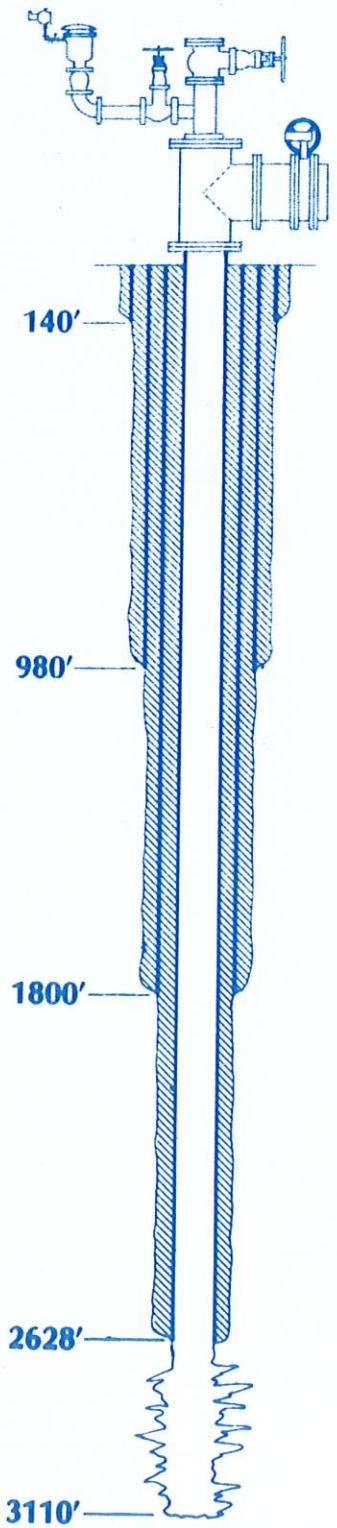
Engineering Report



DRILLING AND TESTING OF THE 8 INJECTION WELLS AND THE 3 MONITORING WELLS

for the South District Regional Wastewater Treatment Plant

of the
Miami-Dade Water and Sewer Authority

Dade County, Florida

MDWSA Contract No. S-154
EPA Contract No. C120377020

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CH2M HILL

CONTENTS

		Page
Preface		iv
	Scope	v
	Acknowledgement	vi
1	SUMMARY	
1.1	Project Description	1.1-1
	Drilling Site Preparation and Monitoring	1.1-1
	Drilling Equipment and Methods	1.1-7
	Well Casings	1.1-8
	Gyroscopic Directional Surveys	1.1-9
	Inclinometer	1.1-10
	Pilot Hole Data Collection	1.1-10
	TV Surveys	1.1-11
	Cementing	1.1-12
	Pressure Tests	1.1-13
	Aquifer Testing	1.1-13
	Potentiometric Surfaces	1.1-15
	Injection Model	1.1-15
1.2	Monitoring Plan	1.2-1
	Purpose	1.2-1
	Boulder Zone	1.2-1
	"2,500-Foot Zone"	1.2-3
	Saltwater Interface--Bottom	1.2-3
	Saltwater Interface--Top	1.2-4
	Floridan Aquifer	1.2-4
	Biscayne Aquifer	1.2-4
	Operational Monitoring	1.2-5
2	WELL CONSTRUCTION	
	Introduction	2.0-1
2.1	Injection Well I-1	2.1-1
2.2	Injection Well I-2	2.2-1
2.3	Injection Well I-3	2.3-1
2.4	Injection Well I-4	2.4-1
2.5	Injection Well I-5	2.5-1
2.6	Injection Well I-6	2.6-1
2.7	Injection Well I-7	2.7-1
2.8	Injection Well I-8	2.8-1
2.9	Injection Well I-9	2.9-1
2.10	Monitoring Well BZ-1	2.10-1
2.11	Monitoring Well FA-1	2.11-1
2.12	Monitoring Well FA-2	2.12-1

CONTENTS--Continued

		Page
3	TESTING	
3.1	Withdrawal Test of I-5	3.1-1
	Purpose	3.1-1
	Background Information	3.1-1
	Step-Drawdown Test	3.1-1
	Constant-Rate Test	3.1-3
	Analysis of Data	3.1-4
	Conclusions	3.1-6
3.2	Potentiometric Surface of the Boulder Zone	3.2-1
	Aquifer Description	3.2-1
	Pumping	3.2-1
	Instrumentation	3.2-4
	Density Determination	3.2-4
	Results of First Survey	3.2-6
	Second Survey	3.2-8
	Results of Second Survey	3.2-13
	Conclusions	3.2-15
3.3	Potentiometric Surface of the Floridan Aquifer	3.3-1
	Upper Floridan	3.3-1
	Instrumentation	3.3-1
	Results	3.3-1
	Lower Floridan	3.3-4
3.4	Model of Effects of Injection	3.4-1
	Assumptions	3.4-1
	Calculation	3.4-1
	Conclusions	3.4-2
4	APPENDIX	
4.A	STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION WELL CONSTRUCTION PERMITS	4.A-1
4.B	PROGRESS MEETING SUMMARIES	4.B-1
4.C	I-5 WITHDRAWAL TEST DATA	4.C-1
4.D	POTENTIOMETRIC SURVEY DATA	4.D-1

TABLES

Table		Page
1.1-1	Summary of Well Construction and Testing	1.1-5
1.1-2	Summary of Injection Test Results	1.1-14
1.2-1	Results of Water Analyses on Samples Collected from Monitoring Wells After Completion and Thorough Flushing	1.2-2
1.2-2	Injection System Monitoring Parameters	1.2-6
1.2-3	Water Quality Monitoring Parameters and Frequency	1.2-7
1.2-4	Effluent Quality Monitoring Parameters and Frequency	1.2-9
2.1-1	Summary of Casing Data, Well I-1	2.1-4
2.1-2	Summary of Cementing of Casings, Well I-1	2.1-5
2.1-3	List of Geophysical Logs and Well Surveys, Well I-1	2.1-6
2.1-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-1	2.1-8
2.1-5	Descriptive Summary of Underwater Television Survey, Well I-1	2.1-11
2.1-6	Lithology from Pilot Hole Formation Samples, Well I-1	2.1-15
2.1-7	Water Quality Data from Pilot Hole Drilling, Well I-1	2.1-29
2.1-8	Summary of Injection Test Results, Well I-1	2.1-32
2.1-9	Injection Test Data, Well I-1	2.1-33
2.1-10	Quality of Injected Water, Well I-1	2.1-35
2.1-11 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring, Site I-1	2.1-36

TABLES--Continued

Table		Page
2.1-11 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site I-1	2.1-38
2.1-11 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well, Site I-1	2.1-40
2.1-11 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site I-1	2.1-42
2.1-11 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site I-1	2.1-44
2.2-1	Summary of Casing Data, Well I-2	2.2-4
2.2-2	Summary of Cementing of Casings, Well I-2	2.2-5
2.2-2A	24-Inch Casing Cementing Summary, Well I-2	2.2-6
2.2-3	List of Geophysical Logs and Well Surveys, Well I-2	2.2-8
2.2-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-2	2.2-10
2.2-5	Descriptive Summary of Underwater Television Survey, Well I-2	2.2-14
2.2-6	Lithology from Pilot Hole Formation Samples, Well I-2	2.2-17
2.2-7	Water Quality Data from Pilot Hole Drilling, Well I-2	2.2-31
2.2-8	Summary of Injection Test Results, Well I-2	2.2-34
2.2-9	Injection Test Data, Well I-2	2.2-35
2.2-10	Quality of Injected Water, Well I-2	2.2-38
2.2-11 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring Well, Site I-2	2.2-39
2.2-11 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site I-2	2.2-41

TABLES--Continued

Table		Page
2.2-11 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well, Site I-2	2.2-43
2.2-11 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site I-2	2.2-45
2.2-11 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site I-2	2.2-47
2.3-1	Summary of Casing Data, Well I-3	2.3-4
2.3-2	Summary of Cementing of Casings, Well I-3	2.3-5
2.3-3	List of Geophysical Logs and Well Surveys, Well I-3	2.3-7
2.3-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-3	2.3-10
2.3-5	Descriptive Summary of Underwater Television Survey, Well I-3	2.3-13
2.3-6	Lithology from Pilot Hole Formation Samples, Well I-3	2.3-16
2.3-7	Water Quality Data from Pilot Hole Drilling, Well I-3	2.3-31
2.3-8	Summary of Injection Test Results, Well I-3	2.3-35
2.3-9	Injection Test Data, Well I-3	2.3-36
2.3-10	Quality of Injected Water, Well I-3	2.3-41
2.3-11 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring Well, Site I-3	2.3-42
2.3-11 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site I-3	2.3-45
2.3-11 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well, Site I-3	2.3-48
2.3-11 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site I-3	2.3-51

TABLES--Continued

Table		Page
2.3-11 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site I-3	2.3-54
2.4-1	Summary of Casing Data, Well I-4	2.4-4
2.4-2	Summary of Cementing of Casings, Well I-4	2.4-5
2.4-3	List of Geophysical Logs and Well Surveys, Well I-4	2.4-6
2.4-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-4	2.4-8
2.4-5	Descriptive Summary of Underwater Television Survey, Well I-4	2.4-14
2.4-6	Lithology from Pilot Hole Formation Samples, Well I-4	2.4-17
2.4-7	Water Quality Data from Pilot Hole Drilling, Well I-4	2.4-32
2.4-8	Summary of Injection Test Results, Well I-4	2.4-35
2.4-9	Injection Test Data, Well I-4	2.4-36
2.4-10	Quality of Injected Water, Well I-4	2.4-40
2.4-11 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring, Site I-4	2.4-41
2.4-11 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site I-4	2.4-43
2.4-11 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well, Site I-4	2.4-45
2.4-11 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site I-4	2.4-47
2.4-11 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site I-4	2.4-49
2.6-1	Summary of Casing Data, Well I-6	2.6-5
2.6-2	Summary of Cementing of Casings, Well I-6	2.6-6

TABLES--Continued

Table		Page
2.6-3	List of Geophysical Logs and Well Surveys, Well I-6	2.6-9
2.6-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-6	2.6-12
2.6-5	Descriptive Summary of Underwater Television Survey, Well I-6	2.6-18
2.6-6	Lithology from Pilot Hole Formation Samples, Well I-6	2.6-21
2.6-7	Water Quality Data from Pilot Hole Drilling, Well I-6	2.6-36
2.6-8	Summary of Injection Test Results, Well I-6	2.6-39
2.6-9	Injection Test Data, Well I-6	2.6-40
2.6-9 W.Q. 70	Water Quality from 70-Foot Monitoring Tube in the 24"/34" Annulus During Injection Test, Well I-6	2.6-44
2.6-9 W.Q. 2,200	Water Quality from 2,200-Foot Monitor Tube in the 24"/34" Annulus During Injection Test, Well I-6	2.6-45
2.6-9 W.L. 2,200	Water Level in 2,200-Foot Monitor Line in the 24"/34" Annulus During Injection Test, Well I-6	2.6-46
2.6-10	Quality of Injected Water, Well I-6	2.6-50
2.6-11 N.E.	Water Quality of Biscayne Aquifer-- N.E. Monitoring Well, Site I-6	2.6-52
2.6-11 N.W.	Water Quality of Biscayne Aquifer-- N.W. Monitoring Well, Site I-6	2.6-55
2.6-11 S.E.	Water Quality of Biscayne Aquifer-- S.E. Monitoring Well, Site I-6	2.6-58
2.6-11 S.W.	Water Quality of Biscayne Aquifer-- S.W. Monitoring Well, Site I-6	2.6-61
2.6-11 W.S.	Water Quality of Biscayne Aquifer-- Water Supply Well, Site I-6	2.6-64

TABLES--Continued

Table		Page
2.7-1	Summary of Casing Data, Well I-7	2.7-4
2.7-2	Summary of Cementing of Casings, Well I-7	2.7-5
2.7-3	List of Geophysical Logs and Well Surveys, Well I-7	2.7-6
2.7-5	Descriptive Summary of Underwater Television Survey, Well I-7	2.7-8
2.7-6	Lithology from Pilot Hole Formation Samples, Well I-7	2.7-11
2.7-7	Water Quality Data from Pilot Hole Drilling, Well I-7	2.7-27
2.7-8	Summary of Injection Test Results, Well I-7	2.7-30
2.7-9	Injection Test Data, Well I-7	2.7-31
2.7-10	Quality of Injected Water, Well I-7	2.7-34
2.7-11 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring Well, Site I-7	2.7-35
2.7-11 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site I-7	2.7-37
2.7-11 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well, Site I-7	2.7-39
2.7-11 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site I-7	2.7-41
2.7-11 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site I-7	2.7-43
2.8-1	Summary of Casing Data, Well I-8	2.8-4
2.8-2	Summary of Cementing of Casings, Well I-8	2.8-5
2.8-3	List of Geophysical Logs and Well Surveys, Well I-8	2.8-6
2.8-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-8	2.8-8

TABLES--Continued

Table		Page
2.8-5	Descriptive Summary of Underwater TV Survey, Well I-8	2.8-11
2.8-6	Lithology from Pilot Hole Formation Samples, Well I-8	2.8-14
2.8-7	Water Quality Data from Pilot Hole Drilling, Well I-8	2.8-29
2.8-8	Summary of Injection Test Results, Well I-8	2.8-32
2.8-9	Injection Test Data, Well I-8	2.8-33
2.8-10	Quality of Injected Water, Well I-8	2.8-36
2.8-11 N.E.	Water Quality of Biscayne Aquifer-- N.E. Monitoring Well, Site I-8	2.8-37
2.8-11 N.W.	Water Quality of Biscayne Aquifer-- N.W. Monitoring Well, Site I-8	2.8-40
2.8-11 S.E.	Water Quality of Biscayne Aquifer-- S.E. Monitoring Well, Site I-8	2.8-43
2.8-11 S.W.	Water Quality of Biscayne Aquifer-- S.W. Monitoring Well, Site I-8	2.8-46
2.8-11 W.S.	Water Quality of Biscayne Aquifer-- Water Supply Well, Site I-8	2.8-49
2.9-1	Summary of Casing Data, Well I-9	2.9-4
2.9-2	Summary of Cementing of Casings, Well I-9	2.9-5
2.9-3	List of Geophysical Logs and Well Surveys, Well I-9	2.9-6
2.9-4	Comparison of Well Paths from Gyroscopic Surveys, Well I-9	2.9-9
2.9-5	Descriptive Summary of Underwater Television Survey, Well I-9	2.9-12
2.9-6	Lithology from Pilot Hole Formation Samples, Well I-9	2.9-15

TABLES--Continued

Table		Page
2.9-7	Water Quality Data from Pilot Hole Drilling, Well I-9	2.9-30
2.9-8	Summary of Injection Test Results, Well I-9	2.9-33
2.9-9	Injection Test Data, Well I-9	2.9-34
2.9-10	Quality of Injected Water, Well I-9	2.9-38
2.9-11 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring Well, Site I-9	2.9-39
2.9-11 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site I-9	2.9-41
2.9-11 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well	2.9-43
2.9-11 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site I-9	2.9-45
2.9-11 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site I-9	2.9-47
2.10-1	Summary of Casing Data, Well BZ-1	2.10-4
2.10-2	Summary of Data on Monitoring Zones, Well BZ-1	2.10-4
2.10-3	Summary of Cementing of Casings, Well BZ-1	2.10-5
2.10-4	List of Geophysical Logs and Well Surveys, Well BZ-1	2.10-7
2.10-5	Descriptions of Cores Collected, Well BZ-1	2.10-9
2.10-6	MDWSA Monitoring Well BZ-1, South District WWTP, Results of Tests on Cores Samples, Wingerter Laboratories, Inc., Miami, Florida	2.10-11
2.10-7	Results of Hydraulic Tests on Cores Collected from Well BZ-1	2.10-12

TABLES--Continued

Table		Page
2.10-8	Descriptive Summary of Underwater Television Survey, Well BZ-1	2.10-19
2.10-9	Lithologic Description of Pilot Hole Formation Samples, Well BZ-1	2.10-26
2.10-10	Water Quality Data from Pilot Hole Drilling, Well BZ-1	2.10-42
2.10-11 N.E.	Water Quality of Biscayne Aquifer-- N.E. Monitoring Well, Site BZ-1	2.10-46
2.10-11 N.W.	Water Quality of Biscayne Aquifer-- N.W. Monitoring Well, Site BZ-1	2.10-48
2.10-11 S.E.	Water Quality of Biscayne Aquifer-- S.E. Monitoring Well, Site BZ-1	2.10-50
2.10-11 S.W.	Water Quality of Biscayne Aquifer-- S.W. Monitoring Well, Site BZ-1	2.10-52
2.10-11 W.S.	Water Quality of Biscayne Aquifer-- Water Supply Well, Site BZ-1	2.10-53
2.11-1	Summary of Casing Data, Well FA-1	2.11-3
2.11-2	Summary of Cementing of Casings, Well FA-1	2.11-4
2.11-3	List of Geophysical Logs and Well Surveys, Well FA-1	2.11-5
2.11-4	Descriptive Summary of Underwater Television Survey, Well FA-1	2.11-6
2.11-5	Lithology from Pilot Hole Formation Samples, FA-1	2.11-9
2.11-6	Water Quality Data from Pilot Hole Drilling, FA-1	2.11-17
2.11-7 N.E.	Water Quality of Biscayne Aquifer-- N.E. Monitoring Well, Site FA-1	2.11-19
2.11-7 N.W.	Water Quality of Biscayne Aquifer-- N.W. Monitoring Well, Site FA-1	2.11-20
2.11-7 S.E.	Water Quality of Biscayne Aquifer-- S.E. Monitoring Well, Site FA-1	2.11-21

TABLES--Continued

Table		Page
2.11-7 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site FA-1	2.11-22
2.12-1	Summary of Casing Data, Well FA-2	2.12-3
2.12-2	Summary of Cementing of Casings, Well FA-2	2.12-4
2.12-3	List of Geophysical Logs and Well Surveys, Well FA-2	2.12-5
2.12-4	Descriptive Summary of Underwater Television Survey, Well FA-2	2.12-7
2.12-5	Lithology from Pilot Hole Formation Samples, Well FA-2	2.12-12
2.12-6	Water Quality Data from Pilot Hole Drilling, Well FA-2	2.12-20
2.12-7 N.E.	Water Quality of Biscayne Aquifer--N.E. Monitoring Well, Site FA-2	2.12-21
2.12-7 N.W.	Water Quality of Biscayne Aquifer--N.W. Monitoring Well, Site FA-2	2.12-22
2.12-7 S.E.	Water Quality of Biscayne Aquifer--S.E. Monitoring Well, Site FA-2	2.12-23
2.12-7 S.W.	Water Quality of Biscayne Aquifer--S.W. Monitoring Well, Site FA-2	2.12-24
2.12-7 W.S.	Water Quality of Biscayne Aquifer--Water Supply Well, Site FA-2	2.12-25
3.1-1	Background Information, I-5 Withdrawal Test	3.1-2
3.1-2	Drawdown During Step-Drawdown Test, I-5 Withdrawal Test	3.1-2
3.1-3	Drawdown During Constant-Rate Test, I-5 Withdrawal Test	3.1-3
3.1-4	Analysis of Water Samples from Pump-Out Tests, I-5 Withdrawal Test	3.1-4

TABLES--Continued

Table		Page
3.2-1	Summary of Pump-Out Information Prior to Boulder Zone Potentiometric Survey	3.2-2
3.2-2	Summary of Water Quality and Construction Details Prior to Potentiometric Survey	3.2-4
3.2-3	Summary of Measuring Point Elevations, Boulder Zone Potentiometric Survey	3.2-5
3.2-4	Pumping and Logging Schedule, Week of January 19, 1981	3.2-7
3.2-5	Elevations of the Potentiometric Surface in the Boulder Zone-- High Tide, 10:45 p.m., January 22, 1981	3.2-9
3.2-6	Elevations of the Potentiometric Surface in the Boulder Zone-- Low Tide, 4:14 a.m., January 23, 1981	3.2-10
3.2-7	Elevations of the Potentiometric Surface in the Boulder Zone-- Low Tide, 12:40 p.m., March 4, 1981	3.2-14
3.3-1	Measuring Point Elevations Referred to Mean Sea Level, Floridan Aquifer Potentiometric Survey	3.3-2

FIGURES

Figure	
1.1-1	Project location
1.1-2	Injection and monitoring well field layout
1.1-3	Summary of well construction
2.1-1	Summary of drilling and logging data--Well I-1
2.2-1	Summary of drilling and logging data--Well I-2
2.3-1	Summary of drilling and logging data--Well I-3
2.4-1	Summary of drilling and logging data--Well I-4
2.5-1	Summary of data from drilling and related operations--Well I-5
2.6-1	Summary of drilling and logging data--Well I-6
2.7-1	Summary of drilling and logging data--Well I-7
2.8-1	Summary of drilling and logging data--Well I-8
2.9-1	Summary of drilling and olgging data--Well I-9
2.10-1	Summary of drilling and logging data--Well BZ-1
2.11-1	Summary of drilling and logging data--Well FA-1
2.12-1	Summary of drilling and logging data--Well FA-2
3.2-1	Potentiometric surface of the Boulder Zone, high tide, 10:45 p.m., January 22, 1981
3.2-2	Potentiometric surface of the Boulder Zone, low tide, 4:15 a.m. January 23, 1981
3.3-1	Water Levels in the Upper Floridan Aquifer, January 22, 1981
3.3-2	Potentiometric surface of the Upper Floridan aquifer, January 22, 1981
3.4-1	Estimated effects of injection at 50 mgd for 30 years on the potentiometric surface of the Boulder Zone

Section 3

TESTING

Chapter 3.1
WITHDRAWAL TEST OF WELL I-5

PURPOSE

The purpose of this test was to obtain data for estimating the hydraulic characteristics of the Boulder Zone, specifically the transmissivity and storage coefficient. This would allow the evaluation, when all wells are completed and tested, of the impact of effluent injection on the Boulder Zone system.

BACKGROUND INFORMATION

Water Level Recorders (Stevens Type F) were installed at well BZ-1 in the 6-inch casing (2,689-foot to 2,960-foot zone) and the 2-inch line (2,455-foot to 2,465-foot zone). Also, at Well I-6 in the 24-inch casing (2,740-foot to 3,112-foot zone) and the 34-inch/24-inch annulus (1,800-foot to 2,294-foot zone) while still open during construction. Background water levels were recorded in these zones for 5 continuous days prior to the test. In addition, a pressure transducer was placed inside another 2-inch line (1,620-foot to 1,630-foot zone) of Well BZ-1 to monitor and record background water levels in this zone. Table 3.1-1 shows the range of background water level fluctuation in each zone. All the background data recorded are presented in Appendixes 4.C-1 to 4.C-3.

STEP-DRAWDOWN TEST

The step-drawdown test was run on December 18, 1979. A 6,000-gpm test pump was set up with approximately 90 feet of column inside of the 20-inch inner casing. The well was pumped at approximately 2,000 gpm for 35 minutes. The pumping rate was then increased to approximately 4,000 gpm, and the well was pumped at this rate for 30 minutes, followed by another increase in pumping rate to approximately 6,000 gpm. After pumping at this rate for 35 minutes, the pump was shut off, followed by a 70-minute recovery period.

Flow measurements were obtained with an orifice plate and a piezometer at the end of the outfall line. Water levels in Well I-5 during pumping and recovery were recorded manually (tape-measurements) and with a pressure transducer recorder. Water levels in Monitoring Well BZ-1 (Boulder Zone and 2,500-Foot Zone) were recorded with Stevens Type F water level recorders (gauge 1:1, 4-hour time scale). Water levels in Injection Well I-6 (Boulder Zone and 1,800-foot to 2,294-foot zone) were recorded with Stevens Type F water level recorders (gauge 1:1, 24-hour time scale). The water level in the 1,620-foot to 1,630-foot zone (lower Floridan aquifer) of Well BZ-1 was monitored by another pressure transducer recorder. However, this zone did not show any drawdown or recovery during the test.

Table 3.1-1
BACKGROUND INFORMATION
I-5 WITHDRAWAL TEST

Item Description	Well BZ-1		Well I-6	
	6-Inch Casing	2-Inch Line	24-Inch Casing	24-Inch/34-Inch Casing
Distance from well I-5, in ft	107	107	693	693
Zone monitored (ft below pad)	2,689-3,110	2,455-2,465	2,740-3,112	1,800-2,294
Measuring point (ft above pad)	5.48	6.08	6.36	4.79
Background water level fluctuation range, in ft (2 x amplitude)	0.40	0.35 to 0.40	0.40	0.30

The data obtained from this test are presented in Appendixes 4.C-4 to 4.C-6. Both unadjusted and adjusted (for tidal fluctuations) data have been included in this appendix. The apparent steady-state drawdowns recorded in each well at each pumping rate are presented in Table 3.1-2. These drawdowns have been adjusted for tidal fluctuations.

Table 3.1-2
DRAWDOWN DURING STEP-DRAWDOWN TEST
I-5 WITHDRAWAL TEST

Flow Rate (gpm)	Well I-5	Drawdown (ft)			
		Well BZ-1		Well I-6	
		6-Inch Casing	2-Inch Line	24-Inch Casing	Annulus
2,077	4.33	0.008	0.010	not measurable	0.000
3,855	11.41	0.017	0.020		0.000
5,875	23.63	0.043	0.039		0.000

The water level in the Boulder Zone and the 2,460-foot zone in BZ-1 showed small but measurable responses to pumping. The water level inside the 24-inch casing (Boulder Zone) of Well I-6 showed some response to pumping; however, the response was too small to measure accurately. No response was seen in the annulus water level at I-6 or in the 1,620- to 1,630-foot zone in BZ-1.

CONSTANT-RATE TEST

The pump-out test was run on December 19, 1979. Well I-5 was pumped at a steady rate of approximately 6,000 gpm for 5 hours and 31 minutes. Exact flow measurements were obtained with an orifice plate and a piezometer at the end of the outfall line. Water levels in Wells I-5, BZ-1 and I-6 were recorded in the same manner as in the step-drawdown test, with the following exceptions: (1) due to mechanical malfunction in the Stevens Type F water level recorder on the 2-inch line (2,460-foot zone) in Well BZ-1, water levels in this line were recorded manually with a tape; (2) The water level recorder on the 24-inch casing (Boulder Zone) of Well I-6 was equipped with a 4-hour time clock and chart during the entire drawdown and recovery period, thus enabling the drawdown and recovery readings to be determined directly from the recorder chart; and (3) recovery data collection was extended to 2 hours and 39 minutes.

The data, both unadjusted and adjusted (for tidal fluctuations) obtained from this test are presented in Appendixes 4.C-7 to 4.C-9. As seen during the step-drawdown test, the 1,620-foot to 1,630-foot zone (lower Floridan aquifer) of Well BZ-1 did not show any drawdown or recovery during this test. The apparent steady-state drawdowns, adjusted for tidal fluctuations, in each well are presented in Table 3.1-3.

Table 3.1-3
DRAWDOWN DURING CONSTANT-RATE TEST (Q ≅ 5,950 gpm)
I-5 WITHDRAWAL TEST

Well No.	Zone and Depth	Drawdown (ft)
I-5	Pumped Well (2,746-foot to 3,200-foot)	23.57
BZ-1	Boulder Zone (2,689-foot to 3,110-foot)	0.048
BZ-1	Lower Monitoring Zone (2,455-foot to 2,465-foot)	0.04
I-6	Boulder Zone (2,740-foot to 3,112-foot)	0.016
I-6	Annulus (temporary) (1,800-foot to 2,294-foot)	0.000

Water samples were collected for chemical analysis after 15 minutes of pumping and every hour thereafter. The quality of the water resembles that of seawater, and did not change significantly during the test. Some of the major parameters are presented in Table 3.1-4. A complete standard chemical analysis of the water is included in Appendix 4.C-10.

Table 3.1-4
ANALYSIS OF WATER FROM PUMP-OUT TEST
I-5 WITHDRAWAL TEST

Parameter	Value
Temperature	65.5°F
Specific gravity	1.0265
Specific conductance	49,400 µmhos/cm
Dissolved solids (estimated from conductivity)	32,100 mg/l
Chloride	19,600 mg/l
Sulfate	2,680 mg/l
Alkalinity, as $CaCO_3$	122 mg/l
Total hardness, as $CaCO_3$	6,590 mg/l
pH	7.40

ANALYSIS OF DATA

A review of the various data plots and associated calculations of aquifer characteristics suggests that standard techniques strictly applied lead to erroneous results. If the basic premise that the Boulder Zone responds as a non-leaky artesian system with a very high transmissivity and a very low storage coefficient is true, then the time/drawdown and recovery data need to be adjusted prior to solving for aquifer characteristics. Data from Well I-6, show that this well, located 693 feet from the pumping well, had a maximum drawdown, corrected for a tidal fluctuation, of only 0.016 ft. A quantitative analysis, using any method, based on this data is of little value. Data from the pumping Well I-5, especially the early time data, are so obscured by pump fluctuations and changes in the density of the pumped water that quantitative analysis is impossible.

The drawdown data from various annuli monitoring points provide only a qualitative assessment of the aquifer hydraulic characteristics (the 2,455-2,465 zone in BZ-1 responds similarly to the 2,689-3,110 zone in the same well; the 2,294-1,800 zone in I-6 did not respond at all).

Therefore, the only data that can be used to analyze for aquifer characteristics are from BZ-1. The time-drawdown data from BZ-1 (Boulder Zone) illustrate that during the

initial 10 minutes, the water level was fluctuating erratically. The reason for this is that the transmissivity of the Boulder Zone is so high that the shock wave produced by pump startup is transmitted almost immediately to BZ-1, 109 feet away. Oscillations induced by the shock wave continue for several minutes after pump startup. Therefore, these data were adjusted by assuming that the first 10 minutes of drawdown and recovery, during which time the water level was fluctuating rapidly, must be disregarded. The data can then be fit to the non-leaky artesian, Thies curve to result in match points which produce transmissivity and storage coefficients in the expected range (see Appendix 4.C-11). Disregarding this early data requires that the data be matched somewhat arbitrarily with the flattened portion of the Thies curve. However, if a reasonable match is made, the resulting transmissivity is 180×10^6 gpd/ft and the storage coefficient is 7.0×10^{-4}. Two facts regarding this assumption should be pointed out. First, work done earlier by F. Meyer, published in the Florida Bureau of Geology Report of Investigation No. 75, concluded from analysis of water level records that the hydraulic characteristics of the Boulder Zone in the vicinity of the Sunset Part injection well were 24×10^6 gpd/ft for transmissivity and 1.5×10^{-5} for storage coefficient. This was based on an assumption of a porosity of 50 percent and an effective aquifer thickness of 15 feet. A study of the geophysical logs from I-5 suggests an aquifer thickness in the vicinity of I-5 of at least 100 feet. Assuming that the porosity and permeability are similar between the Boulder Zone at Sunset Park and at I-5, the calculated transmissivity at I-5 would be 167×10^6 gpd/ft if aquifer thickness is 100 feet. This is the same order of magnitude as that calculated above (180×10^6 gpd/ft). Secondly, assuming that the match of the adjusted time/drawdown recovery data matches the Thies curve on the flat portion where $1/u > 10^4$, a reconstruction of the time/ drawdown recovery curves to fit this Thies curve can be made. By doing this, it is clear that most of the drawdown occurs in less than 1 second, making it impossible to accurately obtain the initial important data necessary for the accurate application of the curve matching technique.

The data from the step-drawdown test (also incorporating the pump-out test data) were analyzed to determine the values of the well loss and aquifer loss, which together make up the total drawdown in the pumping well (I-5). This analysis yielded the following equation (Jacob 1946).

$$S = 0.000959Q + 0.000000925Q^{1.93}$$

where

S = total drawdown in Well I-5, in ft

Q = pumping rate, in gpm

$0.000959Q$ = aquifer loss, in ft

$0.000000925Q^{1.93}$ = well loss, in ft

This equation gives an aquifer loss (actual drawdown, without friction losses) of 5.71 feet in Well I-5 out of a total drawdown of 23.57 feet at a pumping rate of 5,956 gpm. This value of aquifer loss appears to be a little higher than expected. The computer program which was used to derive this equation, along with its imput (data) and output (results), is listed in Appendix 4.C-12.

It is to be noted that the response of the Boulder Zone in Well BZ-1 to these tests is very similar to that of the 2,500-foot zone in the same well, possibly due to interconnection of these two zones.

CONCLUSIONS

The following conclusions have been reached as a result of the aquifer performance testing of I-5.

1. The background diurnal water level fluctuation in BZ-1, I-5, and I-6 in the Boulder Zone is approximately 0.40 feet.

2. The background diurnal water level fluctuations observed in BZ-1, 2,455- to 2,465-foot zone, were similar to Boulder Zone fluctuations of approximately 0.40 feet.

3. The background diurnal water level fluctuations in the I-6 annulus (1,800- to 2,294-foot zone) were approximately 0.30 feet, slightly less than the Boulder Zone fluctuations.

4. Friction losses and density differences between the injected freshwater and native saltwater account for most of the head change in the pumped well. Of the 23.57 feet of total measured drawdown at 5,956 gpm, 17.86 feet was attributed to well loss as determined by the step-drawdown test.

5. Standard curve matching and straight line techniques normally used to determine aquifer characteristics produce erroneous results when applied directly to time-drawdown data from observation well BZ-1.

6. Time-drawdown data from I-6 resulted in a maximum drawdown of only 0.016 feet. These data could not be used to determine aquifer characteristics.

7. Transmissivity and storage coefficient calculated from BZ-1 time-drawdown recovery data, adjusted for early time fluctuations, are 180×10^6 gpd/ft and 7.0×10^{-4}, respectively. Based on work done earlier by F. Meyer,

adjusted for observed conditions at I-5, the transmissivity is probably in the range of 100 to 180 x 10^6 gpd/ft. The storage coefficient is probably in the range of 7 x 10^{-4} to 1 x 10^{-5}.

Chapter 3.2
POTENTIOMETRIC SURFACE OF THE BOULDER ZONE

AQUIFER DESCRIPTION

The high transmissivity associated with the Boulder Zone starts at a depth of approximately 2,450 feet at the project site. The Boulder Zone is characterized by layers of highly fractured hard, brown, crystalline dolomite with abundant solution cavities and channels. These strata alternate with denser and less permeable dolomite and extend to at least the bottom of the holes at about 3,100 feet.

The Boulder Zone shows indications of being present under all of the south Florida peninsula and of being communicated with the Straits of Florida where it outcrops. The water quality in the aquifer at the project site is nearly identical to that of seawater sampled off of Miami Beach. The water temperature in the aquifer is about 60°F, which is about 40°F colder than what it should be in accordance with a normal geothermal gradient. This cooling effect is undoubtedly caused by the presence of 42 to 45°F water in the Straits of Florida at approximately 2,800 feet in depth where the Boulder Zone outcrops. This indicates a very high transmissivity and communication with the ocean, which was also found during the testing on the site. This communication is evident from the tides observed in the Boulder Zone wells following the same pattern as those in the Straits of Florida. Copies of charts showing those tides are in Appendixes 4.C-1 through 4.C-3.

PUMPING

To enable us to determine the potentiometric surface of the Boulder Zone aquifer at the site, six injection wells were pumped. This was done to flush all non-native water (injected during testing) from the wells so the water quality would be uniform over the entire column of each well. Table 3.2-1 summarizes the pumping information.

The temperature of the discharged water from each well was measured every hour to determine when it had stabilized in the well. Water quality was also checked at intervals to provide assurance that only native water was being pumped.

At the end of the pumping period, after the temperature and water quality had stabilized, a final sample was collected. These samples were analyzed for density and salinity by Dr. F. J. Millero of the Rosenthal Institute of Marine Science of the University of Miami.

Table 3.2-1
SUMMARY OF PUMPOUT INFORMATION PRIOR TO
BOULDER ZONE POTENTIOMETRIC SURVEY
(January 19 to 20, 1981)

Well	Time Pumped	Rate	Well Volumes Discharged[a] (3,100 feet deep)	Final Water Temperature (°C)
I-1	7 hours, 26 minutes	1,100 gpm	7.3	18.5
I-3	5 hours, 55 minutes	1,050 gpm	5.6	18.9
I-6	6 hours, 55 minutes	1,000 gpm	6.2	18.4
I-8	5 hours, 18 minutes	1,200 gpm	5.7	17.8
I-9	5 hours, 20 minutes	900 gpm	4.3	18.7
BZ-1	7 hours, 43 minutes	55 gpm	5.6	21.1

[a]Calculated open hole and casing volume based on caliper logs.

Table 3.2-2 shows the results of those analyses. It is of interest to note that the salinities and, therefore, the densities of each well are slightly different. The following factors may suggest explanations for these differences: (1) different periods of time since the injection test on each well and, therefore, varying amounts of dissipation in the aquifer of the fresh injected water and (2) different casing settings in each well.

The salinities observed could be explained by the following reasoning. The BZ-1 sample has the highest salinity, and it was also the only well into which water was never injected. Wells I-1, I-3, and I-6 fall into a median range of salinity and also are cased approximately to the same depth range (2,630 to 2,740 feet). Wells I-8 and I-9 are cased significantly shallower (±2,420 feet). They were also the last two wells to be injected into and have the two lowest salinities, considerably lower than in the other wells.

INSTRUMENTATION

After the wells were pumped and sampled, a Stevens Type F water level recorder was installed on each well. The recorders were set up with 24-hour charts and 1:1 gears, and the reference measuring points surveyed in from a U.S.G.S. benchmark. Elevation of these measuring points were referred to mean sea level with a precision of within ±0.01 foot. These elevations are shown in Table 3.2-3.

After pumping, a temperature log was run on each well to record the temperature profile. Several fluid conductance logs were also run to verify that the water quality was uniform in the casing column.

The water levels were recorded continuously for 2 days, during which time several tidal cycles occurred. High and low tides were chosen in each well to determine the potentiometric surface across the site.

DENSITY DETERMINATION

Using the temperature log and salinity of the water, the weight of the water column was converted to a known pressure at 2,800 feet using the following process. The density of the water at (S ‰) salinity and temperature (°C) was determined by the following formula (Millero 1976).

$$d = d_o + AS(‰) + BS(‰)^{3/2} + CS(‰)^2$$

where

d = Density of water at S ‰ salinity @ 25°C

d_o = Density of pure water @ 25°C (= .997045 $9cm^{-3}$)

Table 3.2-2
SUMMARY OF WATER QUALITY AND CONSTRUCTION DETAILS
PRIOR TO BOULDER ZONE POTENTIOMETRIC SURVEY
(January 19 to 20, 1981)

Well	Final Casing (feet)	Date of Injection Test	Salinity[a] (‰)	Density[a] (@ 25°C) (g/cm^3)
I-1	2,628	8/21/80	35.251	1.023528
I-3	2,629	3/25/80	35.202	1.023489
I-6	2,740	2/13/80	35.215	1.023505
I-8	2,420	1/03/81	34.742	1.023159
I-9	2,418	1/09/81	34.759	1.023181
BZ-1	2,689	None	35.261	1.023567

[a]Determinations made by Dr. Frank J. Millero of the Rosenthal Institute of Marine Science of the University of Miami.

Table 3.2-3
SUMMARY OF MEASURING POINT ELEVATIONS
BOULDER ZONE POTENTIOMETRIC SURVEY

Well	Bronze Disk in Pad (ft msl)	Measuring Point for Test	Measuring Point[a] Elevation (ft msl)
I-1	9.805	Rim of 24" flange	12.010
I-3	9.855	Rim of 24" flange	12.060
I-6	9.788	Rim of 24" flange	11.839
I-8	9.934	Rim of 24" flange	12.121
I-9	9.892	Rim of 24" flange	12.093
BZ-1	9.867	Top of wire line pack-off	13.670

[a]Elevations of measuring points were determined from the elevation data on bronze disks set in the concrete pads at each site within approximately 4 feet of the well heads. Leveling survey was done by Messrs. Brasfield and James of the MDWSA Engineering Department.

S = salinity in parts per thousand (‰)

$A = 8.25938 \times 10^{-4} - 4.4491 \times 10^{-6}t + 1.0485 \times 10^{-7}t^2 - 1.2580 \times 10^{-9}t^3 + 3.315 \times 10^{-12}t^4$

$B = -6.33777 \times 10^{-6} + 2.8442 \times 10^{-7}t - 1.6871 \times 10^{-8}t^2 + 2.83265 \times 10^{-10}t^3$

$C = 5.4706 \times 10^{-7} - 1.9798 \times 10^{-8}t + 1.6641 \times 10^{-9}t^2 - 3.1204 \times 10^{-11}t^3$

t = temperature, °C, determined from the logs

The resulting density (d) was then multiplied by the length of the column in feet (ft) at that given temperature (t), times the unit conversion factor 62.428295 (pounds per cubic foot at 4°C). The results were then the weight of the column of water in pounds per square foot (psf). By adding all the different column weights in a well, the total psf at the chosen depth (2,800 feet) was calculated.

