, Ohio 43081

Date: 1/27/82

Laboratory No. 81521W

WATER ANALYSES REPORT

Sample Taken From: Henderson, Ky.

Source: Well x Other P.W. 24 Hours pumping

Date Sample Taken: 1/19/82

pH	7.05 Units	Total Hardness, $CaCO_3$	332 mg/L
Color	0 Units	Calcium Hardness, $CaCO_3$	216 mg/L
Turbidity	7.9 Units	Magnesium Hardness, $CaCO_3$	116 mg/L
Conductivity	615 micromhos/cm.	Iron, as Fe	0.78 mg/L
Total Dissolved Solids	492 mg/L	Manganese, as Mn	0.15 mg/L
Total Alkalinity, $CaCO_3$	68 mg/L	Copper as Cu	<0.01 mg/L
rbonate Alkalinity, $CaCO_3$	0 mg/L	Silica, as SiO_2	2.1 mg/L
Bicarbonate Alkalinity, $CaCO_3$	68 mg/L	Nitrate as N	1.2 mg/L
Hydroxide Alkalinity, $CaCO_3$	0 mg/L		
Chloride, as Cl	5 mg/L		
Sulfate, as SO_4	21 mg/L		
Fluoride as F	0.71 mg/L		
Phosphate, as PO_4	0.09 mg/L		

Andrew Pappachen

Andrew Pappachen, Director

THE RANNEY COMPANY

DIVISION OF Layne-NEW YORK COMPANY, INC.

2 NORTH STATE STREET • P. O. BOX 72 • WESTERVILLE, OHIO 43081 • (614) 882-3104

December 31, 1981

Fluor Engineers & Constructors, Inc. (ATD)
Post Office Box C11944
Santa Ana, California 92711

Attention: Mr. John Shipp

REFERENCE: WATER QUALITY ANALYSIS: SITE 6

Dear Mr. Shipp:

Please find attached copy of water analysis for a sample obtained from Site 6, as Attachment A. This sample was obtained using a construction pump in the temporary pumping well installed at site of TH-6.

As we discussed, several of the parameters shown; i.e. color and turbidity, as shown, may be somewhat misleading to your process department. It is anticipated that these two values were recorded artificially high due to iron oxidizing in the water sample prior to testing (the sample was reportedly clear when collected). Water samples from Collector well installations have indicated that color and turbidity values are typically negligible.

It is also anticipated that the concentrations of several other parameters (e.g. iron, hardness) may approach the levels observed in the Ohio River, as the percentage of water induced from the river increases with time. An example of this is shown as Attachment B, which outlines a declining hardness trend with time from a vertical well (PW) and a Ranney Collector well located along the Mississippi River.

I hope this information is useful to your process department. More representative samples will be obtained and analyzed during the test pumping procedures. This information will be contained in our final report under Fluor Contract No. 835504-0-K004.

Please let us know if you have any questions in this regard or desire any further information at this time.

Very truly yours,

THE RANNEY COMPANY

Henry C. Hunt

HCH/blw
Enclosures

Aqua Associates, Inc. P. O. Box 1251, West Caldwell, New Jersey 07006 (201) 227-6622

Complete Water Sampling and Analysis

NEW JERSEY STATE DEPT. HEALTH APPROVED LABORATORY
Licensed: Water Supply System Operators (W-1)
Water Treatment Plant Operators (T-1)
Sewage Treatment Plant Operators (S-1)

The Ranney Co.
P.O.Box 72
Westerville, Ohio 43081

Date: 12/21/81

Laboratory No. 81488W

WATER ANALYSES REPORT

Sample Taken From: Tri State Syn Fuel Henderson, Ky.

Source: Well x Other

Date Sample Taken: 12/21/81

pH	7.1 Units	Total Hardness, $CaCO_3$	310 mg/L
Color	10 Units	Calcium Hardness, $CaCO_3$	182 mg/L
Turbidity	60 Units	Magnesium Hardness, $CaCO_3$	128 mg/L
Conductivity	54 micromhos/cm.	Iron, as Fe	5.4 mg/L
Total Dissolved Solids	42.2 mg/L	Manganese, as Mn	0.12 mg/L
Total Alkalinity, $CaCO_3$	66 mg/L	Copper as Cu	0.15 mg/L
Carbonate Alkalinity, $CaCO_3$	0 mg/L	Silica, as SiO_2	2.8 mg/L
Bicarbonate Alkalinity, $CaCO_3$	66 mg/L	Nitrate as N	0.5 mg/L
Hydroxide Alkalinity, $CaCO_3$	0 mg/L		
Chloride, as Cl	3.9 mg/L		
Sulfate, as SO_4	4.9 mg/L		
Fluoride as F	1.02 mg/L		
Phosphate, as PO_4	0.41 mg/L		

Andrew Pappachen

Andrew Pappachen, Director

ATTACHMENT 4

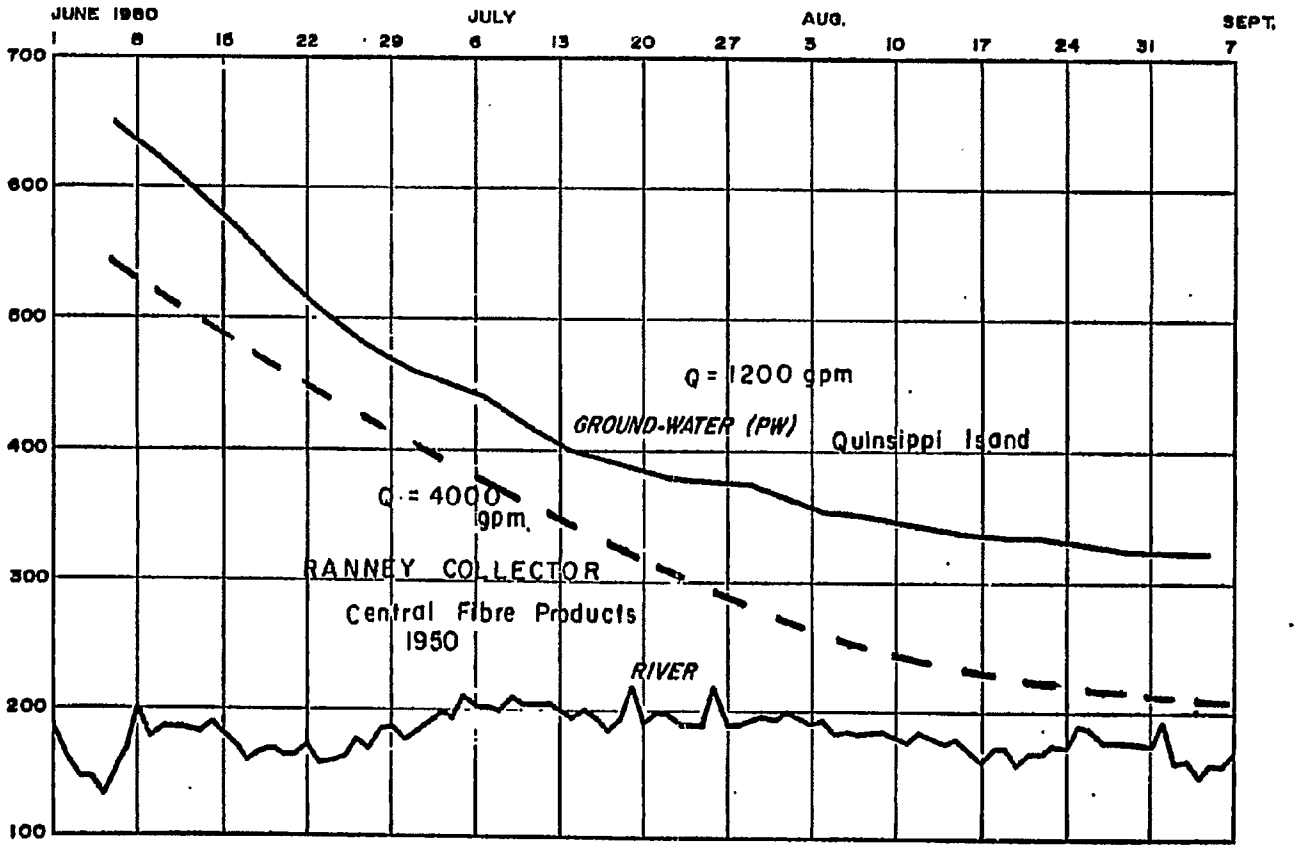

Fig. 16 : RIVER / GROUND-WATER HARDNESS CORRELATION .

City of Quincy, Illinois

Attachment B

TRI-STATE SYNFUELS COMPANY
Indirect Coal Liquefaction Plant
Western Kentucky

FLUOR ENGINEERS AND CONSTRUCTORS, INC.
Contract 835504

SUPPORT MATERIAL

Structural Development Study Number 10

Ranney Water System Versus Intake Structure

Support Material - Table of Contents

APPENDIX A

Intake Structure Designed By Fluor
Including Request for Cost Estimate

305 Cpy

FLUOR

INTEROFFICE CORRESPONDENCE

To: MIKE NORMAN | Date: July 28, 1981

Location: AT2-D1-V9 | Reference: 835504-SO

From: J. G. SHIPP | Client: Tri-State

Location: AT2-D1-E12 | Subject: WATER INTAKE STRUCTURE COST ESTIMATE

Please provide a cost estimate for the attached water intake structure and summary as follows:

ITEM	DESCRIPTION	VOLUME	COST CRITERIA		TOTAL COST
Pump House	Concrete	27.2 CY			
	Concrete Block	1659			
	Roof				
	W8x21	1890 lb.			
	W8x15	1350 lb.			
	Deck	900 S.F.			
	Builtop roof	707 S.F			
	Steel Reinf.				
	# 8	2808 L.G.			
	# 5	1404 L.F.			
	Structure Above Eleveation 381'				
Concrete Cassion	Concrete	341.3 CY			
	Excavation	465.4 CY			
	Steel Reinf.				
	#9	31,862 L.F.			
	From Elev. 381' to Elev. 305' 20' O.D. W/Conc. Plug in bottom				
6' Diam. Jacked Pipe	6' Diam Concrete Pipe	370 L.F			
	Excavation	387.5 CY			
	Materials to Jack through (Length=370')				
	1. Little Resistance				
	2. Moderate Resistance				
	3. Firm Resistance				

FORM G-49 REV. 2/76
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FLUOR

INTEROFFICE CORRESPONDENCE CONTINUATION

July 28, 1981

ITEM	DESCRIPTION	VOLUME	COST CRITERIA		TOTAL COST
Velocity Cap	Concrete	17.3 CY			
	.25" Screen	144 S.F.			
	12' -0 Square Box on River Bottom				
	1. Construction Cost of Coffer				
	2. Cost of Structure				
Electrical	See Item A				134.000
Pumps & Motors	See Item B	2 units @ $136.807 each			273,614
Total Cost of Water Intake Structure					

If you have any questions please contact me on ext. 5097
Please arrange to return estimate by August 28, 1981.