This pressure was then converted back to feet of column by dividing by a common density at a given salinity at 17°C, i.e., the temperature of the Boulder Zone at the site at approximately 2,800 feet in depth. The resulting columns of water then could be compared because they were all adjusted to 17°C water. The common salinity value used was that from BZ-1 water because it was the highest and, therefore, was thought to most closely represent the native formation water.

RESULTS OF FIRST SURVEY

The initial results from these calculations revealed discrepancies in the comparison. This was the result of a temperature equilibrium not being reached in the wells in the 2 to 3 days after pumping when the water levels were measured. As shown in Table 3.2-4, three wells were pumped on Monday and three on Tuesday. One temperature log was run the day following pumping on each well, and several temperature logs were run on I-3, I-6, and I-9.

Water levels were measured at high tide about 10:45 p.m., on Thursday night, and at low tide about 4:15 a.m., on Friday morning. It became apparent from the temperature logs on I-3, I-6, and I-9 that the temperatures in the wells were still rising when the water levels were measured, and appeared to require at least 7 to 10 days in which to reach thermal equilibrium. Therefore, since the temperature logs run up to 2 days before the levels were measured were the basis for the density adjustment calculations, they did not accurately reflect the density at the time of the measurements.

Table 3.2-4
PUMPING AND LOGGING SCHEDULE
WEEK OF JANUARY 19, 1981

Well	Monday 19	Tuesday 20	Wednesday 21	Thursday 22	Friday 23	Saturday 24
I-1		Pumped	Temperature Log			
I-3		Pumped	Temperature Log			Temperature Log
I-5		(Not Pumped)		Temperature Log		
I-6		Pumped	Fluid Conductivity Temperature Logs	Temperature Log	Temperature Log	
I-8	Pumped	Fluid Conductivity Temperature Logs				
I-9	Pumped	Temperature Log	Fluid Conductivity Log	Temperature Log	Temperature Log	
BZ-1	Pumped	Fluid Conductivity Temperature Logs				
				(High Tide 10:45 p.m.)	(Low Tide 4:15 a.m.)	

It was necessary therefore to compensate for the varying times involved between the running of the logs and the water level measurements. Using the three wells with several logs each, time-dependent temperature adjustments were approximated. These were then calculated into the density determinations, and the resulting adjusted columns were used for comparison. The data sheets are compiled in Appendix 4.D-1. These data sheets list the measured temperature from the log for each interval with the appropriate adjustment in the next column. This temperature is then converted to °C and the density determined for that well's salinity. The next column is the pressure that interval of water exerts at the calculated density.

By dividing the total pressure (psf) by the density of water at 17°C and 35.261 ‰ salinity, the previously described water columns are adjusted to the lengths shown in Table 3.2-5. The length of column adjusted is 2,790 feet, which corresponds to the column of water from mean sea level to a depth of 2,790 feet below mean sea level in each well. The bottom of the column was chosen to be the approximate top of the highly fractured dolomite associated with the most transmissive sections of the aquifer. Also, selection of this depth allows a uniform length of column to be adjusted even though the casings are set at different depths.

The measured elevation of the water is treated as a "wafer" on the 2,790-foot column. After it is adjusted for density differences, the wafer, in feet above sea level, is added back to the new column. The resulting elevation is the pressure in the Boulder Zone at each well, converted to feet and referenced to mean sea level. The error introduced by not correcting the 3 to 5 feet of column wafer is negligible (on the order of ±0.004 feet or less).

Table 3.2-5 lists the high tide water elevations for January 22, 1981, at about 10:45 p.m. They range from 2.97 to 5.31 feet above mean sea level. After the water columns are adjusted for temperature and salinity, the water levels range from -0.15 to +0.92 feet mean sea level. The measured low tide water elevations on January 23, 1981 at 4:15 a.m. were approximately 0.3 feet lower than the high tide water elevations in each well as shown in Table 3.2-6. Figure 3.2-1 is a site map showing the locations of the six wells used in this test. The adjusted water elevations for the high tide have been contoured using very generalized contour lines. Figure 3.2-2 shows the contoured low tide elevations. The resulting potentiometric surface is nearly flat, with a slight gradient to the east-southeast. It must be kept in mind that these calculations used to adjust for temperatures are dependent on the accuracy of the temperature logs that were run and, to a greater extent, the temperature equilibrium adjustments. Also, the water quality, i.e., salinity, is assumed to be uniform in each well. Therefore, the resulting

Table 3.2-5
ELEVATIONS OF THE POTENTIOMETRIC SURFACE
IN THE BOULDER ZONE--HIGH TIDE, 10:45 p.m., January 22, 1981

Well	2,790-foot Column (psf)	Equivalent Column (ft)[a]	Measured Water Level High Tide (ft msl)	Adjustment (ft)	Water Level (ft msl)
I-1	1.7846475×10^5	2,787.04	+3.32	-2.96	+0.36
I-3	1.7845655×10^5	2,786.91	+3.30	-3.09	+0.21
I-6	1.7845483×10^5	2,786.88	+2.97	-3.12	-0.15
I-8	1.7837344×10^5	2,785.61	+5.31	-4.39	+0.92
I-9	1.7837408×10^5	2,785.62	+4.96	-4.38	+0.58
BZ-1	1.7842072×10^5	2,786.35	+3.71	-3.65	+0.06

[a]Adjusted to BZ-1 density @ 17°C = 1.0257186 g/cm^3 or 64.0338634 lb/ft^3.

Table 3.2-6
ELEVATIONS OF THE POTENTIOMETRIC SURFACE
IN THE BOULDER ZONE--LOW TIDE 4:15 a.m., January 23, 1981

Well	Measured Water Level Low Tide (ft msl)	Adjustment From Table 3.2-5 (feet)	Water Level (ft msl)
I-1	3.02	-2.96	+0.06
I-3	3.00	-3.09	-0.09
I-6	2.67	-3.12	-0.45
I-8	5.01	-4.39	+0.62
I-9	4.67	-4.38	+0.29
BZ-1	3.37	-3.65	-0.28

Note: Adjusted to BZ-1 density @ 17°C = 64.0338634 lb/ft^3

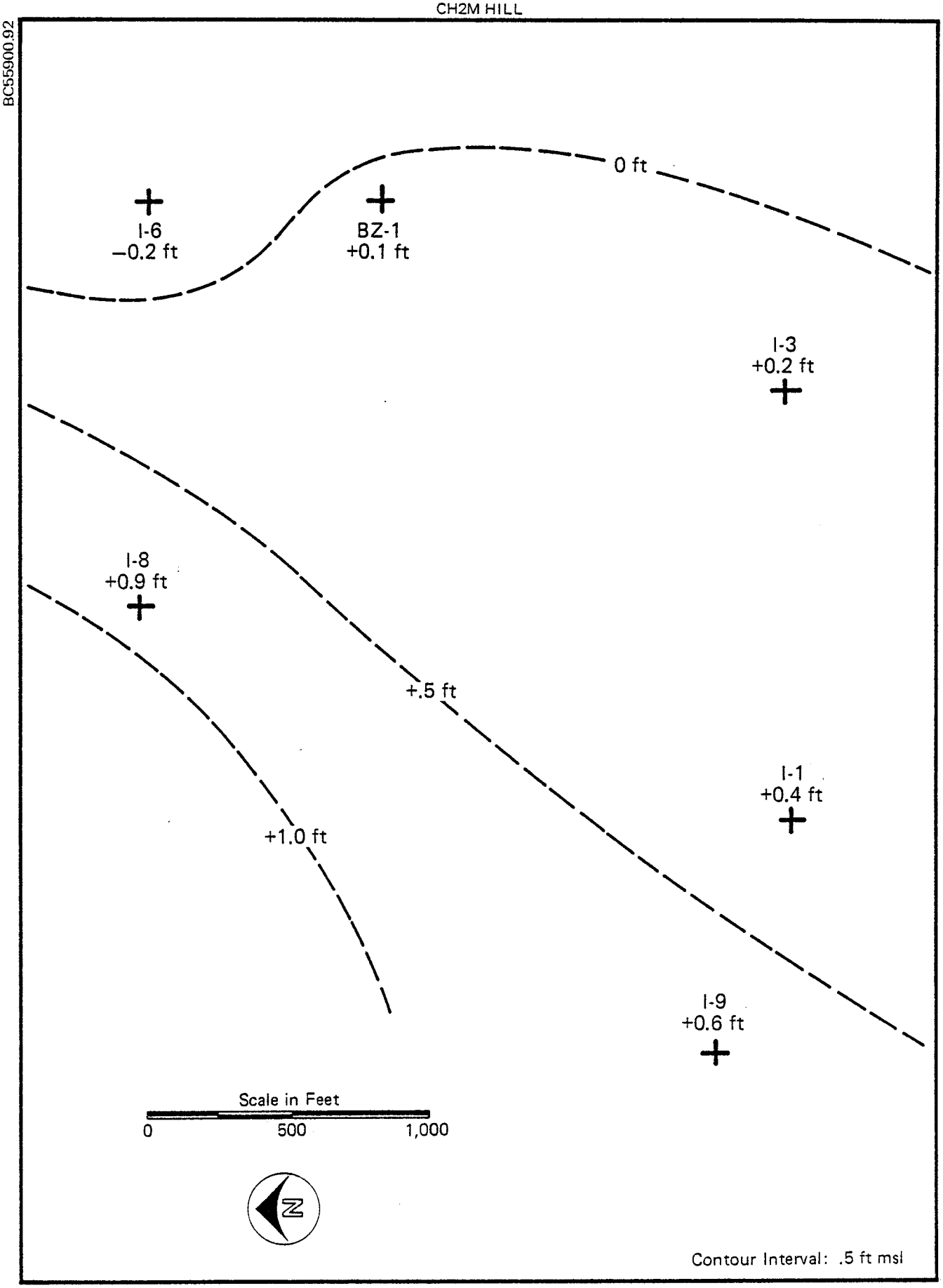

FIGURE 3.2-1. Potentiometric surface of the Boulder Zone, high tide, 10:45 p.m. January 22, 1981 (adjusted as per Table 3.2-5).

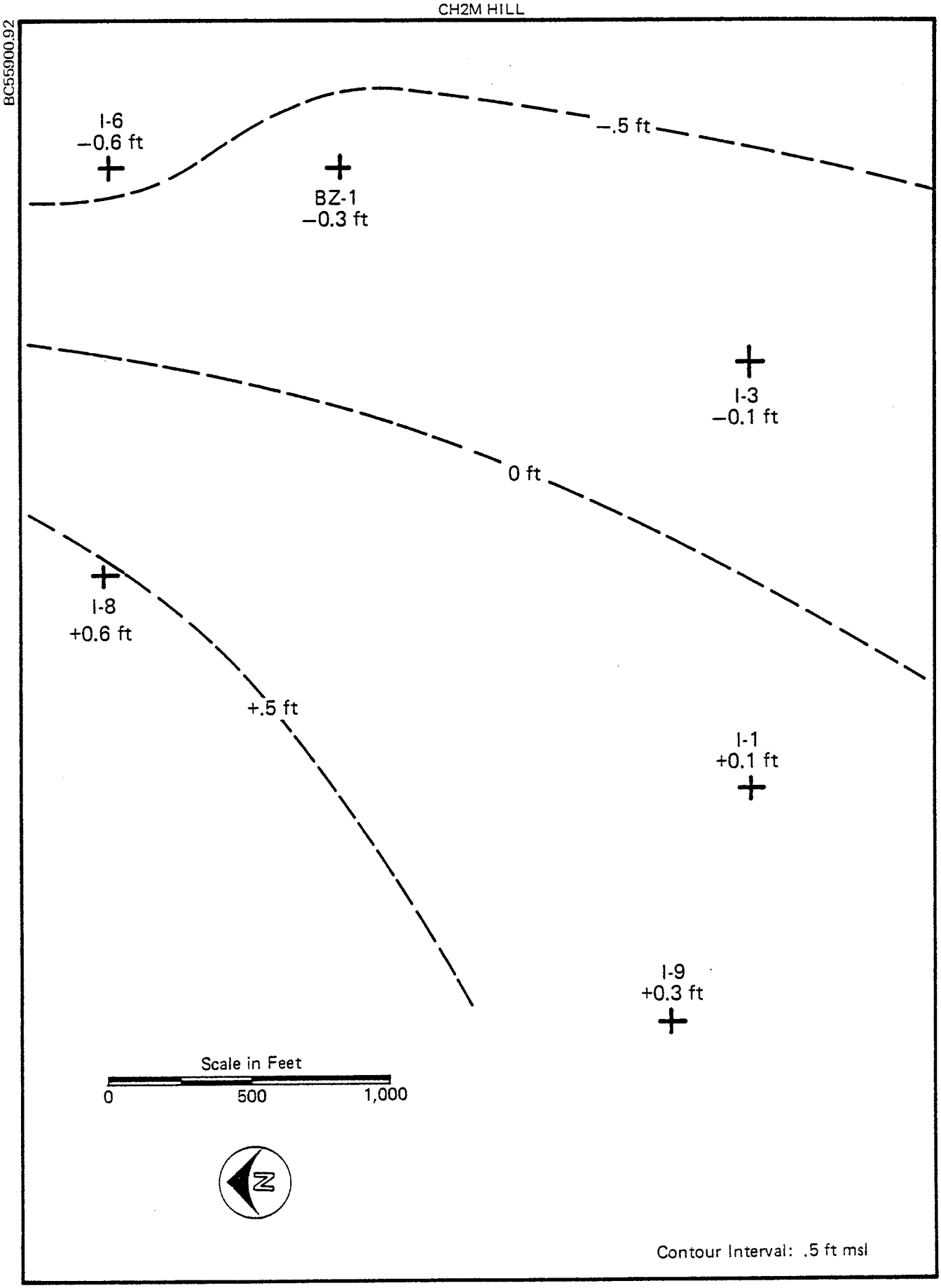

FIGURE 3.2-2. Potentiometric surface of the Boulder Zone, low tide, 4:15 a.m. January 23, 1981 (adjusted as per Table 3.2-6).

water elevations are approximations. For example, an error in the salinity value of only 0.10 ‰ would result in an elevation difference of approximately ±0.10 foot or a temperature error of 0.5°F would result in approximately ±0.25 foot elevation difference. The accuracy could not be improved upon based on the data available. It is for this reason that a second field effort was made to provide additional information on which to draw conclusions.

SECOND SURVEY

As concluded in the first test, the temperature of the wells' water columns had not reached equilibrium when the water levels were measured. This introduced a variable that had to be eliminated by approximated adjustment values to the measure temperatures in each well. In order to check our results and provide additional data on which to draw conclusions, a second survey was made during the week of March 2, 1981. Over 5 weeks had elapsed since the wells were pumped for the first survey, and the wells had been undisturbed during that time. From the temperature logs run for the first survey, it appears that the temperature of the water column reaches stabilization in about 7 to 10 days after pumping. Thus, the columns in the test wells were stabilized at background temperatures when the second survey was made.

Since the wells were left undisturbed, there should have been a minimum of water quality change in the open hole and none in the casings. Therefore, the assumptions for this survey are: (1) temperature profiles were in equilibrium, (2) all profiles in the wells were identical, and (3) salinity was the same in each well as measured during the pumping for the first survey.

In order to obtain water levels at high and low tide, a Stevens Type F water level recorder was installed on I-6. After observing a low tide on the chart, the next high, low, and following high tides were measured with a steel tape in each well. A temperature log was run on I-9 to verify that the temperature profile had indeed stabilized.

The density adjustment calculations were made by constructing a composite equilibrium temperature profile from logs run on I-5, I-7, and the stabilized log on I-9. This was done because of slightly different temperature profiles observed on these wells. Those differences could be caused by logging tool calibrations, well construction factors, or natural earth variations. It was felt that these differences, for whatever reason, should be averaged into a composite log in order to simplify the column adjustments.

RESULTS OF SECOND SURVEY

The water column density calculations are contained in Appendix 4.D-2, and Table 3.2-7 shows the resulting column adjustments. As Table 3.2-7 indicates, the measured low tide water levels from March 4, 1981, range from 4.23 to 6.10 feet above sea level, and the adjusted water levels range from .25 to 1.14 feet above sea level.

These values are slightly higher than those obtained during the first survey, in which the extrapolated temperature profile adjustments were used. However, the overall character of the potentiometric surface is very similar, except for Well I-9. The adjusted elevation of +0.6 foot appears to be too low with respect to the rest of the elevations. Possible reasons for this anomalous result as mentioned above are well construction factors or natural temperature variations across the site.

Table 3.2-7
ELEVATIONS OF THE POTENTIOMETRIC SURFACE
IN THE BOULDER ZONE--LOW TIDE, 12:40 p.m., March 4, 1981

Well	2,790-foot Column (psf)	Equivalent Column (ft)	Measured Water Level Low Tide (ft msl)	Adjustment (ft msl)	Adjusted Water Level (ft msl)
I-1	1.784044×10^5	2,786.10	5.00	-3.90	1.10
I-3	1.7839791×10^5	2,785.99	4.46	-4.01	.45
I-6	1.7839963×10^5	2,786.02	4.23	-3.98	.25
I-8	1.7833701×10^5	2,785.04	6.10	-4.96	1.14
I-9	1.7833926×10^5	2,785.08	5.49	-4.92	.57

Note: BZ-1 density @ 17°C = 64.0338634 lb/ft^3

CONCLUSIONS

Judging from the range of transmissivity values observed in the I-5 pump test, on the order of 100×10^6 gpd/ft, a gradient of anything more than a few inches per mile would seem improbable. As noted earlier, there is a built-in error in the density calculations in the form of the temperature tool calibrations and resolution. The salinity values used are also subject to inaccuracies. These inaccuracies

in themselves are insignificant and well within accepted limits. However, when compounded over the 2,800-foot water column, they become significant with relationship to the actual range of values measured between the wells.

Based on these assumptions, we conclude the following:

1. The elevation of the potentiometric surface of the Boulder Zone at the project site varies with tides at a slightly higher elevation than mean sea level.

2. The tidal range in the Boulder Zone is 0.3 to 0.5 feet based on observations of nearly 1 year of water level records from I-5 and during the surveys.

3. The potentiometric surface measurements must be done with native aquifer water in the entire casing at thermal equilibrium.

4. Water quality of the water standing in the casing must be known at each measuring location.

5. Thermal equilibrium is reached after pumping of a well in approximately 7 to 10 days.

6. The observed gradient is probably too high in light of other test data.

7. There is probably a very slight gradient in an east-southeast direction.

Chapter 3.3
POTENTIOMETRIC SURFACE OF THE UPPER FLORIDAN AQUIFER

UPPER FLORIDAN

The upper Floridan aquifer extends from approximately 1,000 feet to 1,100 feet at the project site. Chlorides in this section range from approximately 1,000 to 1,500 mg/l. Below 1,700 feet, the saltwater interface occurs, with chloride values of approximately 4,000 mg/l at 1,700 feet in depth, increasing to 17,500 mg/l at 1,850 feet.

The three monitoring wells used in this survey were FA-1, FA-2, and BZ-1. The annulus around the 6-5/8-inch casing on the FA wells is open from 980 to 1,020 feet on FA-1 and from 980 to 1,090 feet on FA-2. The upper Floridan monitor tube on BZ-1 is screened and gravel packed from 1,000 feet to 1,037 feet. Prior to the test, the three monitor wells were allowed to flow to ensure that the monitor tubes contained native water. (A minimum of three times the volume in each tube was allowed to flow.)

INSTRUMENTATION

Three precision pressure gauges (repeatability ±0.02 psi) were used to read the pressure of the upper Floridan aquifer in the three wells. The gauge elevations were surveyed in with an accuracy of ±0.01 foot from a county benchmark and are referred to mean sea level. Table 3.3-1 shows the measuring point and elevation referred to mean sea level at each well. The gauge elevations for the test are also shown. After all the gauges were installed, the pressures were read periodically all day on January 22, 1981, and the morning of January 23.

RESULTS

Figure 3.3-1 shows the water levels, converted from pressures, in the monitor wells for the test. As Figure 3.1-1 indicates, the water level rose in BZ-1 and leveled off for approximately 2 hours from 1:10 to 3:10 p.m. During this time, the water levels in FA-1 and FA-2 were still rising. FA-1 leveled off at 2:10 p.m. and FA-2 at about 3:00 p.m. The rising trend was probably caused by the wells being flowed, which would have left cooler water in their casings. As the water warmed up again, the water level rose. At the above-mentioned times, however, the water level was stable, after which it started to rise again. A low tide would affect the levels in this way by counteracting the rise (warming trend) and would flatten the curves.

It is of interest to note that the water level in BZ-1 flattened first, followed by FA-1, and then FA-2, as would be expected if a tide were to propagate through the aquifer from seaward.

Table 3.3-1
MEASURING POINT ELEVATIONS REFERRED
TO MEAN SEA LEVEL
FLORIDAN AQUIFER POTENTIOMETRIC SURVEY

Well	Measuring Point of Well	Elevation[a] (ft msl)	Elevation of Gauge for Test (ft msl)
BZ-1	Top of 6" valve flange	12.999	15.370
FA-1	Top of 19" flange on 12-3/4" casing	10.514	15.514
FA-2	Top of 19" flange on 12-3/4" casing	10.331	15.261

[a]Elevations of measuring points were determined from elevation data on bronze disks set in the concrete pads of BZ-1, I-8, and I-9.

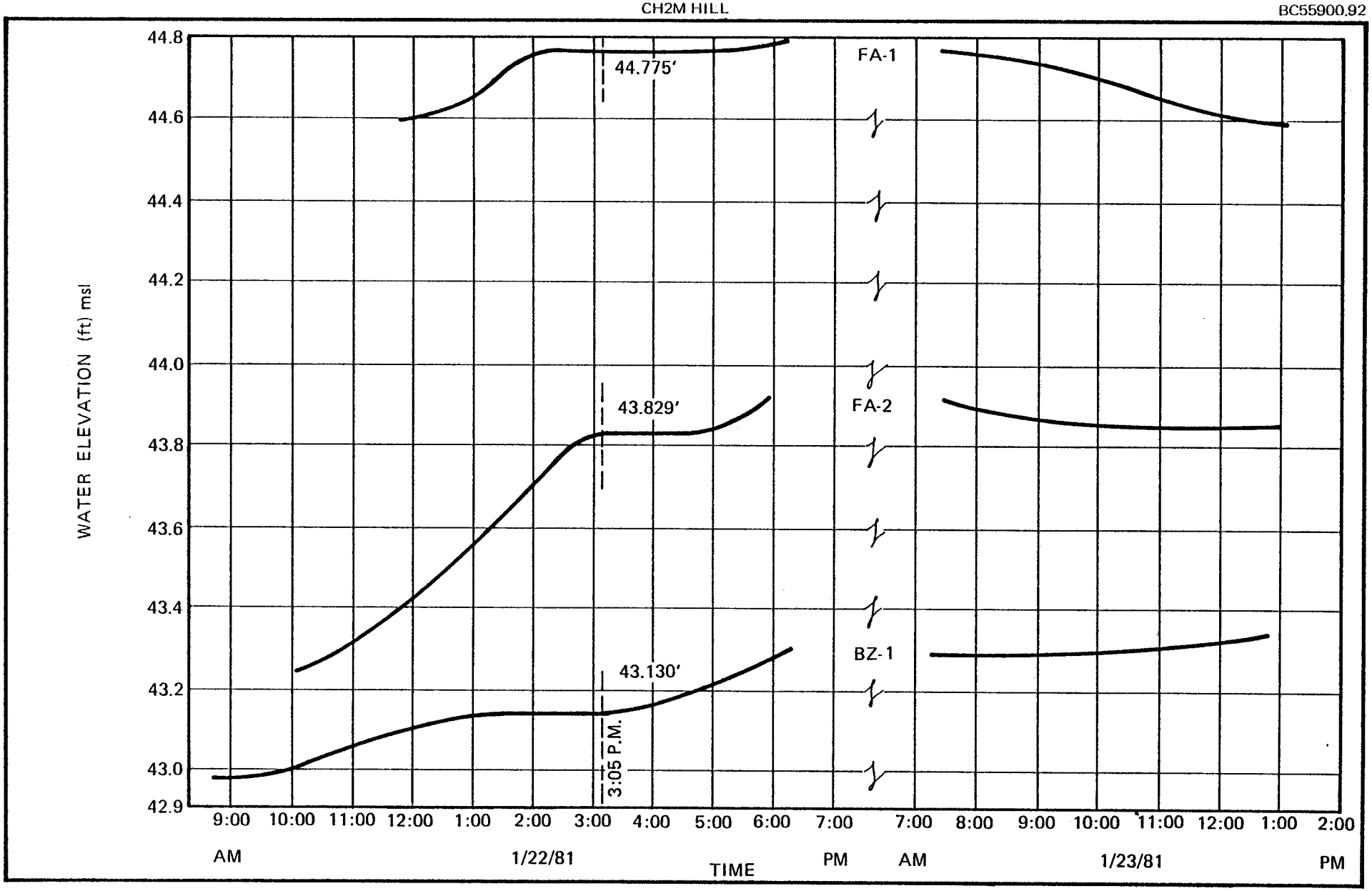

FIGURE 3.3-1. Water levels in the Upper Floridan aquifer, January 22, 1981 (ft msl—converted from pressures).

By taking the water elevations in the three wells at 3:05 p.m., when they were all stable, the potentiometric contour map on Figure 3.3-2 was drawn.

As Figure 3.3-2 indicates, the water level difference between FA-1 and BZ-1 is approximately 1.5 feet, and between FA-1 and FA-2 the difference is approximately 1.0 foot. By plotting the contours using graphical interpolation, the resulting gradient is approximately 4 feet per mile in a south 30° east direction.

LOWER FLORIDAN

The lower Floridan aquifer potentiometric surface could not be determined at the site. The original plans called for FA-1 and FA-2 to be completed in the same zone, along with the middle monitor tube on BZ-1. This would have enabled us to map a potentiometric surface of the lower Floridan aquifer.

After the cementing difficulties of the 24-inch casing on I-2, the final casings of I-8 and I-9 were set at approximately 2,420 feet. This depth was above the lower monitoring zone in BZ-1, which was to be the first zone above the injection strata. The final setting of the FA-1 casing was altered to be set in the next producing zone above the 2,420-foot level, at approximately 1,900 feet. This would then provide an alternate means of monitoring immediately above the lost monitoring zone in BZ-1 and below the Floridan aquifer. FA-1 was completed to a depth of 1,927 feet with casing set at 1,840 feet.

There is a substantial water quality difference between the zone in which FA-1 is completed and the lower zone in FA-2 and BZ-1. This difference occurs because FA-1 penetrates below the brackish/saltwater interface. The chloride concentration in this well is 17,500 mg/l, whereas the chlorides in FA2 and BZ-1 (above the interface) are approximately 4,000 mg/l. Due to the differences in water quality and construction, it is no longer considered appropriate to compare the FA-1 deep zone to the lower Floridan zones in FA-2 or BZ-1. The lack of three data points precludes the modeling of a potentiometric surface of the lower Floridan over the site.

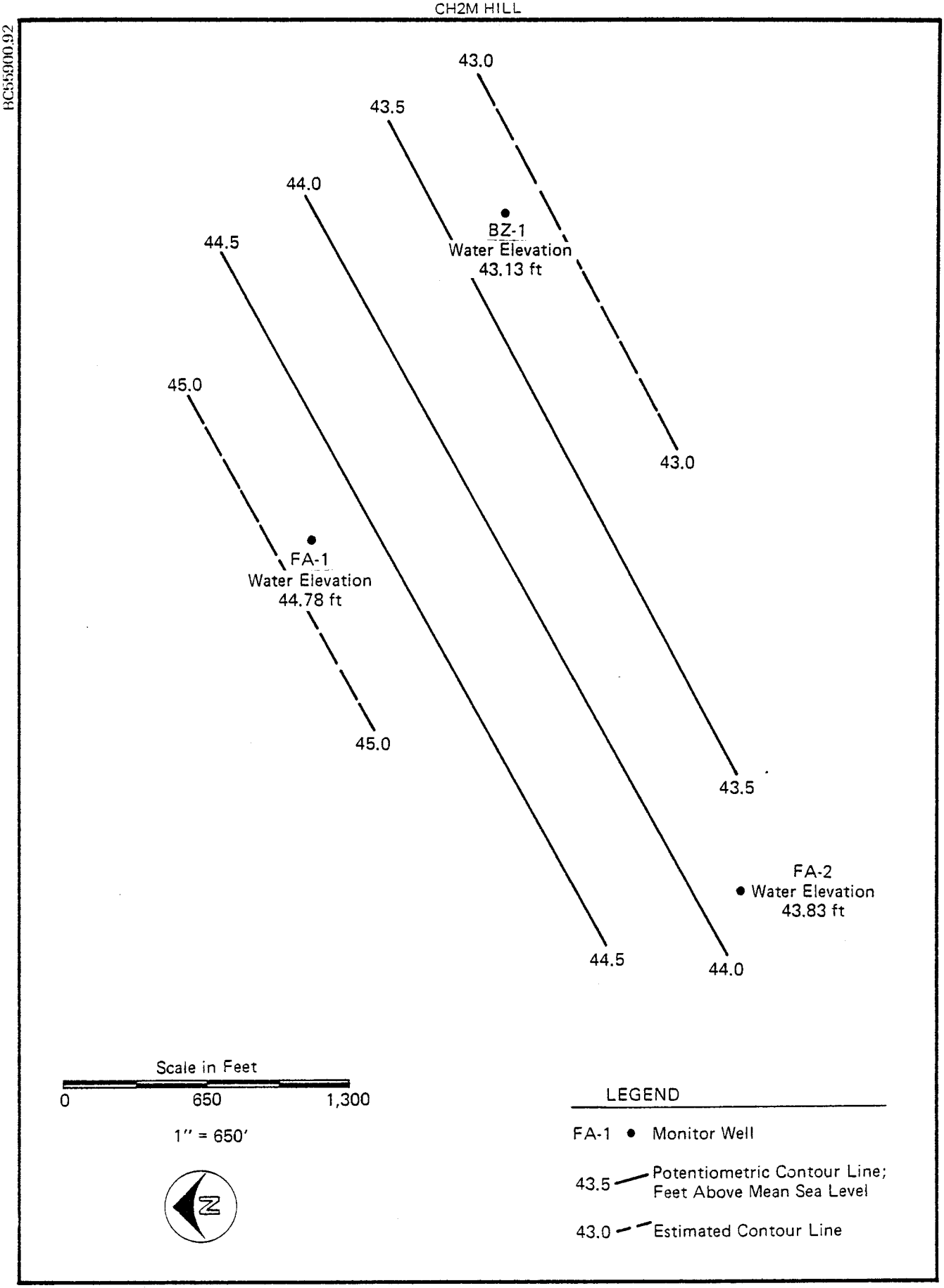

FIGURE 3.3-2. Potentiometric surface of the Upper Floridan aquifer, January 22, 1981.

Chapter 3.4
MODEL OF THE EFFECTS OF INJECTION

ASSUMPTIONS

A model was prepared in order to assess the impact that the operation of the injection well system will have on the potentiometric surface of the Boulder Zone. The following assumptions were used in making the calculations:

1. The average discharge rate is 50 mgd, or 35,000 gpm.
2. The injection wells were treated as one well injecting at 35,000 gpm in the center of the project site.
3. The coefficient of transmissivity of the Boulder Zone is 140 x 10^6 gpd/ft (average value of range given in Chapter 3.1).
4. The aquifer is as a non-leaky artesian aquifer with fully penetrating wells.
5. A discharge boundary exists where it is believed the formation outcrops into the Florida Straits, approximately 30 miles east of the site.
6. There is no water quality difference between the injected and native water.

The coefficient of transmissivity was obtained from the withdrawal test on I-5 (see Section 3.1, I-5 Withdrawal Test). It is an average value of the range estimated from the test. Variations in the transmissivity within the same order of magnitude do not significantly affect the resulting model.

CALCULATION

The existence of a discharge boundary 30 miles east of the site influences the effects on the potentiometric surface from the injection system. The very high transmissivity of the injection zone allows for equilibrium conditions to occur quickly as the rate of injection balances the rate discharged. The following formula (Walton, 1970) was used to calculate the effect of injection on the Boulder Zone:

$$S_r = \frac{528\ Q \log\left(\sqrt{4a^2 + r^2 - 4ar\cos B_r}/r\right)}{T}$$

where

S_r = water level increase at an observation point, in feet

Q = injection rate, in gpm

a = distance from injection well to discharge boundary, in feet

r = distance from observation point to injection well, in feet

B_r = angle between a line connecting the injection and image wells, and a line connecting the injection well and observation point

T = coefficient of transmissivity gpd/ft

CONCLUSIONS

The resulting effects on the potentiometric surface of the Boulder Zone are shown on Figure 3.4-1.

As can be seen, the injection system's impact on the Boulder Zone is very slight, causing a 0.3-foot rise in the potentiometric surface about 1,500 feet away from the center of the site or just beyond the property boundary. About 2 miles from the site there is a rise of only .2 foot. Beyond this point, the effects of the discharge boundary on the contour lines are seen. It causes the contour lines to appear egg-shaped, distorting the lines to the west. The .1-foot line extends to the west 12 miles, to the east 9 miles, and to the north and south about 10 miles.

This model does not take into account the differential density effect of injection on the water levels in the Boulder Zone. The density of the injected effluent is that of freshwater, whereas the native aquifer water density is that of seawater. This density difference will cause the injected fluid to float on top of the native water. This buoyancy force was measured during each injection test as the static freshwater head test at shutdown. The average wellhead pressure from this density difference is about 67 feet of head or 29.0 psi referred to the concrete drilling pads. The density differential is dependent on the amount of mixing of the injected and native water and on how the unmixed fresh injected water is displaced in the upper portion of the Boulder Zone.

The model prepared shows the effects of injection on the Boulder Zone's native water quality potentiometric surface, and not the effects caused by the differential density between the native and injected waters.

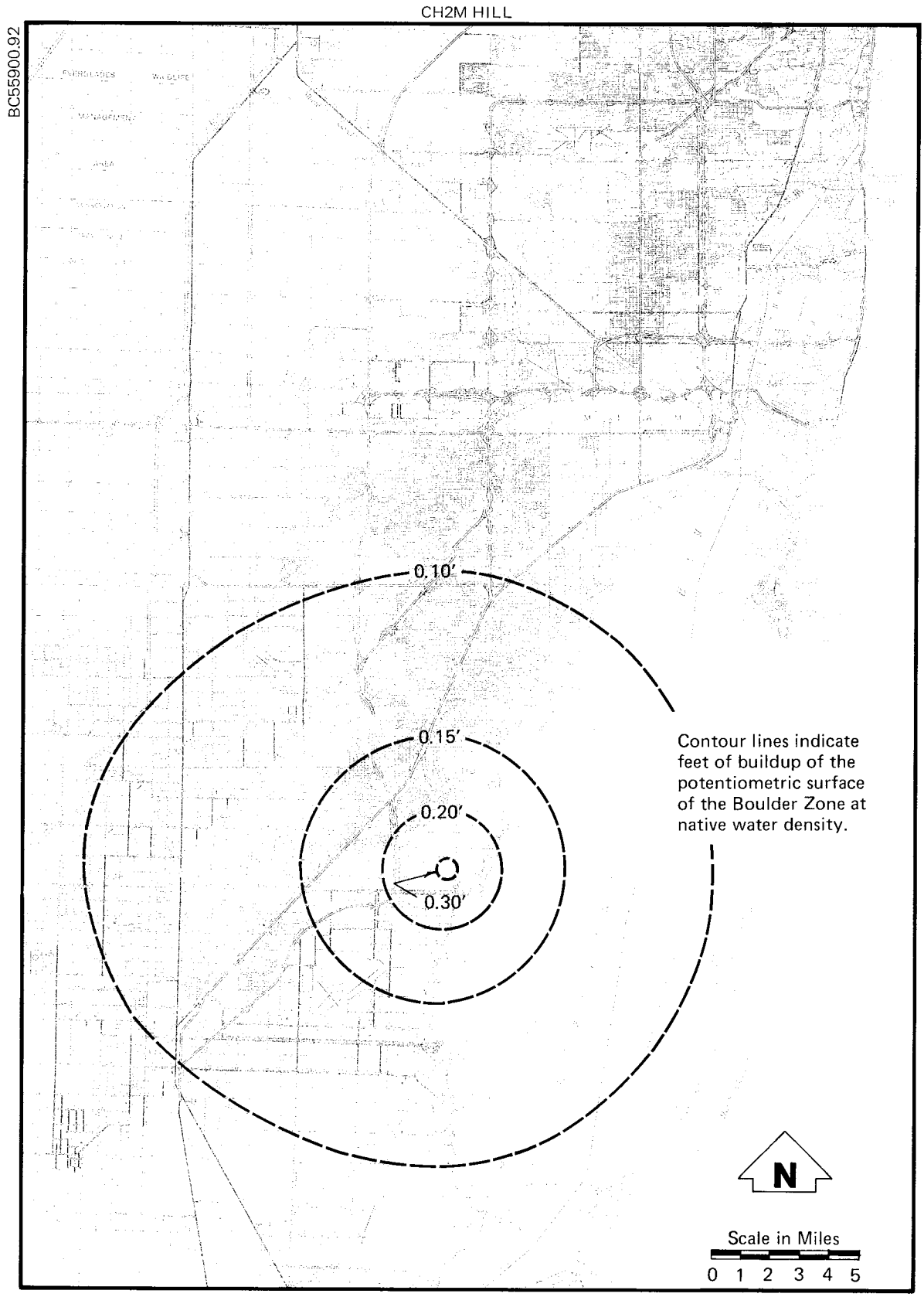

FIGURE 3.4-1. Estimated effects of injection at 50 mgd for 30 years on the potentiometric surface of the Boulder Zone.

Section 4

APPENDIX

Appendix 4.A
STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL REGULATION CONSTRUCTION PERMITS INJECTION AND MONITORING WELLS

SERIAL № 04149

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

FOR South District Regional
Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC I3-5381 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-1) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800 +, 44-inch to 980 + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 32' 52" N. LONG: 80° 20' 42" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
CONSTRUCTION PERMIT PROVISOS

Permit No. UIC 13-5381 Date: May 5, 1978

1. This permit approval is based upon evaluation of the plans and specifications submitted with the application and the data derived from the construction and testing of the injection test well. Any changes in those portions of the plans and specifications relative to design, materials, construction procedures or testing of the wells, except as provided below, must be approved by the Department.

2. In the event the permittee is temporarily unable to comply with any conditions of this permit, he shall immediately notify this Department in writing. Notification shall include pertinent information as to the cause of the problem and what measures are being taken to correct the problem and prevent its recurrence.

3. During the construction period allowed by this permit daily drilling logs shall be submitted to the Department weekly. The package shall include but is not limited to the following:

    a. Description of formation and depth encountered.
    b. Notification of collection of drill cuttings every ten (10) feet or at every change in formation.
    c. Copy of all down hole surveys, geophysical logs, chemical analyses, test results and other such data items, as soon as available.

    d. Description of daily footage drilled by diameter of bit if pilot hole drilling is in progress, or size of hole opener or reamer being used behind the pilot hole.
    e. Description of any construction problems that develop and their status.

4. If any problems develop that may seriously hinder compliance with this permit, construction progress or good construction practice the Department shall be notified by telephone immediately. The Department may require a detailed written report to follow within seven (7) days. The written report will describe, in detail, what problems have occurred, the remedial measures applied to assure compliance and the measures taken to prevent the recurrence.

5. During the construction of this facility, adequate and approved disposal shall be provided for any and all contaminants that may endanger any aquifer or surface waters.

6. The conditions of this permit do not exempt the applicant from complying with all spplicable Federal, State, regional or local authority's rules, regulations, ordinances, codes or limitations in effect on the date of issuance of this permit or that become effective throughout the duration of this permit.

7. A registered professional engineer, pursuant to Chapter 471, Florida Statutes (F.S.) must be retained throughout the construction period. The engineer will provide on-site monitoring by a professional engineer or qualified geologist of the operation and be available to the Department for consultation. The Department must be notified immediately of any change of engineer.

8. This permit shall not be effective until filed in the office of the Clerk of the Circuit Court as required by Section 387.03, Florida Statutes (F.S.).

9. The Department reserves the right to modify these permit provisos or to order a cessation of all operations if it deems necessary. After an evaluation of the reason for the cease order, the Department may seek remedial or corrective measures to protect the environment and assure compliance with plans and specifications or permit provisos. An order to proceed will be based on approval or remedial or corrective measures to be applied. If the Department deems it necessary and so orders, the well shall be abandoned pursuant to Chapter 17-21, Florida Administrative Code, (F.A.C.).