J. G. Shipp

JGS/pp

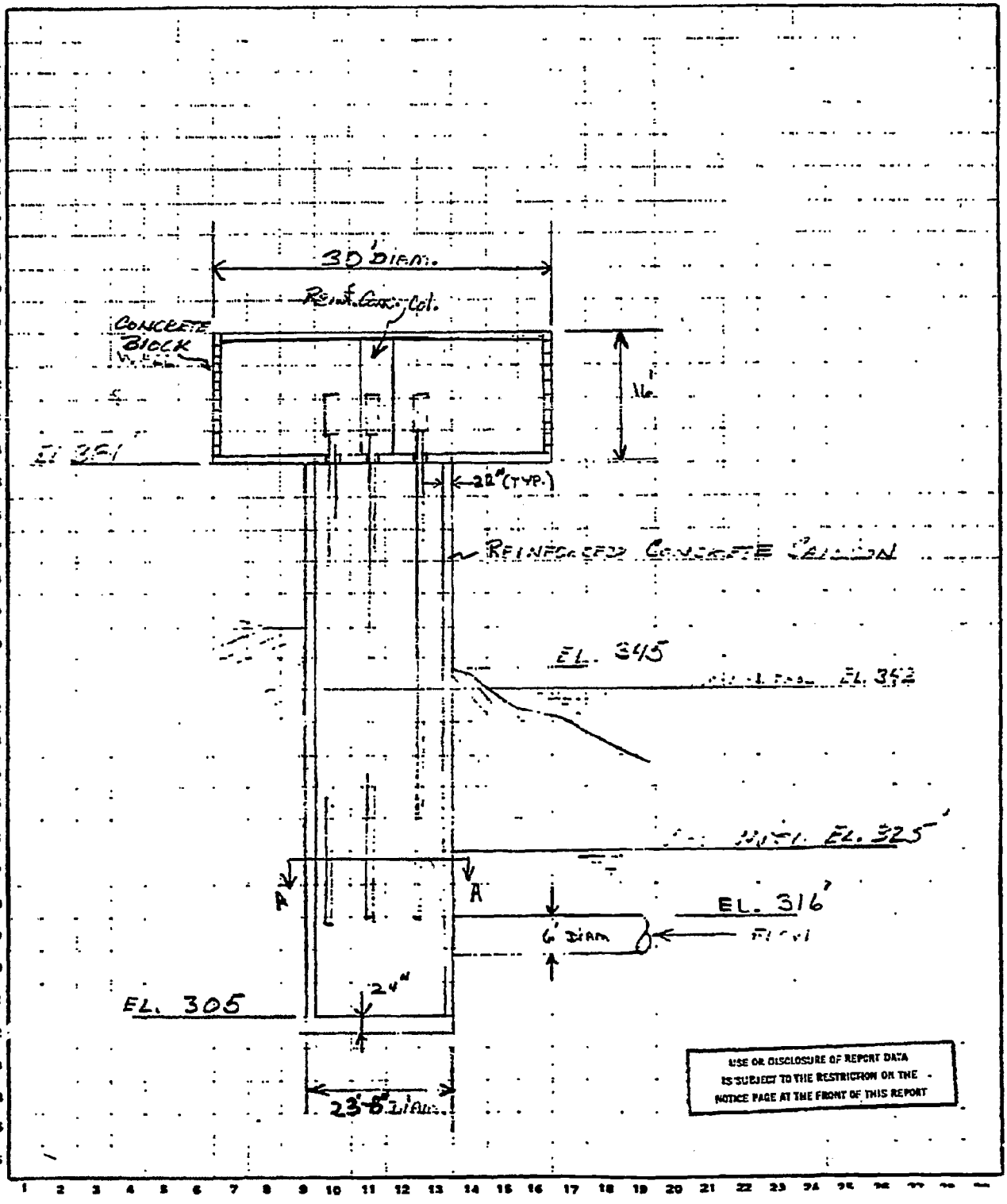
attachments

FORM G-48 (CONT.) REV. 6/72
PRINTED IN U.S.A.

FLUOR

CALCULATIONS and SKETCHES

DATE 7/87
CONT. NO. 833-054
BY EH. CHK'D
SHEET NO. SK-1



FORM E-050 REV. 4/69
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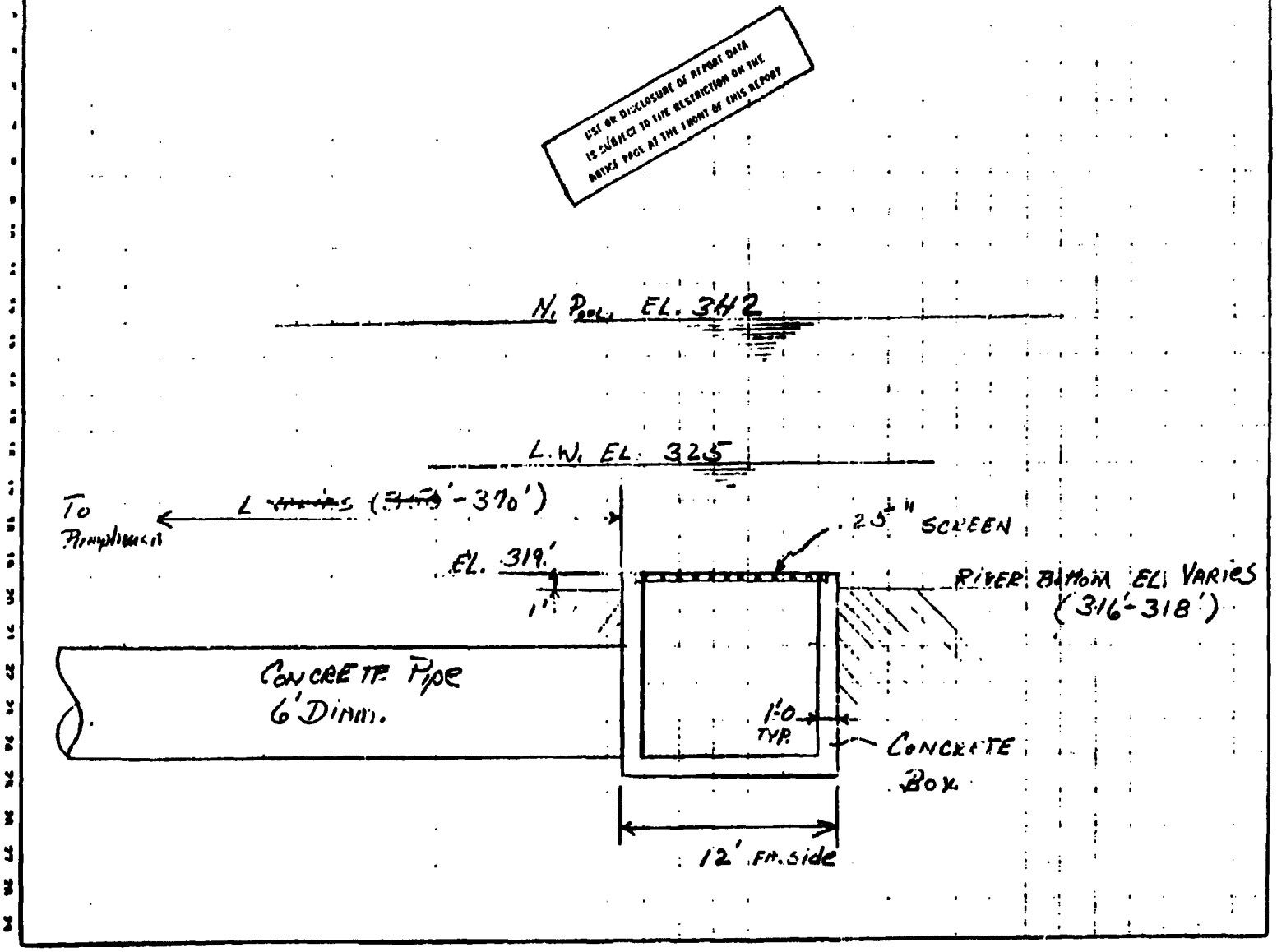


FLUOR

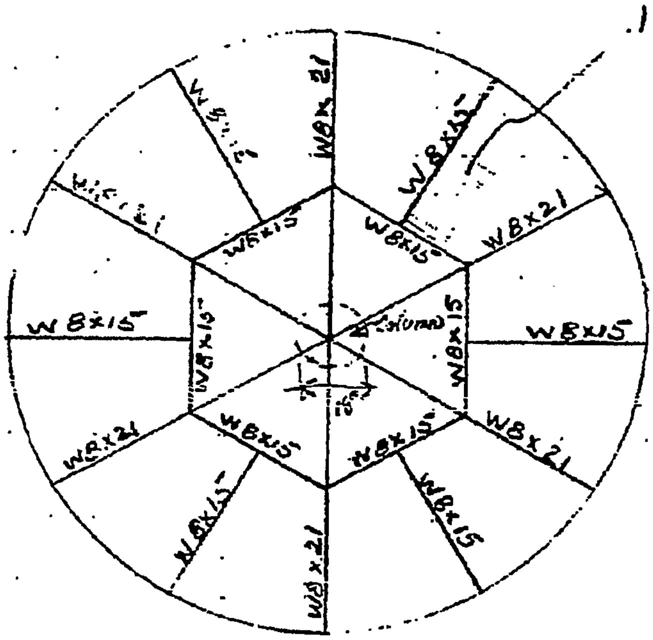
CALCULATIONS and SKETCHES

DATE 7-7-81
CONT. NO. X-2-530
BY TH CHK'D
SHEET NO. 24-2

FLUOR

CALCULATIONS and SKETCHES

DATE 7-7-81
CONT. NO. 835584
BY — CHK'D
SHEET NO. SK-3



PLAN [illegible] ROOF

FLUOR

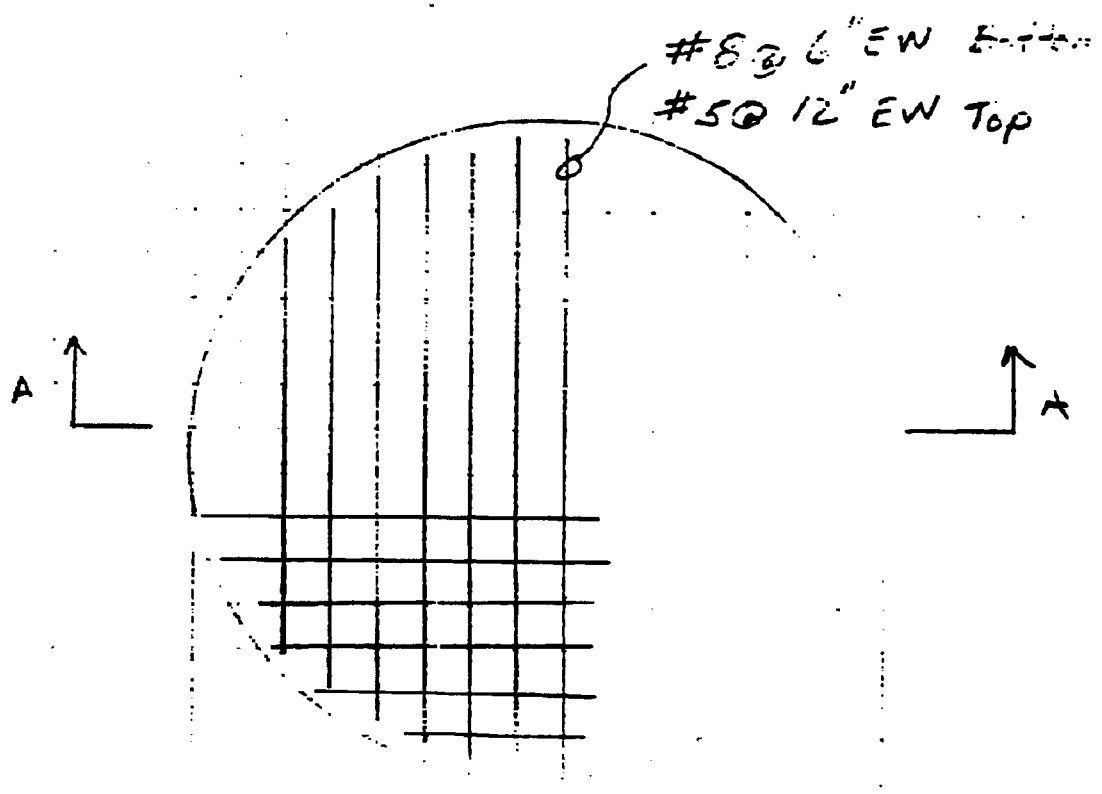
CALCULATIONS and SKETCHES

DATE 7-7-81

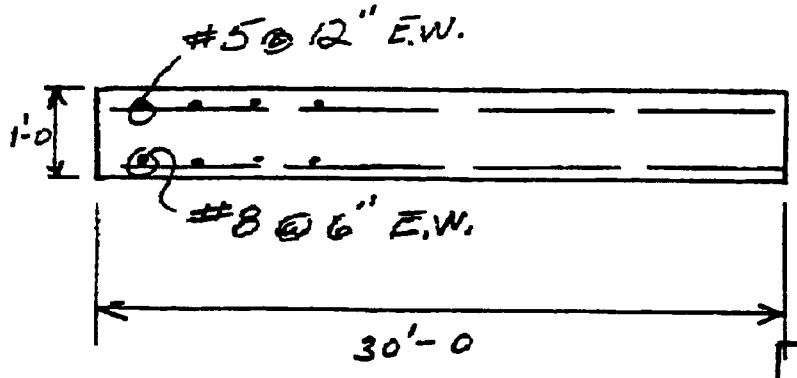
CONT. NO. 8350.16

BY T. F. CHK'D

SHEET NO. SA-4



PLAN SLAB (Pump house)

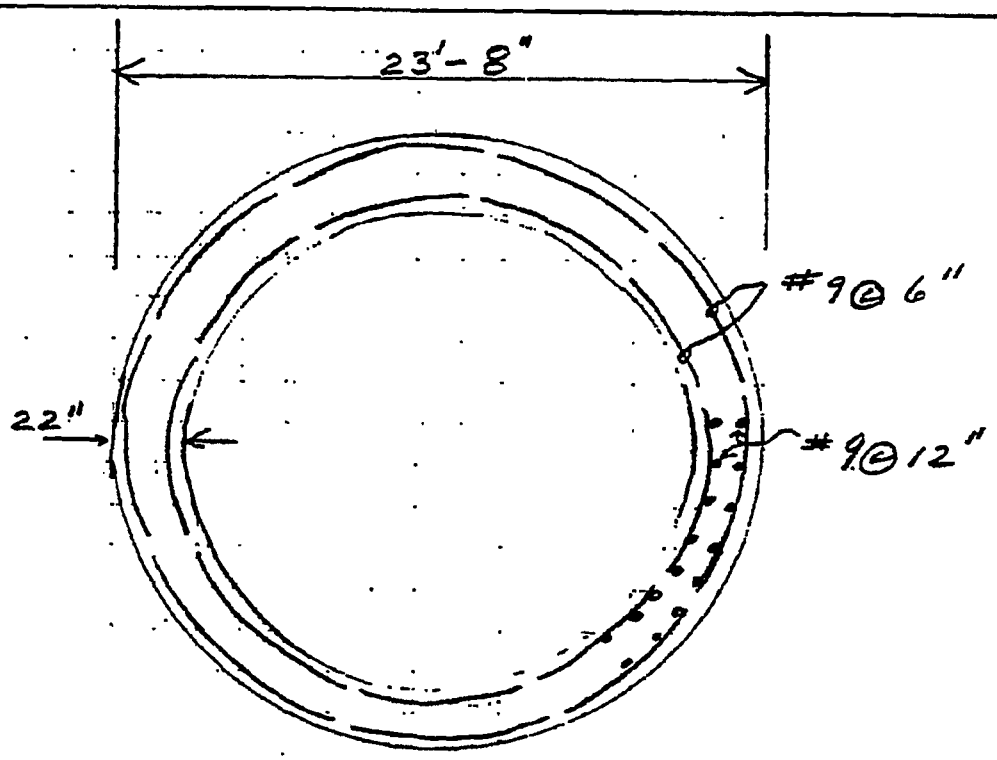


SECTION A-A

FLUOR

CALCULATIONS and SKETCHES

DATE 7-7-81
CONT. NO. 83-102
BY J.H. CHK'D
SHEET NO. SK-5



SECTION B-B

FLUOR

CALCULATIONS and SKETCHES

DATE 8-13-81
CONT. NO. 635304
BY JEH CHK'D
SHEET NO. 1 of 2

MATERIAL TAKEOFF

ITEM		Unit	Volume
CONCRETE			
Cassion	$\left[\frac{\pi(22')^2}{4} - \frac{\pi(18.33')^2}{4}\right]\left[381 - 3.5\right]\left(27\frac{ft^3}{CY}\right)$	CY	327.2
Plug	$\left[\frac{\pi(22')^2}{4}(2')\right]/27$	CY	14.1
Floor Slab	$\left[\frac{\pi(30)^2}{4} \times 1'\right]/27$	CY	26.2
Columns	$\left[\frac{\pi(1.5')^2}{4} \times 15'\right]/27$	CY	1.0
Intake Screen	$\left[2(12\times9\times1)+2(10\times9\times1)+(10\times10\times1)-\left(\frac{\pi(6)^2}{4}\times1\right)\right]/27$	CY	17.3
	144	SF	144
Pipe (6' Diam)		LF	370'
Excavation			
Cassion	$\left[\frac{\pi(20)^2}{4} \times 40\right]/27$	CY	465.4
6' Diam Pipe	$\left[\frac{\pi(6)^2}{4} \times 370\right]/27$	CY	387.5
CONCRETE BLOCK (8"x8"x16")	1474.4 SF / .88 $\frac{SF}{Block}$	unit	1659
ROOF			
W8x21	6 @ 15': 6x15x21	lb.	1890
W8x15	12 @ 7.5': 12x7.5x15	lb.	1350
DECK	THE: Inryco 1½"-A-22 ga.		
	30x30	SF.	900
Built up Roof	$\pi(30)^2/4$	SF	707
STEEL REINF.			
SLAB	#8 - 26x54x2	LF	2808
	#5 - 26x27x2	LF	1404

FLUOR

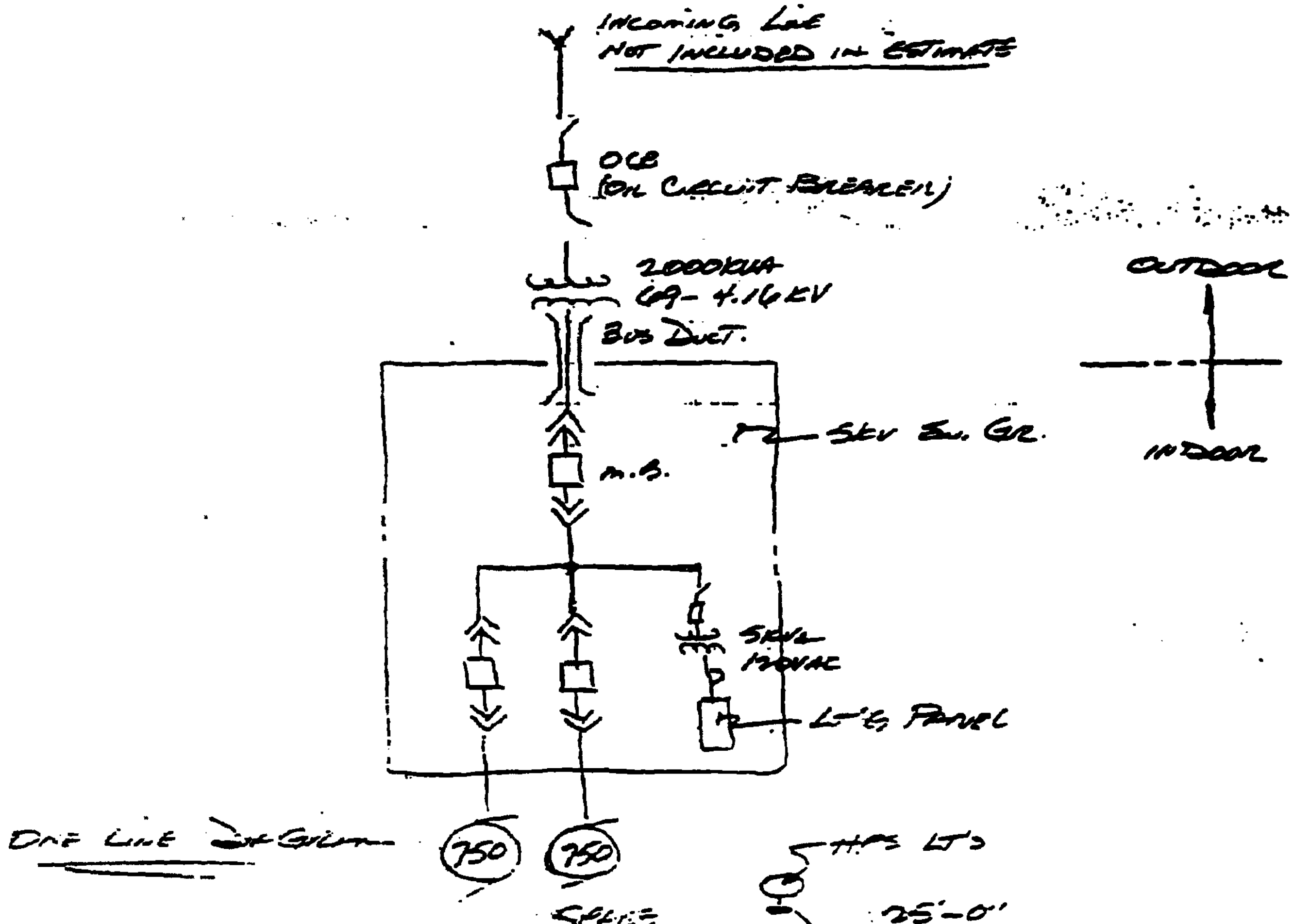
CALCULATIONS and SKETCHES

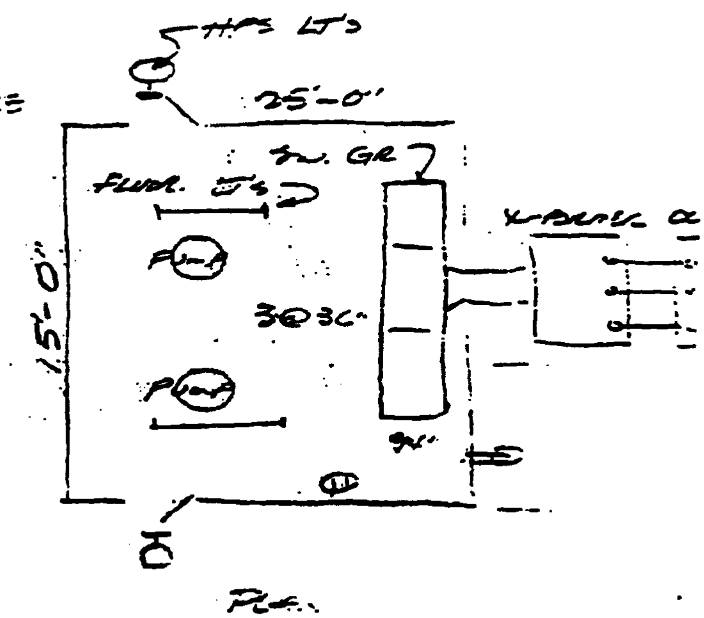
DATE
CONT. NO.
BY JCH CHK'D
SHEET NO. 2 of 2

		Unit	Total
STEEL REINF.			
CASSION	HORIZONTAL #9: 153 X [2π(11.66 + 10.17)]	LF.	20,952 ✓
	VERTICAL #9: [68 X 80] 2	LF.	10,880 ✓

Typical Estimate
pumping station

Jn 5132
July 28, 1981
Ed Cook





PLAN

ITEM (A)

Elec Est.
pumping station

The State
July 28, 1981

Rough Estimate Only
Based on Similar Projects for Hampshire

Major Equip.	100,000.-
Sw. Gr.	
X-form.	
O.C.B.	
etc.	
Misc Equip.	6000.-
Bus	
Meters	
etc.	
Sub Total	106,000.-

Man Hours for Installation
800 hrs.

800 hrs x $35/hrs = 28000.-

TOTAL 134,000. ±

± Estimate assumes power comes from utility source at the pumping station & not from the plant switchyard

ITEM (6)

[illegible] INFORMATION [illegible]

HP	Voltage	Phase	Enclosure
1/2 → 250	460V	3	TEFC
250 → 1000	4160V	↓	WP-I
ABOVE 1000	13.8KV or 4160V	↓	WP-II.