10. A pressure test designed to demonstrate the integrity of the final casing shall performed after the final casing has been set and cemented. The testing pressure and period shall not be less than 100 psi and one (1) hour respectively and the test shall be performed prior to drilling through the plug placed during the cementing operation. To be considered as a successful test, no pressure losses are acceptable.

11. All underground drinking water sources of 10,000 mg/l total dissolved solids or less shall be protected by casing cemented to the surface.

12. Temperature surveys shall be run within twelve (12) hours of completion of cementing operation. Cementing procedures shall be continuous for each stage after cementing begins. If loss of circulation or no return of cement is encountered, and the problem is not corrected in a reasonable period of time, the Department shall be notified immediately of what remedial measures are underway to re-establish the lost circulation and complete cementing program according to well design and specifications.

13. The applicant shall provide all geological and physical characteristics available, including logs and cores of the injection interval, if possible, and the overlying confining beds including:

a. Thickness
b. Area extent, vertical and horizontal
c. Lithology, transmissivity
d. Location, extent and effects of known or suspected faulting, fracturing, and natural solution channels
e. Formation fluid chemistry, including water quality characteristic measurements per specifications
f. Fracturing gradients

14. After construction completion, a final report shall be submitted. This report shall document and discuss all testing results, chemical and physical analysis of the monitoring data, temperature surveys and pressure test results. Review of this report by the appropriate agencies will determine recommended action. Interim reports may be required by the agencies or offered by the permittee as problems or other situations of concern arise. Copies of all reports shall be provided to all concerned agencies.

15. The proposed outfall pipe across L31E to be utilized for transporting drill water into the estuary shall be provided with adequate controls to check erosion and the turbidity of the fluid discharged into the estuary. The discharge shall not violate the Water Quality Standards of the State.

16. Meetings between concerned agencies, (United States Geological Survey; South Florida Water Management District; Metropolitan Dade County Environmental Resources Management; United States Environmental Protection Agency, Atlanta; Florida Department of Environmental Regulation - South Florida Subdistrict and Tallahassee), the permittee, permittee's engineers, and the well contractor shall be held during the construction period of the well. The initial meeting will be held prior to construction start-up, but after the contractor has been selected. Scheduling of future meetings will be a part of the agenda during each meeting. If deemed necessary, the permittee or the Department may call additional meetings.

17. The following surveys may be required at the intervals indicated by the depth penetrated in an open uncased hole. The specified depths and specific surveys to be run will vary with the site, data already available (from previous drilling operations in the area) and specific geological conditions. As construction progresses, the engineer shall recommend a survey program for each stage and secure the concurrence of the Department before advancing to the next stage of construction.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
CONSTRUCTION PERMIT PROVISOS

Survey	Depth
Electric Gamma Ray Caliper	0 feet to 900± feet
Electric Gamma Ray Caliper Flow Meter Temperature Fluid Resistance Acoustic Bond	900± feet to 1800± feet
Caliper Flow Meter Temperature Acoustic Bond	1800± feet to final depth of well
Borehole T.V. with recorded capability for later viewing	0 feet to final depth of well cased and open hole
"Core Band" Series (Schulumberger or equivalent	Injection Zone Confining Zone

18. The period of this permit allows sufficient time for the construction and the operational testing and evaluation of the injection and monitoring system. At least three (3) months prior to the initiation of the system operational test (or first scheduled injection of treated effluent) a comprehensive test plan shall be submitted to the Department for approval. The operational test plan shall be designed to accomplish but need not be limited to the following objectives:

    A. Verify the adequacy, accuracy and reliability of the system
    B. Verify the performance of the injection system including the effluent pumps, pump controls, inter-connecting piping, valves and wells. Specific attention should be given to operation procedures, alarm systems, potential for pressure surges and water hammer effects and emergency procedures.
    C. Empirical evaluation of the transmissivity of the injection zone and the maximum capacity, within safe pressure limits, of each injection well.

SERIAL Nº 04150

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

FOR South District Regional
Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5382 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-2) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800' +, 44-inch to 980' + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 32' 52"N. LONG: 80° 20' 26" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL № 04151

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

South District Regional
FOR Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5383 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (±) gpm injection well (I-3) to receive secondary-treated effluent, drilled to a total depth of 3100' ± with cemented casings as follows: 24-inch to 2750' ±, 34-inch to 1800' ±, 44-inch to 980' ± and 52-inch to 140' ±. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 32' 52" N. LONG: 80° 20' 10" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL № 04152

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

FOR South District Regional Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5384 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-4) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800' +, 44-inch to 980 + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 33' 05" N. LONG: 80° 20' 03" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

DER Form PERM 11-1 (Mar. 76)

SERIAL № 04153

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

South District Regional
FOR Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5385 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-6) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800' +, 44-inch to 980' + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 33' 38" N. LONG: 80° 19' 55" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN, FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Ray M Dubee Jr

JOSEPH W. LANDERS JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL Nº 04154

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

FOR South District Regional
Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5386 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-7) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800' +, 44-inch to 980' + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 33' 37" N. LONG: 80° 20' 10" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Ray M Dubé Jr

J W Landers Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL № 04155

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

South District Regional
FOR Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5387 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-8) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800' +, 44-inch to 980' + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 33' 37" N. LONG: 80° 21' 26" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL Nº 04156

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

South District Regional
FOR Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5388 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: 10,000 (+) gpm injection well (I-9) to receive secondary-treated effluent, drilled to a total depth of 3100' + with cemented casings as follows: 24-inch to 2750' +, 34-inch to 1800' +, 44-inch to 980' + and 52-inch to 140' +. Subject to the attached provisos #1 through #18.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 32' 56" N. LONG: 80° 22' 01" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL № 04145

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

FOR South District Regional
Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5378 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:
GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: Monitoring Well (BZ-1) to monitor zones at estimated depths of 1010' - 1020', 1640' - 1650', 2490' - 2500' and 2750' - 3100'; at the injection well field serving the South District Regional Wastewater Treatment Facility. Subject to the attached provisos #1 through #19.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 33' 22" N. LONG: 80° 19' 55" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION
CONSTRUCTION PERMIT PROVISOS

Permit No. UIC 13-5378 Date: May 5, 1978

1. This permit approval is based upon evaluation of the plans and specifications submitted with the application and the data derived from the construction and testing of the injection test well. Any changes in those portions of the plans and specifications relative to design, materials, construction procedures or testing of the walls, except as provided below, must be approved by the Department.

2. In the event the permittee is temporarily unable to comply with any conditions of this permit, he shall immediately notify this Department in writing. Notification shall include pertinent information as to the cause of the problem and what measures are being taken to correct the problem and prevent its recurrence.

3. During the construction period allowed by this permit daily drilling logs shall be submitted to the Department weekly. The package shall include but is not limited to the following:

    a. Description of formation and depth encountered.
    b. Notification of collection of drill cuttings every ten (10) feet or at every change in formation.
    c. Copy of all down hole surveys, geophysical logs, chemical analyses, test results and other such data items, as soon as available.

    d. Description of daily footage drilled by diameter of bit if pilot hole drilling is in progress, or size of hole opener or reamer being used behind the pilot hole.
    e. Description of any construction problems that develop and their status.

4. If any problems develop that may seriously hinder compliance with this permit, construction progress or good construction practice the Department shall be notified by telephone immediately. The Department may require a detailed written report to follow within seven (7) days. The written report will describe, in detail, what problems have occurred, the remedial measures applied to assure compliance and the measures taken to prevent the recurrence.

5. During the construction of this facility, adequate and approved disposal shall be provided for any and all contaminants that may endanger any aquifer or surface waters.

6. The conditions of this permit do not exempt the applicant from complying with all spplicable Federal, State, regional or local authority's rules, regulations, ordinances, codes or limitations in effect on the date of issuance of this permit or that become effective throughout the duration of this permit.

7. A registered professional engineer, pursuant to Chapter 471, Florida Statutes (F.S.) must be retained throughout the construction period. The engineer will provide on-site monitoring by a professional engineer or qualified geologist of the operation and be available to the Department for consultation. The Department must be notified immediately of any change of engineer.

8. This permit shall not be effective until filed in the office of the Clerk of the Circuit Court as required by Section 387.03, Florida Statutes (F.S.).

9. The Department reserves the right to modify these permit provisos or to order a cessation of all operations if it deems necessary. After an evaluation of the reason for the cease order, the Department may seek remedial or corrective measures to protect the environment and assure compliance with plans and specifications or permit provisos. An order to proceed will be based on approval or remedial or corrective measures to be applied. If the Department deems it necessary and so orders, the well shall be abandoned pursuant to Chapter 17-21, Florida Administrative Code, (F.A.C.).

10. A pressure test designed to demonstrate the integrity of the final casing shall be performed after the final casing has been set and cemented. The testing pressur and period shall not be less than 100 psi and one (1) hour respectively and the test shall be performed prior to drilling through the plug placed during the cementing operation. To be considered as a successful test, no pressure losses are acceptable.

11. All underground drinking water sources of 10,000 mg/l total dissolved solids or less shall be protected by casing cemented to the surface.

12. Temperature surveys shall be run within twelve (12) hours of completion of cementing operation. Cementing procedures shall be continuous for each stage after cementing begins. If loss of circulation or no return of cement is encountered, and the problem is not corrected in a reasonable period of time, the Department shall be notified immediately of what remedial measures are underway to re-establish the lost circulation and complete cementing program according to well design and specifications.

13. The applicant shall provide all geological and physical characteristics available, including logs and cores of the injection interval, if possible, and the overlying confining beds including:

a. Thickness
b. Area extent, vertical and horizontal
c. Lithology, transmissivity
d. Location, extent and effects of known or suspected faulting, fracturing, and natural solution channels
e. Formation fluid chemistry, including water quality characteristic measurements per specifications
f. Fracturing gradients

14. After construction completion, a final report shall be submitted. This report shall document and discuss all testing results, chemical and physical analysis of the monitoring data, temperature surveys and pressure test results. Review of this report by the appropriate agencies will determine recommended action. Interim reports may be required by the agencies or offered by the permittee as problems or other situations of concern arise. Copies of all reports shall be provided to all concerned agencies.

15. The proposed outfall pipe across L31E to be utilized for transporting drill water into the estuary shall be provided with adequate controls to check erosion and the turbidity of the fluid discharged into the estuary. The discharge shall not violate the Water Quality Standards of the State.

16. Meetings between concerned agencies, (United States Geological Survey; South Florida Water Management District; Metropolitan Dade County Environmental Resources Management; United States Environmental Protection Agency, Atlanta; Florida Department of Environmental Regulation - South Florida Subdistrict and Tallahassee), the permittee, permittee's engineers, and the well contractor shall be held during the construction period of the well. The initial meeting will be held prior to construction start-up, but after the contractor has been selected. Scheduling of future meetings will be a part of the agenda during each meeting. If deemed necessary, the permittee or the Department may call additional meetings.

17. The following surveys may be required at the intervals indicated by the depth penetrated in an open uncased hole. The specified depths and specific surveys to be run will vary with the site, data already available (from previous drilling operations in the area) and specific geological conditions. As construction progresses, the engineer shall recommend a survey program for each stage and secure the concurrence of the Department before advancing to the next stage of construction.

Survey	Depth
Electric Gamma Ray Caliper	0 feet to 900± feet
Electric Gamma Ray Caliper Flow Meter Temperature Fluid Resistance Acoustic Bond	900± feet to 1800± feet
Caliper Flow Meter	1800± feet to final depth of well
Borehole T.V. with recorded capability for later viewing	0 feet to final depth of well cased and open hole
"Core Band" Series (Schulumberger or equivalent	Injection Zone Confining Zone

18. All wells which are to be used for monitoring purposes shall be disinfected and sealed when construction is completed.

19. The period of this permit allows sufficient time for the construction and the operational testing and evaluation of the injection and monitoring system. At least three (3) months prior to the initiation of the system operational test (or first scheduled injection of treated effluent) a comprehensive test plan shall be submitted to the Department for approval. The operational test plan shall be designed to accomplish but need not be limited to the following objectives:

    A. Verify the adequacy, accuracy and reliability of the system
    B. Verify the performance of the injection system including the effluent pumps, pump controls, inter-connecting piping, valves and wells. Specific attention should be given to operation procedures, alarm systems, potential for pressure surges and water hammer effects and emergency procedures.
    C. Empirical evaluation of the transmissivity of the injection zone and the maximum capacity, within safe pressure limits, of each injection well.

SERIAL № 04146

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

South District Regional
FOR Wastewater Treatment Facility
Miami-Dade Water and Sewer Authority
P. O. Box 330316
Miami, Florida 33133

PERMIT NO. UIC 13-5379 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: Monitoring Well (FA-1) to monitor zones at estimated depths of 980' - 1100' and 1550' - 1650'; at the injection well field serving the South District Regional Wastewater Treatment Facility. Subject to the attached provisos #1 through #19.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 33' 37" N. LONG: 80° 20' 28" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Ray M Duke Jr

J W Landers Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

SERIAL № 04148

STATE OF FLORIDA
DEPARTMENT OF
ENVIRONMENTAL REGULATION

CONSTRUCTION PERMIT

FOR South District Regional Wastewater Treatment Facility

Miami-Dade Water and Sewer Authority

P. O. Box 330316

Miami, Florida 33133

PERMIT NO. UIC I3-5380 DATE OF ISSUE May 5, 1978

PURSUANT TO THE PROVISIONS OF SECTIONS 403.061 (16) AND 403.707 OF CHAPTER 403 FLORIDA STATUTES AND CHAPTERS 17-4 AND 17-7 FLORIDA ADMINISTRATIVE CODE, THIS PERMIT IS ISSUED TO:

GARRETT SLOAN, DIRECTOR

FOR THE CONSTRUCTION OF THE FOLLOWING: Monitoring Well (FA-2) to monitor zones at estimated depths of 980' - 1100' and 1550' -1650'; at the injection well field serving the South District Regional Wastewater Treatment Facility. Subject to the attached provisos #1 through #19.

LOCATED AT Silver Palm Drive and Southwest 87 Avenue, Miami, Dade County, Florida LAT: 25° 32' 57" N. LONG: 80° 22' 02" W.

IN ACCORDANCE WITH THE APPLICATION DATED February 22, 1978

ANY CONDITIONS OR PROVISOS WHICH ARE ATTACHED HERETO ARE INCORPORATED INTO AND MADE A PART OF THIS PERMIT AS THOUGH FULLY SET FORTH HEREIN. FAILURE TO COMPLY WITH SAID CONDITIONS OR PROVISOS SHALL CONSTITUTE A VIOLATION OF THIS PERMIT AND SHALL SUBJECT THE APPLICANT TO SUCH CIVIL AND CRIMINAL PENALTIES AS PROVIDED BY LAW.

THIS PERMIT SHALL BE EFFECTIVE FROM THE DATE OF ISSUE UNTIL June 30, 1981 OR UNLESS REVOKED OR SURRENDERED AND SHALL BE SUBJECT TO ALL LAWS OF THE STATE AND THE RULES AND REGULATIONS OF THE DEPARTMENT.

Roy M Duke Jr

J W Landers Jr

JOSEPH W. LANDERS, JR.
SECRETARY

DISTRICT MANAGER
Warren G. Strahm

SGC

Appendix 4.B
PROGRESS MEETING SUMMARIES

CH2M HILL
engineers
planners
economists
scientists

SUMMARY OF MEETING

DATE: 9 February 1979, 10:00 a.m. to 3:00 p.m.

RE: Preconstruction Meeting--Injection and Monitoring Wells, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant

AT: Board Room, Miami-Dade Water and Sewer Authority, 3575 LeJeune Road, Miami, Florida

ATTENDING:

Barry Amos	EPA--Atlanta
Roy Duke	DER--West Palm Beach
Abe Kreitman	SFWMD--West Palm Beach
Russell J. Kerrn	Alsay-Pippin Corp.
H. L. Pippin	Alsay-Pippin Corp.
Cathie Cash	DER--Tallahassee
Jim Cowgill	MDW&SA
Murray Grant	MDW&SA
J. I. Garcia-Bengochea	CH2M HILL
Fred Meyer	USGS--Miami
Richard E. Friberg	MDW&SA
P. Smits	MDW&SA
Udai P. Singh	CH2M HILL
Albert M. LaSala, Jr.	USGS--Miami
Robert McCullogh	MDW&SA
Bob Celette	MDW&SA
Frank Reynolds	CH2M HILL
Ross Sproul	CH2M HILL
James N. Hutchinson	EPA/C of E--Miami Beach
O. F. Acy	Halliburton Services
Thomas M. McCormick	MDW&SA
Gerald Badeaux	Halliburton Services
Jeff Lehnen	CH2M HILL
Mike Lockamy	C.O.E.
Peter E. Robinson (observer)	Hazen and Sawyer, P.C.
Herbert K. Kunen	MDW&SA

1. Notice to proceed has not been sent to the contractor as yet. The date of expiration of the contractor's bond is 26 February. The EPA representative informed that the delay is with the Equal Opportunity Opportunity Office of the EPA, and minority involvement is the item of concern.

Gainesville Office
7201 N.W. 11th Place, P.O. Box 1647, Gainesville, Florida 32602 904/377-2442

He said that the notice to proceed should be granted by EPA by or prior to 26 February. Because of this delay, the contractor stated that he will make a request for dismissal of liquidated damages.

2. The proposed work schedule (attached with this summary) was distributed by the contractor. The contractor wants at least six padsites to be ready by the starting date. Five are ready now. Miami-Dade Water and Sewer Authority (MDW&SA) was asked to get either I-8 or I-2 site ready. Pipes will be brought into the site according to the following schedule, as informed by the contractor.

54"	early March
44"	early March
34"	late February
24"	hold until later

They will be stored at the site of the chlorine contact chamber of the WWTP. However, pipes may have to be moved at a later date. MDW&SA asked about blasting in the area (1,500 feet to 2,000 feet from the worksite). The contractor expressed that no problems are anticipated from the blasting.

3. It is planned to have radio communication within the jobsite. There will be a radio at each rig, a radio at the main office-trailer, and a pocket two-way radio each with one representative of CH2M HILL and one of MDW&SA, 24 hours per day.

4. Work on building concrete pads on six drilling sites will be started as soon as notice to proceed is received by contractor.

5. It was agreed by all that the pads could be 92' x 120' in lieu of 98' x 120'. This will result in a savings of $492.40 per pad.

6. The time of construction of the Biscayne aquifer monitoring and water supply wells was discussed (before or after building the pad?). The contractor asked it to be left to his convenience, and he would guarantee that these wells will be protected. This was agreed by all.

7. It was agreed that sampling of the wells in item 6 will be once a week during construction of the injection wells

unless some unexpected event occurs. However, eight background samples will be collected from the above wells within 2 weeks of the start of drilling of the injection well.

8. Two sets of geologic samples from each pilot hole drilling will be collected. The samples will be staged per casing setting. One set will be sent to the Bureau of Geology, and the other will remain at the jobsite.

9. Pilot hole water samples will be collected every 30 feet and analyzed for chloride, specific conductance, temperature, and density.

10. The following reports will be submitted weekly to the agencies indicated as work progresses and data are available.

Jobsite reports:

(1) Shift reports (only to DER--Tallahassee)
(2) Daily summary (from shift reports)
(3) Biscayne aquifer monitoring
(4) Geologic logs
(5) Water quality logs during pilot hole drilling
(6) Pumpout tests
(7) Injection tests
(8) Vertical deviation surveys

Reports will be distributed as follows.

(1) Department of Environmental Regulation--Tallahassee
(2) Department of Environmental Regulation--West Palm Beach
(3) South Florida Water Management District--West Palm Beach
(4) U.S. Environmental Protection Agency--Atlanta
(5) U.S. Geological Survey--Miami
(6) U.S. Army Corps of Engineers--Miami Beach
(7) Miami-Dade Water and Sewer Authority (at jobsite)

11. Progress meetings will be held at the jobsite for each well as follows.

1st meeting: to determine ≅1,800-foot casing depth
2nd meeting: to determine ≅2,800-foot casing depth
3rd meeting: at completion of the well

Meetings will not be required during injection tests. However, unforeseen circumstances during well construction may require other additional meetings.

12. Referring to proviso 17 of the well construction permits, it was proposed that the acoustic bond log survey be omitted, and only the temperature log survey be used to track the cement. The acoustic bond log survey would have to be done by Schlumberger only for the inner casing of each well. This would be decided at the first scheduled progress meeting. Also in proviso 17, the following logs need to be added.

1,800 feet to total depth:	gamma ray electric fluid resistance

The "Core Bond" series log and cement-bond logging of the inner casing will have to be decided at one of the scheduled progress meetings.

13. TV surveys will be performed on each well as follows.

BZ-1:	open hole 900' to 1,800', 1,800' to 2,800', 2,800' to total depth
I series:	finished casing and hole
FA series:	finished casing and hole

TV video tapes will be sent to:

DER--Tallahassee
South Florida Water Management District--West Palm Beach
USGS--Miami

One set of tapes will be retained at the jobsite.

14. A long discussion took place to decide whether to have single-shot or gyroscopic directional surveys to assure that reamed hole includes pilot hole at each site. The cost of using single-shot directional surveys has been estimated by the contractor to be $63,760 per injection well. Also, the contractor felt that if he is asked to use single-shot directional surveys, he was not ready to bear the responsibility unless the accuracy of the surveys was guaranteed. It was agreed (subject to final agreement by Gene Coker, EPA, Atlanta) to have the single-shot non-directional survey as specified in the contract documents. In addition, gyroscopic surveys will be performed on the

pilot hole and reamed hole at 1,800-foot and 2,800-foot depths. In the case of disagreement between the surveys (i.e., if the gyro survey shows two holes), TV and sonar log surveys would be performed to confirm these directional surveys. If confirmatory surveys prove that there are actually two holes, then the contractor will pay for these confirmatory tests, the standby time, and corrective measures to make sure that there is only one hole. On the other hand, if the contractor is right and there is only one hole, then Miami-Dade Water and Sewer Authority will pay for the confirmatory tests and downtime. As requested by the EPA representative, the contractor will notify him in writing his method of drilling to reasonably assure drilling of <u>one</u> hole only.

15. The proposed drilling of a pilot hole to 4,000-foot depth was turned down because its cost would not be grant-eligible.

16. It was agreed that pumpout tests of I-5 with water level observations in BZ-1 and I-6 will have to wait until the end of year 1979 because I-6 will not be completed until then.

17. It was agreed that coring of BZ-1 will take place as follows.

Number of Cores To Be Taken	Approximate Depth (feet)
One	1,500
One	2,200
One	2,400
One	1,800 to 1,900
Six	2,500 to 2,800

18. It was agreed that the USGS will perform acoustic televiewer logs of the first five pilot holes, subject to EPA approval. EPA will soon notify MDW&SA whether this will be grant-eligible or not.

19. It was agreed that the final report, prepared by CH2M HILL, will include:

    (1) Summary of drilling and hydrogeological data on each well.
    (2) Potentiometric surface of Boulder Zone.
    (3) Potentiometric surface of lower Floridan aquifer.
    (4) Potentiometric surface of upper Floridan aquifer.
    (5) Model showing impact of 50 mgd of effluent injected into the Boulder Zone.

20. It was agreed that the job supervision will be done 24 hours per day by at least two qualified persons, one from CH2M HILL and the other from MDW&SA. For the first 3 months, CH2M HILL will provide one senior hydrologist, one hydrogeologist, two geologists, and one technical inspector. In addition, MDW&SA will provide four qualified men to work with CH2M HILL staff. After 3 months, the senior hydrogeologist's involvement will reduce to about 50% of the time. CH2M HILL and MDW&SA will have a meeting with each other every 3 months to discuss if any more MDW&SA qualified persons could replace CH2M HILL men on the jobsite. In any case, at least two qualified persons from CH2M HILL will be at the jobsite throughout the duration of the project.

ldt

CH2M HILL
engineers
planners
economists
scientists

SUMMARY OF MEETING

DATE: 9 February 1979, 3:00 p.m. to 4:30 p.m.

RE: Preconstruction Meeting--Injection and Monitoring Wells, Miami-Dade Water and Sewer Authority, South District Regional Wastewater Treatment Plant

AT: Board Room, Miami-Dade Water and Sewer Authority, 3575 LeJeune Road, Miami, Florida

ATTENDING:

Russell J. Kerrn	Alsay-Pippin Corp.
H. L. Pippin	Alsay-Pippin Corp.
Jim Cowgill	MDW&SA
Murray Grant	MDW&SA
J. I. Garcia-Bengochea	CH2M HILL
Richard E. Friberg	MDW&SA
P. Smits	MDW&SA
Udai P. Singh	CH2M HILL
Robert McCullogh	MDW&SA
Bob Celette	MDW&SA
Frank Reynolds	CH2M HILL
Ross Sproul	CH2M HILL
James N. Hutchinson	EPA/C.O.E.--Miami Beach
Thomas M. McCormick	Miami-Dade W&S
Jeff Lehnen	CH2M HILL
Mike Lockamy	C.O.E.
Herbert K. Kunen	MDW&SA

1. Contractor said that he is willing to start work before 26 February (i.e., before he gets the notice to proceed) but needs pads to start and to store pipes.

2. MDW&SA handed to the contractor a list of field office requirements. The contractor handed out their proposed field office plan. In general, the contractor was agreeable to MDW&SA's requirements. Minor differences in the plan and the remaining details pertaining to the field offices will be worked out between MDW&SA, CH2M HILL, and the contractor prior to start of work. A list of special radio communication and video equipment needed at the jobsite was discussed and made up. Radio communication equipment will include:

Gainesville Office
7201 N.W. 11th Place, P.O. Box 1647, Gainesville, Florida 32602 904/377-2442
In the Southeast, CH2M HILL was formerly known as Black, Crow and Eidsness.

8 pocket two-way radio communicators
for 2 inspectors-geologists
1 resident manager
1 hydrologist
3 contractor's tool pushers
1 spare

5 desk or wall two-way radio communicators
1 for each of the 3 rigs
1 for control center (main trailer)
1 for spare

MDW&SA and the contractor will get together before the start of the job to obtain such equipment.

3. Contractor does not have Dade County construction permit as yet, but he said that he will get it before the starting date.

4. Contractor has submitted the insurance certificate including builder's risks. He is providing fire, wind, and storm insurance on all aboveground nonsubmerged structures. Effort will be made so that he may not have to obtain same insurance for underground submerged structures (wells and casing).

5. Contractor has the occupational license for Dade County for drilling. However, occupational license for building the drilling pads needs to be obtained and will be done so before the starting date.

6. Contractor will send a copy of their certificate of competency to MDW&SA soon.

7. Contractor will soon submit to MDW&SA a list of subcontractors for approval and will include for each, the following.

Name and address
License number of company
Certificate of competency
Insurance certificate

Contractor is trying very hard to obtain minority subcontractors on the project, with no luck so far.

8. Contractor submitted a copy of cost breakdown for payment of lump sum items. MDW&SA will review it in the next few days. Contractor was informed that invoices must be submitted to MDW&SA by the 25th of each month on forms specified by MDW&SA. Payment will be made in 50 days after the submittal.

9. Ten copies of all shop drawings need to be made (six MDW&SA, two CH2M HILL, and two contractor). Approval will be given within 10 days after submittal. No work can start without approved copies.

10. Contractor will refer all design, shop drawings, and technical matters to CH2M HILL. All site problems, work schedules, payments, and extra work will be reported to Bob Celette of MDW&SA.

11. Tentative date of commencement: 26 February 1979

    Tentative date of completion: 800 days after start of job

    Liquidated damages: $500 per day per contract

    Contractor project manager: Russell J. Kerrn

ldt

CH2M HILL
engineers
planners
economists
scientists

SUMMARY OF MEETING (Revised)

DATE: 22 May 1979, 10:00 a.m. to 12:00 noon.

RE: Miami-Dade Water & Sewer Authority
Injection Wells, Progress Meeting No. 1

AT: Board Room, Miami-Dade Water and Sewer Authority
3575 LeJeune Road, Miami, Florida.

ATTENDING:

Jim Cowgill	MDWSA
Murray Grant	MDWSA
Gene Coker	EPA, Atlanta
Udai P. Singh	CH2M HILL
Oliver P. Board	DER, West Palm Beach
Roy M. Duke	DER, West Palm Beach
Cathie Cash	DER, Tallahassee
Fred Meyer	USGS, Miami
B.F. Paty, Jr.	Alsay-Pippin Corp. Attorney
H.L. Pippin	Alsay-Pippin Corp.
Ross Sproul	CH2M HILL
J.I. Garcia-Bengochea	CH2M HILL
Paul G. Jakob	SFWMD, West Palm Beach
R. V. Celette	MDWSA
Carlos Carle	COE/EPA, Miami
Joseph E. Welsh	COE/EPA, Miami
John D. Coleman	Eastman Whipstock
Bruce E. MacDonald	Eastman Whipstock

1. Progress to date was summarized by Ross Sproul. I-6 has been drilled to 985 ft and 54 inch, and 44-inch casings have been set and cemented. I-3 has been drilled to 529 ft, and 54-inch casing has been set and cemented in the hole to 145-ft depth. Drilling of BZ-1 has just begun.

2. It was agreed to summarize of all activities on-site (for all wells) on only one daily summary report. Roy Duke asked CH2M HILL to include more detailed information on the daily summary reports than is presently being furnished.

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3. Garcia-Bengochea updated information on inclination and gyroscopic surveys for this project. It is planned to conduct gyroscopic surveys on each hole as follows:

   a. 1st survey, on pilot hole, from 1,000 ft to 1,800 ft, approximately.

   b. 2nd survey, on reamed hole, from 1,000 ft to 1,800 ft, approximately.

   c. 3rd survey, on pilot hole, from 1,800 ft to 2,800 ft, approximately.

   d. 4th survey, on reamed hole, from 1,800 ft. to 2,800 ft, approximately.

   Results of (a.) will be compared to those of (b.) and similarly, results of (c.) with those of (d.) to find out if reamed hole wipes out the pilot hole in each case. Eastman Whipstock is the company selected by Miami-Dade Water & Sewer Authority to perform the gyroscopic surveys.

4. Eastman Whipstock personnel explained the methodology they would use to conduct these gyroscopic surveys. They would lower their instrument with a wire line inside the drill pipe to about 30 ft from bottom. Inclination and direction measurements will be taken every 30 ft on both up and down runs. By this methodology, the maximum uncertainty in the results of the survey (position of center of hole at the bottom) in a 2,000-ft survey would be 7 to 8 inches at 99% probability. Upon being asked to comment on the drilling method being used by Alsay-Pippin Corp., Eastman Whipstock personnel stated that it is "next to impossible" to have two holes using this drilling technique. They also said that they will make the results of the gyroscopic surveys available within 3 hours of the surveys. Computer results, which would confirm the field calculation results., would probably be available within 24 hours of the survey.

5. H. L. Pippin stated that he did not object to having the gyroscopic surveys performed. The question of who would assume liability for the "hole" while the gyroscopic surveys are being performed was discussed at length. A decision was reached to use logic, instead of written formalities, based on each case and what has actually happened in it.

6. It was decided unanimously to go ahead and schedule gyroscopic surveys at I-6. The first survey between 1,000 ft and 1,800 ft is expected to be performed by 30 May. The regulatory agencies will be notified when the survey is to be run.

7. The next progress meeting will be called to determine the depth of 34-inch casing to be set in I-6 and is expected to be held in early June.

8. EPA recommended that acoustic televiewer logs be run on each well. MDWSA and USGS will get together and resolve pending subject of liability while performing logging operations.

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SUMMARY OF MEETING

DATE: 5 June 1979, 10:00 a.m. to 1:00 p.m.

RE: Miami-Dade Water & Sewer Authority
Injection Wells, Progress Meeting No. 2

AT: Project Office Trailer,
South District Plant,
Cutler Ridge, Florida

ATTENDING:

Oliver P. Board	DER, West Palm Beach
Cathie Cash	DER, Tallahassee
Roy Duke	DER, West Palm Beach
Barry Amos	EPA, Atlanta
Gene Coker	EPA, Atlanta
Fred Meyer	USGS, Miami
R. V. Celette	MDWSA
Jim Cowgill	MDWSA
Tom McCormick	MDWSA
Dave Cabit	Alsay-Pippin Corp.
Russell J. Kerrn	Alsay-Pippin Corp.
David Snyder	CH2M HILL
Ross Sproul	CH2M HILL
J. I. Garcia-Bengochea	CH2M HILL

COPIES: J. M. Hutchinson (COE/EPA, Miami)

1. Reviewed Summary of Meeting dated 22 May. Added one more sentence at the end of Item 5 and added one more item (8).

2. Geophysical logs run on I-6 to approximately 1,850 feet are:

   Electric (single point resistivity and S.P.)
   Gamma radiation
   Temperature

   It was not possible to run either caliper or fluid conductivity because logger hoist was damaged by the weight and drag of the gyroscope (see Item 5) and it was not considered safe to run them. It was agreed that logs must be run in coming sections, as follows:

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Electric
Gamma radiation
Temperature
Caliper
Fluid resistivity
Flowmeter whenever well is flowing (BZ-1)

3. Section of I-6 between 1,000 and 1,850 feet looks very much like I-5 but approximately 4 feet stratigraphically higher. Saltwater starts at 1,640 feet in depth.

4. Agreed to set 34-inch casing in I-6 to 1,790 feet in depth and to bottom 42-inch reaming at 1,800 feet. Depth reference is top of drill pad immediately around well. Agreed also to run temperature log inside each 34-inch and 24-inch casing after primary cementing to identify top of cement.

5. Results of gyroscopic survey on I-6 pilot hole indicate excellent verticality and alignment to 1,882 feet in depth but survey cost was much higher than anticipated ($28,310 versus $10,000) because drill pipe got stuck in hole while running survey and it took approximately 48 hours to free pipe and get hole under control again. Mud in hole had to be thinned down and hole allowed to flow before pipe got free. Then hole had to be killed again with mud and salt. Gyroscope was lowered with geophysical logger. Weight of gyroscope plus centralizer drag damaged logger hoist. This prevented running the temperature and fluid resistivity logs in the 1,000- to 1,900-foot section of hole. A heavier hoist unit will be available for future surveys.

6. It was decided that there will be no need to run gyroscopic survey on BZ-1. EPA has authorized funding of survey on I-6 and two more wells.

7. First water-bearing zone above injection zone needs to be identified. This will be done in BZ-1.

8. Coring in BZ-1 was discussed. Ten coring intervals will be selected in BZ-1 to cover confining zones. Most coring to be done between 2,200 and 2,700 feet, with one interval around 1,500 feet and another one around 1,800 feet.

9. MDWSA expressed concern regarding borehole televiewer logging and will discuss possible arrangements with USGS on subject.

ldt

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SUMMARY OF MEETING

DATE: 3 August 1979

PROJECT: BC55900.92

RE: Miami-Dade Water and Sewer Authority
Injection Wells, Progress Meeting No. 3

AT: Project Office Trailer, South District
Plant, Cutler Ridge, Florida

ATTENDING: Fred Meyer, USGS, Miami
Roy Duke, DER, West Palm Beach
Oliver P. Board, DER, West Palm Beach
Cathie Cash, DER, Tallahassee
J. I. Garcia-Bengochea, CH2M HILL
Gene Coker, EPA, Atlanta
P. Jakob, SFWMD
Udai P. Singh, CH2M HILL
Tom McCormick, MDWSA
Bob Cellette, MDWSA
Ross Sproul, CH2M HILL
Joseph E. Welsh, Corps of Engineers
Jeff Lehnen, CH2M HILL
David G. Snyder, CH2M HILL
Jim Cowgill, MDWSA
Murray Grant, MDWSA

1. Reviewed last meeting summary. Starting with this meeting, summaries will be sent out as soon as possible after meeting and ahead of following meeting.

2. Went over progress to date: I-6 reaming with 32-inch bit at 2,175 ft; BZ-1 drilling at 2,636 ft in order to core next interval (±2,730 ft); I-3 lowering 44-inch casing, presently at 780 feet.

3. Reviewed field calculations of gyroscopic survey (tangential method) to 2,745 feet (bottom of hole 2.25 feet south, 0.41 feet east of center of well at pad elevation). Eastman-Whipstock office computations (radius of curvature method) will be mailed 8 August. Results very close to field calculations (bottom of hole 2.19 feet south 0.63, feet east of center of well at pad elevation).

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4. Reviewed geophysical logs of the pilot hole for I-6 to approximately 2,762 ft: Electric, gamma ray, caliper, and temperature; fluid resistivity gave no results. Decided to set bottom of 24-inch casing in I-6 at 2,740 feet in depth (estimated 65 feet above dolomite and 85 above injection zone).

5. Delivered to participants weekly report dated 8/3/79.

6. Setting of bottom of casing and monitoring zones in BZ-1 will be left to decision of MDWSA/CH2M HILL based on geophysical logs and TV survey. Geophysical logs to be sent to the regulatory agencies immediately after completion with letter report describing basis of decision.

7. Went over coring program. Progress to date is as follows:

7/5/79	1,506'-1,517'	Very poor recovery, no samples to Core Lab.
7/10/79	1,840'-1,851'	Two samples to be tested at Core Lab.
7/19/79	2,189'-2,193'	One sample to be tested at Core Lab.
7/22/79	2,398'-2,407'	Two samples to be tested at Core Lab.
7/24/79	2,460'-2,466'	Two samples to be tested at Core Lab.
7/26/79	2,497'-2,504'	Two samples to be tested at Core Lab.
7/29/79	2,557'-2,567'	One sample to be tested at Core Lab.
8/1/79	2,636'-2,650'	One sample to be tested at Core Lab.

Next core section will be at 2,730 ft - 2,760 ft (planning two cores from this interval).

8. Discussed test to run on core samples. Agreed to run vertical and horizontal permeabilities and porosity on each of the above samples. Also modulus of elasticity in as many of the samples as possible.

9. Agreed to eliminate daily summaries making them weekly and to mail copies of shift report with weekly reports.

10. Decided to distribute quarterly updated Contractor's time schedule.

11. Next meeting is estimated for 20 August to discuss:

    Casing setting and monitoring zone of BZ-1.
    Final gyroscopic survey at I-6.
    Casing setting at ±1,800 feet at I-3.

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SUMMARY OF MEETING

DATE: 31 August 1979

PROJECT: Miami-Dade Water and Sewer Authority
South District Plant Injection Wells
BC55900.92

RE: Progress Meeting No. 4

AT: Project Field Office, Cutler Ridge

ATTENDING: Don Preus, DC DERM, Miami
R. J. Kerrn, Alsay-Pippin Corp., Miami
David Snyder, CH2M HILL, Miami
Joseph E. Welsh, COE, Miami
Richard Knittel, DER, Tallahassee
Ross Sproul, CH2M HILL, Gainesville
Richard E. Friberg, MDWASA, Miami
Fred Meyer, USGS, Miami
Tom McCormick, MDWASA
O. P. "Woody" Board, DER, West Palm Beach
Murray Grant, MDWASA, Miami
Gene Coker, EPA, Atlanta
Barry Amos, EPA, Atlanta
Udai P. Singh, CH2M HILL, Miami
Jim Cowgill, MDWASA, Miami

1. Went over progress to date: I-6 casing set to 2,740 feet, cement to 2,733 feet, cementing still in progress; BZ-1 drilled to 2,750 feet, (last core run to 2,759 feet), casing depth and monitoring depths selected: I-3 pilot hole drilled to 1,900 feet, geophysical logs and directional survey done, casing depth selected at 1,800 feet: I-4 rig set up; drilling mousehole, no drilling on well. Recommended casing depth for BZ-1 is 2,710 feet. Monitoring zones will be: 910 feet-1,050 feet, 1,635 feet-1,685 feet, and 2,405 feet to 2,515 feet. Exact depths may vary slightly, depending on cement fillup efficiency between zones.

2. Described cementing problem on I-6: First stage of 2,100 sacks of cement produced no fillup of annulus. Indications were that it was lost into a cavity below the casing bottom. While trying to tag cement, 2,751 feet

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of tremie pipe was lost in the well. Backfilled hole below casing with gravel to a depth of 2,747 feet. Again attempted cementing with 2,050 sacks of cement. Obtained only about 5 feet of fillup in annulus. Lost another 524 feet of tremie pipe while tagging cement. Pumped another 915 sacks of cement through tremie pipe, with less than 2 feet of fillup. Pumped 125 sacks of cement with no fillup. Repositioned tremie pipe and pumped 200 sacks, again with no fillup. Repositioned tremie pipe again and pumped 125 sacks with no fillup. Began gravel packing to depth of 2,706 feet.

3. Proposed program to complete cementing of I-6 is to fill annulus with gravel to 2,706-foot level before pumping more cement.

4. Discussed additional testing and data collection that could be done to allow more accurate prediction of cement requirements and to avoid potential problem areas. EPA (Coker) requested recommendation from consultant for such additional work and stated that EPA will participate in cost of such work. Consultant's tentative recommendation is to conduct flowout tests to identify permeable zones as the most certain method. Details and estimated cost of flow tests will be submitted to EPA.

5. Discussed what steps to take if zones of probable cement loss are identified in sections to be cemented. Pointed out that one of the potentially most troublesome of these zones is the upper Floridian aquifer (980-1,100 feet) Coker (EPA) stated that this zone may be gravel-packed if it appears likely to require excessive amount of cement to fill. Gravel-packing was discussed, and generally agreed to be acceptable method of bridging cement loss zones in all sections covered by more than one casing.

6. Discussing how to prevent excessive cement loss in 1,800-2,700-foot section. Agreed that avoidance of permeable zones should be the goal, but the actual depth to set this casing string (24-inch) in each well is to be decided on a well-by-well basis.

7. Consultant agreed to provide EPA, by letter, with recommendations for additional testing to determine cement requirements, basis for cement requirement calculations, and casing setting depth criteria.

8. Coker (EPA) requested that a gravel-packed monitoring zone be provided at the 2,500-foot zone in I-6. Basis for request in concern that the broken-off tremie pipe in the annulus could possibly provide communication between the Boulder Zone and 2,500-foot monitor zone. Consultant will evaluate feasibility and means of providing this monitoring capability. MDWASA commented that installation of this monitoring zone should be the responsibility of the contractor.

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SUMMARY OF MEETING

DATE: 19 October 1979

RE: Miami-Dade Water and Sewer Authority
Injection Wells, Progress Meeting No. 5

PROJECT: MDWSA S-154;
BC55900.92

AT: Miami-Dade Water and Sewer Authority Office,
3575 South LeJeune Road, Miami, Florida

ATTENDING:

Richard Knittel	DER--Tallahassee
Tom McCormick	MDWSA
Ross Sproul	CH2M HILL
Russell Kerrn	Alsay-Pippin Corp.
Jeffrey D. Lehnen	CH2M HILL
Udai P. Singh	CH2M HILL
Gerald Badeaux	Halliburton Services Fort Myers, FL
Joseph E. Welsh	COE--Miami Beach
Robert V. Celette	MDWSA
Paul Jakob	SFWMD
Herbert K. Kunen	MDWSA
Richard E. Friberg	MDWSA
Fred Meyer	USGS--Miami
Roy Duke	DER--West Palm Beach
Stallings Howell	EPA--Atlanta
Gene Coker	EPA--Atlanta
Jim Cowgill	MDWSA
J. I. Garcia-Bengochea	CH2M HILL

1. Reviewed last meeting summary. Some doubts were expressed regarding the approval during last meeting of the 1,800-foot depth for the 34-inch casing on I-3. After discussion, this casing installation depth was formally approved at this meeting.

2. Went over progress to date: I-3--drilling 14-3/4-inch pilot hole at 1,892 feet; I-4--preparing to run 44-inch casing to 980 feet; I-7--drilling 60-inch hole at 47 feet; BZ-1--drilling 5-5/8-inch hole at 2,797 feet; I-6--waiting for injection test with well drilled to 3,112 feet and 24-inch casing cemented up to 2,295 feet.

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In the Southeast, CH2M HILL was formerly known as Black, Crow and Eidsness

3. USGS representative inquired if there was any possibility of drilling BZ-1 to a depth greater than 3,100 feet. This matter was discussed during Preconstruction meeting of 9 February 1979 and was turned down because its cost would not be cost eligible (Item 15, page 5, Summary 9 February 1979).

4. The loss of tremie pipes in I-6 was discussed. It was pointed out that the contractor did attempt to fish out the tremie pipes, but was unsuccessful. Also, at that point, it was extremely difficult to pull out 550,000 pounds of 24-inch casing and then fish out the tremie pipes. All persons attending were notified that the TV survey of the well showed about 7 feet of the bottom of the longer tremie pipe, which appeared straight (vertical) and undamaged, but it was not clear whether the bottom of the pipe was plugged or not. The upper end of this pipe could not be determined by the annular TV survey because the camera could not be lowered deeper than 70 feet on the side that the pipe was dropped due to annular space restrictions at that depth. The recorded TV survey showing the closeup of the bottom section of the tremie pipe below the 24-inch casing was shown to all at this meeting.

5. The contractor reported that in order to reduce the chances of losing tremie pipes in wells, Hydril A-95 1-1/2-inch tremie pipe will be used hereafter as soon as it is available. Formal notification of this action will be sent to the regulatory agencies.

6. The following procedure for correction of the loss in I-6 of tremie pipe problem was agreed upon:

   a. Basically follow procedure indicated in Engineering Report of October 1979 and consider the use of dye-tracer (Rhodamine WT) for additional information.

   b. Prepare detailed pumping and testing procedure to run test and correct leakage, if any appears. This procedure to be submitted to the group prior to the next meeting before test is conducted.

   c. That it is not necessary to cement the entire inside section of the lost tremie pipes as long as the leaks, if any, are completely eliminated by the cementing

program. Also, if leaks through the tremie pipe cannot be eliminated by cementing from the top, then cementing might have to be attempted through the bottom end of the tremie pipe (extremely difficult procedure according to the Contractor).

7. Regulatory agency representatives notified that if this kind of accident (loss of tremie pipe in well) occurs in the future and cannot be fished out, all activity on the well should be stopped, and approval of a plan of action should be obtained from them before proceeding any further.

8. Alternatives to minimize cement losses (as described in the cementing report to the regulatory agencies, October 1979) were discussed. CH2M HILL representative (Garcia) and MDWSA recommended alternative B of the report (to set 24-inch casing above 2,500 feet) on the basis that construction wise it would be safer and less expensive and still provides ample confining thickness. However, regulatory agencies representatives wanted to keep the 2,500-foot zone as a monitoring zone and inject lower, close to the Boulder Zone. Also, they were concerned about possible contamination through abandoned unplugged oil wells in the area if the effluent is injected to the 2,500 foot zone. So, Alternatives B and E were ruled out.

9. MDWSA expressed concern about Alternative C because of increased risks and costs and this alternative was ruled out.

10. A modified form of Alternative A was accepted by the representatives of the regulatory agencies. The following procedure will be adopted for the remaining injection wells:

    a. After setting the 34-inch casing, drill a pilot hole to 2,700 feet.

    b. Run electric, gamma-ray, and caliper logs.

    c. Run a flow (pumpout) test at approximately 800 gpm while running flowmeter and temperature logs.

    d. Run underwater TV survey.

e. Select depth to set bottom of the 24-inch casing as follows:

--If no transmissive ("lost cement") zone is found near the bottom of hole (approximately 2,700 feet) set casing at approximately 2,660 feet.

--If transmissive (lost cement) zone is found near or at the bottom of hole, set casing following report (Alternative A).

f. --If no transmissive zone is found near the bottom of hole, fill bottom with 10 feet of cement plug.

--If transmissive zone is found, fill pilot hole with pea gravel (or cement, if it will hold) to 40 feet above this zone and cap fill with 10 feet of cement plug.

g. Ream the pilot hole to 20 feet above cement plug, lower casing, and cement.

The estimated cost of this procedure will be approximately the same as that of Alternative A, as determined in the cementing report. If a transmissive zone is encountered much above 2,700 feet, the regulatory agencies must be contacted for a course of action to be followed.

11. It was decided to run acoustic log from 1,800 feet to 2,700 feet on one well. EPA agreed to participate in its cost.

12. Cement program forms were distributed and tentatively approved. Preliminary cement volume calculations for the 44-inch casing on I-4 were passed on to the regulatory agencies.

13. Roy Duke (DER--West Palm Beach) stated that he will evaluate the permit for necessary revisions as per the new plan [modified Alternative A, as in Item (10)].

14. If it is found useful, a cement bond log would be run in I-6 before any more cementing is done. CH2M HILL will check with the cement bond log company and then decide.

15. Roy Duke reminded everyone that the representatives of the agencies attending these progress meetings are really an advisory group and will try to make decisions on the spot in order to streamline the operations of this project. Anything that cannot be decided on the spot has to be submitted to the regulatory agencies and decisions will be made after proper evaluation. To help this advisory group make fast decisions, the following should be done:

    a. Copies of the logs should be sent to them before the meeting, if possible.

    b. At the meeting time, MDWSA should be fully aware of and in agreement with CH2M HILL's recommendations.

    c. The agenda should be followed closely at the meeting, and more important items should be discussed first.

    d. Anything that is suggested by the advisory group as a result of this brainstorming operation during the meetings does not have to be accepted by the engineers if they do not concur. The responsibility for design and consequences are still with the engineers and not with the regulatory agencies, who only regulate this project from environmental safety aspects.

11. It was decided to review the injection test program (I-6) in detail with the regulatory advisory group sometime during the next 2-3 weeks.

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SUMMARY OF MEETING

DATE: 7 November 1979

RE: Miami-Dade Water and Sewer Authority
Injection Wells--Progress Meeting No. 6

PROJECT: MDWSA S-154
BC55900.92

AT: Miami-Dade Water and Sewer Authority Office
3575 South Le Jeune Road, Miami, Florida

ATTENDING:
Tom McCormick (MDWSA)
Russell J. Kerrn (Alsay-Pippin)
R. V. Celette (MDWSA)
Don Preus (DERM)
Abe Areitman (SFWMD)
Udai P. Singh (CH2M HILL)
Fred Meyer (USGS--Miami)
Roy Duke (DER--WPB)
Barry Amos (EPA--Atlanta)
Jim Cowgill (MDWSA)
Murray Grant (MDWSA)
Richard Knittel (DER--Tallahassee)
Herbert K. Kunen (MDWSA)
Joseph E. Welsh (COE--Miami)
Jeffrey D. Lehnen (CH2M HILL)
J. I. Garcia-Bengochea (CH2M HILL)

1. Reviewed last meeting summary. No changes.

2. Went over progress to date:

   a. I-3--reaming at 2,314 feet.

   b. I-4--reaming at 1,321 feet.

   c. I-7--Completed logging to a depth of 1,000 feet. Rigging up to ream.

   d. I-6--No activity. Waiting on pump-out and injection tests.

   e. BZ-1--Waiting to repair air compressor. Depth still at 2,888 feet.

3. Discussed I-3 logs to determine 24-inch casing setting depth. Two depths were discussed: (1) 2,435 feet and (2) 2,650 feet. Depth No. 1 was recommended by CH2M HILL, whereas depth No. 2 was the one in accordance with the regulatory agencies' recommendations from last meeting (with the exception of a 20-foot cement plug instead of 10-foot plug). Cement calculations for each case were distributed. It was pointed out that cementing the casing up from 2,650 feet could cost $258,000, whereas that from 2,435 feet of casing would involve only $144,000 (mainly due to avoiding cementing losses in the lower zones). However, the regulatory agencies felt that since it is important to retain the "2,500-foot zone" as a monitoring zone, the casing depth should not be raised to 2,435 feet. It was agreed to set 24-inch casing at 2,650 feet, with a 20-foot cement plug from 2,680 feet to 2,660 feet in depth.

4. Discussed I-4 logs. Agreed to install 34-inch casing to 1,800 feet.

5. USGS representative suggested that mud resistivity should be determined when electric logs are being run in the hole. CH2M HILL will follow this suggestion.

6. Decided to run acoustic log from 1,800 feet to 2,700 feet on I-4. It was pointed out that there may be some waiting (standby) time involved (of the logger or the rig) in this operation.

7. The pumping test programs for wells I-5 and I-6 were passed on to all attendees. Agreed to these programs. The following corrections should be made on the program sheets:

   a. Page 1--Withdrawal test I-5--9th line from bottom: Change "1,500-foot zone" to "1,650-foot zone." 8th line from bottom: Change "1,800-foot zone" to "2,450-foot zone." Delete 4th and 5th lines from bottom ("run flowmeter. . .if possible"). Delete "If about not possible" from 3rd line from bottom, and start paragraph. Run static flowmeter, temperature, and . . . .

   b. Page 2--General Procedure--9th line from bottom: Change "Measure temperature, density, and temperature" to "Measure temperature, density, and conductivity." 5th line from bottom: Change "4 p.m." to "3 p.m.."

c. Page 3--Injection test I-6--Under the topic "Instrumentation" add the following below the 6th line: "Stevens Type F water level recorder, inside 20-inch casing of well I-5."

d. Page 4--Item 11--First sentence should read "Pressurize annulus to not more than 30 psi above static level by slowly injecting native saltwater into it."

e. Page 5--2nd line from top: Read "Make cap of 24"/34" casing annulus airtight."

8. It was suggested by the USGS representative that during the injection test on well I-6, temperature and conductivity logs should be run in well I-5. It was left to CH2M HILL to see if they can do it without running into difficulities.

9. It was suggested by the SFWMD representative that differential temperature logs should be run on the remaining wells, if possible. CH2M HILL will consider this request.

10. Since only the first three wells (I-6, I-3, and I-4) had been authorized to undergo gyroscopic surveys, and well I-7 (fourth well) will be ready for this survey, if required, in about 2-3 weeks, the regulatory agencies agreed to send notification within 10 days after receiving recommendation from Miami-Dade Water and Sewer Authority and CH2M HILL on the need to continue gyroscopic surveys on more than three wells.

11. Agreed that Miami-Dade Water and Sewer Authority will send a detailed breakdown of cost of gyroscopic survey per well to EPA.

PUMPING TEST PROGRAMS FOR WELLS I-5 AND I-6
SOUTH REGIONAL WASTEWATER PLANT INJECTION SYSTEM

WITHDRAWAL TEST I-5

Instrumentation

I-5 Flowmeter to indicate rates of 3,000-10,000 gpm

Pressure transducer and recorder for water levels in pumping well

Conductivity meter, thermometer, and densimeter

12 sample bottles for Cl^- determinations

Forms for time, elapsed time, flow rate, water level in pumping well, drawdown, and remarks

Forms for time, electrical conductivity, temperature, density, and chloride concentration

Two sample bottles for standard chemical analysis, including iron and H_2S

I-6 Type F Stevens water level recorder in 24-inch casing

Type F Stevens water level recorder in 24/34 annulus (2,200 feet)

I-3 Type F Stevens water level recorder in 24-inch casing (if ready)

BZ-1 Type F Stevens water level recorder in 6-inch casing

Type F Stevens water level recorder in 1,650-foot zone

Type F Stevens water level recorder in 2,450-foot zone

(All above water level recorders provided with 1:1-gauge scale and 24-hour time gears.)

Run static flowmeter, temperature, and conductivity logs in BZ-1 between 2,700 and TD near the start and end of test.

General Procedure

Have all water level recorders (Stevens Type F) installed and operating by 3 p.m. of day D-2.

Have pumping and flowmeter equipment ready together with pressure transducer and recorder in Well I-5 by 3 p.m. of day D-1.

At 3 p.m. on day D-1, start pumping Well I-5 at 2,000 gpm. Pump for 30 minutes, recording water levels in I-5 every minute.

At 3:30 p.m., increase pumping rate to 4,000 gpm and pump for 30 minutes, recording water levels in I-5 every minute.

At 4 p.m., increase pumping rate to 6,000 gpm and pump for 30 minutes, recording water levels in I-5 every minute.

At 4:30 p.m. of day D-1, stop pumping and record recovery every minute for 90 minutes in I-5. Check operation of all other recorders in observation wells.

At 7 a.m. of day D, start pumping test at 6,000 gpm. Continue pumping at same rate until 3 p.m.

Collect water samples for standard chemical analysis and Cl^- after 15 minutes of pumping. Measure temperature, density, and conductivity.

Measure temperature, density, and conductivity every hour after pumping start, except last sample. Take it at 2:45 p.m. Collect additional sample for second standard chemical analysis at same time.

Stop pumping at 3 p.m. and record recovery in I-5 until 6 p.m.

Leave all recorders operating until next morning. Next day, remove instruments and equipment.

End of test.

INJECTION TEST I-6

(Including remedial procedures to cement tremie pipes in annulus between 24- and 34-inch casings.)

Instrumentation

Flowmeter to indicate rates between 6,000 and 10,000 gpm, as per project specifications.

Stevens Type F water level recorder, in monitoring line to 2,100 feet in depth.

Stevens Type F water level recorder, in ~~monitoring line to 70 feet in depth~~ 24"/34" ANNULUS.

Stevens Type F water level recorder, inside 20-inch casing of well I-5.

Stevens water level recorders to be installed at the monitoring lines in 6-inch stilling wells, connected to each monitoring line and provided with 1:1 gauge scale and 24-hour time scale.

Pressure gauge to measure wellhead injection pressure, as per project specification.

Conductivity meter, thermometer, and densimeter.

Burette, glassware, reagents, etc., for chloride determinations.

General Procedure

1. Install each water level recorder in stilling well, connected to the corresponding monitoring line. Connection will allow water level in stilling well to be representative of that in the monitoring line.

2. Provide each monitoring line with spigot or valved tap to allow for collection of water samples.

3. Install flowmeter in the injection line and pressure gauge to wellhead.

4. Record water level in monitoring lines for not less than 24 hours prior to start of injection.

5. Collect not less than three water samples from each monitoring line and from the source of water for injection during the 24-hour period preceding start of injection. Samples are to be collected at beginning, middle, and end of 24-hour period. Source of water for injection shall be fresh (Cl ~500 mg/l) and sampled at approximately the intake level and at approximately

2 feet above bottom and 2 feet below water surface of pond or canal to be used as source. All samples shall be analyzed for temperature, density, electrical conductivity, and chloride.

6. Discharge from each monitoring line a volume of water equal to 1.2 times the volume inside the monitoring line before collecting sample. Use 0.045 gallons per linear foot of 1.0 inch (I.D.) sampling line or 0.092 gallons per linear foot of 1.5 inch (I.D.) sampling line to compute volume. Discharge volume as rapidly as possible, record time used for discharge, and analyze its effect on the corresponding water level recorder. Pump out lines if necessary.

7. Start injection at approximately 10,000 gpm, recording wellhead injection pressures and flow rates as quickly as possible until both readings seem to have stabilized and then at every hour thereafter.

8. Observe charts of water level recorders installed on monitoring lines.

9. Collect water samples from monitoring lines and the injection water (fresh) every hour or at any time a trend of water level rise in any of the monitoring lines is noticed. Realize that shortly after injection starts, a change in water level in the monitoring lines is expected. This will be more noticable in the 2,100-ft line. It will be caused by the heat transfer through the casing of the temperature difference between the water being injected and that in the annulus. This change in water level should be noticed and stabilized during the first hour of injection unless significant changes of the temperature of the injected water are noticed.

10. Any leakage into the annulus will cause a steady rise in water level and freshening of its water. If no signs of leakage are noticed, cement annulus to 1,700 feet in depth.

11. Pressurize annulus to not more than 30 psi by slowly injecting native saltwater into it. When 30 psi are reached and pressure is maintained without any addition of water into the annulus for 30 minutes, tremie pipes will be considered plugged.

12. Complete cementing of annulus to 100 feet below pad level. Run cement bond log. Complete cementing to pad surface.

13. If leakage is detected from the short (70-ft) monitoring lines, start lowering and sampling the monitoring line

until no freshening of the annulus water is noticed while injection continues. Sampling shall be done every time a new section of pipe is lowered. When no freshening is noticed, the monitoring line is below the top of the tremie pipe in the annulus. Bring cement in annulus to bottom of last setting of the monitoring line. Make cap of 24/34-inch casing annulus airtight. Pump Halliburton Spherelite cement with friction reducing and retarding additives. Volume of cement to add shall be equal to:

1.2 x annulus volume corresponding to length of last section of monitoring line added + 1.0 x capacity of tremie pipe lost.

As soon as cement is all pumped in, shut valves off and keep casing capped until cement setting time. Observe any discharge of cement from the bottom of the tremie pipe at 2,750 feet in depth by observing it with sideview underwater TV camera.

14. Perform pressure test as per subparagraph 11 above. If no leaks are detected, proceed as per subparagraph 12 above. If leaks still are present, repeat cement and test procedure until no leaks are detected.

15. If leakage is detected from the long (2,100-ft) monitoring line, follow same procedure as indicated in subparagraph 13. Then cement annulus to 1,700 feet in depth and then follow pressure test under subparagraph 11 above.

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SUMMARY OF MEETING

DATE: 7 November 1979

RE: Construction and Testing Procedures I-3, I-5, and I-6

ATTENDING: Jim Kerrn (Alsay-Pippin)
Jeff Lehnen (CH2M HILL)
Udai Singh (CH2M HILL)
Tom McCormick (MDWSA)
J. I. Garcia-Bengochea (CH2M HILL)

1. The schedule for completion of BZ-1 was discussed, as follows:

   a. Drill to TD 3,100 feet.

   b. Install screen and gravel pack in upper monitor zone.

   c. Cement annulus to surface.

   d. Run pressure test (Paragraph 102-07 of specs) on 6-5/8-inch casing.

   e. Allow monitor tubes to flow for 1 week during cementing and pressure test.

   f. Disinfect well and monitor tubes according to specs (Paragraph 102-09).

   g. Develop each monitor zone. Collect water samples and test for fecal coliform as per specs (Paragraph 102-07 and 102-08).

2. The pump-out test on I-5, scheduled to start upon completion of BZ-1, was outlined. The test is planned as follows:

   a. Install Stevens F water level recorder in the 6-5/8-inch casing on BZ-1, the 2,400-foot monitor, and I-6. The 1,600-foot and 1,000-foot monitors on BZ-1 will have pressure gauges if their potentiometric surfaces are too high.

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b. Install pressure transducer in I-5 above the bowls on the pump and connect to recorder.

c. Install water level recorder on I-3 if completed at the time.

d. Start recorders 24 hours before pumping I-5 for background measurements.

e. Pump I-5 in accordance with pumping test program for I-5 and I-6, agreed upon during today's regulatory meeting.

f. Maintain water level recorder and pressure gauges for 4 to 8 hours after the end of the pumping test for recovery data.

3. The injection test on I-6 will follow completion of the testing on I-5. The schedule for testing on I-6 was discussed as described in the program distributed at the meeting earlier in the day at the MDWSA offices.

The sampling tubes in the annulus of I-6 were discussed. It was decided that these will be two tubes to 70 feet. One will have a water level recorder and the other will be used for pumping water samples. The sampling tube to 2,100 feet will require ±25 minutes to displace for a water sample. The water level recorder float will have to be removed and a plug installed each time a water sample is desired. A T fitting will be used on this tube.

The contractor will assist in fabricating a stand for the water level recorders. He also plans to float a vertical turbine pump on the lake adjacent to I-6. CH2M HILL will take water samples from the lake at 2 feet, 10 feet, and 35 feet deep. The samples will be analyzed for conductivity, chlorides, temperature, and density.

4. The 24-inch casing setting on I-3 was discussed. It was decided to ream with the 32-inch bit to 2,668 feet. Cement will be installed down drill pipe after tagging the bottom. The cement plug will come up to 2,660 feet to be verified with a tag. To avoid the possibility of a channel in the cement caused by insufficient clearance below the casing, the 24-inch casing will be lowered to 2,665 feet. This will demonstrate that the hole is open below casing. The casing will be lowered and its bottom set at a depth of 2,650 feet.

The first stage of cement will be calculated to bring the level up to 2,300 feet with Class H neat cement. This will be done using the overdrill factor currently being calculated from the pilot hole.

5. The contractor was questioned about the overdrill problem on some of the pilot holes. No conclusions were reached. He was asked to look into it to determine any causes that may be connected.

6. J. I. Garcia-Bengochea commented on the amount of standby involved on I-3 and I-4 on 1 November and 2 November. Discussion followed, with no conclusions arrived at.

pme

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SUMMARY OF MEETING

DATE: January 9, 1980

RE: Miami-Dade Water and Sewer Authority
Injection Wells--Progress Meeting No. 7

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA Office at 3575 South LeJeune Road, Miami, Florida

ATTENDING:

Murray Grant/MDWSA
Tom McCormick/MDWSA
Ross Sproul/CH2M HILL
Paul Jakob/SFWMD
Roy Duke/DER--WPB
Russell J. Kerrn/APCO
R. V. Celette/MDWSA
Herbert K. Kunen/MDWSA
J. I. Garcia-Bengochea/CH2M HILL
Fred Meyers/USGS--Miami
Jeff Lehnen/CH2M HILL
Craig L. Helpling/DER--Tallahassee
Udai P. Singh/CH2M HILL
Richard E. Friberg/MDWSA
Leslie Wedderburn/SFWMD
Richard Knittel/DER--Tallahassee

1. Reviewed last meeting summary. No change.

2. Presented progress to date:

   A. I-3 completed to TD of 3,123 ft, TV survey to 3,108 ft. Final logging and injection test to be completed in February.

   B. BZ-1 completed to TD of 3,108 ft. Geophysical logs and TV survey completed to 2,960 ft, where hole is bridged. There is no need to clean hole again.

   C. I-4 reamed to 1,810 ft with 42-inch assembly. Preparing to set 34-inch casing at 1,800 ft.

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In the Southeast, CH2M HILL was formerly known as Black, Crow and Eidsness.

D. I-7 reaming at 1,455 ft for the 34-inch casing. Setting depth to be discussed today.

E. I-8 reaming at 1,380 ft for the 34-inch casing. Setting depth to be discussed today.

F. I-6 being prepared for the injection test planned for the end of this month.

3. Reviewed TV survey on I-3 from surface to 3,123 ft TD. Final logging is scheduled for the week of January 14, when the differential temperature tool is expected to arrive, otherwise, will postpone logging until the tool arrives.

The cement bond log will be run on I-6 and BZ-1 the week after the injection tests (about mid-February). Some discussion followed concerning the open annulus left on I-3 for the CBL's calibration. It was agreed that a minimum of 80 ft should be left open.

4. The geophysical (LSN) logs on I-7 and I-8 were examined for the formation fluid's conductivity. After this information was presented to the attendees, it was decided to set the bottom of 34-inch casings for I-7 and I-8 at 1,800 ft.

CH2M HILL agreed to send fluid conductance logs with corrected scales to replace incorrectly labeled originals on I-8. Also to send the cement calculations on I-7 and I-8 with expected pumping dates for agency approval.

The plans for an interim report upon the completion of each well were announced. The attendees agreed as to the value of this report.

5. Showed slides of the pump-out tests on I-5. Presented the preliminary drawdown values for each monitored point and the respective tidal influence. Notified the attendees that the pump test report will be completed in about a month. Agreed with USGS representative's recommendation to install a water level recorder on I-5 to gather background water levels for several months if possible.

6. Scheduled the I-6 injection test for the last week of January. Made the following modifications to the injection test procedures distributed at the last meeting, held on November 7, 1979:

Install the Stevens F Water Lever Recorder in the 24- to 34-inch annulus instead of in the 70-foot monitoring line.

Pump water samples from the 70-foot line as planned.

Provide an injection water source with chlorides of less than 2,000 mg/l instead of less than 500 mg/l.

Record water levels only (no water samples) for the first 6 hours of injection, then collect water samples as planned.

7. Tentatively scheduled the I-3 injection test for the first part of February, upon completion of testing on I-6. Test will be conducted as per specifications using the same criteria for injection water as on I-6 re: $\leq$ 2,000 mg/l chlorides.

8. Discussed the status of future gyroscopic surveys and agreed not to run any more until further notice from EPA. I-4 surveys will be completed as previously planned.

9. Clarified the acoustic logs to be run on I-4 pilot hole from 1,800 to 2,700 ft. Logs to be run are the acoustic suite provided by Schlumberger or equivalent. A sonic caliper is not planned at present.

10. Discussed the drilling problems caused by the cement plug in I-3. The contractor informed the attendees that the drilling of the plug caused delays in his production schedule and that he may ask for time compensation if it happens at other wells.

It was agreed that CH2M HILL will re-evaluate the 24-inch casing setting procedure and report the conclusions in letter form to the agencies.

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SUMMARY OF MEETING

DATE: February 6, 1980

RE: Miami-Dade Water and Sewer Authority (MDWSA)
Injection Wells--Progress Meeting No. 8

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA Office at 3575 South LeJeune Road, Miami, Florida

ATTENDING:

Tom McCormick/MDWSA
Fred Meyer/USGS
Udai P. Singh/CH2M HILL
Paul Jakob/SFWMD
Leslie Wedderburn/SFWMD
Roy Duke/DER/WPB
Barry Amos/EPA-ATL
Richard Knittel/DER-Tallahassee
Richard E. Friberg/MDWSA
J. I. Garcia-Bengochea/CH2M HILL
Ross Sproul/CH2M HILL
Murray Grant/MDWSA
Russell J. Kerrn/APCO
Joseph E. Welsh/Corps of Engineers

1. Reviewed last meeting summary. No change.

2. Presented progress to date: (site layout and progress charts attached)

   A. I-2 pilot hole drilled to 1,000 ft. Geophysical logs begin run today.

   B. I-3 cement bond log will be run by Schlumberger later this week. Waiting on centralizers to run final bottom logs (2,629' to 3,100'). This will be followed by injection test and final TV survey, scheduled for the week of February 18.

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C. I-4 pilot hole has been completed to 2,700 ft. Schlumberger is presently running acoustic log along with caliper and induction logs. CH2M HILL will then run static logs, followed by the flow (pump-out) test and TV survey. Gyroscopic survey of the hole from 1,800 ft to 2,700 ft is scheduled after completion of the TV survey.

D. I-7 reamed to 2,628 ft with 32-inch reamer assembly.

E. I-8 reamed to 1,810 ft with 42-inch reamer assembly. This hole is being left open until the bigger rig (TR-800) is moved in after completion of wells I-7, I-2, and I-1.

3. The geophysical logs on I-7 (to 2,700 ft) were reviewed. It was explained that no flow (pump-out) test was run on this well because serious difficulties would have been created for other contractors by laying necessary piping. Also, the static logs are very indicative of where the possible trouble zones are: (a) at 2,699 ft, and (b) a slight one at 2,646 ft. It was decided to set the bottom of the 24-inch casing at 2,628 ft with port holes at 2,624 ft (four 2" x 2" at 90°). Before cementing the casing, the bottom of the hole will be tagged by the cement line. Then the following procedure will be adopted:

A. If tag is 2,635' or less, proceed with cementing casing by setting cement line at ±2,624'.

B. If tag is between 2,635' and 2,645', place 5' cement plug above tag.

C. If tag is between 2,645' and 2,679', fill hole with cement to 2,640'.

D. If tag is below 2,680', fill hole with gravel to 2,680' and cement to 2,640'.

The above casing setting depth and cementing procedure was agreed upon.

4. The information necessary to select the 24-inch casing depth on well I-4 is not yet ready. However, the steps described in item 2C above are being followed. To

select the casing depth and cementing procedure, it was decided to follow the same criteria and procedure as on I-7 above, but with additional data of the flow test and TV survey. No meeting will be required for this purpose. The geophysical (static and flow) logs, along with the recommendation for casing setting depth, will be mailed to the regulatory agencies early next week by CH2M HILL. The information provided by the static logs will be correlated with that provided by the flow (pump-out) tests and TV surveys to determine the necessity of flow test and TV survey in each of the remaining wells. This will be discussed in the next meeting to finalize criteria for selection of the 24-inch casing depth and a general procedure for cementing this casing in the remaining wells.

5. The injection test on well I-6 is planned for 8:00 a.m., February 13, 1980. Background water levels will be recorded on this well for about six days prior to the test. Richard Knittel, DER, is planning to attend the test.

   CH2M HILL will call Roy Duke or Woody Board, DER West Palm Beach, not later than Tuesday February 12, to confirm the test schedule. Duke or Board will pass on the information to Knittels, who plans to be in West Palm Beach that day.

6. MDWSA asked for permission to have the well cuttings disposed of on the project site instead of having them hauled to a more distant landfill (as is presently being done). This would reduce project costs somewhat. Roy Dukes (DER) agreed to check into this with the solid waste section of DER and also with DERM, and let MDWSA know the decision.

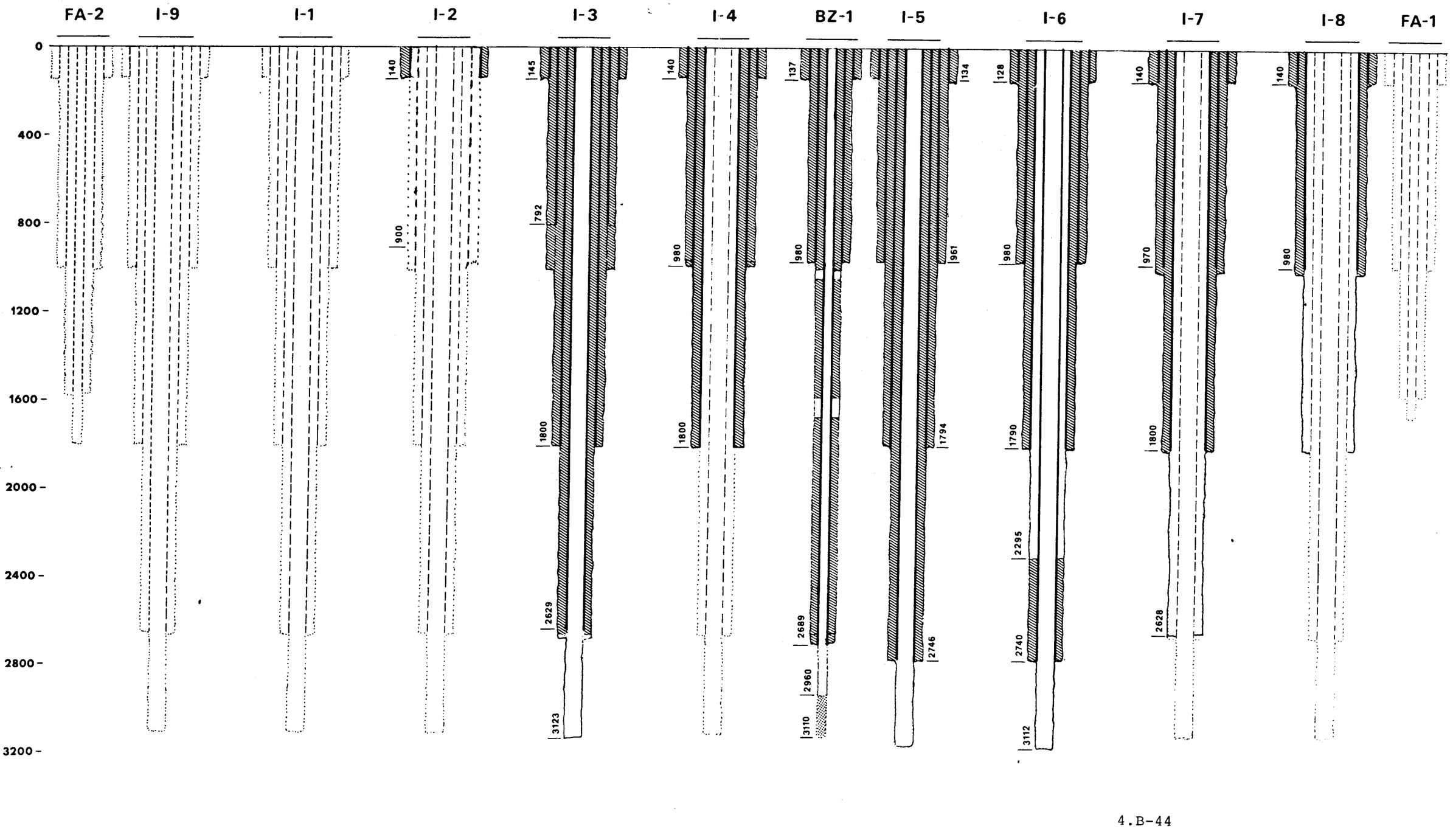
7. The preliminary unchecked results from the pump-out test of well I-5 were passed on to the regulatory agencies. A draft report on this test will be sent to the regulatory agencies for their review and input.

pkb

Miami-Dade Water & Sewer Authority Project S-154

INJECTION & MONITOR WELLS

Progress as of 6 February 1980



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SUMMARY OF MEETING

DATE: March 25, 1980

RE: Miami-Dade Water and Sewer Authority (MDWSA)
Injection Wells--Progress Meeting No. 9

PROJECT: MDWSA S-154
BC55900.92

LOCATION: Project Office Trailer
South District Plant, Cutler Ridge, Florida

ATTENDING:

Russell J. Kerrn/Alsay-Pippin Corp.
Thomas M. McCormick/MDWSA
Richard Knittel/DER
J. I. Garcia-Bengochea/CH2M HILL
Jim Cowgill/MDWSA
Murray Grant/MDWSA
Richard E. Friberg/MDWSA
Udai P. Singh/CH2M HILL
Fred Meyer/USGS
Roy Duke/DER
Ross Sproul/CH2M HILL
Paul Jakob/SFWMD
Leslie Bell/FDER
Gene Coker/EPA
Joseph E. Welsh/Corps of Engineers--Miami Beach

1. Reviewed last meeting summary. No change.

2. Presented progress to date (progress chart attached):

   a. I-1--44-inch casing cemented to 980 ft.
   b. I-2--Reamed 42-inch hole to 1,810 ft. 34-inch casing to be set after rig TR-800 is moved in.
   c. I-3--Running injection test.
   d. I-4--Drilled 22-inch hole to 3,133 ft (total depth). Running geophysical logs.

e. I-6--Ran caliper log in open hole below 24-inch casing, but found obstruction at 2,966 ft. This depth appears to be main receiving zone. Staging cement in 24"/34" annulus.
f. I-7--Reamed 32-inch hole to 2,628 ft and will set 24-inch casing at this depth as soon as rig is moved off I-4 to this well.
g. I-8--Reamed 42-inch hole to 1,810 ft. After I-2 is completed a rig will be moved to this well, and 34-inch casing will be set at 1,800 ft.
h. I-9--Moved rig to start drilling this well.
i. BZ-1--Completed.
j. FA-1 and FA-2--Should be started in about two months.

2. The draft report on the I-5 pump-out test was presented to each agency. All the original data from this test have been reproduced in this report. Based on the data analysis and results, the values determined for transmissibility and storage coefficient of the Boulder Zone are 180×10^{6} gpd/ft and 7×10^{-4}, respectively. Also, there appears to be an interconnection between the 3,000-ft and 2,460-ft zones in well BZ-1. This draft is for agency review. It was agreed that they will send their input to CH2M HILL in approximately one month, so that the report can be put in final form.

3. The injection test report on well I-6 was discussed. It was agreed that the present summary report, sent to the agencies at the end of February 1980, is adequate, and that cement should be staged in the 24"/34" annulus to 1,700 ft and the annulus pressure tested as recommended earlier. An underwater TV survey will be run during the pressure test to watch the bottom of the tremie pipe for leakage. If there is no pressure drop the annulus will be cemented to 100 ft below the pad.

4. It was agreed to set the 34-inch casing on well I-2 at a depth of 1,800 ft. It was also agreed that it is not necessary to call meetings to determine 34-inch casing setting depths on wells I-1 and I-9. If there is no significant change in data obtained from these wells compared to data from the previously discussed well, the 34-inch casing on these two wells will be set at approximately 1,800 ft.

5. Injection test procedures for the remaining wells were briefly discussed. CH2M HILL recommended that the water quality criteria to be applied to these wells be the same as those used for wells I-6 and I-3, so that injection water with chlorides up to 2,000 mg/l may be used. It was agreed to use whatever water is available for injection, as long as the water quality data on the water being injected are collected regularly during the injection test and proper adjustments made.

6. A detailed schedule for each well through April 30, 1980, was distributed to all attendees (sheet attached). Unless unforeseen circumstances occur, it was agreed to hold the next meeting after the pilot hole on well I-1 is drilled to 2,700 ft (probably sometime in May).

MDW&SA SOUTH DISTRICT REGIONAL W.W.T.P.
DEEP INJECTION & MONITORING WELLS

RE: SCHEDULE THROUGH 30 APRIL

24 MARCH 1980

WELL NO	STATUS ON 3/24/80	WORK SCHEDULED THRU 4/80
I-1	TR-700 on well. Reamed 52" hole at 990'. Cementing 44" casing to 980'.	Set 44" casing at 980'. Drill pilot hole to 1850'. Ream and set 34" casing. Begin drilling pilot hole to 2700'.
I-2	42" hole reamed to 1810'. 3-AT moved to I-9.	Move in TR-700 to set 34" casing. (After 4/30)
I-3	Completed except cementing top 15'.	Run injection test, TV survey and geophysical logs.
I-4	TR-800 completing hole to T.D.	Complete to T.D., run test, TV survey & logs. Move TR-800 to I-7.
I-6	Completed except cementing annulus. Start annulus cementing.	Cement annulus from 2200'. Run TV survey.
I-7	32" hole reamed to 2628'.	Move in TR-800 to set 24" casing, begin drilling to T.D.
I-8*	42" hole reamed to 1810'. No rig on hole.	No work expected.
I-9*	Rigging up 3-AT.	Set 54" and 44" casings. Begin drilling pilot hole to 1900'.
BZ-1*	Completed except installing well head.	---
FA-1*	Not started.	---
FA-2*	Not started.	---

* Division A wells (800-day contract). All others 600-day time of completion.