BREAK HP.

No. [illegible] - Whatever you [illegible]
Flow - 18,000 GPM
T.D.H. = 137 feet

AT2-D1-E16
James Harris
X5095

1 operating.
1 spare
- 36" GOULDS
- Vertical Turbine type
[illegible] - like [illegible] or enclosed line shaft
- bottom support req'd.

PRICING

TYPE	$ AMT
PUMP	81,909
MOTOR	54,898
total length - 66'	
FREIGHT	
EXP. PACK	—
TOTAL EACH	$136,807
QUANTITY	2
TOTAL	$273,614

7-16-81 D. WALKER

BHP 778

EFFIC 80%

COOLING WATER No

GOULDS - VIT
36EHC @ 880 RPM
NPSHR ~ 27'
DELIVERY ~ 40 wks.
MOTOR ~ 900 H.P. @ 900 RPM.
MATL ~ CI/BRZ.

FLUOR

INFO-MEMO

TO: JOHN SHIPP · DATE: 8/17/81

ATION: AT2-D1-E12 REFERENCE: 835504-50.

FROM: BOB CUSTOMER: TRI-STATE

LOCATION: A4-1-101 (375-3628) SUBJECT: PUMP HOUSE

JOHN;

ENCLOSED - MY IDEAS ON PUMP HOUSE & INTAKE INSTALLATION FOR COMMENTS

ANY CHANGES, QUESTIONS ETC. GIVE ME A CALL.

ESTIMATE TO FOLLOW LATER.

SIGNED: BOB SEEDS.

PLEASE REPLY HERE

TO: DATE:

SIGNED:

NOTE: INDIVIDUAL ORIGINATING MEMO RETAINS THIRD COPY.
FORWARDING FIRST AND SECOND.
ADDRESSEE REPLIES AND RETURNS ORIGINAL TO ORIGINATOR.

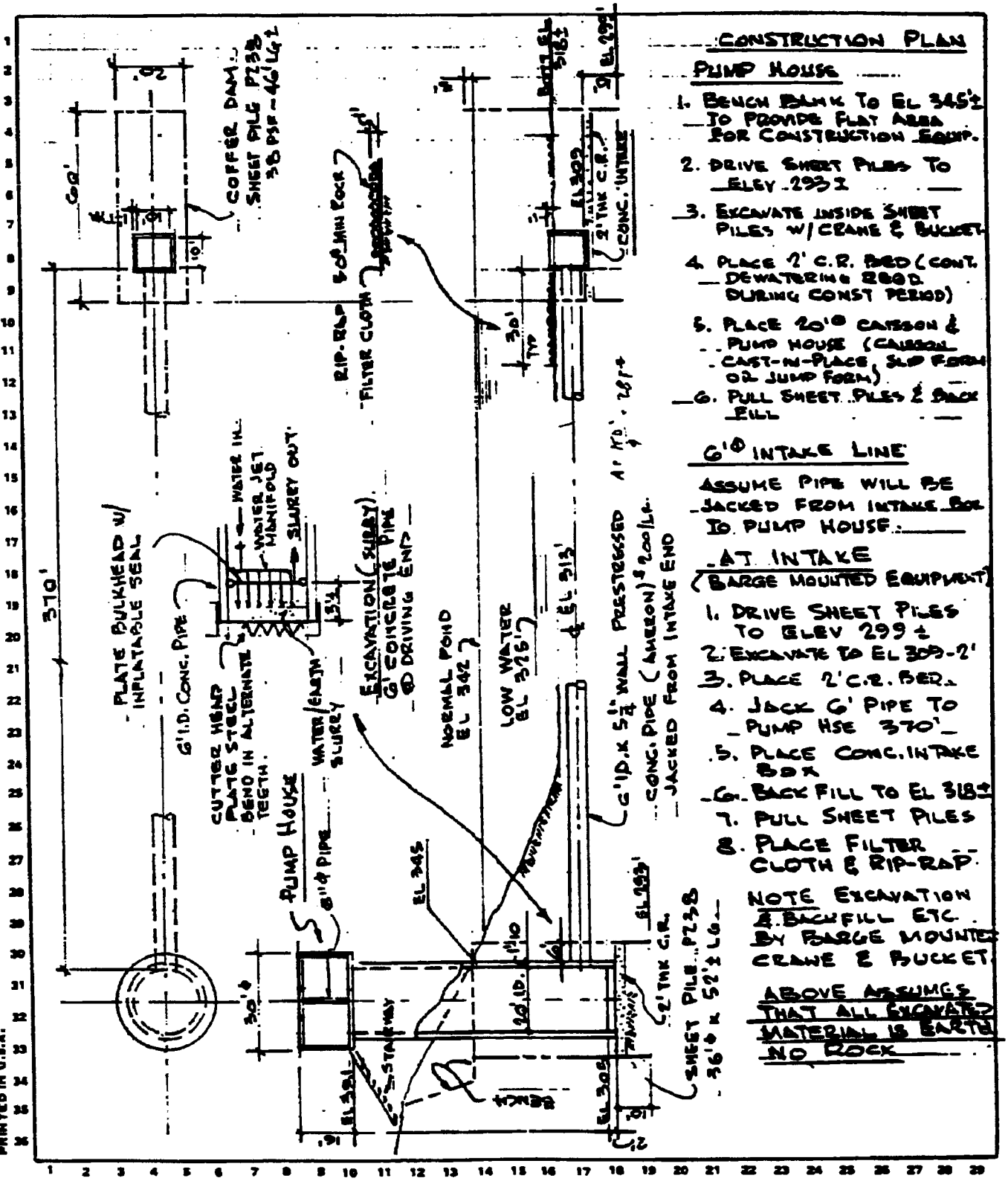
FLUOR

CALCULATIONS and SKETCHES

DATE 8/16/81
CONT. NO. 835804-50
BY SEARS CHK'D
SHEET NO. 1 OF 3

TRI-STATE

WATER INTAKE STRUCTURE



CONSTRUCTION PLAN

PUMP HOUSE

1. BENCH BANK TO EL 345'± TO PROVIDE FLAT AREA FOR CONSTRUCTION EQUIP.
2. DRIVE SHEET PILES TO ELEV 293 ±
3. EXCAVATE INSIDE SHEET PILES W/ CRANE & BUCKET
4. PLACE 2' C.R. BED (CONT. DEWATERING REQD. DURING CONST PERIOD)
5. PLACE 20'ø CAISSON & PUMP HOUSE (CAISSON CAST-IN-PLACE, SLIP FORM OR JUMP FORM)
6. PULL SHEET PILES & BACK FILL

6'ø INTAKE LINE

ASSUME PIPE WILL BE JACKED FROM INTAKE BOX TO PUMP HOUSE.

AT INTAKE

(BARGE MOUNTED EQUIPMENT)

1. DRIVE SHEET PILES TO ELEV 299 ±
2. EXCAVATE TO EL 309-2'
3. PLACE 2' C.R. BED
4. JACK 6' PIPE TO PUMP HSE 370'
5. PLACE CONC. INTAKE BOX
6. BACK FILL TO EL 318±
7. PULL SHEET PILES
8. PLACE FILTER CLOTH & RIP-RAP

NOTE EXCAVATION & BACKFILL ETC. BY BARGE MOUNTED CRANE & BUCKET

ABOVE ASSUMES THAT ALL EXCAVATED MATERIAL IS EARTH NO ROCK

FLUOR

CALCULATIONS and SKETCHES

DATE 8/16/81
CONT. NO. 835504-50
BY SEARS CHK'D
SHEET NO. 2 OF 3

TRI-STATE

WATER INTAKE STRUCTURE

PUMP HOUSE STRUCTURE

EXCAVATION		
BENCH	ASSUME 100'$^{\text{D}}$ x 5' DEEP AVG : 100^3 x 5' / 27 = 1852	1850 CY
CAISSION	0.7854(36'^{2})(44')/27 = 1659	1660 CY
CRUSHED ROCK BED	0.7854(36'^{2})(2)/27 = 75	75 CY.
SHEET PILES	36ft x 52 = 5881 SF x 38PSF/2000 = 111.7 T	118.0 TON.
BACKFILL	0.7854(36^2 − 23.7^2) 44'/27 = 939 CY (5765 SF)	940 CY.
CONCRETE		
PUMP HSE FLOOR	0.7854(30^2)(1)/27 = 26.2 CY (707 SF)	26.2 CY.
CAISSON	21.83ft (1.83)/27 = 4.65 CY/LF x 78' = 362.7 CY	362.7 CY
BOTTOM PLUG	0.7854(20^2)(2)/27 = 23.3 CY	23.3 CY
PUMP HOUSE	(0.7854(30'^{2}) = 707 SF	
ROOF	3 PLY COMPO & GRAVEL	707 SF
	2" RIGID BOARD INSULATION	707 SF
	1 1/2" x 22GA STEEL DECK	707 SF
	GRAVEL STOP 30ft	95 LF
ROOF STEEL	W8x21 $\frac{3}{30}$ ~ 90LF x 21 = 1890	2.0 TONS
	W8x15 $\frac{17}{8}$ ~ 96 x 15 = 1440	
	CENTER POST 6" SCH 40 PIPE 16' x 19PLF = 300	
	CAP PL − 2'$^{\text{D}}$ x 1/2" PL 0.7854(2^2)(20.4PSF) = 64	
	BASE PL 12"$^{\text{D}}$ x 1/2" PL = 16	
	3710 + 370 + 10% = 4080#	
WALLS	8" CONC BLOCK 30ft x 16' = 1508 SF	1510 SF
	LIGHTING	707 SF
	HVAC	707 SF
DOOR	PR 6'0" x 7'0"	1 EA.
ENTRANCE STAIRS	(36' VERT) (ALLOW)	2 TON.
	LANDING SAY. 5' x 10' x 25PSF	1.3 TON

FLUOR

CALCULATIONS and SKETCHES

DATE 8/16/91
CONT. NO. 855504-50
BY SEARS CHK'D
SHEET NO. 3 OF 3

TRI-STATE

WATER INTAKE STRUCTURE

INTAKE — 1200 SF

EXCAVATION $20'(60')(318'-30')/27 = 489^{CY}$ — 490^{CY}

SHEET PILES $2(20+60) = 160 LF \times 46' = 7360^{SF} \times 38 PSF/2000 = 139 T$ — 140 TONS

CRUSHED ROCK BED $20(60)(2)/27 = 88.9$ — 90^{CY}

BACKFILL $490 - 90 - [12'^2(10')/27] = 347^{CY}$ — 350^{CY}

INTAKE SILT PROTECTION (AROUND CONC INLET BOX) $30+30+12 = 72'$

FILTER CLOTH $72^2 - 12^2 = 5040^{SF}$ + 10% LAPS = SAY — 5500^{SF}

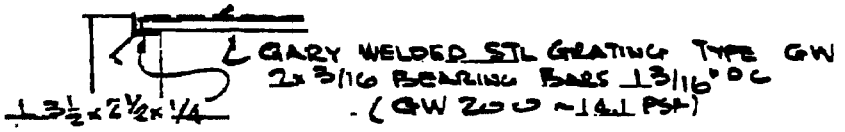
RIP-RAP $5040^{SF}(1)/27 = 187^{CY}$ — 190^{CY}

CONCRETE

INLET BOX WALL $44 \times 10 \times 1 = 440$
BOTT $12^2 \times 1 = 144$
$584/27 = 21.6^{CY}$ — 21.6^{CY}

STEEL COVER — $10.5'SQ = 110^{SF}$ — 110^{SF}

¼" MESH SCREEN



6'Φ PRESTRESSED PIPE (JACKED IN PLACE) — 370 LF

6' ID x 5¼" WALL 1623 PLF (AMERON) $1623 PLF(370')/2000 = 300^{T}$

NOTE EXCAVATION ASSUMED PER EXCAVATION (SURRY) DETAIL (SH #1) PUMP INTO POND @ INTAKE END OR PUMP TO SHORE

APPENDIX B

Cost Estimate for Intake Structure Designed by Fluor

FLUOR

INFO—MEMO

TO: JOHN SNIPP DATE: 8-26-81

LOCATION: AT2-D1-E12 REFERENCE:

FROM: DON HARRIS CUSTOMER: TRI STATE SYNFUELS

LOCATION: AT2 D1 V10 SUBJECT:

THE COMPLETE SELL PRICE FOR THE WATER INTAKE STRUCTURE, INCLUDING SUB CONTRACTED CONSTRUCTION, FIELD SUPERVISION AND QC AND HOME OFFICE ENGINEERING IS $1,751,000.

LET ME KNOW IF YOU HAVE FURTHER QUESTIONS

SIGNED Don R Harris

PLEASE REPLY HERE

TO: DATE:

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SIGNED

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FORM G-57 REV. 6/71

COST ESTIMATE

FLUOR

CLIENT Tri-State Synfuels | DESCRIPTION Water Intake Structure | PROP. NO. | W.O. NO. | CONT. NO. 635504 | MADE BY | APPROVED BSC

LOCATION Henderson, KY

PROJECT Coal Gasification Plant

A/C NO.	ITEM & DESCRIPTION	MANHOURS	ESTIMATED COST LABOR	SUB-CONTRACTS	MATERIALS	TOTAL
	Complete Water Intake Str. Incl. Pump House, Caisson, Jacked Pipe, Velocity Caissons, Electric Pumps & Motors			1,268 000		1,268 000
	Constr. Sup. QC, Contract Admin. Cost & Fees	2240	33 600			33 600
	DIRECT FIELD COSTS		33 600	1268 000		1301 600
90-00	International Expense					
91-00	Temporary Construction Facilities					
92-00	Constr. Services, Supplies & Expense					
93-00	Field Staff, Subsistence & Expense					33 600
94-00	Craft Benefits, Payroll Burdens & Insur.					
95-10	Equipment Rental					
95-50	Small Tools					
99-40	Field Staff Overhead Costs					
	INDIRECT FIELD COSTS					33 600
	TOTAL FIELD COSTS					1335 200
96-00	Home Office Construction					
	Project Engineering					
	Process Engineering					
	Design					
	Purchasing					
	Business Services					
97-00	Office Expense 17% DFC					
98-00	Office Payroll Burdens					
99-50	Office Overhead Costs					
	TOTAL OFFICE COSTS					221 272
	TOTAL FIELD & OFFICE COSTS					1556 472
98-30	Sales Tax					
98-10	Escalation					
98-20	Contingency 10%					155 647
	TOTAL					1712 119
99-60	Fee					38 912
	TOTAL PROJECT					1751 031
					549	1175.1 000

17%

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DATE _____ REVISION NO. _____ REVISION DATE _____ PAGE NO. _____

FORM E-154A REV. 1/80

PRINTED IN A.

CLIENT IRI. STATE

CONSTRUCTION COSTS

FLUOR

LOCATION HENDERSON KY. — WATER INTAKE STRUCTURE — C.O. NO. _____ JOB NO. 8355-21

PROJECT COAL GASIFICATION PLANT — SUMMARY — MADE BY SEARS APVD. _____

A/C NO.	ITEM & DESCRIPTION	QUAN.	UNIT	MANHOURS PER UNIT	MANHOURS TOTAL	MANHOURS RATE	COST/UNIT LABOR	COST/UNIT SUB CONTR.	COST/UNIT MAT'L	COSTS ( ) LABOR	COSTS ( ) SUB CONTRACT	COSTS ( ) MATERIAL	COSTS ( ) TOTAL
	SUMMARY												
	STRUCTURE ABOVE ELEV 381' (PUMP HOUSE										48000		
	CONCRETE CAISSON										334000		
	81" Φ JACKED PIPE										333000		
	VELOCITY CAP										145000		
	ELECTRICAL										134000		
	PUMPS & MOTORS										274000		
											1,268,000		

CLIENT JKL STATE — CONSTR' ON COSTS — FLUOR

LOCAT. HENDERSON KY — WATER INTAKE STRUCTURE — C.O. NO. _____ JOB NO. 835504

PROJECT COAL GASIFICATION PLANT — STRUCTURE ABOVE EL 381' — MADE BY SEARS APVD. _____

A/C NO.	ITEM & DESCRIPTION	QUAN.	UNIT	MANHOURS PER UNIT	MANHOURS TOTAL	MANHOURS RATE	COST/UNIT LABOR	COST/UNIT SUB CONTR.	COST/UNIT MAT'L	COSTS ( ) LABOR	COSTS ( ) SUB CONTRACT	COSTS ( ) MATERIAL	COSTS ( ) TOTAL
	30'Φ X 16' HIGH PUMP HOUSE	707	SF										
	ROOF												
	4 PLY COMPO & GRAVEL	707	SF					1.00			710		
	2" RIGID BOARD INSULATION	707	"					0.80			570		
	1 1/2" x 22GA GALV. STEEL DECK	707	"					1.70			1200		
	GRAVEL STOP	95	LF					5.00			480		
	ROOF STEEL (LIGHT)	2.0	TON					2000			4000		
	WALLS												
	8" REINF CONC. BLOCK	1510	SF					6.00			9060		
	FLOOR SLAB (ELEVATED)												
	STRUCTURAL CONCRETE	26.2	CY					600			15720		
	ENTRANCE DOOR PR 6'0"x7'0"	1	EA					600			600		
	DO STAIRS STEEL	2	TON					2200			4400		
	DO LANDING DO 5'#10'	1.3	TON					2200			2860		
	PAINTING												
	CONC. BLOCK 1 SEAL 2 FINISH = 3 COAT	3020	SF					0.65			1960		
	STR STEEL 2+2+1.3 = 2 COAT	5.3	TON					130			690		
	ELECTRICAL LIGHTING	707	SF					5.00			3540		
	HVAC (WALL UNITS)	2	EA					800			1600		
											47390		
										SAY	48000		
	$48000/707^{SF} = $67.90/SF.												

CLIENT TRI-STATE

LOCATI HENDERSON KY.

PROJECT COAL GASIFICATION PLANT

CONSTR[illegible]ON COSTS

WATER INTAKE STRUCTURE

CAISSION ~ EL 305 TO 331'

FLUOR

C.O. NO. _____ JOB NO 835504-

MADE BY SEARS APVD. _____

A/C NO.	ITEM & DESCRIPTION	QUAN.	UNIT	MANHOURS PER UNIT	MANHOURS TOTAL	MANHOURS RATE	COST/UNIT LABOR	COST/UNIT SUB CONTR.	COST/UNIT MAT'L	COSTS ( ) LABOR	COSTS ( ) SUB CONTRACT	COSTS ( ) MATERIAL	COSTS ( ) TOTAL
	CAISSION 20' I.D. x 1'-10" WALL x 78' LONG												
	EXCAVATION												
	CUT BENCH (BULL DOZER)	1850	CY					3.00			5550		
	CAISSON PIT (CLAMSHELL)	1660	CY					5.50			9130		
	BACKFILL (COMP. 8" LIFTS)	940	CY					6.80			6300		
	CRUSHED ROCK BED	75	CY					10.00			750		
	SHEET PILES PZ35 (59000 SF) (DRIVE PULL & SALVAGE)	118	TON					400			47200		
	SHEET PILE WALERS	47200	#					20%			9440		
	CONCRETE												
	CAISSON 20'ID x 1'-0 WALL x 78'	363	CY					600			217.800		
	BOTTOM PLUG 20'0" x 2'THK	24	CY					600			14,400		
	PUMPING PIT. ALLOW	3	MO					6000			18000		
	MOBILIZATION & DEMOB	ALLOW									5000		
											333660		
										USE	334,000		

DATE _____ REVISION NO. _____ REVISION DATE _____ CODE _____ PAGE NO. _____

LOCATION HENDERSON KY — WATER INTAKE STRUCTURE — C.O. NO. _____ JOB NO. 835504-5

PROJECT COAL GASIFICATION PLANT .. 6'Φ CONCRETE PIPE INLET . — MADE BY SEARS . APVD. _____

A/C NO.	ITEM & DESCRIPTION	QUAN.	UNIT	MANHOURS PER UNIT	MANHOURS TOTAL	MANHOURS RATE	COST/UNIT LABOR	COST/UNIT SUB CONTR.	COST/UNIT MAT'L	COSTS ( ) LABOR	COSTS ( ) SUB CONTRACT	COSTS ( ) MATERIAL	COSTS ( ) TOTAL
	CONCRETE PIPE WATER INTAKE (JACKED INTO PLACE)												
	6' I.D. CONCRETE PIPE	370	LF					900			333,000		

CLIENT CI-STATE

LOCATIO HENDERSON KY

PROJECT COAL GASIFICATION PLANT

CONSTRUCTION COSTS

WATER INTAKE STRUCTURE

VELOCITY CAP

FLUOR

C.O. NO. _____ JOB NO. 835504-S

MADE BY SEARS APVD. _____

A/C NO.	ITEM & DESCRIPTION	QUAN.	UNIT	MANHOURS PER UNIT	MANHOURS TOTAL	MANHOURS RATE	COST/UNIT LABOR	COST/UNIT SUB CONTR.	COST/UNIT MAT'L	COSTS ( ) LABOR	COSTS ( ) SUB CONTRACT	COSTS ( ) MATERIAL	COSTS ( ) TOTAL
	VELOCITY CAP ~ WATER INLET												
	EXCAVATION												
	INSIDE SHEET PILES (CLAMSHELL)	490	CY					5.50			2700		
	CRUSHED ROCK BED	90	L					10.00			900		
	BACKFILL (COMP 8" LIFTS)	350	L					6.80			2380		
	SHEET PILES PZ38 (7360 SF)	140	TON					400			56000		
	DRIVE, PULL & SALVAGE												
	SHEET PILE WALERS	56M	$					20%			11200		
	WATER INLET - SILT PROTECTION												
	FILTER CLOTH	5500	SF					0.50			2750		
	RIP-RAP	190	CY					40			7600		
	CONCRETE INLET BOX	22	CY					600			13200		
	12'Φ x 10' HIGH WALLS												
	INLET BOX COVER (110 SF)	1	EA								2200		
	2" GARY GRATING W/ 1/4" MESH SCREEN												
	PUMPING PIT (ALLOW)	3	MO					6000			18000		
	MOBILIZATION & DEMOB	ALLOW									5000		
	MISCELLANEOUS												
	BARGE RENTAL @ $3000/MO	3	MO					6000			18000		
	1 CRANE 1 MATR = 2 EA												
	CREW BOAT	3	MO					1000			3000		
	DIVER $250/DAY	10	DAYS					250			2500		
	NOTE: ABOVE ASSUMES THAT 6'Φ CONC. PIPE WILL BE JACKED FROM THIS END										145,430		
										USE	145,000		

DATE _____ REVISION NO. _____ REVISION DATE _____ CODE _____ PAGE NO. _____

PRINTED IN U.S.A.