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SUMMARY OF MEETING

DATE: April 16, 1980

RE: Miami-Dade Water and Sewer Authority
Injection Wells--Progress Meeting No. 10

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA North District WWTP
Interama Plant Meeting Room

ATTENDING:
Gene Coker/EPA
Fred Meyer/USGS
Thomas McCormick/MDWSA
David G. Snyder/CH2M HILL
Russell J. Kerrn/Alsay-Pippin Corp.
Jeffrey D. Lehnen/CH2M HILL
Don Preus/DC-DERM
Leslie Wedderburn/SFWMD
Roy Duke/DER-WPB
J. I. Garcia-Bengochea/CH2M HILL
C. R. Sproul/CH2M HILL
R. Knittel/DER-Tallahassee
Jim Cowgill/MDWSA

Agenda

1. Reviewed last meeting summary. No change.

2. Presented progress to date (progress chart attached):

   a. I-9; reaming with 60" bit assembly at 50 ft.
   b. I-1; installed the 34" casing to 1,800 ft and cemented to the surface.
   c. I-4; made corrections on last meeting progress chart to show the 24" casing uncemented to 194 ft below pad.
   d. I-6; completed cementing the 24" casing from 2,740 to 97 ft below pad.
   e. I-7; installed the 24" casing to 2,628 ft and cemented to 200 ft below pad.
   f. Scheduled to move the TR-800 rig to I-1 to set the 24" casing when the TR-700 rig has finished reaming and has moved to I-2 to set the 34" casing.

3. The TV survey on I-3 was presented to the attendees. Pieces of cement sheath from 2,633' to 2,659' were viewed and discussed. The main source of the problem seems to be the setting of a cement plug below the 24" casing that cannot be completely reamed out. It was agreed to try to clean the bottom section of I-3 before the completion of the project.

4. The setting of the 24" casing on I-7 was reviewed. A sketch was shown on the blackboard showing the plugging operation of the pilot hole below the 24" casing. Based on this information and experience with the other wells, it was requested that future pilot holes be drilled to approximately 2,640 ft instead of 2,700 ft as is presently being done, in order to avoid possible cavities below 2,640 ft. The geophysical logs on I-7 were presented and, after discussion, the agencies in attendance agreed with the request. The 24" casings will be set in the remaining wells at approximately 2,630 ft unless the geological data and geophysical logs indicate change in the lithology.

5. The TV survey on I-4 was presented, with discussion on a piece of the cement sheath at 2,703 ft. The attendees agreed to try to clean the bottom section of this well also before the completion of the project.

6. A sketch of the cementing operation of the 24" casing on I-7 was distributed. A copy was included in the April 18, 1980 weekly summary. The course of events leading up to the tremie pipe being cemented in from 1,133 ft to 2,205 ft was explained. Also, the two pipes being cemented from 340 ft to 111 and 186 ft, respectively, were shown. The agencies agreed that the integrity of the well was not affected by these pipes as all were full of cement and in cement when dropped.

7. The contractor requested that the clean-out operations on I-3 and I-4 be delayed until after completion of the work on his existing schedule.

pkb

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SUMMARY OF MEETING

DATE: May 28, 1980

RE: Miami-Dade Water and Sewer Authority
Injection Wells--Progress Meeting No. 11

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA South District Plant Construction Site

ATTENDING: Russel J. Kerrn/APCO
David Snyder/CH2M HILL
Roy Duke/DER (West Palm Beach)
Fred Meyer/USGS
Richard Friberg/MDWSA
Robert Celette/MDWSA
Tom McCormick/MDWSA
Murray Grant/MDWSA
Ross Sproul/CH2M HILL
Jack Fischer/USGS
Richard Knittel/DER (Tallahassee)
Leslie Wedderburn/South Fla. Water Management District
David Cabit/APCO
Barry Amos/EPA (Atlanta)
J. I. Garcia-Bengochea/CH2M HILL

AGENDA:

1. Reviewed summary of April 16 meeting (Progress Meeting No. 10). No changes or additions.

2. Presented progress since April 16 meeting (Program chart updated to May 28 attached).

   a. I-9; 54-inch casing set and cemented at 140 feet. Pilot hole to 1,000 feet completed. Now reaming 52-inch hole at 922 feet.

   b. I-1; 24-inch casing set and cemented at 2,628 feet. (Cemented to 220 feet below surface.) Now attempting to remove cement line from inside casing.

c. I-2; 34-inch casing set and cemented at 1,800 feet. Now reaming 32-inch hole at 1,929 feet.

d. I-7; well completed except cementing annulus from 200 feet to surface. Now preparing for injection test, TV survey, and cement bond log.

e. I-3, I-4, BZ-1, I-5, I-6, FA-1, and FA-2; no changes.

3. Reviewed geophysical logs for I-2. Geology is essentially the same as in I-1 and I-9. Agreed upon depth of 2,628 feet for setting 24-inch casing.

4. Discussed completing cementing upper annulus in I-3, I-4, and I-6. Cement bond logs in these wells give little indication of the quality of the cement bond. Discussions with logging companies and others indicate that results are about as good as can be expected in casings larger than 16 inches in diameter. The best assurance of cement integrity is the way in which the cementing is done: neat cement slurry (weight 15.4 to 15.6 pounds/gallon) is pumped out the bottom of the 24-inch casing into a nominal 32-inch hole filled with water (weight 8.4 to 8.5 pounds/gallon). The casing is centralized in the nominal 32-inch hole, providing a minimum 4-inch annulus. Channeling of cement is essentially impossible with this procedure, thereby assuring the placement of 200 to 400 feet of cement of unquestioned integrity at the bottom of the 24-inch casing. A secondary indication of complete annulus fill-up is the cementing efficiency:

$$\left(\frac{\text{Theoretical fillup}}{\text{Actual fillup}} \times 100\right)$$

Calculated efficiencies to date range from 53 percent for I-6, where a large amount of cement was lost to the formation, to 119 percent for I-1, where almost no loss to formation was indicated. Other efficiencies to date are: I-3, 82 percent; I-4, 96 percent; and I-7, 96 percent. It was agreed to proceed with completion of cementing to the surface I-3, I-4, and I-6. Also I-7 if the CBL shows no indications of problems. A different log display (WAVE-train log), which may give better interpretations of cement quality, will be used in I-7 and other wells. It was also agreed that the USGS will

bring their acoustic and other logging equipment to the site and conduct experiments in cement bond logging in Well I-1.

5. Discussed data presentation (format and content) for interim completion reports. Fred Meyer suggested including geophysical log data for the open hole portions of each well. It was agreed that this would be done except when hole conditions prevent obtaining logs in the Boulder Zone.

6. Presented anticipated schedule for June:

   a. I-1; drill to TD, run injection test (pending successful removal of stuck cement pipe).

   b. I-2; set 24-inch casing, drill to TD. Should be ready for injection test by end of June.

   c. I-9; complete reaming of 52-inch hole. Set 44-inch casing. Drill pilot hole to 1,800 feet, and begin reaming 42-inch hole.

   d. I-8; set and cement 34-inch casing to 1,800 feet. Begin drilling pilot hole to 2,640 feet.

   e. I-7; run injection test, TV survey, and CBL.

7. Other matters:

   a. Discussed problem of stuck cement pipe in I-1 and described attempts to remove. The contractor will run pressure test and TV inspection after pipe is free.

   b. Delivered final TV inspection tape of I-6 and interim tapes of I-3 and I-4 to EPA, USGS, DER, SFWMD, and MDWSA.

   c. Delivered cement bond logs of I-4 and I-6 to EPA, USGS, DER, SFWMD, and MDWSA.

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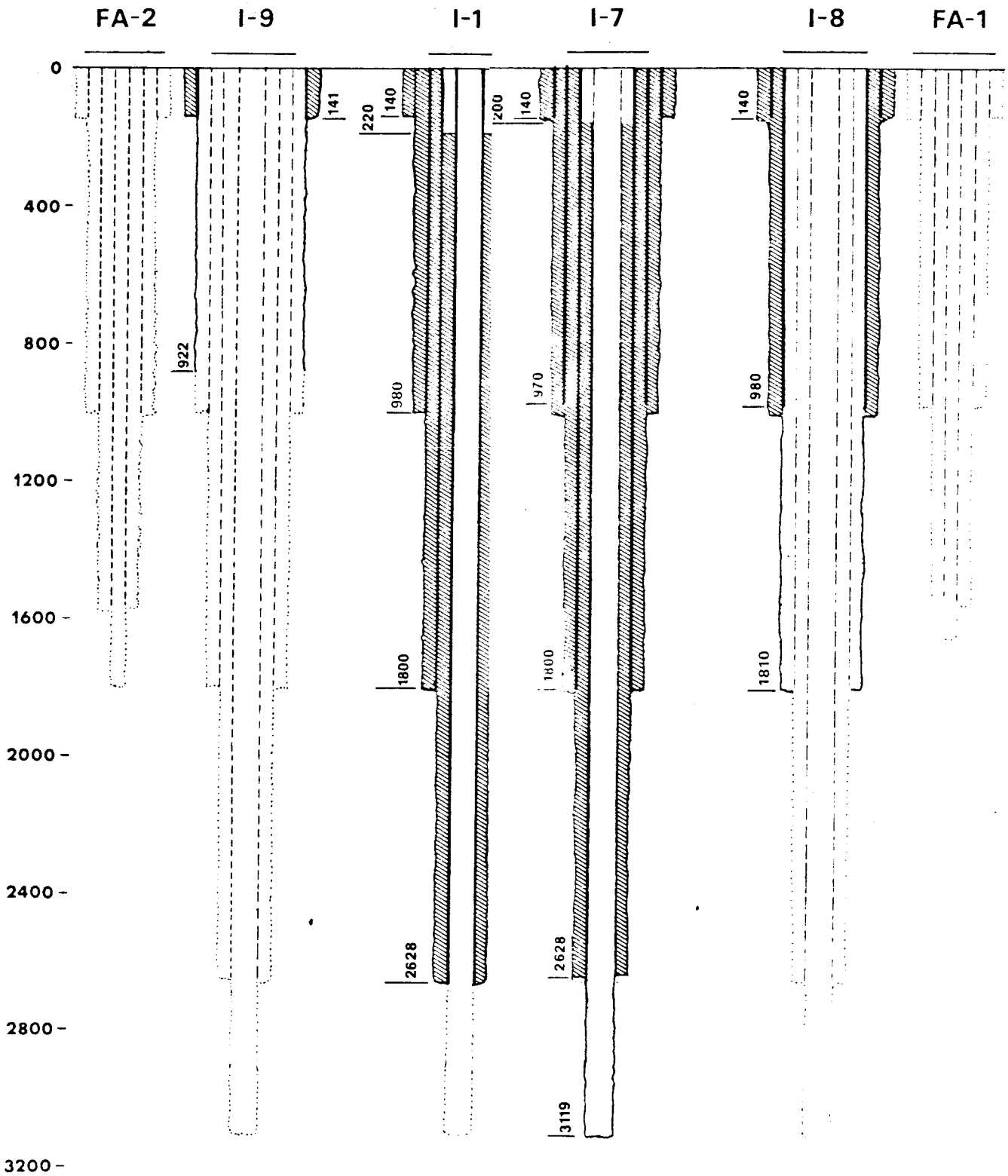
Attachments

Miami-Dade Water & Sewer Aut

INJECTION & MONITOR WELLS Progress as of May 28, 1980



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SUMMARY OF MEETING

DATE: July /, 1980

RE: Miami-Dade Water and Sewer Authority
Injection Wells--Progress Meeting No. 12

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA South District Plant Construction Site

ATTENDING: Fred Meyer/USGS
Richard Knittel/DER (Tallahassee)
Ross Sproul/CH2M HILL
Tom McCormick/MDWSA
Robert Celette/MDWSA
David Cabit/APCO
Mario Machado/EPA (Atlanta)
Roy Duke/DER (West Palm Beach)
Gene Coker/EPA (Atlanta)
David G. Snyder/CH2M HILL
Leslie Wedderburn/South Fla. Water Management District
J. I. Garcia-Bengochea/CH2M HILL

1. Reviewed summary of May 28 meeting (Progress Meeting No. 11). Need to make the following changes:

   a. Flow meter survey during injection test to be run in Well I-1.

   b. USGS logging was done in I-4, not in I-1 as planned.

2. Progress to date since May 28 meeting is as follows (program chart updated through July 1 is attached).

   a. FA-2; 20-inch casing set and cemented at 140 feet. 19-inch hole being reamed at 150 feet.

   b. I-9; 44-inch casing set and cemented at 980 feet. 34-inch hole reamed to 1,810 feet. Moved 3AT rig to FA-2.

   c. I-1; reached total depth with 22-inch bit to 3,110 feet. Moved TR-800 rig to I-2. Delivered Eastman

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Whipstock Surveys to representatives of regulatory agencies: Well Path Comparison (file 936, ream hole 1,800 to 2,500 feet, pilot hole 0 to 2,620 feet), Record of Survey, Radius of Curvature Method (ream hole 1,800 to 2,580 feet, May 5, 1980 and pilot hole 0 to 2,610 feet April 20, 1980).

d. I-2; 32-inch hole reamed to 2,628 feet. Moved TR-700 rig to I-8.

e. I-8; 34-inch casing set and cemented to 1,800 feet. Pilot hole drilled to 2,640 feet. Reaming 32-inch hole at 2,305 feet.

3. Fred Meyer discussed results of USGS logging in Well I-4. Logging was done in Well I-4. An acoustic velocity log was run inside 24-inch casing to a depth of 2,655 feet, and acoustic wave train photographs were obtained at various depths. A gamma-gamma density log was run to a depth of 500 feet. The borehole televiewer was not run as originally planned due to the risk of losing the probe in the well. Both the acoustic and density logs show clearly the cement top at 190 feet. The acoustic log shows more details than the Schlumberger CBL, but the log response is reversed. A few sections of possible relatively weak cement or bonding are shown on the acoustic log. The density log shows whether or not cement is present behind the casing and gives subjective indication of the density of the cement.

   The recommended approach to cement bond logging in future wells, as agreed between agencies, MDWSA, and CH2M HILL, is as follows: (1) continue working with Schlumberger or other commercial company to obtain better log presentation; (2) substitute acoustic wave train display for variable density display (Schlumberger has indicated that they can do this on request); and (3) run density log to supplement acoustic log interpretation.

4. Geophysical logs of pilot hole at I-8 between 1,810 and 2,640 feet were presented and discussed. Possible loss-of-cement zones are at 2,455 and 2,620 feet. CH2M HILL recommended setting 24-inch casing at 2,400 feet or, if that depth is not acceptable to regulatory agencies, at least above 2,620. Agreed to set casing at 2,614 feet.

5. Distributed copies of Corelab report of June 6, 1980 with results on cores collected from BZ-1. These

results, with those from Wingerter Laboratories, will be included in the interim report for BZ-1.

6. Agreed that interim reports on each well completed will be furnished in 3-ring binders with no geophysical logs, because these have been or are being forwarded to regulatory agencies as soon as they are being completed.

7. Discussed completion of uncemented top section of annuli between 34- and 24-inch casings in Wells I-1, I-3, I-4, I-6, and I-7. Cementing of these annuli can be completed to surface as cement bond logs have been done. The same procedure will be followed in remaining wells: leave top 150 to 200 feet of 34- and 24-inch annuli uncemented until cement bond is run, then complete cementing of annuli.

8. Agreed to drill the section below the bottom of the 12-inch casing (±980 feet) of wells FA-1 and FA-2 with 11½-inch bit to total depth. Geophysical logs to be run in these wells will be as follows:

140 to 980 feet:	Electric Gamma radiation Caliper Acoustic (by USGS)
980 to 1,650* feet:	Electric Gamma radiation Fluid resistivity Temperature Caliper Flow meter Acoustic (USGS) Borehole TV (in lieu of 6-inch casing)

*Estimated total depth (TD) of wells. Actual TD to be determined during drilling. Drilling to be done with reverse air, letting wells flow and discharging brackish water into adjoining injection wells.

9. Reviewed TV survey of 24-inch casing in Well I-1, where cement pipeline was stuck (at ±2,450 feet) after cement pipeline had been removed and cement redrilled to near casing total depth (2,628 feet). No signs of damage to casing were observed.

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Attachments

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SUMMARY OF MEETING

DATE: August 13, 1980

SUBJECT: Miami-Dade Water and Sewer Authority

Injection Wells Progress Meeting No. 13

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA South District Plant Construction Site

ATTENDING: Roy Duke/DER-WPB
Russell J. Kerrn/Alsay-Pippin Corp.
David G. Snyder/CH2M HILL
Leslie Wedderburn/SFWMD-WPB
Fred Meyer/USGS-Miami
Jeffrey D. Lehnen/CH2M HILL
Murray Grant/MDWSA
Tom McCormick/MDWSA
Richard Knittel/DER-Tallahassee
David Cabit/Alsay-Pippin Corp.
J. I. Garcia-Bengochea/CH2M HILL

1. Reviewed summary of July 1 meeting (Progress Meeting No. 12). Need to change date of meeting to July 1, 1980 instead of July 3, 1980.

2. Progress to date since July 1 meeting is as follows (program chart updated through August 13 is attached):

   a. FA-2--Inner casing (6-5/8-inch) set at 1,645 feet in depth and cemented up to 1,020 feet. Open annulus from 1,020 feet to surface.

   b. FA-1--Surface casing (20-inch) set at 140 feet in depth and cemented to surface. Ready to set and cement 12-inch casing at 980 feet in depth.

      I-9--Pilot hole drilled to 2,640. Eastman survey and geophysical logs run. Reamed with 32-inch bit to 2,470 and waiting on orders since noon August 12. Eastman Whipstock on site to run ream hole survey. Need to make decision today on setting depth for 24-inch casing.

I-1--Completed. Scheduled to run injection test next Wednesday, August 20.

I-2--Cementing 24-inch with tremie pipe at 1,477 feet on north side and 1,480 feet on south side. Pumping cement today. Should be 100 feet below pad by later today.

I-3, I-4, I-6, and I-7--Completed. I-7 shows blockage at 2,820 feet in depth. It will be cleaned before final acceptance together with I-3 and I-4.

I-8--Reamed hole ready to 2,614 feet in depth. Will lower and cement casing and complete I-8 as soon as I-9 is completed.

3. Review of cementing problems on I-2. CH2M HILL presented to regulatory agencies preliminary summary of information on cementing, placing of gravel and cost on the subject. Copies of preliminary summary is attached. Actually 24-inch casing in I-2 is cemented from 2,470 feet up. Section from 2,470 to 2,628 is practically graveled except for about 37 feet between 2,566 and 2,603 feet in depth where a combination of Thixotropic and Type H cement may have held. Wedderburn (SFWMD) requests that a temperature log inside casing be run as soon as cementing is completed.

4. Setting depth of 24-inch casing in well I-9. Copies and geophysical logs of pilot hole in this well from 1,802 to 2,613 feet were delivered to Duke and Knittel (DER), Wedderburn (SFWMD), Meyer (USGS) and McCormick (MDWSA) by CH2M HILL. Coker's (EPA) copies will be mailed. Based on the information given on 3 above, CH2M HILL (Garcia) states that there seems to be more evidence that high transmissivity zone starts at approximately 2,430-2,450 feet in depth, that this zone and the deeper zones of +2,650 feet are communicated and that the 24-inch casing setting in well I-9 should be determined after reassessing the setting of the casing in well I-8. The above statement is supported by:

   a. The drawdown experienced during withdrawal test of I-5 (December 1979) in the 2,455-2,465 feet zone in BZ-1 (0.04 ft) is almost equal to that in the 2,455-2,465 feet zone in the same well (0.048 ft).

b. The presence of a hard ledge at approximately 2,430 feet in depth in wells I-8 , I-2, and I-9 among others, together with a temperature anomaly at the same depth.

c. The presence of cooling effects at approximately 2,430 feet in depth in wells I-1, I-3, I-4, and I-7, after cementing which indicate the presence of a cooling water circulation zone at that depth.

5. In view of the supporting evidence given in 4 above, the troubles experienced in I-2 and summarized in 3 above, and that logs of I-8 show stronger evidence of cool water circulation at 2,430 feet in depth. CH2M HILL (Garcia) recommends changing the 24-inch casing setting of well I-8 from 2,614 to 2,420 feet in depth, and that the same casing setting be applied to I-9. After a long discussion at meeting and telephone consultation by Duke (DER) and Meyer (USGS) with Coker (EPA) in Atlanta, it was agreed that the value of the 2,455-2,465-foot monitoring zone is very questionable and that the 24-inch casings in well I-8 and I-9 must be set at 2,420 feet in depth. It was also agreed to extend the 6-5/8-inch casing in well FA-1 deeper in order to locate another monitoring zone below 1,800 feet in depth.

6. Roy Duke expressed DER's request that MDWSA and CH2M HILL start preparing a program to effectively operate the monitoring system, especifically in what it respects to correlation of injection flows and well head pressures of each well.

Meeting was adjourned at 12:30 p.m.

This Summary of Meeting prepared August 15, 1980 by CH2M HILL.

J. I. Garcia-Bengochea, P.E.

ble

24" CASING CEMENTING OPERATION
7/10/80 - 8/1 /80
PRELIMINARY - SUBJECT TO REVIEW

		TAG N.	TAG S.
7/10/80	Placing Cement Stage #1 (3000 Sks. H Neat)	No fill-up	
7/11/80	Placing Cement Stage #2 (200 Sks. Thixotropic)	2627	2627
7/12/80	Tag In Annulus After Cement Stage #2	2627 (+0)	2627 (+0)
7/12/80	Placing Cement Stage #3 (350 Sks. Thixotropic)		
7/13/80	Tag In Annulus After Cement Stage #3	2628 (-1)	2628 (-1)
7/14/80	Tag Inside 24" Casing After Trennie Re-tally	2626.76' Inside 24" Casing	
7/14/80	Tag In Annulus After Pressure/Injection Test on 7/13	2634 (-6)	2633 (-5)
7/15/80	Placing Gravel Stage #1 (3 ft.^{3})	No Fill-up	
7/15/80	Placing Gravel Stage #2 (15.5 ft.^{3} Total-up to This Tag)	2628 (+6)	2627 (+6)
7/15/80	Placing Gravel Stage #3 (1.5 ft.^{3})	2629 (-1)	2626 (+1)
7/16/80	Tag Inside 24" Casing	2624.79 (+2)	
7/16/80	Placing Cement Stage #4 (200 Sks. Thixotropic)		
7/16/80	Tag Inside 24" Casing	2616 (+8.79)	
7/17/80	Tag in Annulus After Cement Stage #4	2592 (+37)	2622 (+4)
7/17/80	Placing Cement Stage #5 (93 Sks. Thixotropic)		
7/18/80	Tag in Annulus After Cement Stage #5	2625 (-32)	2626 (-4)
7/19/80	Placing Gravel Stage #4 (25 ft.^{3})	2622 (+3)	2623 (+3)
7/19/80	Placing Gravel Stage #5 (28 ft.^{3})	2622 (0)	2623 (0)
7/19/80	Placing Gravel Stage #6 (40 ft.^{3})	2623 (-1)	
7/20/80	Placing Gravel Stage #7 (20 ft.^{3})	2624 (-1)	
7/20/80	Placing Gravel Stage #8 (12 ft.^{3})	2622 (+2)	
7/21/80	Placing Gravel Stage #9 (60 ft.^{3})	2621 (+1)	2621 (+2)
7/21/80	Placing Gravel Stage #10 (50 ft.^{3})	2619 (+2)	2618 (+3)
7/21/80	Placing Gravel Stage #11(109 ft.^{3})		
7/22/80	Placing Gravel Stage #12 (40 ft.^{3})	2620 (-1)	
7/22/80	Placing Gravel Stage #13 (75 ft.^{3})	2616 (+4)	2619 (-1)
7/22/80	Placing Gravel Stage #14 (115 ft.^{3})		2604 (+15,
7/22/80	Placing Gravel Stage #15 (65 ft.^{3})	2610 (+6)	2610 (-6)

		TAG N.	TAG S.
7/23/80	Placing Gravel Stage #16 (282 ft.^{3})	2612 (-2)	
7/23/80	Placing Gravel Stage #17 (50 ft.^{3})	2607 (+5)	
7/24/80	Placing Gravel Stage #18 (50 ft.^{3})	2606 (+1)	
7/24/80	Placing Cement Stage #6 (550 Gal. Flow Check & 30 Sks. Thixotropic		
7/25/80	Tag in Annulus After Cement Stage #6	2603 (+3)	2616 (-6)
7/25/80	Placing Gravel Stage #19 (115 ft.^{3})		2616 (+0)
7/25/80	Placing Gravel Stage #20 (100 ft.^{3})		2605 (+11)
7/26/80	Placing Gravel Stage #21 (50 ft.^{3})		2607 (-2)
7/26/80	Placing Gravel Stage #22 (90 ft.^{3})	2603 (+0)	2607 (+0)
7/26/80	Placing Cement Stage #7 ($CaCl_2$/Flow Check w/50 Sks. Neat	2560 (+43)	2556 (+51)
7/27/80	Placing Cement Stage #8 (80 Sks. Thixotropic)	2570 (-10)	2565 (-9)
7/28/80	Placing Cement Stage #9 (150 Sks. H Neat)	2562 (+8)	2561 (+4)
7/29/80	Placing Cement Stage #10 (750 Sks. H Neat)	2560 (+2)	2564 (-3)
7/29/80	Placing Cement Stage #11 (240 Sks. Thixotropic)	2546 (+14)	2532 (+32)
7/30/80	Placing Cement Stage #12 (150 Sks. Thixotropic)	2532 (+14)	2553 (-21)
7/31/80	Placing Cement Stage #13 ($CaCl_2$/Flow Check & 35 Sks. H Neat	2563 (-31)	2564 (-11)
8/1/80	Placing Gravel Stage #23 (50 ft.^{3})		2551 (+13)
8/2/80	Placing Gravel Stage #24 (50 ft.^{3})	2555 (+8)	
8/2/80	Placing Gravel Stage #25 (100 ft.^{3})	2554 (+1)	2554 (+3)
8/2/80	Placing Gravel Stage #25A (100 ft.^{3})	2566 (-12)	2554 (+0)
8/2/80	Placing Gravel Stage #25B (100 ft.^{3})	2556 (+10)	2553 (+1)
8/3/80	Placing Gravel Stage #26 (100 ft.^{3})	2532 (+22)	
8/3/80	Placing Gravel Stage #27 (100 ft.^{3})		2535 (+19)
8/3/80	Pump 35 Sks. Thix's' Cement Stage #14	2529 (+3)	2528 (+7)
8/4/80	Pump 50 Sks. H Neat Cement Stage #15	2529 (0)	2527 (-1)
8/4/80	Pump 50 Sks. H Neat Cement Stage #16	2545 (-16)	2545 (-18)
8/5/80	Placing Gravel Stage #28 (200 ft.^{3})	2544 (+1)	2542 (+3)
8/5/80	Placing Gravel Stage #29 (200 ft.^{3})	2525 (+19)	2528 (+14)

		TAG N.	TAG S.
8/5/80	Placing Gravel Stage #30 (100 ft.^{3})		
8/5/80	Approximately 50 Pails Stage #30A (50 ft.^{3})	2512 (+13)	2519 (+9)
8/5/80	Halliburton Jets on Gravel Plug		
8/5/80	Adding 50 Pails Gravel #31 (50 ft.^{3})	2525 (-13)	2522 (-3)
8/5/80	Adding 100 Pails Gravel #32 (100 ft.^{3})	2520 (+5)	2514 (+8)
8/6/80	Adding 100 Pails Gravel #33 (50 ft.^{3} S S Only		2513 (+1)
8/6/80	Tag N. Side After Unpluging Trennie	2517 (+3)	---
8/6/80	Placing Gravel Stage #34 (80 ft.^{3})	2515 (+2)	2516 (-3)
8/6/80	Placing Gravel Stage #35 (200 ft.^{3})	2488 (+27)	2504 (+12)
8/7/80	Re-tag Before Halliburton Jets Gravel Plug	2485 (+3)	2502 (+2)
8/7/80	Halliburton Jets Gravel Plug (5½ bbls. per min. for 23 min.)	2488 (-3)	2512 (-10)
8/7/80	Placing Gravel Stage #36 (25 ft.^{3})	2503 (-15)	2499 (+
8/7/80	Placing Cement Stage #17 (30 sks. H Neat)		
8/7/80	Tag Cement Stage #17	2535 (-32)	2531 (-32)
8/8/80	Placing Gravel Stage #37 (82 ft.^{3})	2519 (+16)	2544 (-13)
8/8/80	Placing Gravel Stage #38 (70 ft.^{3})	2515 (+4)	2510 (+34)
8/8/80	Placing Gravel Stage #39 (95 ft.^{3})	2485 (+30)	2483 (+27)
8/8/80	Placing Gravel Stage #40 (45 ft.^{3})	2482 (+3)	2480 (+3)
8/8/80	Circulated and Tagged	2473 (+9)	2470 (0)
8/8/80	Circulated and Tagged	2470 (+3)	2470 (0)
8/9/80	Circulated and Tagged	2470 (0)	2470 (0)
8/9/80	Circulated and Tagged	2469 (+1)	2469 (+1)
8/9/80	Circulated and Tagged	2469 (0)	2470 (-1)
8/9/80	550 Gal. Flow Check & 35 Sks. Neat + 4% $CaCl_2$ W/4% $CaCl_2$ Stage #~~17~~ 18	2448 (+21)	2445 (+25)
8/9/80	50 Sks. Neat Stage #~~42~~ 19	2410 (+38)	2408 (+37)
8/10/80	480 Sks. Neat Stage #~~43~~ 20	2293 (+117)	2292 (+116)
8/10/80	750 Sks. Neat Stage #~~44~~ 21	2138 (+155)	2133 (+159)
8/10/80	1000 Sks. Neat Stage #~~45~~ 22	1873 (+265)	1865 (+268)
8/11/80	1625 Sks. Class H 2% Gel # 23	1480 (+393)	1477 (+388)
8/ /80	2757 Sks. Class H 2% Gel (0 - 100' From Surface) # 24		

PRELIMINARY COST BREAKDOWN ON CEMENTING OF 24" CASING WELL I-2

Standby & Extra Work Charges - APCO	:	$123,360.00
Standby & Extra Work Charges - Halliburton	:	75,129.37
Cement Costs	:	196,993.12
Gravel & Associated Materials	:	6,099.36
TOTAL ESTIMATED COSTS		$401,581.85

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SUMMARY OF MEETING

DATE: October 8, 1980

SUBJECT: Miami-Dade Water and Sewer Authority
Injection Wells Progress Meeting No. 14

PROJECT: MDWSA S-154
BC55900.92

LOCATION: MDWSA Offices-3575 Le Jeune Road

ATTENDING: Tom McCormick/MDWSA
David G. Snyder/CH2M HILL
Roy Duke/DER-WPB
Ed Holland/Alsay-Pippin Corp.
Jim L. Gerlach/Alsay-Pippin Corp.
Gene Coker/EPA
Barry Amos/EPA
Fred Meyer/USGS
Richard E. Friberg/MDWSA
J. I. Garcia-Bengochea/CH2M HILL
Richard Knittel/DER-Tallahassee
Robert V. Celette/MDWSA
J. T. Cowgill/MDWSA
Leslie Wedderburn/SFWMD-WPB

1. Reviewed summary of August 13 meeting (Progress Meeting No. 13). Need to change progress chart as follows:

   a. Well FA-2--inner casing is uncemented from 1,020 feet to surface. This will leave annulus for monitoring purposes.

   b. Well BZ-1--add monitoring screen between 2,455 and 2,465 feet, middle point at 2,460 feet in depth. Gravel section between 2,434 and 2,474 feet in depth.

   c. Richard Knittel (DER) suggested changing the word must to the word may in page 3, item 5, near the end of line 13. This was agreed to.

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2. Progress to date since the August 13 meeting has been as follows (progress chart updated through October 8 is attached):

   a. FA-1: Inner casing (6-inch) set at 1,840 feet in depth and cemented to 1,090 feet. Annulus between 20- and 6-inch casings is open from 1,090 to ground level. Upper monitoring zone is between 980 and 1,090 feet in depth. Bottom hole is open from 1,840 to 1,947 feet. Water samples collected after development of well show electrical conductivity of 44,000 μmhos/cm, TDS of 32,500 mg/l, chloride of 17,000 mg/l, and sulfate 2120 mg/l.

   b. I-9: Inner casing (24-inch) set at 2,418 feet and cemented up to within 100 feet from ground surface. No bottom hole yet.

   c. I-1: Injection test run August 21, 1980; 10,000 gpm with 89 feet of injection head.

   d. I-2: Inner casing (24-inch) is cemented up to within 100 feet from ground surface. Bottom hole is at 2,824 feet in depth. Contractor has been fishing for the lead bit at this depth for approximately the last 40 days.

   e. I-8: Inner casing (24-inch) is cemented from 2,420 feet up to within 100 feet from ground surface. Bottom hole is at 3,023 feet and drilling.

3. Disposition of washed samples of formation cuttings--MDWSA will keep them at plantsite.

4. Presentation and review of draft of completion reports on wells BZ-1, I-3 and I-6. Copies of draft distributed to participants. Regulatory agencies will send comments to CH2M HILL within 30 days. Planning to include all wells in a single report using double sided printing.

5. Discussed two methods to determine potentiometric surface of the Boulder Zone at the project site: 1) quartz gages from Reservoir Data Inc., and 2) ~~Kiuler~~ Water level recorders. CH2M HILL (Garcia) distributed copies of information received from Reservoir Data Inc., Houston, TX, dated September 30, 1980, and pointed out the repeatability of the instruments (± 0.4 psi or ± 0.9 ft). A discussion followed, noting that expected water levels between the wells furthest apart could be

on the order of 0.05 feet. It was also noted that water level recorders be installed in wells I-8, I-6, BZ-1, I-3, and I-9 after pumping out each well at approximately 500 gpm until native water is pumped out (Cl^- ± 18,500, Spec. Cond. ± 50,000); then a sample would be collected and the temperature and total dissolved solids determined. When all five wells are set with recorders, each well would be logged for temperature and the elevation of the water level corrected. Then water levels would be recorded for a minimum of 24 hours and correlated with each other. It was noted that reference elevations must be set at each well with an error of not more than ± 0.01 ft. It was agreed to follow the second method using the water level recorders.

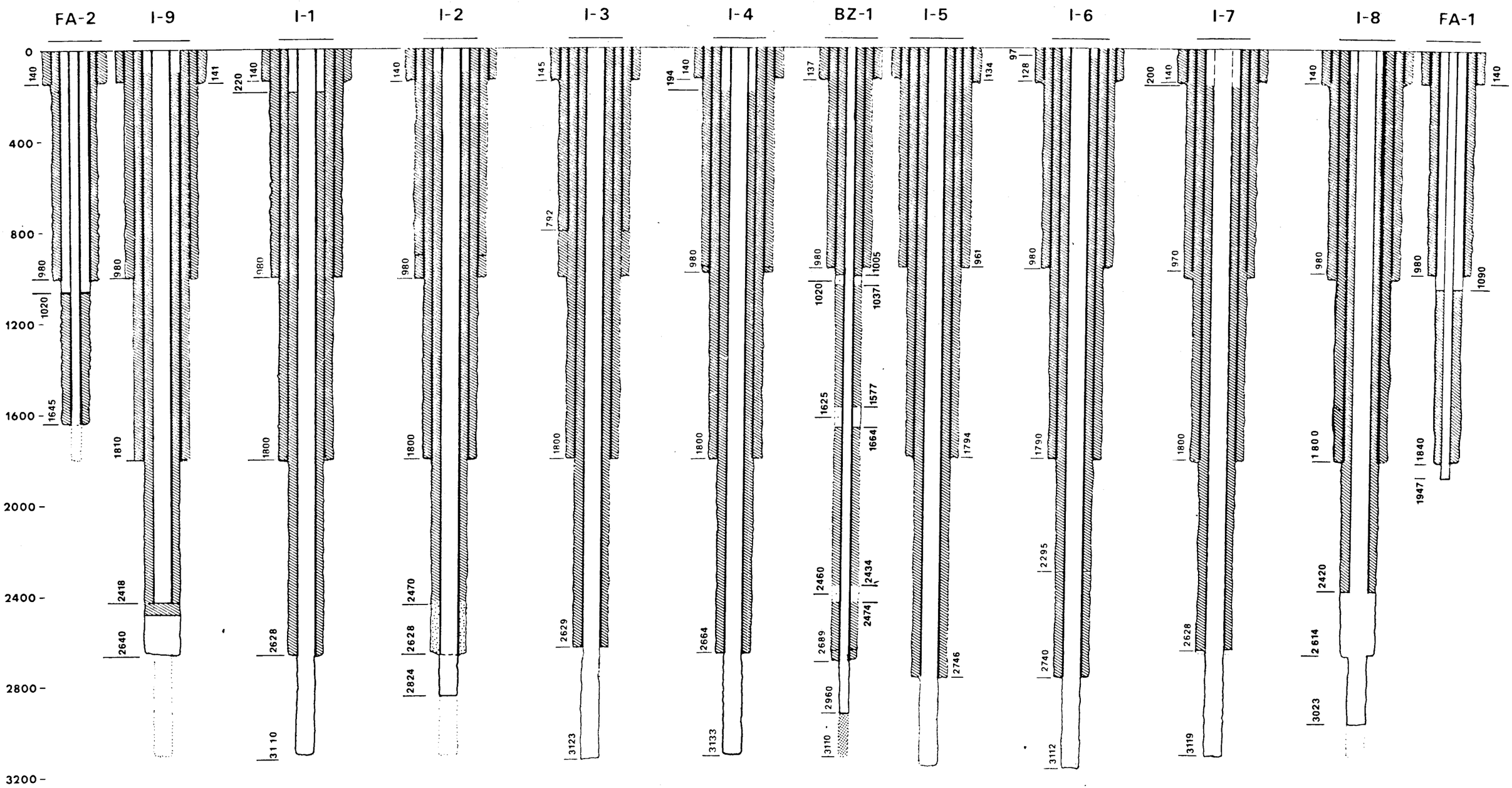
6. The condition of well I-2 was once again mentioned for discussion. Alsay Pippin Corp. (APCO) wants to place cement in the area where the fish (lead bit) is supposed to be (± 2824 ft) to try to consolidate the hole before any other attempt is made. MDWSA wants to see the fish and its position before any cementing is done. Two TV surveys have been run with clear water in the hole with no sign of the fish has yet appeared. APCO is trying to drill approximately 5 feet below 2,824 feet with a 12-inch bit, clean the hole, and run another TV survey. CH2M HILL (Garcia) asked APCO representatives if they could leave the meeting room while MDWSA, regulatory agencies, and CH2M HILL discuss some possible alternatives to the problem under consideration. APCO representatives acceded to the request. Garcia then brought up the point that the video tapes (already run) of the open hole below the bottom of the casing (from 2,628 to 2,824 feet) show very cavernous zones starting just below bottom of the casing and all the way down to 2,824 feet. Garcia also expressed his opinion that the hole at its present depth would probably meet the injection test requirements and that in order to save time and more possible fishing hazards he recommends negotiating with APCO about running the injection test at the present depth and that, if acceptable, no further drilling would be required in this hole. This should be done with the understanding that APCO would proceed to clean the bottom of wells I-3, I-4 and I-7 with no more arguments and demands for extra payment. There appear to be some loose material in the bottom of those three wells which could cause present or future blockage of the wells thereby reducing their injection capacity. There are differences of opinion between APCO and MDWSA about whether or not the work required to clean those

three holes falls within the scope of the contract. An acceptance by MDWSA of well I-2 at is present condition, if it passes the injection test, would entail APCO's acceptance of cleaning the bottom of wells I-3, I-4 and I-7 within the scope of their contract. After reviewing the video tapes of well I-2 between 2,620 and 2,824 feet in depth, regulatory and MDWSA representatives agreed with the above recommendation. APCO representatives were then called back and were informed by MDWSA of the above proposal APCO's representatives stated that they had to consult with their headquarters before agreeing to the above proposal.