FORM E-163A REV. 11/72

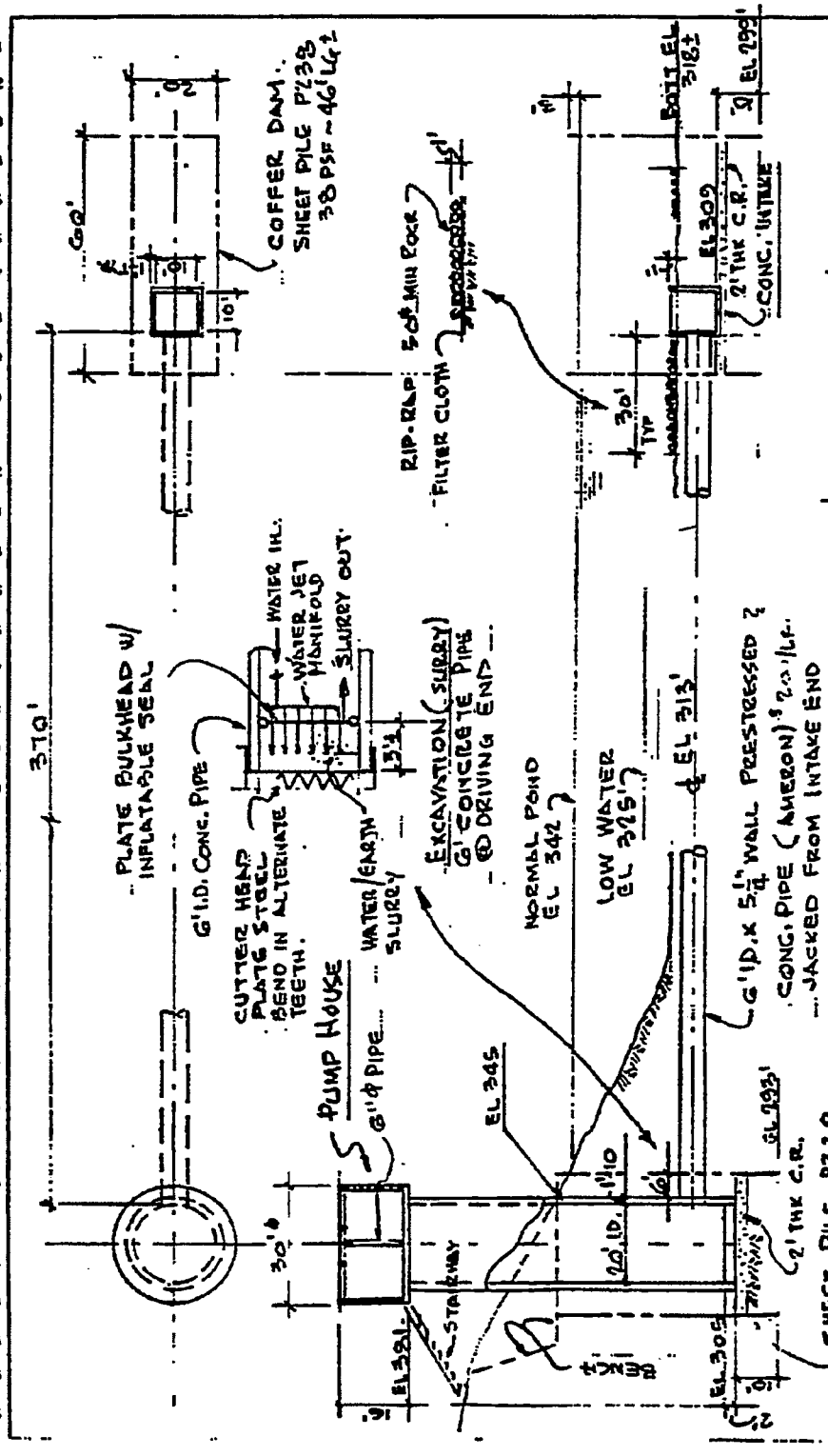
FLUOR

CALCULATIONS and SKETCHES

DATE 8/16/81
CONT. NO. 835504-50
BY SEARS CHK'D
SHEET NO. 1 OF 3

TRI-STATE

WATER INTAKE STRUCTURE



CONSTRUCTION PLAN

PUMP HOUSE

1. BENCH BANK TO EL 345'± TO PROVIDE FLAT AREA FOR CONSTRUCTION EQUIP.
2. DRIVE SHEET PILES TO ELEV 293'±
3. EXCAVATE INSIDE SHEET PILES W/ CRANE & BUCKET
4. PLACE 2' C.R. BED (CONT. DEWATERING REQ'D DURING CONST PERIOD)
5. PLACE 20'ϕ CAISSON & PUMP HOUSE (CAISSON. CAST-IN-PLACE, SLIP FORM OR JUMP FORM)
6. PULL SHEET PILES & BACK FILL

6'ϕ INTAKE LINE

ASSUME PIPE WILL BE JACKED FROM INTAKE BOX TO PUMP HOUSE.

AT INTAKE (BARGE MOUNTED EQUIPMENT)

1. DRIVE SHEET PILES TO ELEV 299'±
2. EXCAVATE TO EL 309-2'
3. PLACE 2' C.R. BED.
4. JACK 6' PIPE TO PUMP HSE 370'
5. PLACE CONC. INTAKE BOX
6. BACK FILL TO EL 318±
7. PULL SHEET PILES
8. PLACE FILTER CLOTH & RIP-RAP

NOTE EXCAVATION & BACKFILL ETC. BY BARGE MOUNTED CRANE & BUCKET.

ABOVE ASSUMES THAT ALL EXCAVATED MATERIAL IS EARTH - NO ROCK.

FLUOR

CALCULATIONS and SKETCHES

DATE 8/16/81
CONT. NO. 835504-S0
BY SEARS CHK'D
SHEET NO. 2 OF 3

TRI-STATE

WATER INTAKE STRUCTURE

PUMP HOUSE STRUCTURE

EXCAVATION		
BENCH ASSUME	$100' \times 100' \times 5'$ DEEP AVG $100^3 \times 5'/27 = 1852$	1850 CY
CAISSON	$0.7854(36')^2(44')/27 = 1659$	1660 CY
CRUSHED ROCK BED	$0.7854(36')^2(2)/27 = 75$	75 CY.
SHEET PILES	$36\pi \times 52 = 5881^{SF} \times 38 PSF/2000 = 111.7^T$	118.0 TON.
BACKFILL	$0.7854(36^2 - 23.7^2)\,44'/27 = 939^{CY}$ (5765^{SF})	940 CY.
CONCRETE		
PUMP HSE FLOOR	$0.7854(30^2)(1)/27 = 26.2$ CY (707^{SF})	262 CY.
CAISSON	$21.83\pi\,(1.83)/27 = 4.65^{CY/LF} \times 78' = 362.7^{CY}$	362.7 CY
BOTTOM PLUG	$0.7854(20^2)(2)/27 = 23.3^{CY}$	23.3 CY
PUMP HOUSE	$(0.7854(30^2) = 707^{SF}$	
ROOF	4 PLY COMPO & GRAVEL	707 SF.
	2" RIGID BOARD INSULATION	707 SF.
	1 1/2" x 22GA STEEL DECK	707 SF.
	GRAVEL STOP 30 LF	95 LF.
ROOF STEEL	W8 x 21 $\frac{S}{B0}$ ~ 90 LF x 21 = 1820 LB	2.0 TONS
	W8 x 15 $\frac{17}{B}$ ~ 96 x 15 = 1440	
CENTER POST	6" SCH 40 PIPE 16' x 19 PLF = 300	
	CAP PL - 2' Φ x 1/2" PL 0.7854(2²)(20.4 PSF) = 64	
	BASE PL 12" Φ x 1/2" PL = 16	
	3710 * 370/40 Sq.Ft. +10%	
WALLS	8" CONC BLOCK $30\pi \times 16' = 1508^{SF}$	1510 SF.
	LIGHTING	707 SF.
	HVAC	707 SF.
DOOR	PR 6° x 7°.	1 EA.
ENTRANCE STAIRS	(36' VERT) (ALLOW)	2 TON.
	LANDING SAY. 5' x 10' x 25 PSF	1.3 TON.
PAINTING	CONCRETE BLOCK $1510^{SF} \times 2$ SIDES	3020 SF.
	STRUCTURAL STEEL	

FLUOR

CALCULATIONS and SKETCHES

DATE 8/16/81
CONT. NO. 835504-50
BY SEARS CHK'D
SHEET NO. 3 OF 3

TRI-STATE

WATER INTAKE STRUCTURE

INTAKE

EXCAVATION $20'(60')(31\frac{1}{3}'-30')/27 = 489^{CY}$ (1200 SF) — 490 CY

SHEET PILES $2(20+60) = 160 LF \times 46' = 7360^{SF} \times 38 PSF/2000 = 139.8$ — 140 TONS

CRUSHED ROCK BED $20(60)(2)/27 = 88.9$ — 90 CY.

BACKFILL $490 - 90 - [12^2(10\frac{5}{12})/27] = 347^{CY}$ — 350 CY.

INTAKE SILT PROTECTION (AROUND CONC INLET BOX) $30+30+12 = 72'$

FILTER CLOTH $72^2 - 12^2 = 5040^{SF}$ + 10% LAPS = SAY — 5500 SF

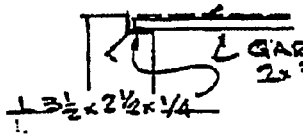
RIP-RAP $5040^{SF}(1)/27 = 187^{CY}$ — 190 CY

CONCRETE

INLET BOX WALL $44 \times 10 \times 1 = 440$
BOTT $12^2 \times 1 = 144$
$584/27 = 21.6^{CY}$ — 21.6 CY

STEEL COVER — $10.5'SQ = 110^{SF}$ — 110 SF

$\frac{1}{4}$" MESH SCREEN



61Φ PRESTRESSED PIPE (JACKED IN PLACE) — 370 LF

6' ID x 5¼" WALL 1623 PLF (AMERON) $1623 PLF(370')/2000 = 300^{T}$

NOTE EXCAVATION ASSUMED PER EXCAVATION (SURRY) DETAIL (SH #1) PUMP INTO POND @ INTAKE END OR PUMP TO SHORE

APPENDIX C

River Stage Data and Corps of
Engineers Ohio River Profiles

Morley and Associates INC.
CONSULTING ENGINEERS/LAND SURVEYORS
45 S.E. SEVENTH STREET/EVANSVILLE, INDIANA 47713/(812) 464-9585

RECEIVED
FEB 25 1982
ATD CONTRACTS DEPT

LETTER OF TRANSMITTAL

DATE	JOB NO
February 20, 1982	82-584-1

ATTENTION: Mr. Jack Buckamier

RE: Tri-State Synfuels, Henderson County, KY

TO: Fluor Engineers and Constructors, Inc.
P.O. Box C11944
Santa Ana, CA 92711

GENTLEMEN:

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items:

☐ Shop drawings ☐ Prints ☒ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO	DESCRIPTION
1	9/22/76	1	Corps of Engineers, Louisville District - Daily Ohio River Bulletin
1	1972	2	Ohio River Profile - Mile 780 to Mile 810
1	1972	3	Ohio River Profile - Mile 810 to Mile 840
1	1981	4	USGS Topographic Map (partial)
1	1981	5	USGS Topographic Map (partial)

Received
FEB 25 1981
John G. Sipp

THESE ARE TRANSMITTED as checked below:

☐ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☐ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☐ For review and comment ☐ _____

REMARKS

This is the data which I was telling you about in our telephone conversation yesterday. The river stage given on our weekly work schedule is based on Evansville gage. To obtain water elevation, add river stage to 329.18 (zero gage) and then subtract 0.48 feet to convert from Ohio River Datum to USGS datum. All river gages and river stages are based on Ohio River Datum (ORD) and most topographic maps are based on United States Geological Survey Datum (USGS). To determine inundation on the topo maps, it is necessary to convert over to USGS. This will allow you to determine when your observation wells will be accessible or inundated.

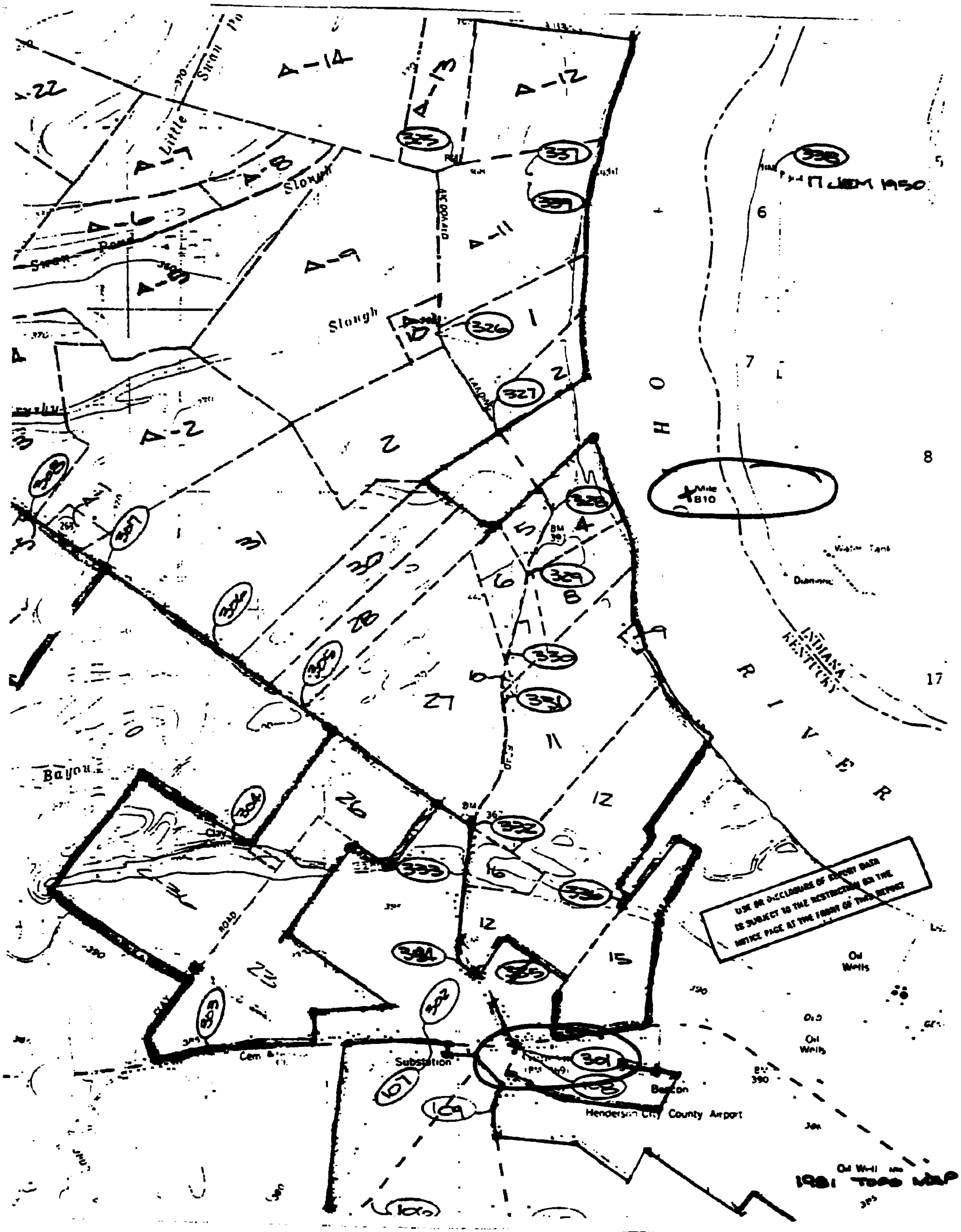
EXAMPLE:
Zero Gage = 329.18 ORD
River Stage = +31.2 ORD
360.38 ORD
ORD to USGS = - .48
359.90 USGS

If we can be of further assistance, feel free to contact us.

COPY TO File

SIGNED: Lee A. McClellan/tw
Lee A. McClellan, PE LAM/tw

If enclosures are not as noted, kindly notify us at once.


A-14
A-13
A-12
A-22
A-7
A-8
A-6
A-9
A-11
A-2
Little
Swan Pond
Slough
Slough
6
7
8
17
O
H
R
I
V
E
R
INDIANA
KENTUCKY
Mile 810
Water Tank
Bayou
Clay
ROAD
Substation
Beacon
Henderson City County Airport
Oil Wells
Oil Wells
Oil Well
326
327
328
329
330
331
332
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337
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107
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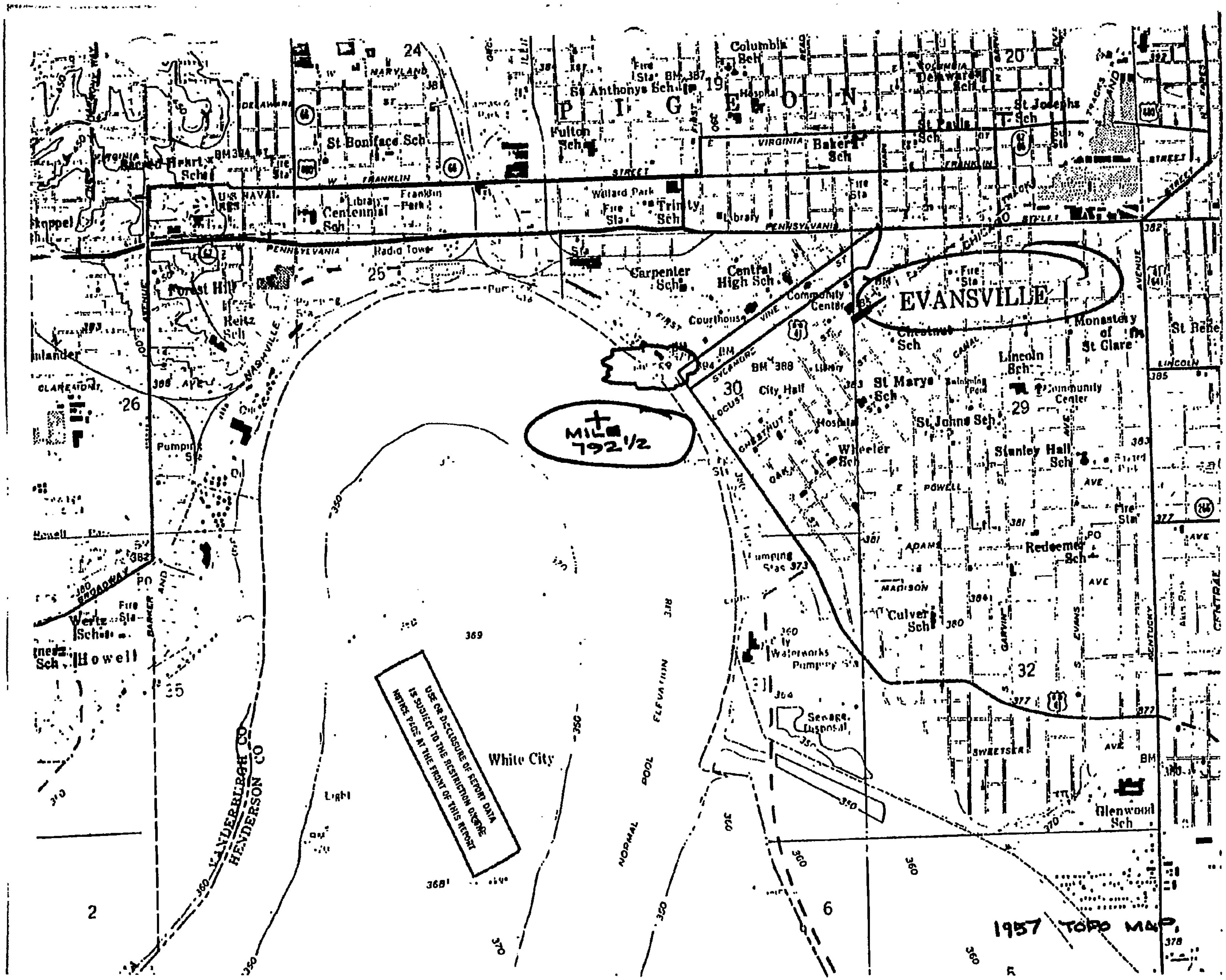
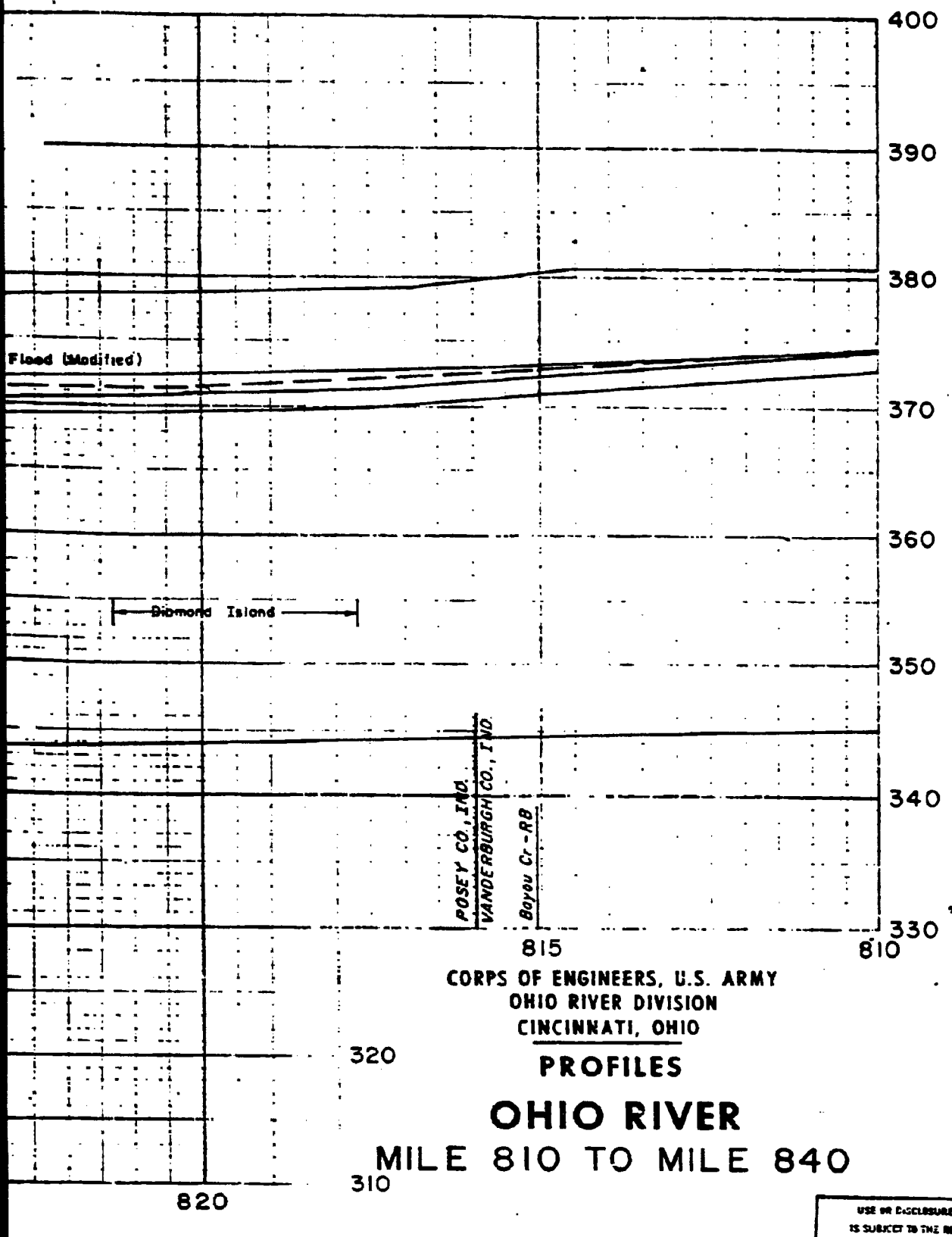
109
USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT
1981 TOPO MAP


EVANSVILLE
PIGEON
MILE 792 1/2
1957 TOPO MAP
USE OR DISCLOSURE OF REPORT DATA IS SUBJECT TO THE RESTRICTION ON THE NOTICE PAGE AT THE FRONT OF THIS REPORT
VANDERBURGH CO
HENDERSON CO
NORMAL POOL ELEVATION 338
White City
Courthouse
Central High Sch
Carpenter Sch
City Hall
Waterworks Pumping Sta
Sewage Disposal
Glenwood Sch
St Marys Sch
St Johns Sch
Stanley Hall Sch
Lincoln Sch
Monastery of St Clare
St Boniface Sch
St Anthonys Sch
Fulton Sch
Baker Sch
Trinity Sch
Forest Hill
Reitz Sch
Radio Tower
Centennial Sch
Willard Park
Culver Sch
Redeemer Sch
Wheeler Sch
Chestnut Sch
Howell
Wertz Sch