Miami-Dade Water & Sewer Authority Project S-154

INJECTION & MONITOR WELLS

Progress as of October 8, 1980



Appendix 4.C-1
BACKGROUND WATER LEVEL CHARTS FOR I-5

Client: MDWSA

Location: I-5 Boulam Zone

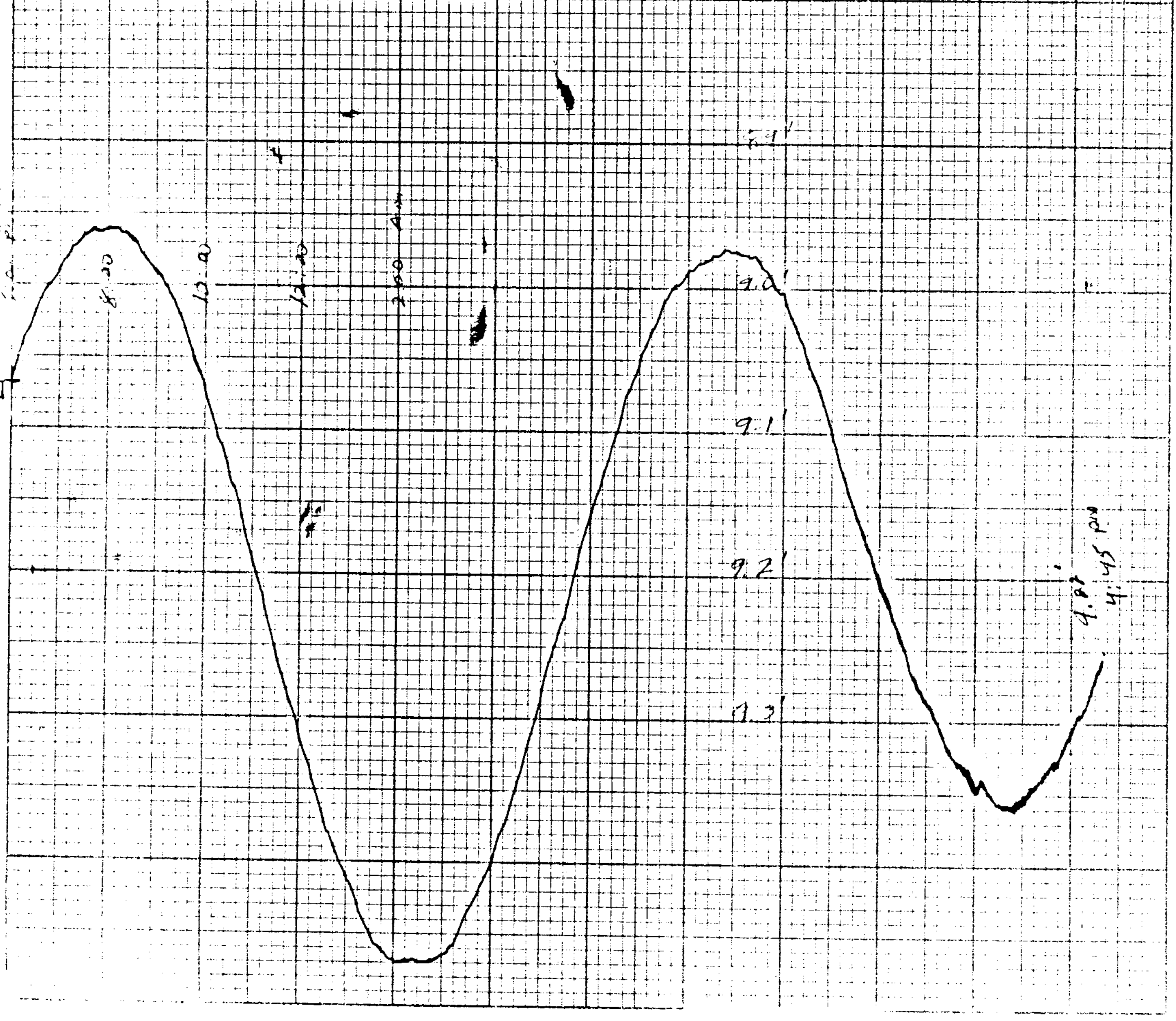
CH2M HILL

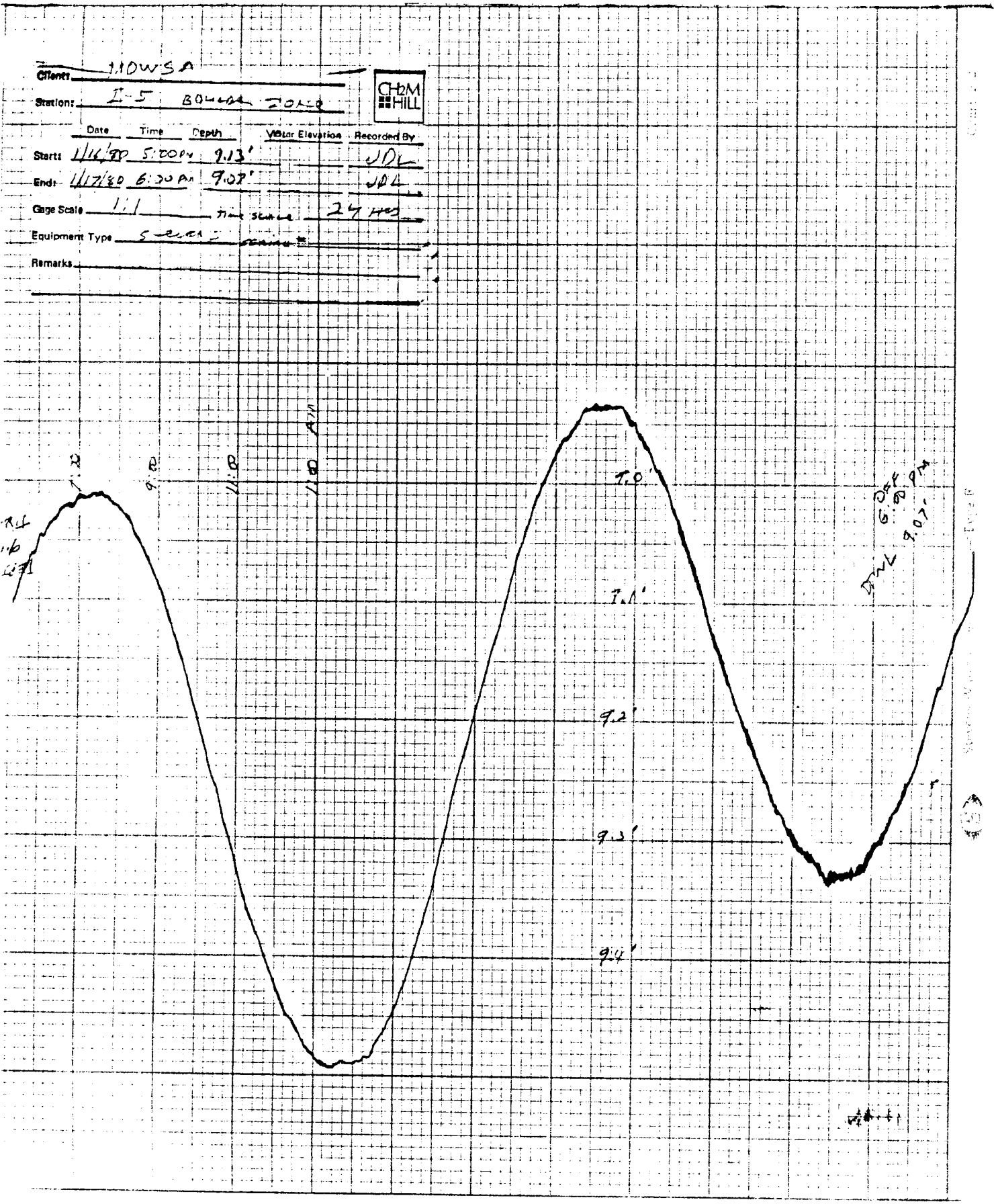
	Date	Time	Depth to WL	Water Elevation	Recorded By
Start:	1/17/80	6:10 PM	9.07'		JDL
End:	1/18/80	4:45 PM	9.22'		

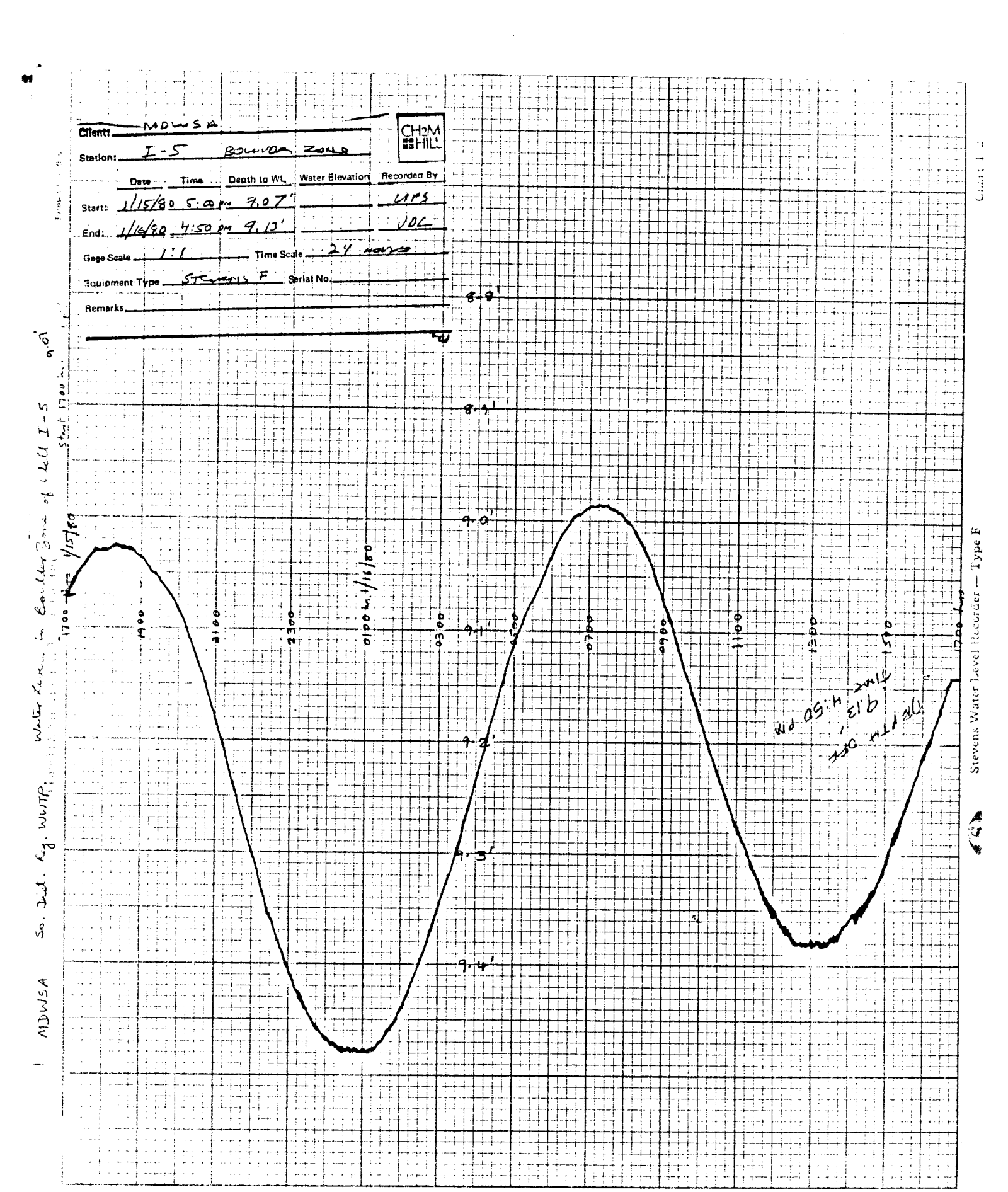
Gage Scale: 1:1 Time Scale: 2 in/hrs

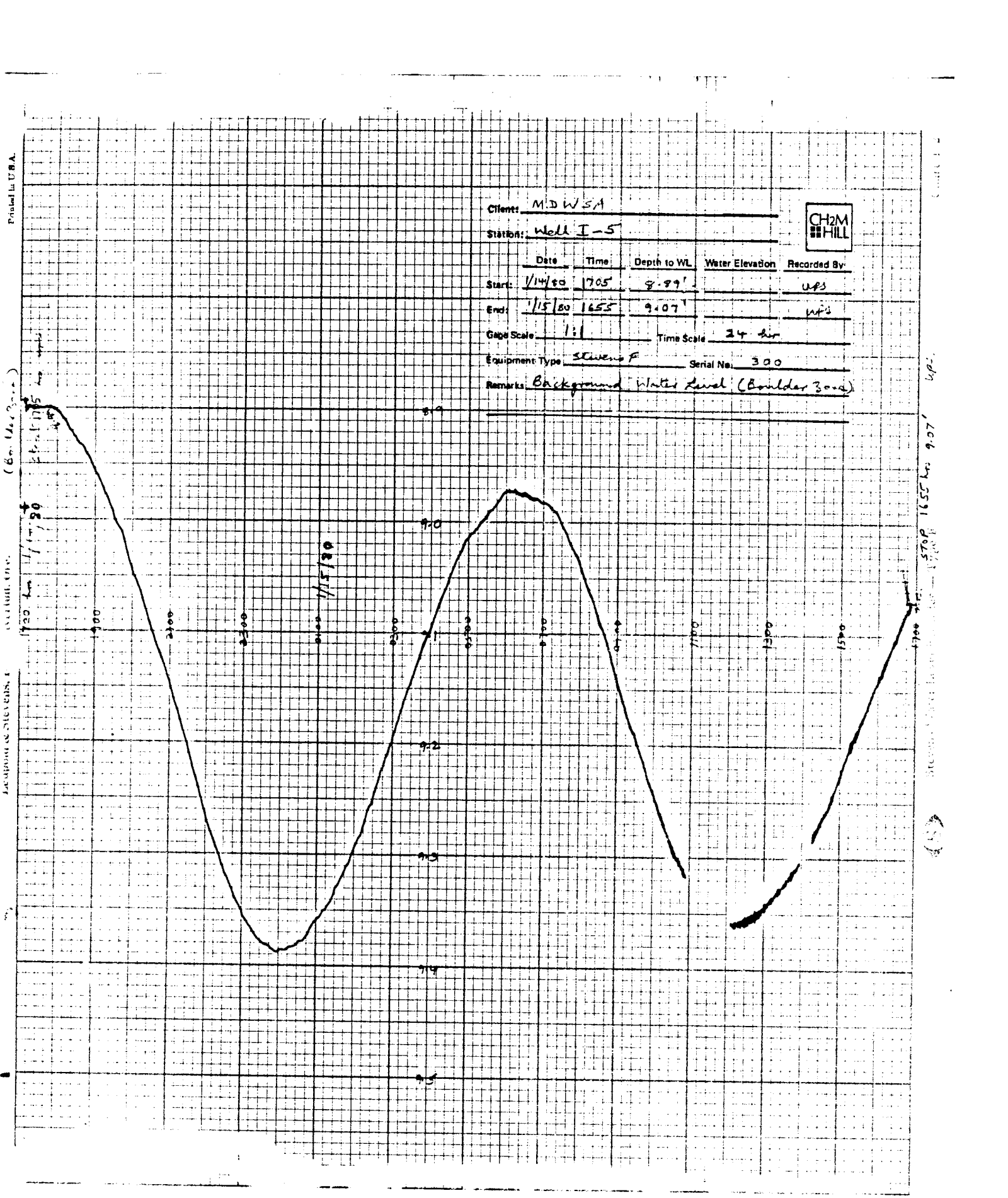
Equipment Type: Stevens F Serial No. 300

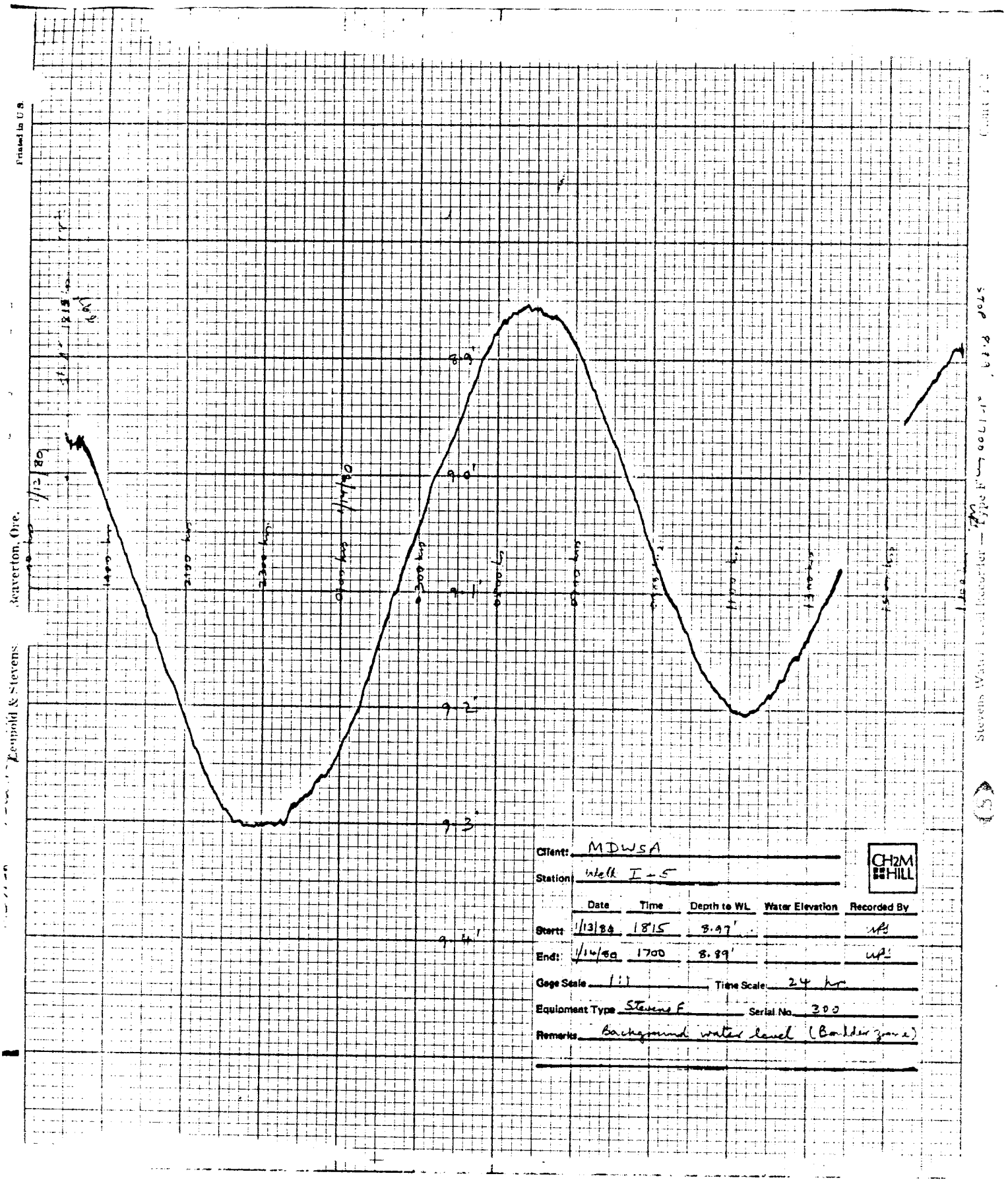
Remarks:

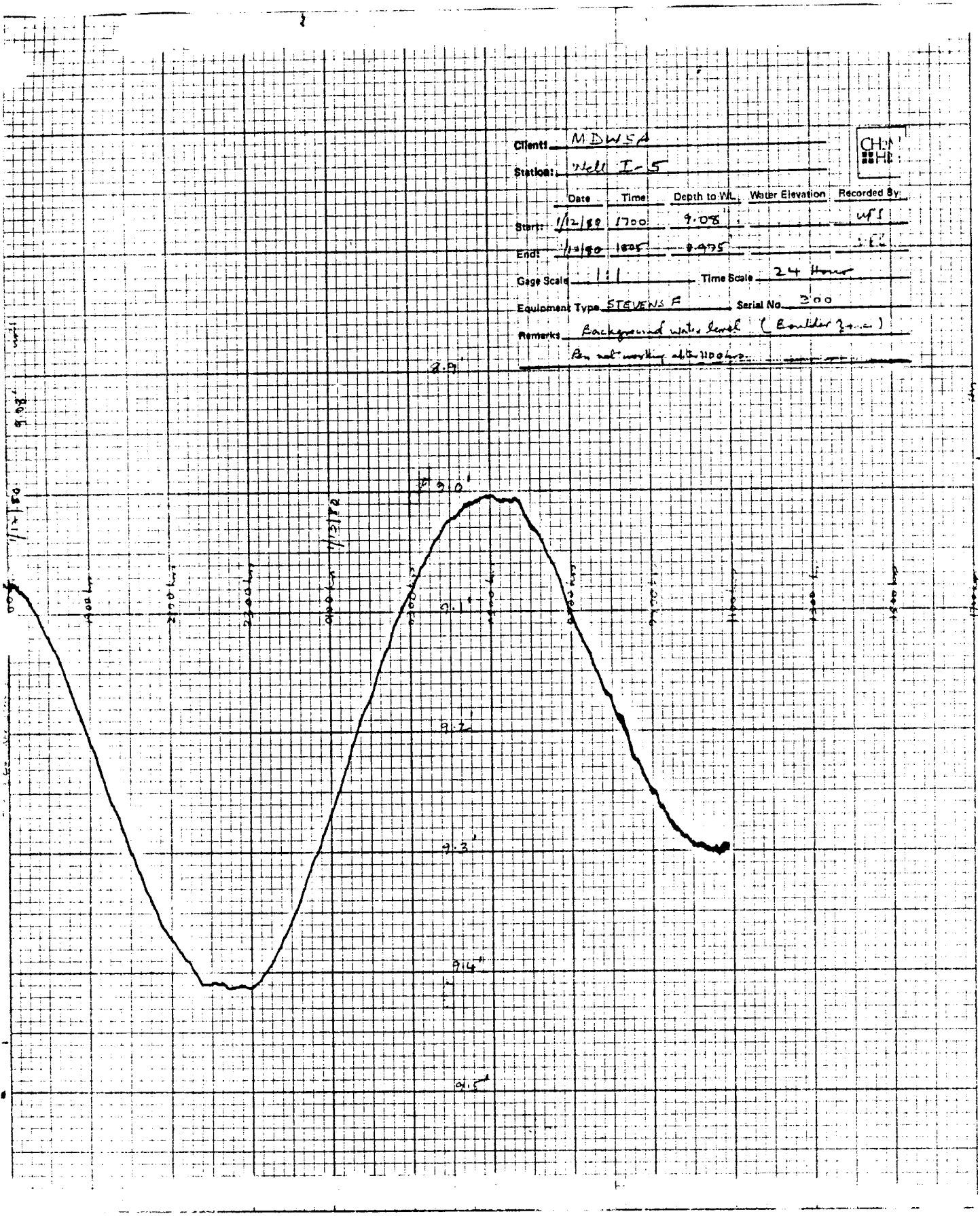


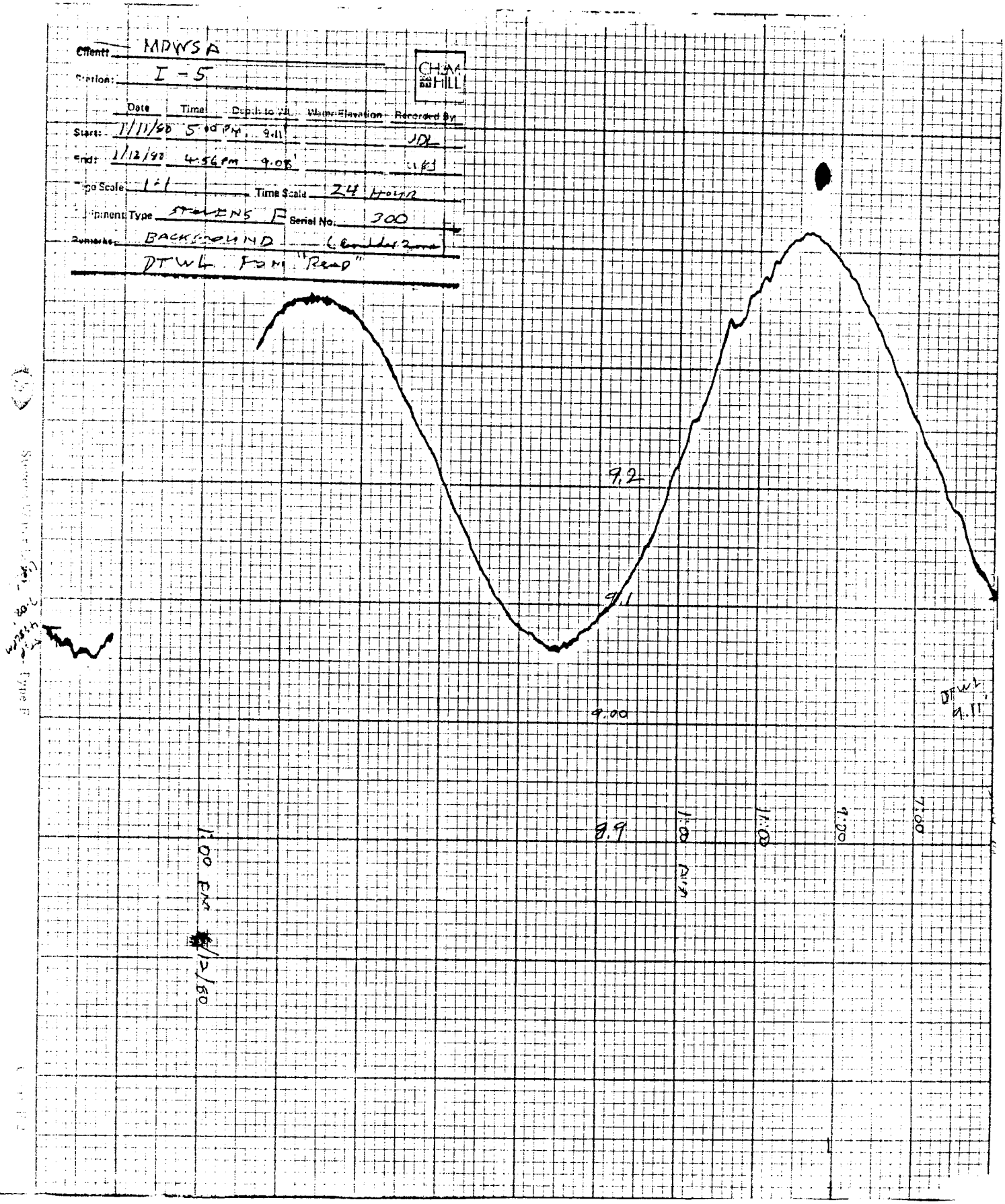

Client: NOWSA
Station: I-5 BOULDER ZONE
Date Time Depth VBar Elevation Recorded By
Start: 1/16/90 5:00PM 9.13' JDL
End: 1/17/90 6:30 AM 9.07' JDL
Gage Scale 1:1
Time Scale 24 Hrs
Equipment Type
Remarks
CH2M HILL
7.0'
7.1'
9.2'
9.3'
9.4'
6:30 PM
9.07'


Client: MDWSA
Station: I-5 Boulder Road
CH2M HILL
Date Time Depth to WL Water Elevation Recorded By
Start: 1/15/80 5:00 pm 9.07' LMS
End: 1/16/80 4:50 pm 9.13' JDL
Gage Scale 1:1 Time Scale 24 hours
Equipment Type Stevens F Serial No.
Remarks
8.9'
9.0'
9.1'
9.2'
9.3'
9.4'
1700
1900
2100
2300
0100
0300
0500
0700
0900
1100
1300
1500
1700
1/15/80
1/16/80
Stevens Water Level Recorder — Type F

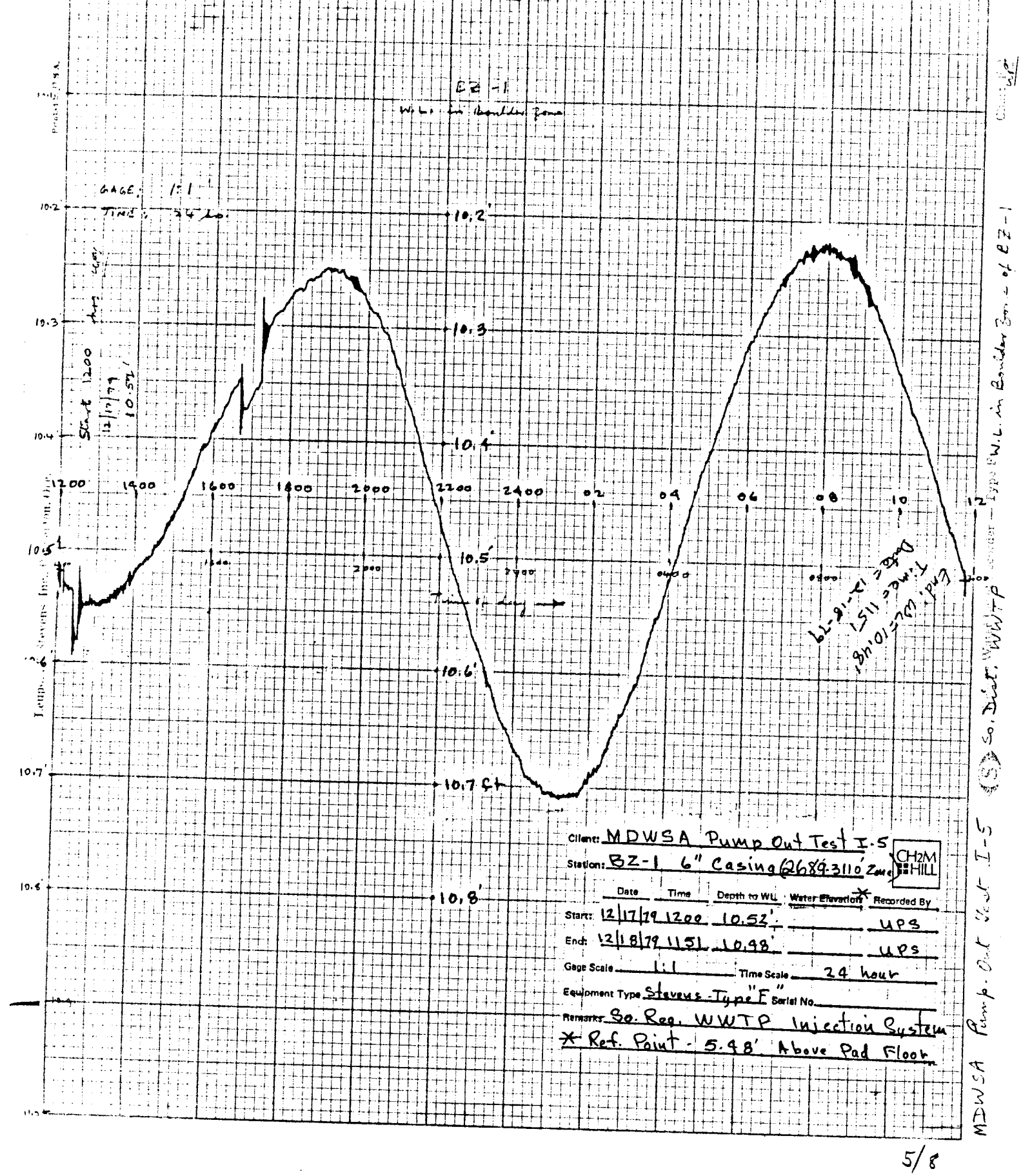

Client: MIDWSA
Station: Well I-5
Date
Time
Depth to WL
Water Elevation
Recorded By
Start: 1/14/80 1705 8.89' UPS
End: 1/15/80 1655 9.07' UPS
Gage Scale 1:1
Time Scale 24 hr
Equipment Type Stevens F
Serial No. 300
Remarks Background Water Level (Boulder 30-a)
CH2M HILL
8.9
9.0
9.1
9.2
9.3
9.4
9.5
STOP 1655 hr 9.07'

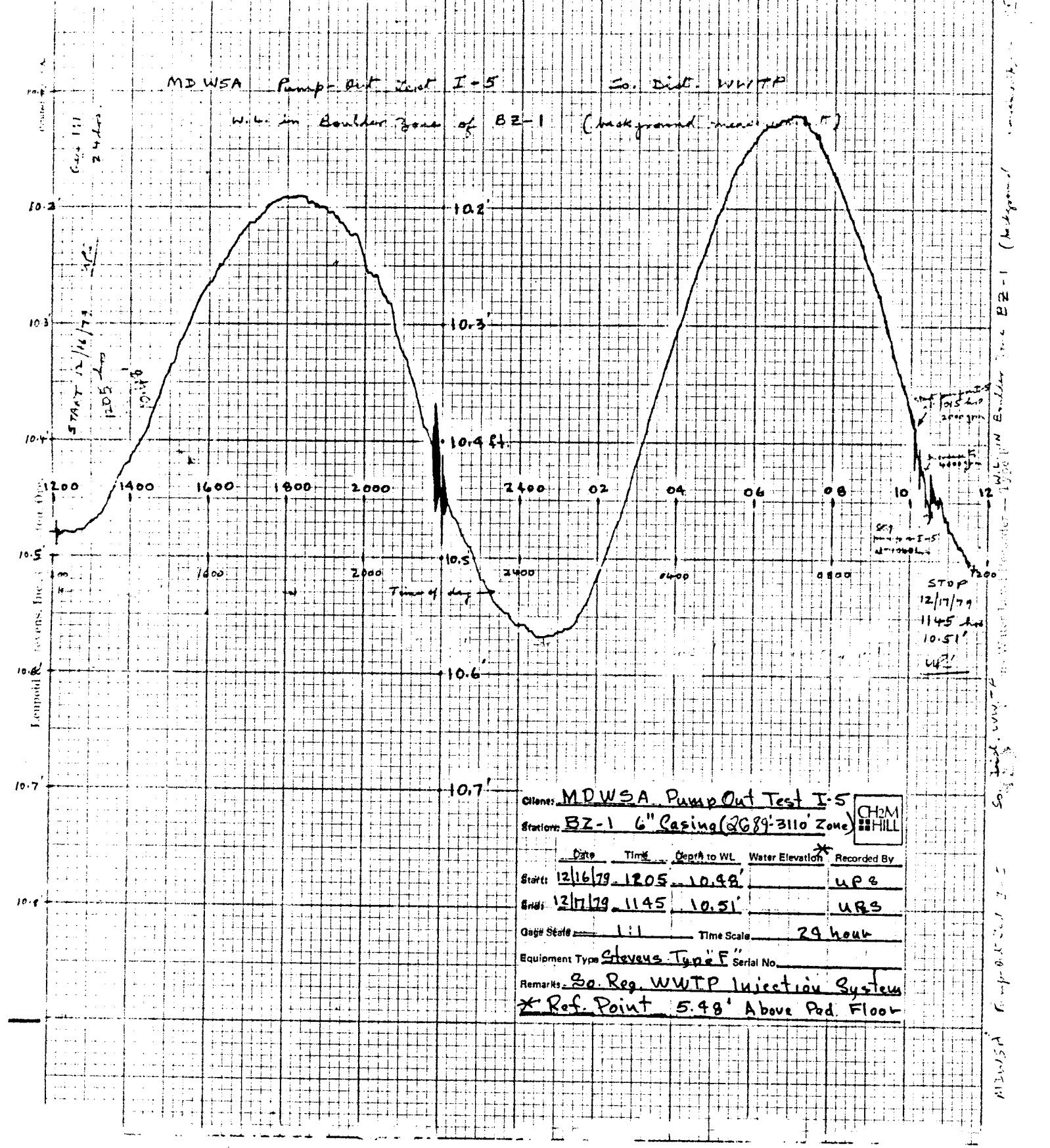

Client: MDWSA
Station: Intell I-5
Date | Time | Depth to WL | Water Elevation | Recorded By
Start: 1/13/84 | 1815 | 8.97' | | MP
End: 1/14/84 | 1700 | 8.89' | | MP
Gage Scale 1:1 Time Scale 24 hr.
Equipment Type Stevens F Serial No. 300
Remarks Background water level (Boulder zone)
CH2M HILL
8.9'
9.0'
9.1'
9.2'
9.3'
9.4'


Client: MDWSA
Station: Well I-5
Date Time Depth to WL Water Elevation Recorded By
Start: 1/12/89 1700 9.08 WFI
End: 1/19/90 1825 9.975 "
Gage Scale 1:1 Time Scale 24 Hours
Equipment Type STEVENS F Serial No. 300
Remarks Background water level (Boulder Zone)
Pen not working after 1 pm
8.9'
9.0'
9.2'
9.3'
9.4'
9.5'

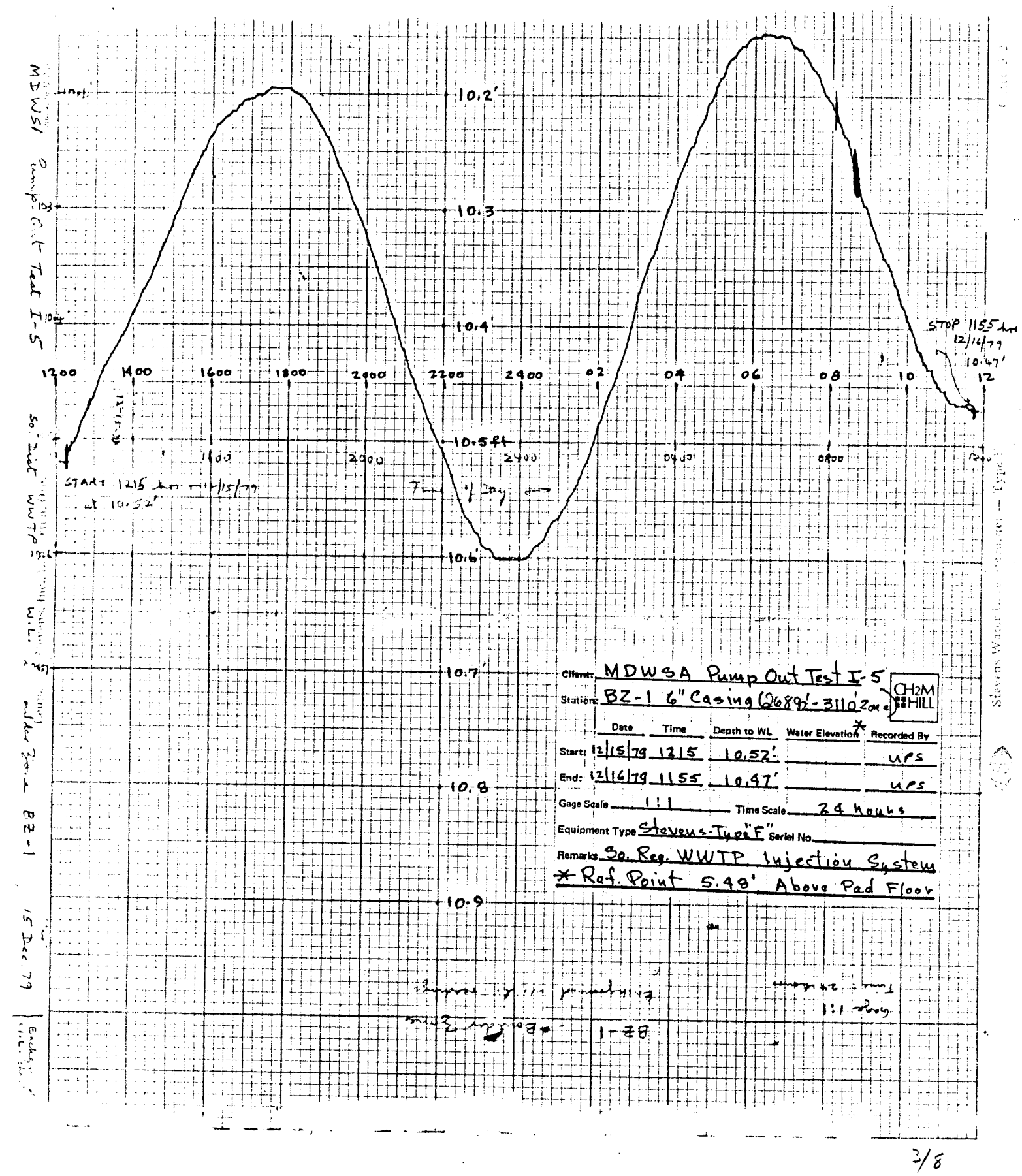

Client: MDWSA
Station: I-5
Date Time Depth to WL Water Elevation Recorded By
Start: 1/11/80 5:00 PM 9.11 JDL
End: 1/12/80 4:56 PM 9.08 [illegible]
Map Scale 1:1 Time Scale 24 Hours
Instrument Type STEVENS F Serial No. 300
Remarks: BACKGROUND (Boulder Zone)
DTWL from "Read"
9.2
9.1
9.00
9.9
1:00 PM 1/12/80
DTWL 9.11'

Appendix 4.C-2
BACKGROUND WATER LEVEL CHARTS FOR BZ-1


BZ-1
W.L. in Boulder Zone
GAGE: 1:1
TIME: 24 hr.
Start 1200 thru 1151
12/17/79
10.52'
10.2'
10.3'
10.4'
10.5'
10.6'
10.7 Ft
10.8'
1200
1400
1600
1800
2000
2200
2400
02
04
06
08
10
12
Time in days
Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing @ 6894.3110' Zone
CH2M HILL
Date Time Depth to WL Water Elevation * Recorded By
Start: 12/17/79 1200 10.52' UPS
End: 12/18/79 1151 10.98' UPS
Gage Scale 1:1 Time Scale 24 hour
Equipment Type Stevens-Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point - 5.98' Above Pad Floor
So. Dist. WWTP
MDWSA Pump. Out Test I-5
W.L. in Boulder Zone of BZ-1
5/8

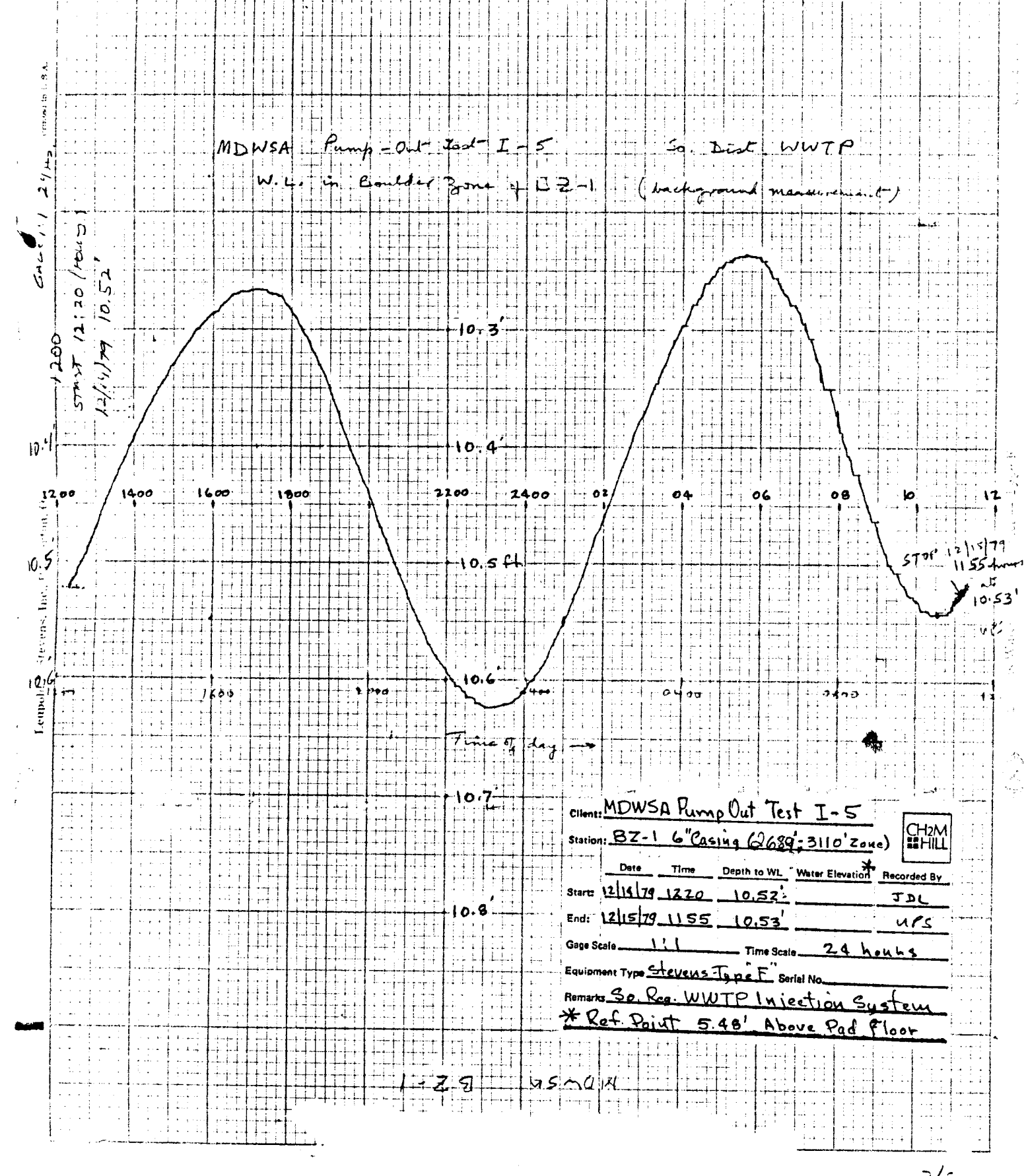

MD WSA Pump-Out Test I-5 So. Dist. WWTP
W.L. in Boulder Zone of BZ-1 (background measurement)
Scale 1:1
24 hrs.
START 12/16/79
1205 hrs
10.48'
1200
1400
1600
1800
2000
2400
02
04
06
08
10
12
10.2'
10.3'
10.4 ft.
10.5'
10.6'
10.7'
Time of day
STOP
12/17/79
1145 hrs
10.51'
Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2689-3110' Zone)
CH2M HILL
Date Time Depth to WL Water Elevation* Recorded By
Start: 12/16/79 1205 10.48' UPS
Ends: 12/17/79 1145 10.51' URS
Gage Scale 1:1 Time Scale 24 hour
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 5.48' Above Pad Floor

4/8


MDWSA Pump Out Test I-5
So. Reg. WWTP
W.L. in Upper Zone BZ-1
15 Dec 79
10.2'
10.3
10.4
10.5ft
10.6'
10.7'
10.8
10.9
1200
1400
1600
1800
2000
2200
2400
02
04
06
08
10
12
START 1215 hrs 12/15/79 at 10.52'
STOP 1155 hrs 12/16/79 10.47'
7 hrs = 1 Day
Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2689'-3110' Zone)
Date Time Depth to WL Water Elevation* Recorded By
Start: 12/15/79 1215 10.52' ups
End: 12/16/79 1155 10.47' ups
Gage Scale 1:1 Time Scale 24 hours
Equipment Type Stevens-Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 5.48' Above Pad Floor
CH2M HILL
Stevens Water Level Recorder — Type F

MDWSA Pump-Out Test I-5 So. Dist. WWTP

W.L. in Boulder Zone + BZ-1 (background measurement)



Client: MDWSA Pump Out Test I-5

Station: BZ-1 6"Casing (2689'-3110' zone)

CH2M HILL

	Date	Time	Depth to WL	Water Elevation *	Recorded By
Start:	12/14/79	1220	10.52'		JDL
End:	12/15/79	1155	10.53'		UPS

Gage Scale 1:1 Time Scale 24 hours

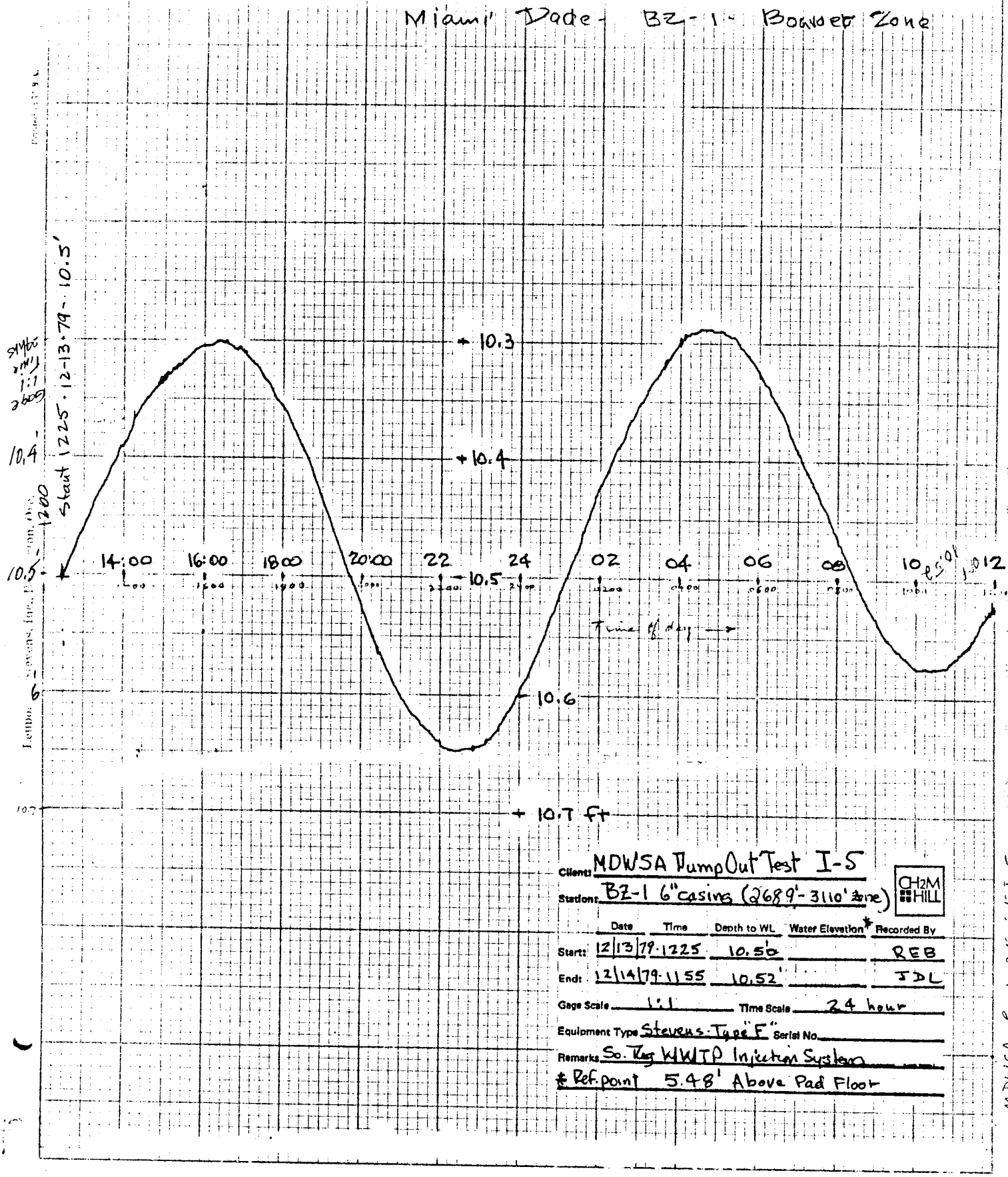
Equipment Type Stevens Type "F" Serial No.

Remarks So. Reg. WWTP Injection System

* Ref. Point 5.48' Above Pad Floor

2/8

Miami Dade - BZ-1 - Boulder Zone



Client: MDWSA Pump Out Test I-5

Station: BZ-1 6" casing (2689'-3110' zone)

CH2M HILL

	Date	Time	Depth to WL	Water Elevation*	Recorded By
Start:	12/13/79	1225	10.5'		REB
End:	12/14/79	1155	10.52'		JDL

Gage Scale 1:1 Time Scale 24 hour

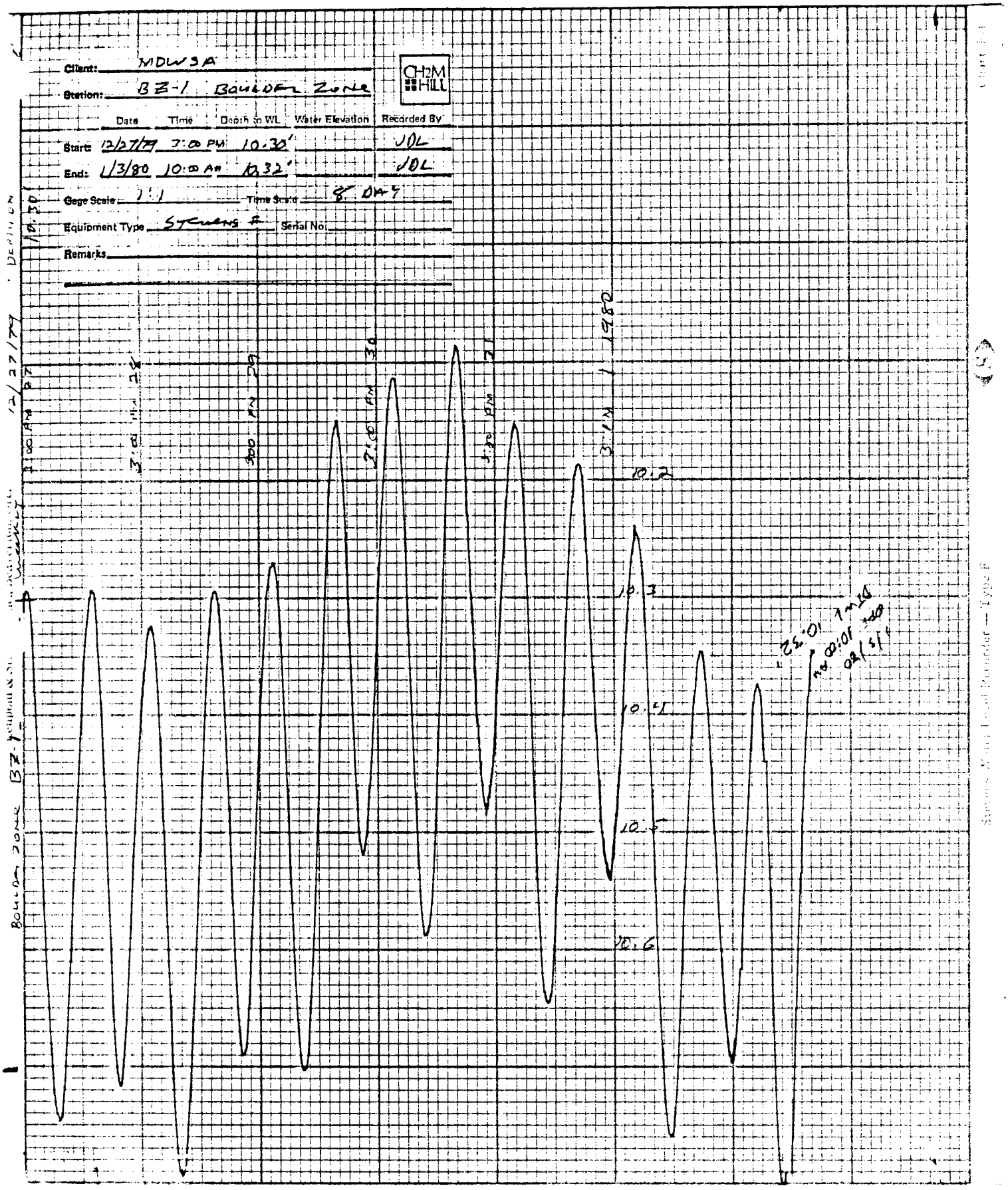
Equipment Type Stevens Type "F" Serial No.

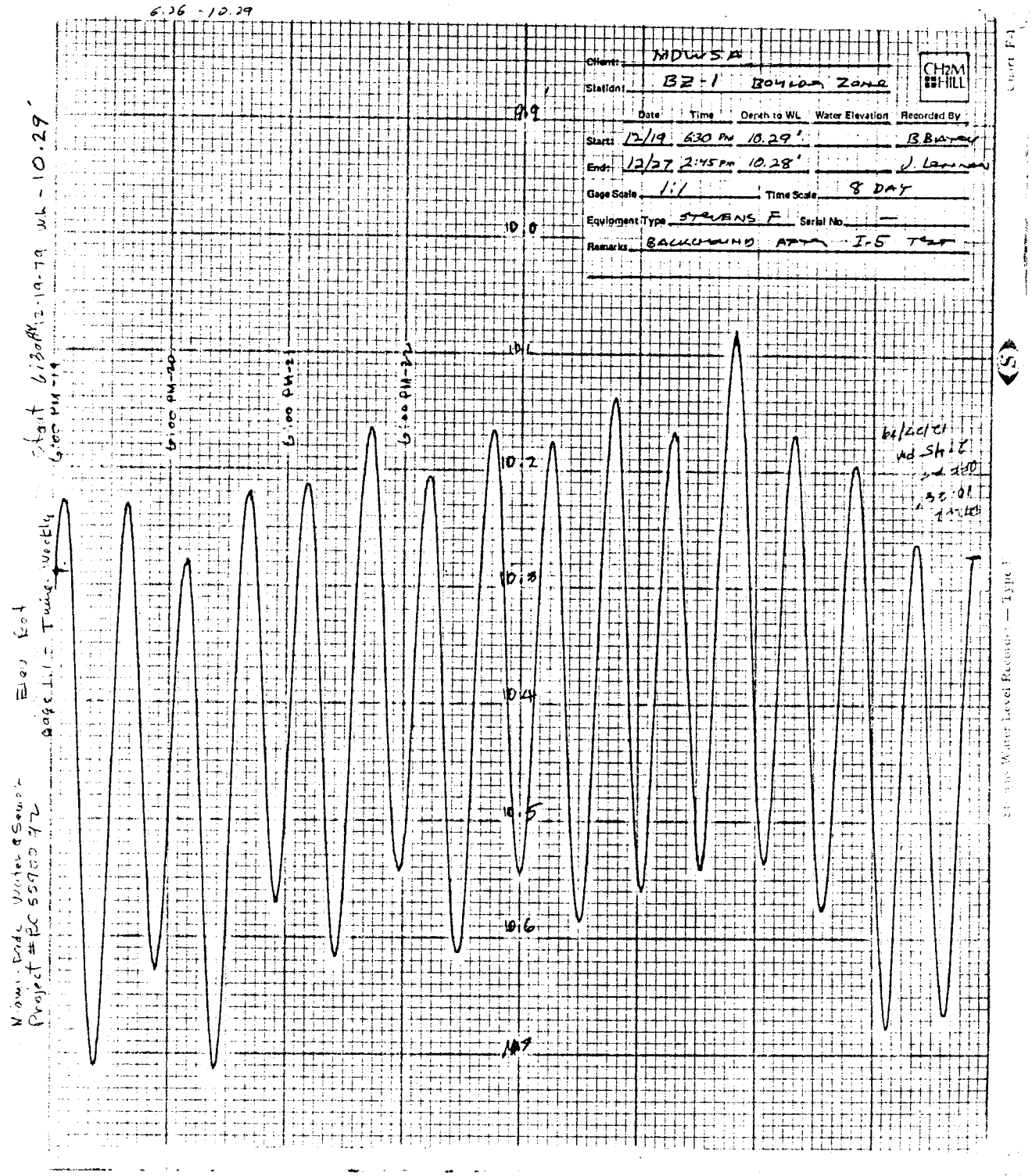
Remarks So. Dade WWTP Injection System

* Ref. point 5.48' Above Pad Floor

MDWSA Pump Out Test I-5 So. Dade WWTP BZ-1

1/8


Client: MDWSA
Station: BZ-1 Boulder Zone
CH2M HILL
Date Time Depth to WL Water Elevation Recorded By
Start: 12/27/79 1:00 PM 10.30' JDL
End: 1/3/80 10:00 AM 10.32' JDL
Gage Scale 1:1 Time Scale 8 DAY
Equipment Type Stevens A Serial No.
Remarks
10.2
10.3
10.4
10.5
10.6
BZ-1 Boulder Zone


6.36 - 10.29
Client: MDWSA
Station: BZ-1 Bowlan Zone
Date Time Depth to WL Water Elevation Recorded By
Start: 12/19 630 PM 10.29' B. Bla
End: 12/27 2:45 PM 10.28' J. Lan
Gage Scale 1:1 Time Scale 8 DAY
Equipment Type STEVENS F Serial No. —
Remarks BACKGROUND AT I-5
CH2M HILL
10.0
10.2
10.4
10.6
10.8
Start 6:30 PM 12-19-79 WL - 10.29'
Bldg Ext
Bldg Ext = Twice Weekly
Nimitz Bridge Water & Sewer
Project # EPC 55900 #2

Miami - Dade - BZ-1 - 2450' 2" well
1:1 gage - Weekly - Time

Client: MDWSA Pump Out Test I-5
Station: BZ-1 2" Casing (2455'-2465' zone)

CH2M HILL

	Date	Time	Depth to WL	Water Elevation*	Recorded By
Start:	12/13/79	1515	1.21'		REB
End:	12/18/79	1135	1.38'		REB

Gage Scale 1:1 Time Scale Weekly (8 days)
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 6.08' Above Pad Floor

12/13/79 - 1515 - 1.21'
12/18/79 - 1135 - 1.38'

1.0 1.1 1.2 1.3 1.4

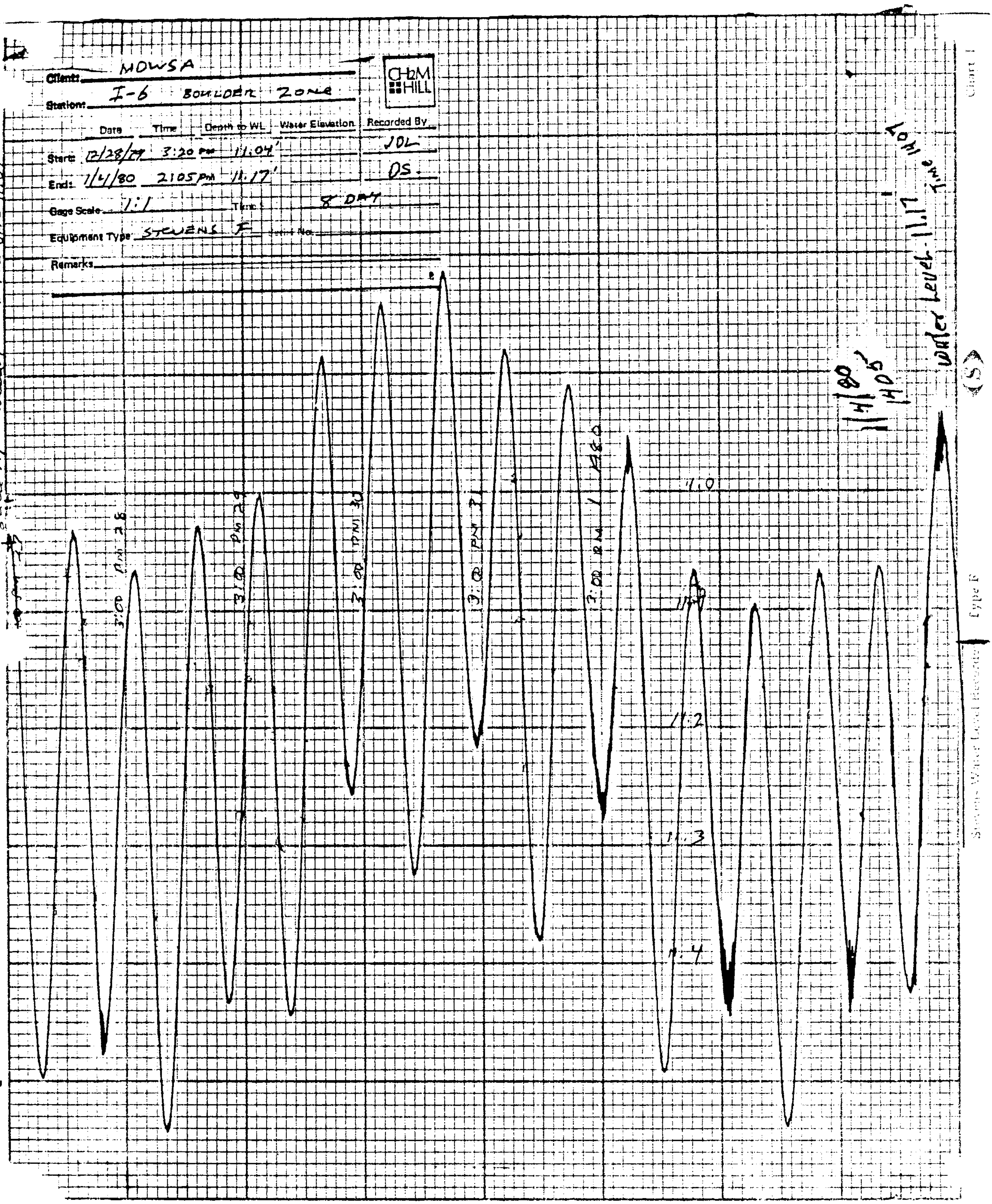
1.1 ft
1.1'
1.2'
1.3'
1.4'
1.5'

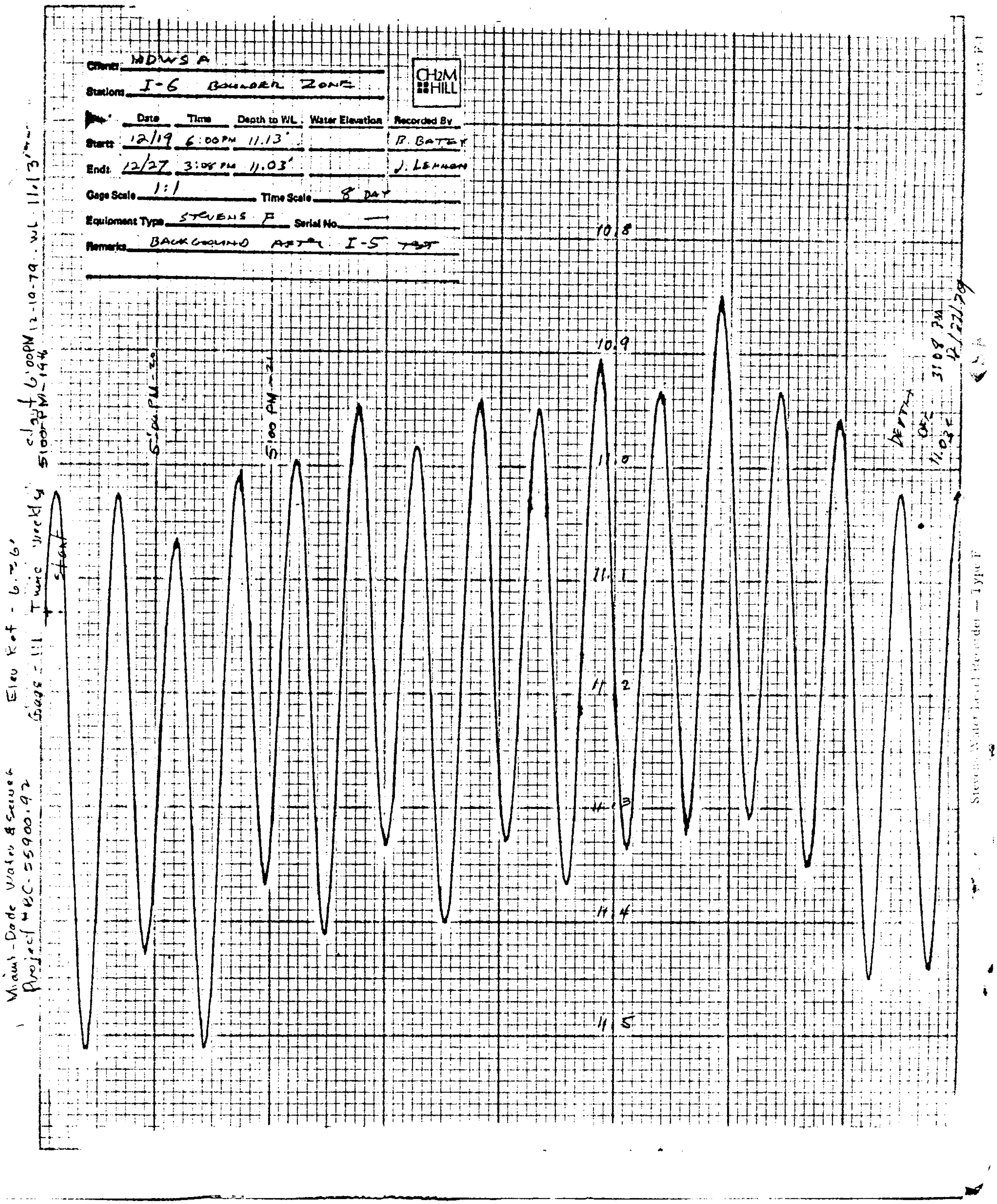
1500 03 1500 03 1500 1500 03 1500 03 1500 03 1500 03 1500

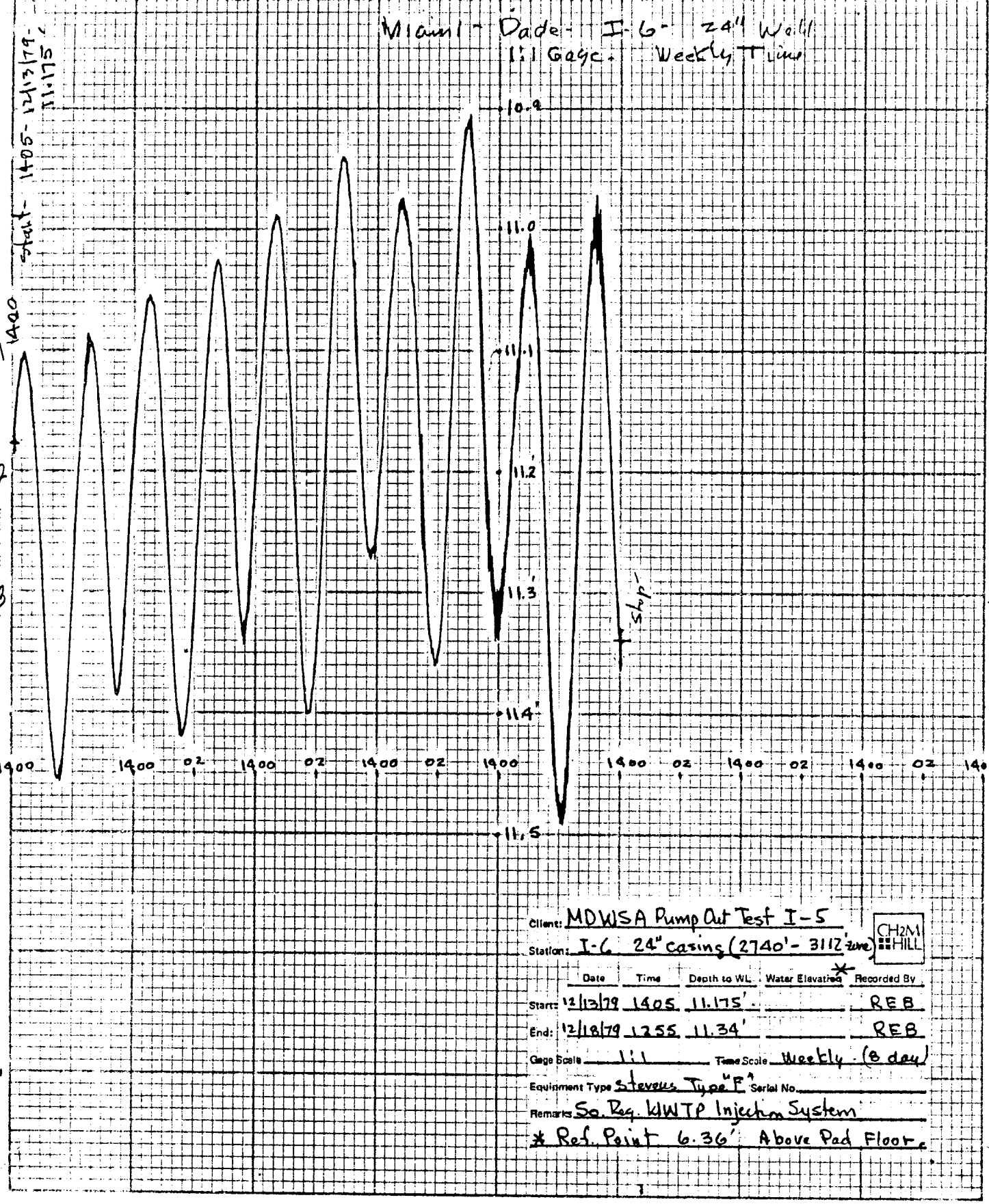
Sept-11-35AM-12-18-79

8/8

Appendix 4.C-3
BACKGROUND WATER LEVEL CHARTS FOR I-6

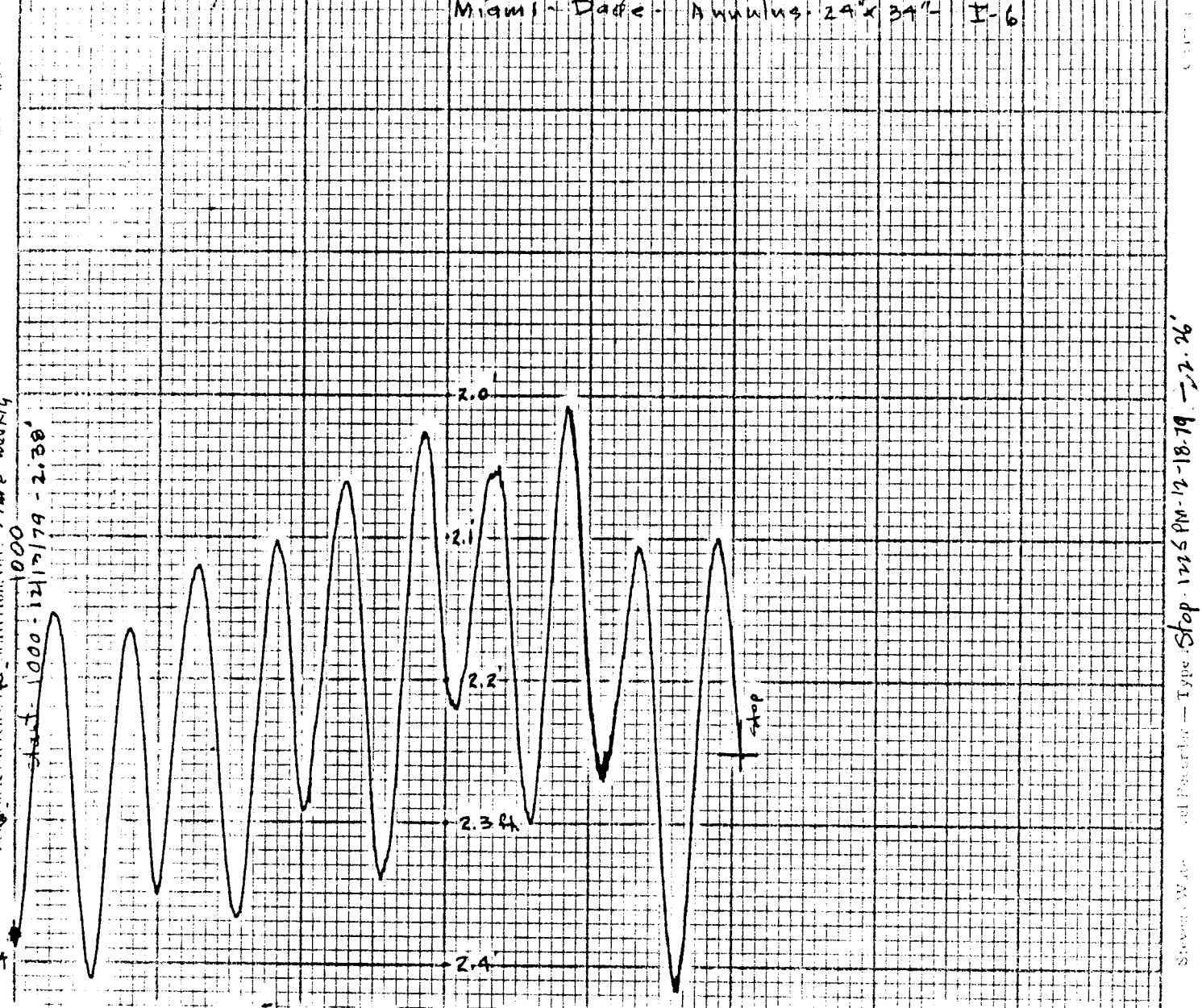

Client: MOWSA
Station: I-6 BOULDER ZONE
Date Time Depth to WL Water Elevation Recorded By
Start: 12/28/79 3:20 pm 11.04' JDL
End: 1/4/80 2105pm 11.17' DS.
Gage Scale 1:1 Time 8 DAY
Equipment Type STEVENS F
Remarks
CH2M HILL
3:00 AM 28
3:00 PM 29
3:00 PM 30
3:00 PM 31
3:00 AM 1 1980
11.0
11.2
11.3
11.4
1/4/80 2105
Water Level 11.17 Time 2107


Client: MDWSA
Station: I-6 BOULDER ZONE
Date / Time / Depth to WL / Water Elevation / Recorded By
Start: 12/19 6:00PM 11.13' B. BATEY
End: 12/27 3:08PM 11.03' J. LEMMON
Gage Scale 1:1 Time Scale 8 DAY
Equipment Type STEVENS F Serial No. —
Remarks BACKGROUND AFTER I-5 TEST
10.8
10.9
11.0
11.1
11.2
11.3
11.4
11.5


Miami - Dade - I-6 - 24" Well
1:1 Gage - Weekly Time
Start - 1405 - 12/13/79 - 11.175'
Stop - 12:55 PM - 12-18-79 - 11.34'
10.9
11.0
11.1
11.2
11.3
11.4
11.5
1400
02
1400
02
1400
02
1400
02
1400
02
1400
02
1400
Client: MDWSA Pump Out Test I-5
Station: I-6 24" casing (2740' - 3117' zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation* | Recorded By
Start: 12/13/79 | 1405 | 11.175' | | REB
End: 12/18/79 | 1255 | 11.34' | | REB
Gage Scale 1:1 Time Scale Weekly (8 day)
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 6.36' Above Pad Floor.