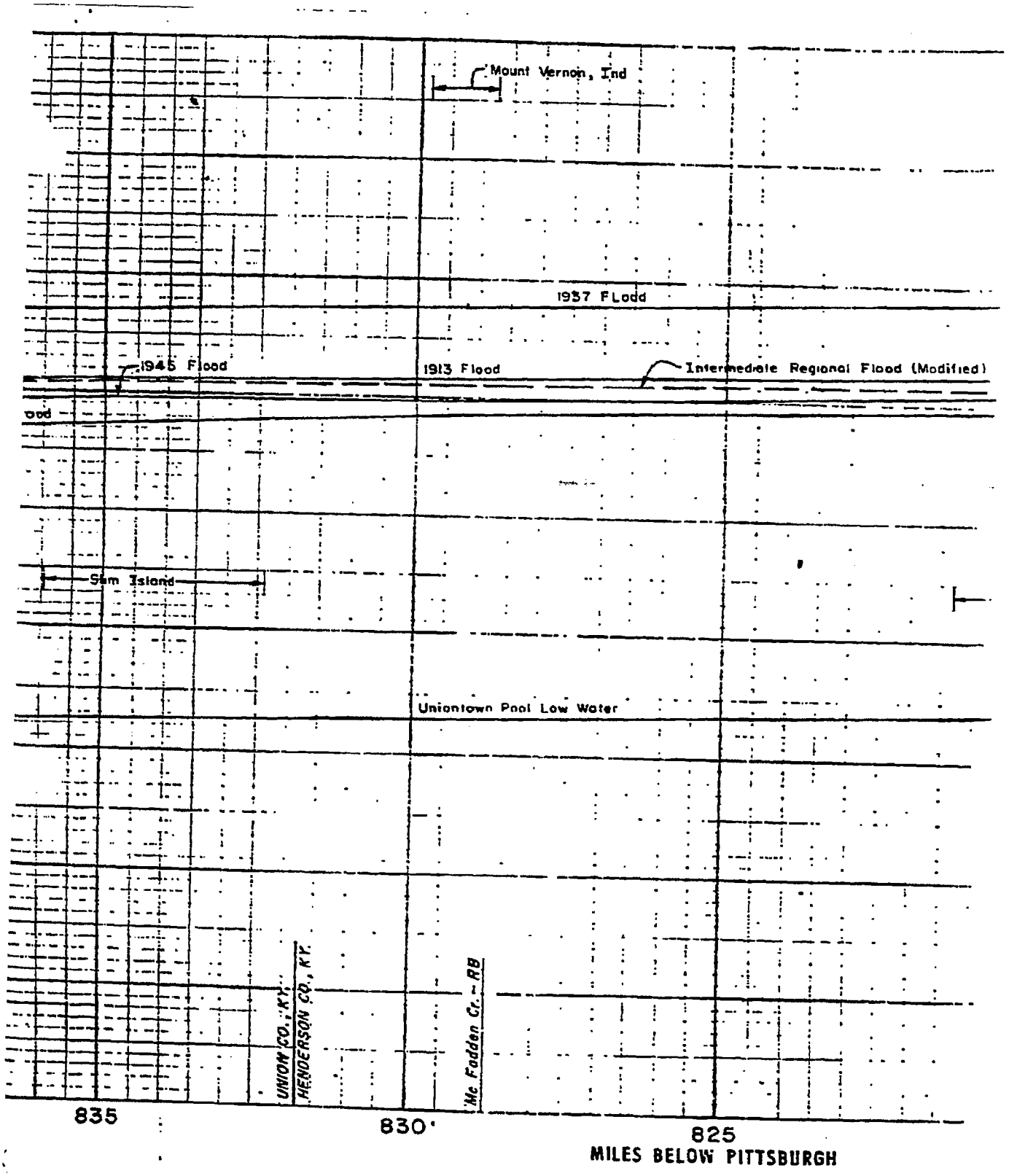


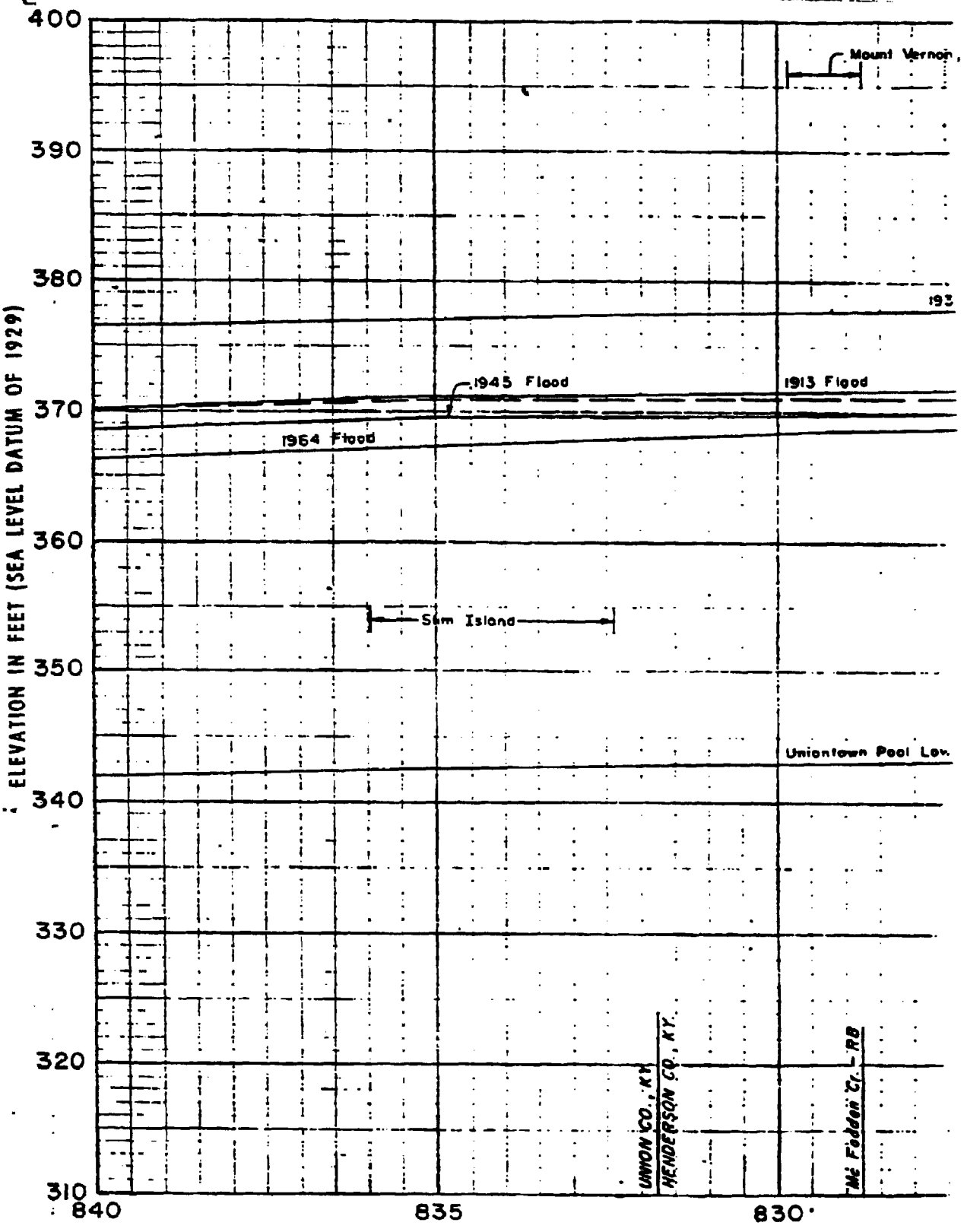
CORPS OF ENGINEERS, U.S. ARMY
OHIO RIVER DIVISION
CINCINNATI, OHIO

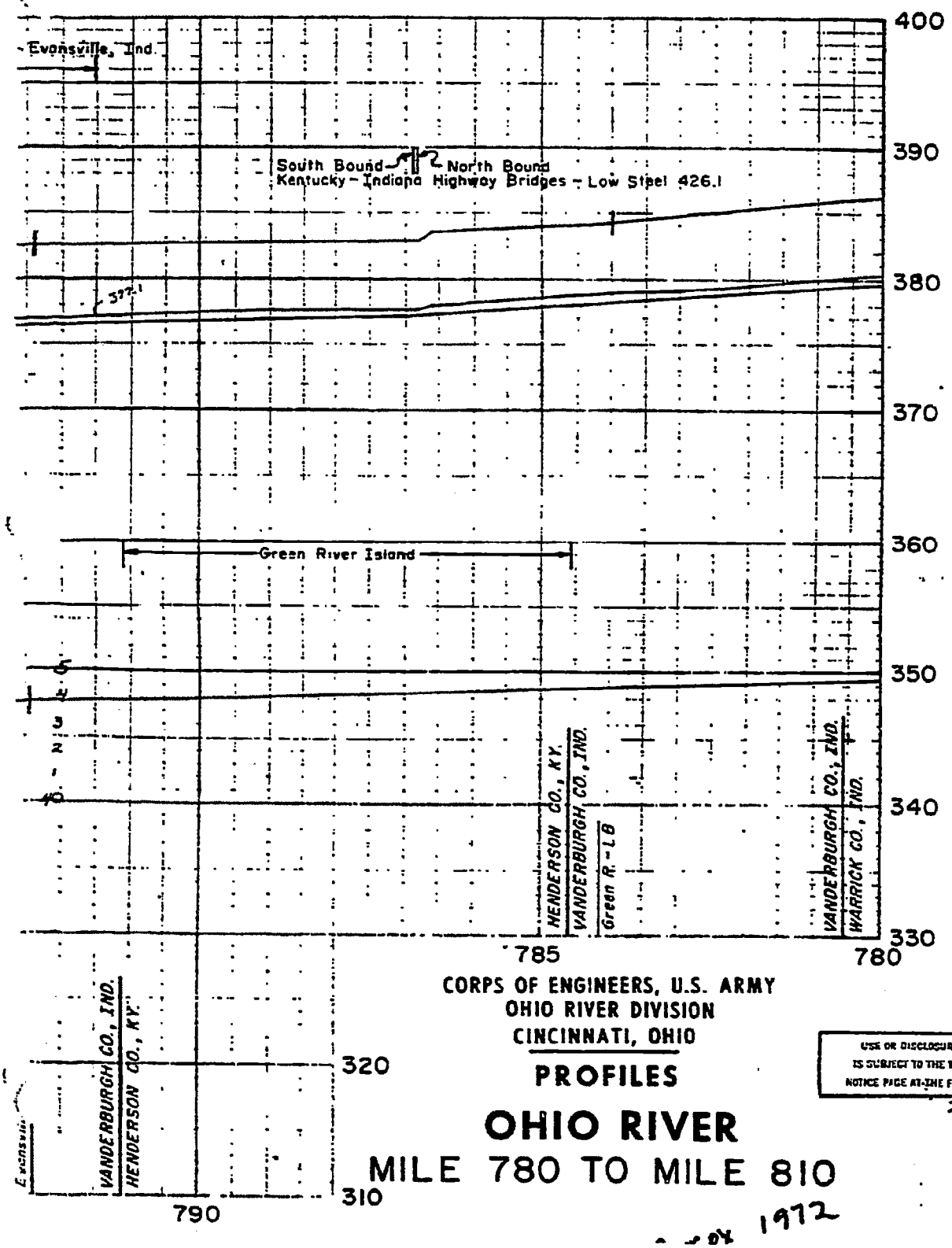
PROFILES

OHIO RIVER

MILE 810 TO MILE 840







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OHIO RIVER DIVISION
CINCINNATI, OHIO

PROFILES

OHIO RIVER

MILE 780 TO MILE 810

1972