7/8

Miami - Dade - Annulus 24" x 36" - I-6



Client: MDWSA Pump Out Test I-5

Station: I-6 Annulus 24/36 (2299'-1800' Zone)

CH2M HILL

	Date	Time	Depth to WL	Water Elevation*	Recorded By
Start:	12/13/79	1000	2.38'		REB
End:	12/18/79	1225	2.26'		REB

Gage Scale: 1:1 Time Scale: Week/4 (8 day)

Equipment Type: Stevens Type "F" Serial No.:

Remarks: So. Reg WWTP Injection System

* Ref. Point 4.79' Above Pad Floor

6/8

Appendix 4.C-4
STEP DRAWDOWN PUMPING TEST RECORD
PUMPING RATE, DRAWDOWN, AND WATER LEVELS
IN PUMPING WELL I-5

PUMPING TEST RECORD

Test: STEP- DRAWDOWN TEST I-5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/13/72 Sheet 1 of 3

Record of: Pumping Rate & Drawdown @ Pumping Well I-5

Measuring Point: [illegible]

Time	t Elapsed Time (minutes)	Flowmeter		Drawdown			Remarks
		Piezometer Head h (inches)	Q (gpm)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
[illegible]				0.00	[illegible]	0.00	Static level
1325	0						Start pump
[illegible]	1		2,250				
[illegible]	2		2,275				
1327	2		2,450				
[illegible]	4	10.0	2,179				
[illegible]	5	9.0	2,077				
[illegible]	10	9.0	2,077				
1340	15	8.75	2,048	4.13	−0.06	4.07	
1345	20	9.0	2,077				
1346	21			4.33	−0.06	4.27	
1350	25	9.0	2,077				
1351	26			4.36	−0.06	4.30	
1355	30	9.0	2,077				
[illegible]	34	9.0	2,077	4.39	−0.06	4.33	
[illegible]	35	30.0	3,792				Stop pump flow rate at 1400 hrs
1401	36	31.0	3,855				
1402	37	30.5	3,824				
[illegible]	38	31.0	3,855				
[illegible]	39	30.5	3,824				
[illegible]	40	30.5	3,824				
[illegible]	[illegible]	[illegible]	[illegible]	11.46	−0.06	11.40	

PUMPING TEST RECORD

Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 2 **of** 3

Record of: Pumping Rate and Drawdown in Pumping Well I-5
Measuring Point: Water depth from top of 20-inch flange (2.45 ft above concrete pad)

Time	t Elapsed Time (minutes)	Flowmeter		Drawdown			Remarks
		Piezometer Head h (inches)	Q (gpm)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1410	45	31.0	3,855				
1412	47			11.49	−0.06	11.43	
1415	50	31.0	3,855				
1418	53			11.40	−0.06	11.34	
1420	55	31.0	3,855				
1423	58			11.47	−0.06	11.41	
1425	60	31.0	3,855				
1429	64			11.38	−0.05	11.33	
1430	65	31.0	3,855				Step up flow rate at 1430 hrs
1431	66	71.0	5,834				
1432	67	72.0	5,875				
1433	68	72.0	5,875				
1434	69	72.0	5,875				
1435	70	71.5	5,854				
1436	71	72.0	5,875				
1437	72	71.5	5,854	23.67	−0.05	23.62	
1438	73	72.0	5,875				
1440	75	72.0	5,875				
1442	77			23.67	−0.05	23.62	
1445	80	72.0	5,875				
1448	83			23.65	−0.04	23.61	
1450	85	72.0	5,875				

PUMPING TEST RECORD

Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 2 of 2

Record of: Pumping Rate and Drawdown in Pumping Well I-5
Measuring Point: Water Depth from top of 20-inch Flange 2.45' [illegible]

Time	t Elapsed Time (minutes)	Flowmeter		Drawdown			Remarks
		Piezometer Head h (inches)	Q (gpm)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1455	90	73.0	5,916				
1458	93			23.54	−0.03	23.51	
1504	99			23.66	−0.03	23.63	
1505	Recovery 0		0	Recovery			[illegible] of pump at 1505 hours
1517	12		0	22.40	−0.01	22.39	[illegible]
1530	25		0	22.31	−0.02	22.29	
1545	40		0	22.45	−0.04	22.41	

PUMPING TEST RECORD

Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 1 **of** 3

Record of: Pumping Rate and Water Level in Pumping Well I-5
Measuring Point: Water depth from top of 20-inch flange (2.45 ft above concrete pad)

Time	t Elpased Time (minutes)	Flowmeter		Water Level		Remarks
		Piezometer Head h (inches)	Q (gpm)	Depth to Water (feet)	Δs (feet)	
1207				9.61	0.00	Static water level
1325	0					Start pump
1326	1		2,250			
1327	2		2,275			
1328	3		2,450			
1329	4	10.0	2,189			
1330	5	9.0	2,077			
1335	10	9.0	2,077			
1340	15	8.75	2,048	13.74	4.13	
1345	20	9.0	2,077			
1346	21			13.94	4.33	
1350	25	9.0	2,077			
1351	26			13.97	4.36	
1355	30	9.0	2,077			
1359	34	9.0	2,077	14.00	4.39	
1400	35	30.0	3,792			Step-up flow rate at 1400 hrs
1401	36	31.0	3,855			
1402	37	30.5	3,824			
1403	38	31.0	3,855			
1404	39	30.5	3,824			
1405	40	30.5	3,824			
1407	42	31.0	3,855	21.07	11.46	

PUMPING TEST RECORD

Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 2 **of** 3

Record of: Pumping Rate and Water Level in Pumping Well I-5
Measuring Point: Water depth from top of 20-inch flange (2.45 ft above concrete pad)

Time	t Elpased Time (minutes)	Flowmeter		Water Level		Remarks
		Piezometer Head h (inches)	Q (gpm)	Depth to Water (feet)	Δs (feet)	
1410	45	31.0	3,855			
1412	47			21.10	11.49	
1415	50	31.0	3,855			
1418	53			21.01	11.40	
1420	55	31.0	3,855			
1423	58			21.08	11.47	
1425	60	31.0	3,855			
1429	64			20.99	11.38	
1430	65	31.0	3,855			Step-up flow rate at 1430 hrs
1431	66	71.0	5,834			
1432	67	72.0	5,875			
1433	68	72.0	5,875			
1434	69	72.0	5,875			
1435	70	71.5	5,854			
1436	71	72.0	5,875			
1437	72	71.5	5,854	33.28	23.67	
1438	73	72.0	5,875			
1440	75	72.0	5,875			
1442	77			33.28	23.67	
1445	80	72.0	5,875			
1449	84			33.26	23.65	
1450	85	72.0	5,875			

PUMPING TEST RECORD

Test: STEP- DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 3 **of** 3

Record of: Pumping Rate and Water Level in Pumping Well I-5
Measuring Point: Water Depth from Top of 20-inch flange (2.45 ft above concrete pad)

Time	t Elpased Time (minutes)	Flowmeter		Water Level		Remarks
		Piezometer Head h (inches)	Q (gpm)	Depth to Water (feet)	Δs (feet)	
1455	90	73.0	5,916			
1458	93			33.15	23.54	
1504	99			33.27	23.66	
1505	Recovery 0		0		Recovery	Shut off pump at 1505 hrs
1517	12		0	10.87	22.40	24 hr measured after pumping stopped
1530	25		0	10.93	22.31	
1545	40		0	10.82	22.45	

Appendix 4.C-5
STEP DRAWDOWN PUMPING TEST RECORD
DRAWDOWN AND WATER LEVELS
IN MONITORING WELL BZ-1

PUMPING TEST RECORD

Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 1 **of** 5

Record of: Drawdowns in Monitoring Well EZ-1
Measuring Point: 6" casing at 5.48 ft above pad; 2" line at 6.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1312		0.000	0.000	0.000				Static level
1315					0.000	0.000	0.000	Static level
1325	0							Start pump at 2000 gpm
1325:10 sec	0.17	0.032	−0.003	0.029				
1325:20 sec	0.33	0.054	−0.003	0.029				
1325:30 sec	0.5				0.005	−0.002	0.003	
1326	1.0	−0.032	−0.003	−0.035				
1326:10 sec	1.17	−0.012	−0.003	−0.015				
1326:20 sec	1.33	0.037	−0.003	0.034				
1326:30 sec	1.50	0.064	−0.003	0.061				
1326:40 sec	1.67	0.040	−0.003	0.037				
1326:50 sec	1.83	−0.017	−0.003	−0.020				
1327	2	−0.034	−0.004	−0.038				
1328	3	−0.018	−0.004	−0.022	0.010	−0.003	0.007	
1330	4	−0.017	−0.004	−0.021				
1330	5	−0.008	−0.005	−0.013	0.012	−0.004	0.008	
1330:30 sec	5.5	0.027	−0.005	0.022				
1331	6				0.012	−0.004	0.008	
1332	7	0.008	−0.005	0.003	0.012	−0.004	0.008	
1333	8	0.017	−0.006	0.011	0.013	−0.005	0.008	
1334	9				0.013	−0.005	0.008	

PUMPING TEST RECORD

Test: STEP- DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 2 **of** 6

Record of: Drawdowns in Monitoring Well BZ-1
Measuring Point: 6" casing at 5.48 ft above pad; 2" line at 4.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1335	10	0.015	−0.006	0.009	0.013	−0.005	0.008	
1336	11				0.013	−0.005	0.008	
1337	12	0.014	−0.007	0.007	0.014	−0.006	0.008	
1338	13	0.015	−0.007	0.008	0.014	−0.006	0.008	
1339	14	0.016	−0.007	0.009	0.015	−0.006	0.009	
1340	15	0.019	−0.008	0.011	0.016	−0.006	0.010	
1342	17	0.016	−0.008	0.008	0.016	−0.006	0.010	
1345	20	0.019	−0.008	0.011	0.030	−0.006	0.024	
1351	26	0.016	−0.008	0.008	0.025	−0.005	0.019	
1355	30	0.016	−0.008	0.008	0.019	−0.006	0.013	
1358	33				0.020	−0.006	0.014	
1400	35	0.016	−0.008	0.008				Start pump at 1400 hrs
1400:10 sec	35.17	0.018	−0.008	0.010	0.020	−0.006	0.014	
1400:20 sec	35.33	0.027	−0.008	0.019				
1400:30 sec	35.50	0.048	−0.008	0.040				
1400:40 sec	35.67	0.053	−0.008	0.045				
1400:50 sec	35.83	0.034	−0.008	0.026				
1401	36	0.034	−0.008	0.026	0.027	−0.006	0.021	
1402	37	0.014	−0.008	0.006	0.025	−0.006	0.019	
1402:30 sec	37.5	0.040	−0.007	0.032				
1403	38	0.018	−0.008	0.010	0.026	−0.006	0.020	

PUMPING TEST RECORD

Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 **Sheet** 3 **of** 4

Record of: Drawdowns in Monitoring Well BZ-1
Measuring Point: 6" casing at 5.49 ft. above pad; 2" line at 4.08 ft. above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1404	39	0.022	−0.008	0.014	0.026	−0.006	0.020	
1405	40	0.025	−0.008	0.017	0.026	−0.006	0.020	
1406	41				0.027	−0.006	0.021	
1410	45	0.025	−0.008	0.017	0.028	−0.006	0.022	
1415	50				0.029	−0.006	0.023	
1419	54	0.026	−0.008	0.018				
1420	55				0.030	−0.006	0.024	
1425	60	0.024	−0.007	0.017	0.035	−0.006	0.029	
1426	61	0.030	−0.007	0.023				
1430	65	0.025	−0.007	0.018				Step-up pump rate to 1500 gpm
1430:20 Sec	65.33	0.041	−0.006	0.035				
1430:40 Sec	65.67	0.060	−0.006	0.054				
1431:00 Min	66.00	0.046	−0.006	0.040				
1431	66	0.031	−0.006	0.025	0.029	−0.006	0.023	
1432	67	0.036	−0.005	0.031	0.029	−0.006	0.023	
1433	68	0.038	−0.005	0.033	0.031	−0.005	0.026	
1434	69	0.041	−0.004	0.037	0.031	−0.005	0.026	
1435	70				0.031	−0.004	0.027	
1436	71	0.042	−0.003	0.039	0.040	−0.004	0.036	
1437	72				0.030	−0.004	0.026	
1438	73				0.032	−0.004	0.028	

PUMPING TEST RECORD

Test: [illegible] – DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 Sheet 4 of [illegible]

Record of: Drawdowns in Monitoring Well B2-1
Measuring Point: 6" casing at 5.42 ft above land, [illegible]

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
[illegible]	74	0.039	0.000	0.039	[illegible]	−0.001	[illegible]	
1440	75				[illegible]	+0.001	[illegible]	
1445	80	0.040	+0.003	0.043	[illegible]	+0.003	[illegible]	
1450	85	0.033	+0.010	0.043	[illegible]	+0.010	[illegible]	
1453	88				[illegible]	+0.014	[illegible]	
1454	89	0.028	+0.015	0.043				
1457	[illegible]	0.022	+0.020	0.042				
1500	95				[illegible]	+0.025	[illegible]	
1505	100	[illegible]	+0.028	0.043				[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+0.005	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+0.005	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+0.005	[illegible]	
[illegible]		[illegible]	−0.001	[illegible]	[illegible]	+0.004	[illegible]	
[illegible]	[illegible]	[illegible]	−0.001	[illegible]				
[illegible]	[illegible]	[illegible]	−0.001	[illegible]	[illegible]	+0.004	[illegible]	
[illegible]	[illegible]	[illegible]	−0.001	[illegible]				
[illegible]		[illegible]	−0.002	0.035	[illegible]	+[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	−0.002	[illegible]				
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
[illegible]	[illegible]	[illegible]	−0.003	−0.002				
[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	[illegible]

PUMPING TEST RECORD

Test: _____

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: _____ Sheet ____ of ____

Record of: _____

Measuring Point: _____

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1503	3	0.013	− 0.004	0.009		0.00	0.02	
1504	4	0.023	− 0.005	0.018				
1505	5	0.028	− 0.007	0.021	0.02	0.00	0.02	
1506	6	0.035	− 0.008	0.027		0.00		
1507	7	0.041	− 0.005	0.036	0.03	0.00	0.03	
1508	8	0.038	− 0.010	0.028	0.035	0.00	− 0.035	
1509	9	0.047	− 0.011	0.036	0.04	− 0.01	0.03	
1510	10	0.046	− 0.012	0.034				
1511	11	0.047	− 0.013	0.034		− 0.01	0.02	
1512	12	0.051	− 0.014	0.037	0.04	− 0.01	0.02	
1513	13	0.052	− 0.015	0.037	0.04	− 0.01	0.03	
1514	14	0.054	− 0.016	0.038				
1515	15	0.055	− 0.017	0.038	0.03	− 0.01	0.02	
1516	16	0.055	− 0.018	0.038				
1517	17	0.062	− 0.020	0.042	0.04	− 0.01	0.03	
1518	18	0.063	− 0.022	0.041	0.04	− 0.01	0.03	
1519	19	0.063	− 0.024	0.039	0.05	− 0.02	0.03	
1520	20	0.070	− 0.026	0.043				
1521	21	0.072	− 0.028	0.044	0.04	− 0.03	0.03	
1522	22	0.073	− 0.029	0.044	0.03	− 0.02	0.02	
1523	23	0.078	− 0.034	0.041	0.04	− 0.04	0.02	

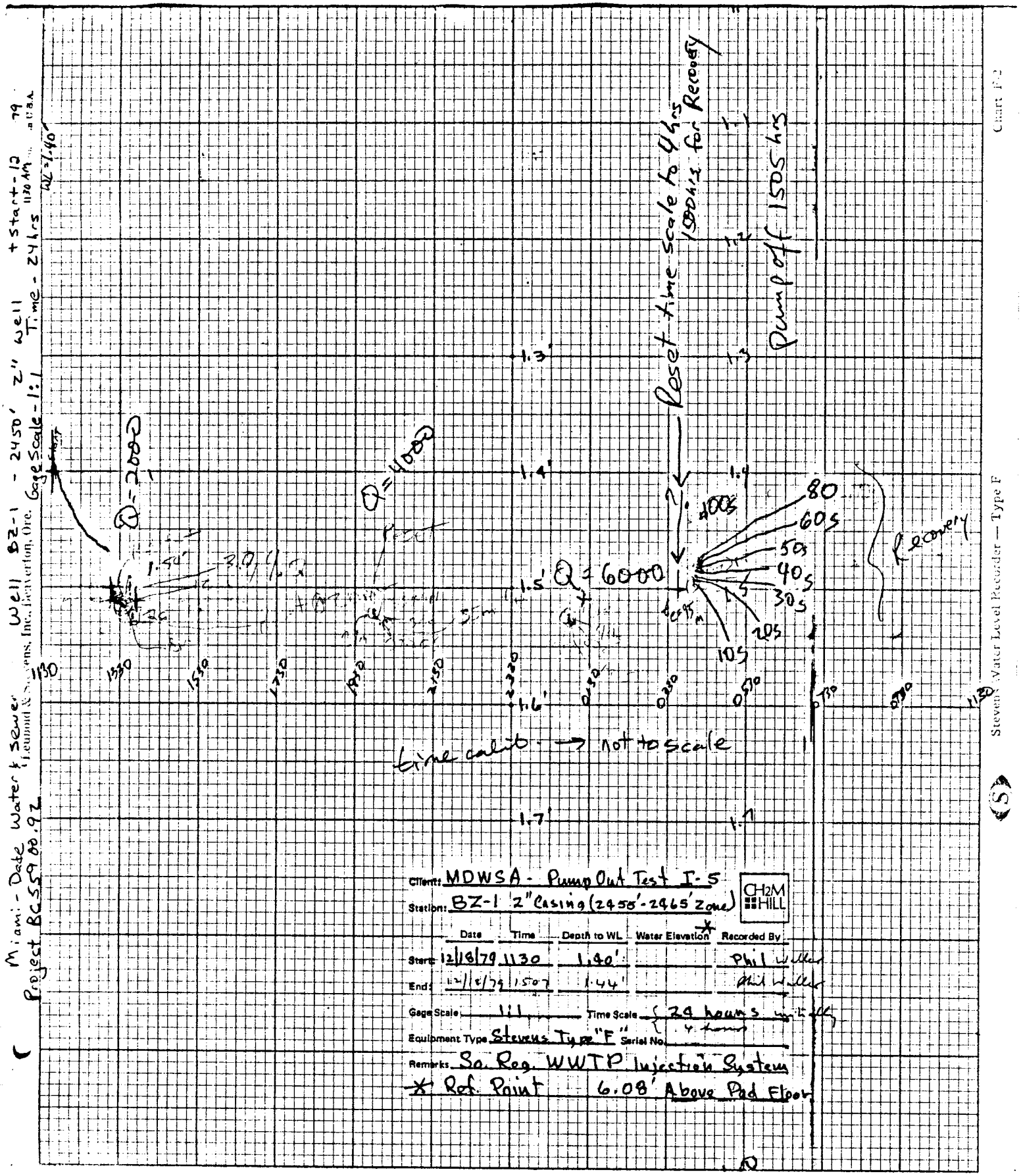
PUMPING TEST RECORD

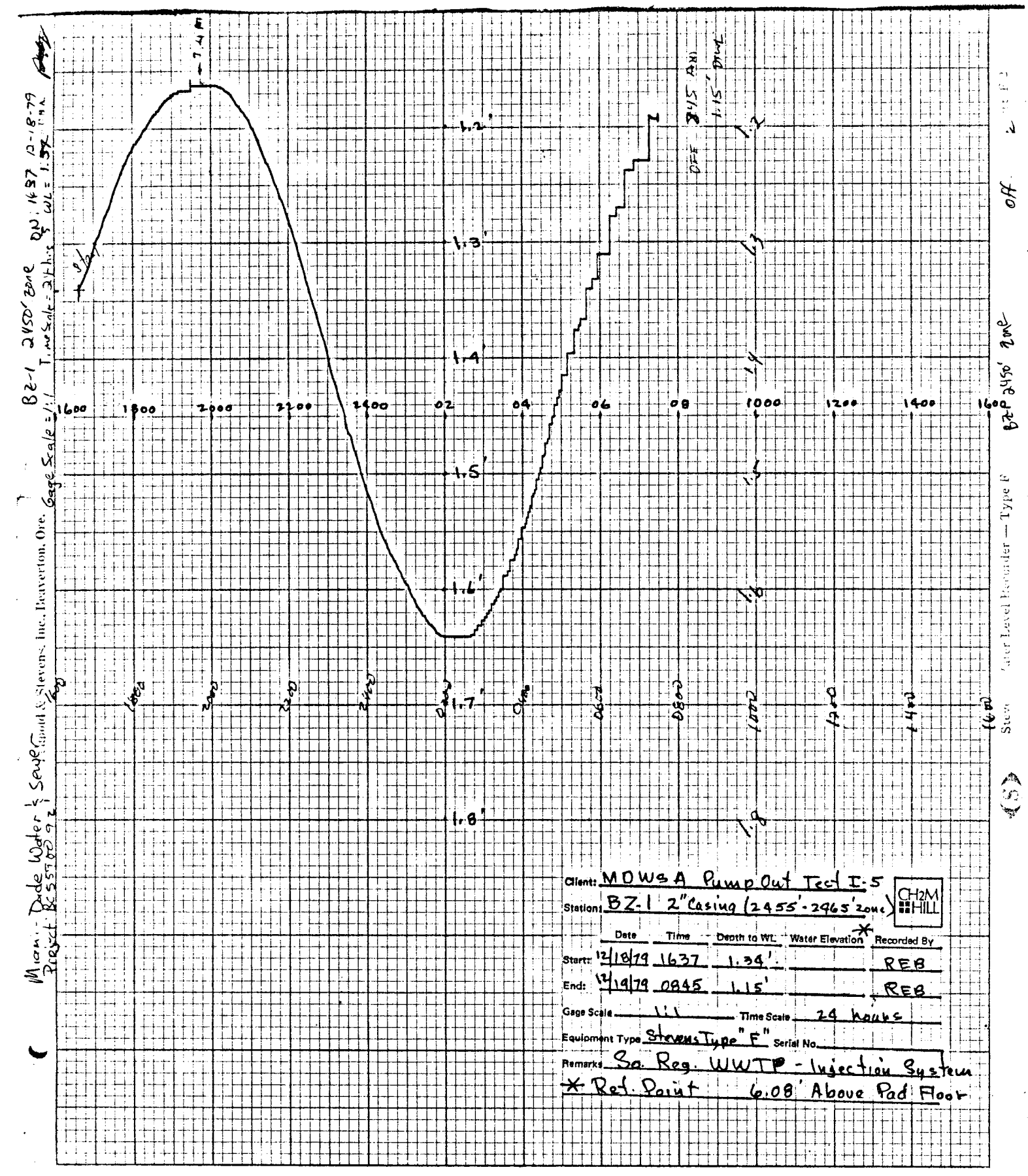
Test: STEP-DRAWDOWN TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

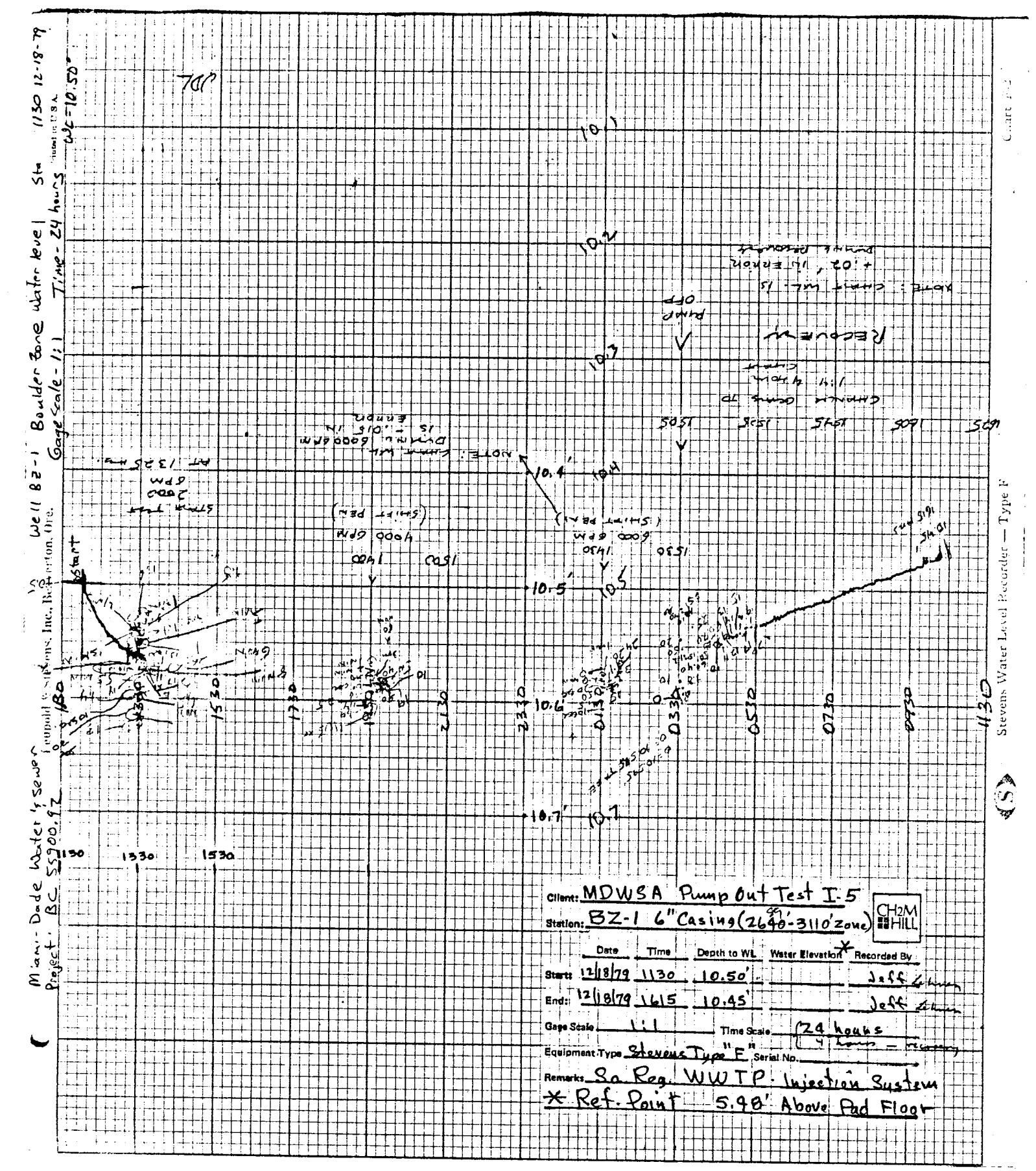
Project No.: BC55900.92
Date: 12/12/03 Sheet 1 of 1

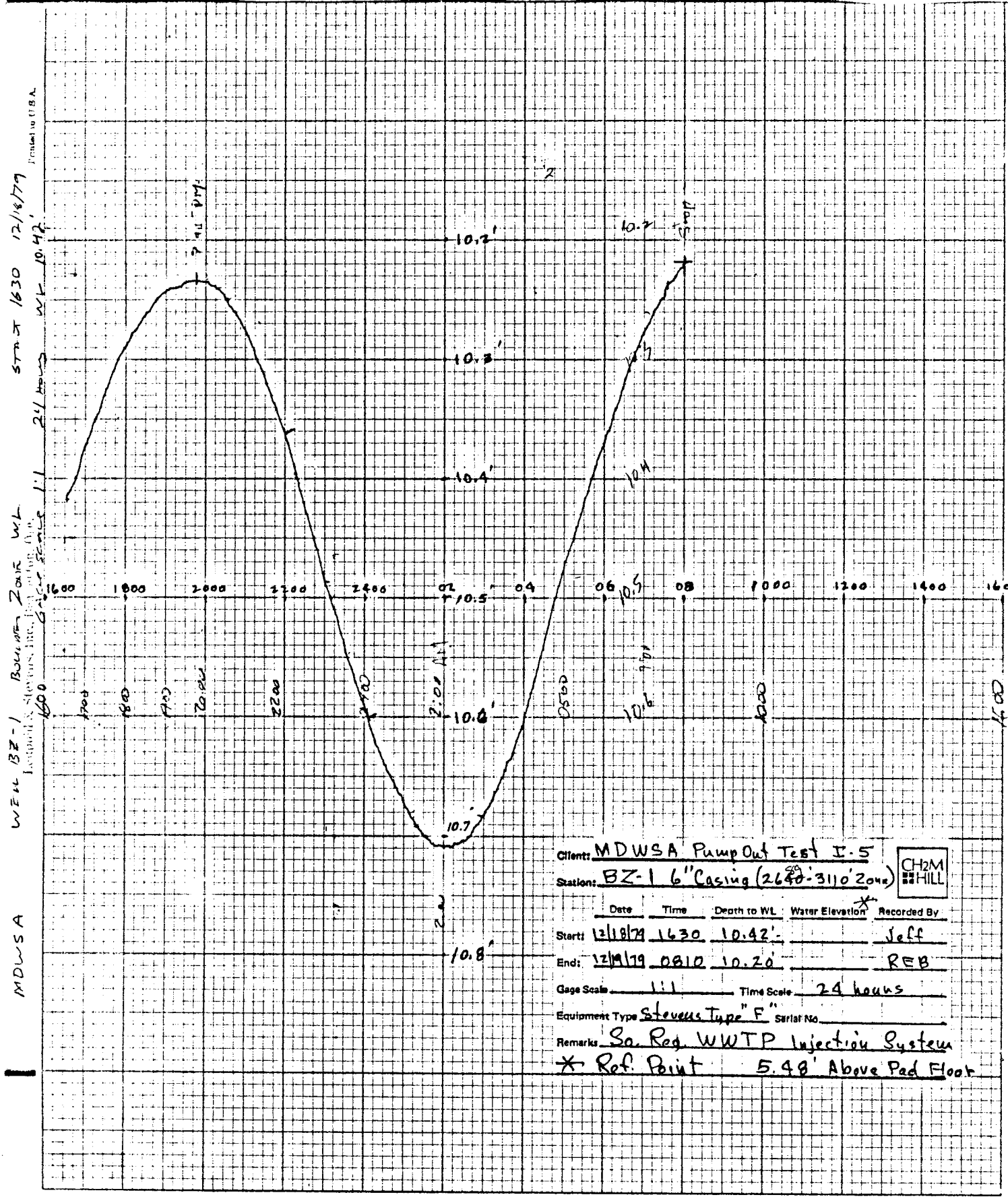
Record of: Drawdowns in Monitoring Well EZ-1
Measuring Point: 6" casing at 5.48 ft above pad. 2" line at 5.09 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1550	45	0.096	−0.054	0.042	0.07	−0.04	0.03	
1555	50	0.101	−0.060	0.041	0.07	−0.05	0.02	
1600	55				0.09	−0.06	0.03	
1605	60	0.115	−0.073	0.042	0.09	−0.06	0.03	
1615	70	0.125	−0.084	0.041				


Miami - Date Water & Sewer
Project BC559 00.92
Well BZ-1 - 2450' 2" well
Time - 24 hrs
Gage Scale - 1:1
Stevens Water Level Recorder — Type F
Chart No.
Q = 2000
Q = 4000
Q = 6000
Reset time scale to 48 hrs
1000 hrs for Recovery
Pump off 1505 hrs
Recovery
80
60s
50s
40s
30s
20s
10s
time calib. → not to scale
Client: MDWSA - Pump Out Test I-5
Station: BZ-1 2" Casing (2455'-2465' zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation * | Recorded By
Start: 12/18/79 | 1130 | 1.40' | | Phil Waller
End: 12/21/79 | 1507 | 1.44' | | Phil Waller
Gage Scale: 1:1 | Time Scale: 24 hours
Equipment Type: Stevens Type "F" | Serial No.
Remarks: So. Reg. WWTP Injection System
* Ref. Point 6.08' Above Pad Floor


Miami-Dade Water & Sewer
Project: BZ-1 2450' zone
Gage Scale 1:1
Time Scale 24 hours
Client: MDWSA Pump Out Test I-5
Station: BZ-1 2" Casing (2455'-2965' zone)
CH2M HILL
Date Time Depth to WL Water Elevation Recorded By
Start: 12/18/79 1637 1.34' REB
End: 12/19/79 0845 1.15' REB
Gage Scale 1:1 Time Scale 24 hours
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP - Injection System
* Ref. Point 6.08' Above Pad Floor
Stevens Water Level Recorder — Type F


Miami-Dade Water & Sewer
Project: BC 559001.12
Well BZ-1 Boulder Zone Water Level Stn 1130 12-18-79
Gage Scale - 1:1 Time - 24 hours
Stevens Water Level Recorder — Type F
Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2640'-3110' zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation * | Recorded By
Start: 12/18/79 | 1130 | 10.50' | | Jeff
End: 12/18/79 | 1615 | 10.45' | | Jeff
Gage Scale 1:1 Time Scale 24 hours
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 5.98' Above Pad Floor


Start 1630 12/18/79
24 hours
1:1
Gage Scale
Barometric Zone WL
Well BZ-1
MDWSA
10.42'
10.2'
10.3'
10.4'
10.5'
10.6'
10.7'
10.8'
1600
1800
2000
2200
2400
02
04
06
08
1000
1200
1400
1600
10.7
10.4
10.5
10.6
Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2640'-3110' Zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation* | Recorded By
Start: 12/18/79 | 1630 | 10.42' | | Jeff
End: 12/19/79 | 0810 | 10.20' | | REB
Gage Scale 1:1 Time Scale 24 hours
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 5.48' Above Pad Floor
Stop 8:10AM-12-19-79-10.

Appendix 4.C-6
STEP DRAWDOWN PUMPING TEST RECORD
WATER LEVEL IN I-6

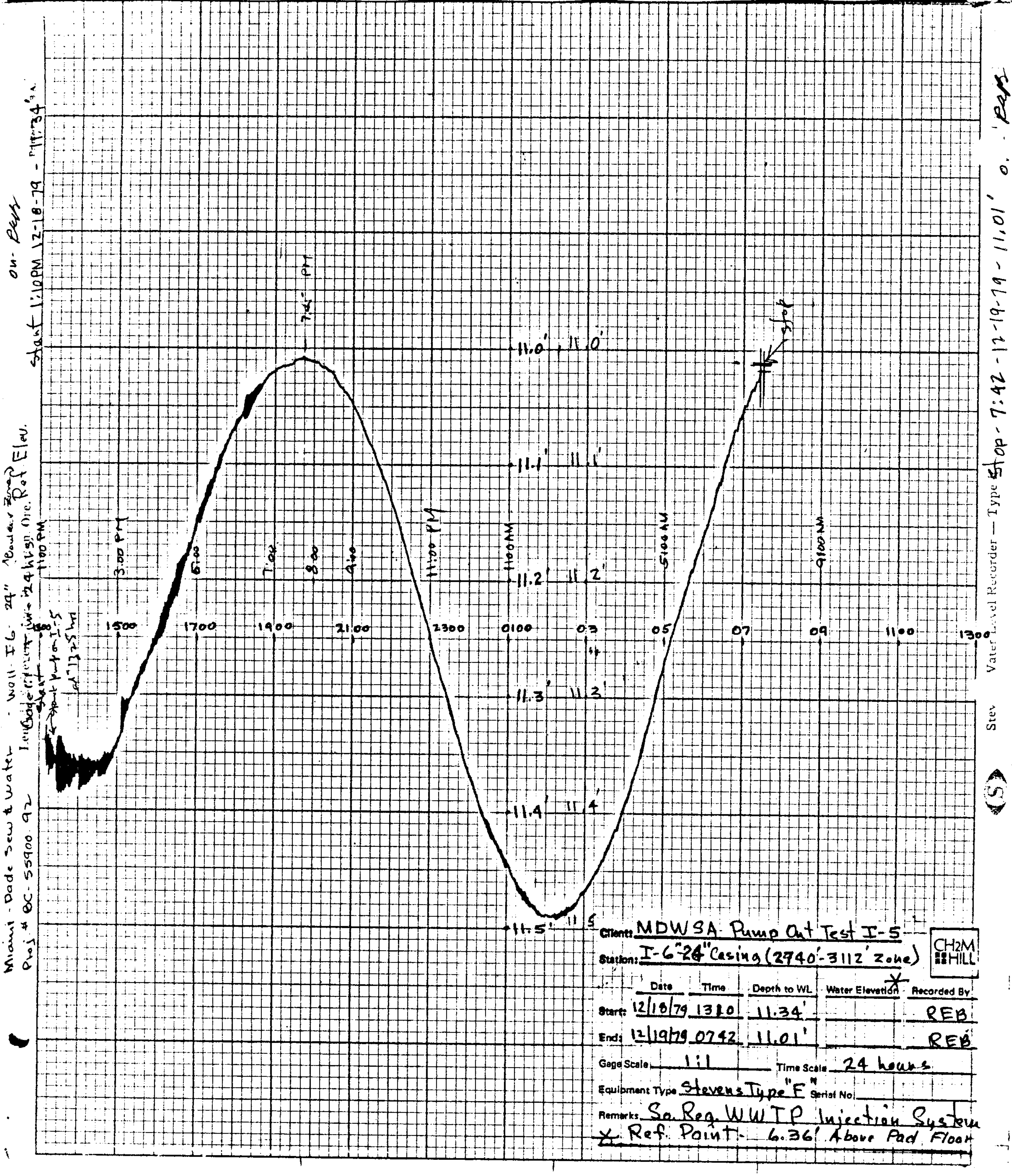
PUMPING TEST RECORD

Test: Step-Drawdown I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/79 Sheet 1 of ____

Record of: I-6 Boulder Zone
Measuring Point: 6.36 ft above pad

Time	t Elapsed Time (minutes)	Flowmeter		Water Level		Remarks
		Totalizer	Indicator Q (gpm)	(ft)	Δs (feet)	
1313				11.35		static water level



Miami - Dade Sew & Water · Well I-6 24" Boulder Zone
Proj # OC-55900.92
Start 1:10PM 12-18-79 - on REB
Stop - 7:42 - 12-19-79 - 11.01' on REB
11.0'
11.1'
11.2
11.3'
11.4
11.5'
1500
1700
1900
2100
2300
0100
05
07
09
1100
1300
3:00 PM
7:00
8:00
9:00
11:00 PM
1:00 AM
5:00 AM
9:00 AM
Client: MDWSA Pump Out Test I-5
Station: I-6 24" Casing (2940'-3112' Zone)
Date
Time
Depth to WL
Water Elevation
Recorded By
Start: 12/18/79 1310 11.34' REB
End: 12/19/79 0742 11.01' REB
Gage Scale 1:1
Time Scale 24 hours
Equipment Type Stevens Type "F"
Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 6.36' Above Pad Floor
CH2M HILL
Stevens Water Level Recorder — Type F

PUMPING TEST RECORD

Test: Step – Drawdown I-5
'sposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/18/74 Sheet 1 of ____

Record of: I-6 24"/34" annulus (2250' zone)
Measuring Point: 4.79 ft. above pad

Time	t Elapsed Time (minutes)	Flowmeter		Water Level		Remarks
		Totalizer	Indicator Q (gpm)	(ft)	Δs (feet)	
1311				2.28		static w. level

on - PER Start WL - 2.27' 12:37 PM - 12-18-79

Ref. Elev. -

Well - I-6 Annulus
Leupold & Gage Tip - Time 24 hrs

Miami-Dade Water & Sewer
Project # BC-55900.R2

Client: MDWSA Pump Out Test I-5

Station: I-6 Annulus 24/34 (2294"-1800' 2040)

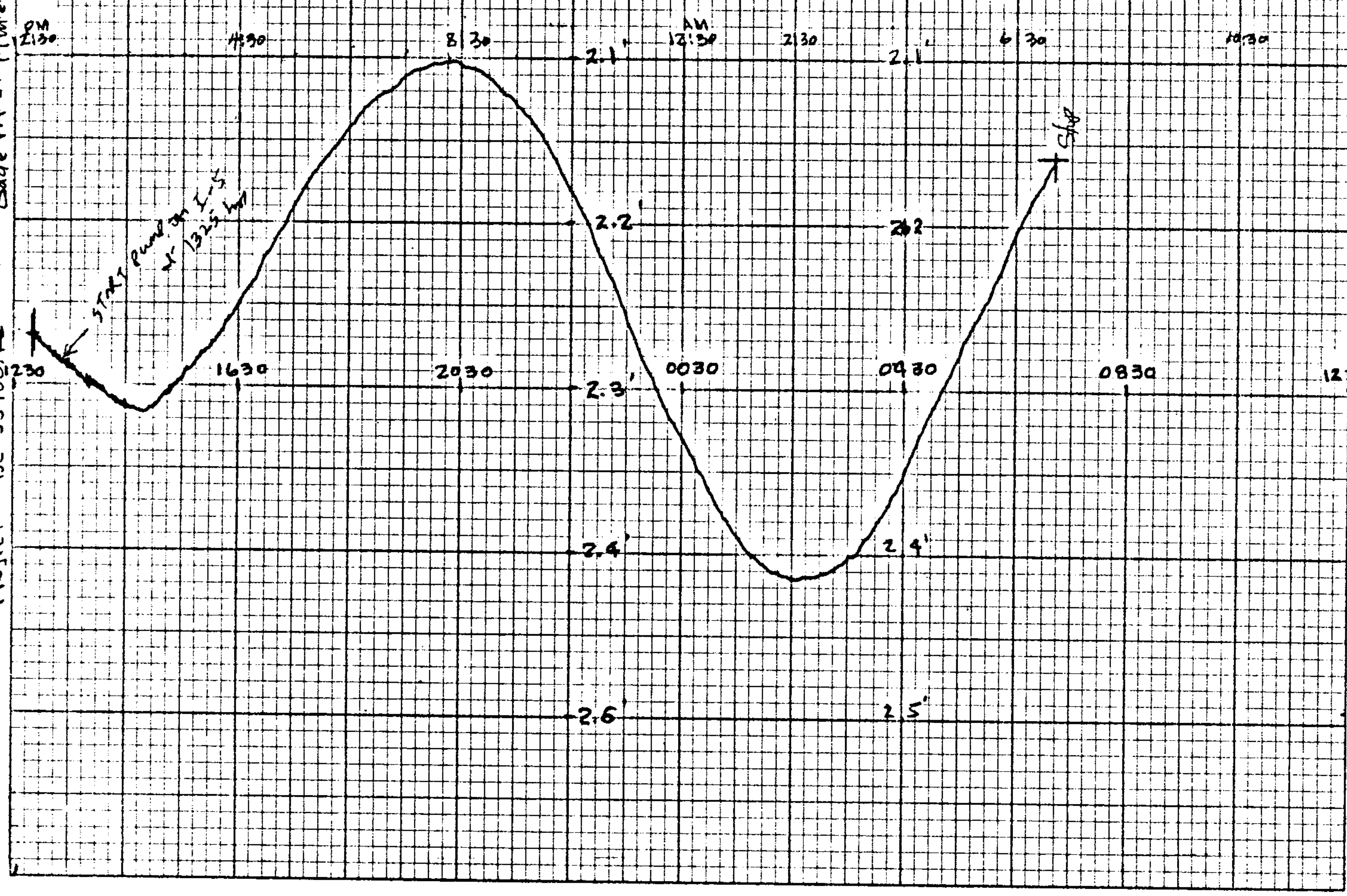
	Date	Time	Depth to WL	Water Elevation*	Recorded By
Start:	12/18/79	1237	2.27'		REB
End:	12/19/79	0729	2.17'		REB

Gage Scale 1:1 Time Scale 24 hours

Equipment Type Stevens Type "F" Serial No.

Remarks So. Rgo. WWTP. Injection System

* Ref. Point 4.79' Above Pad Floor



off - Pump

Stop - 0729 AM - 12-19-79 - 2.17'

Appendix 4.C-7
PUMP OUT TEST
PUMPING RATE, DRAWDOWN, AND WATER LEVELS IN I-5

PUMPING TEST RECORD

Test: Pump-Out Test I-5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 1 of 2

Record of: Pumping Rate and Drawdown in Pumping Well I-5
Measuring Point: Water depth from top of 20-inch flange (2.45 ft above concrete pad)

Time	t Elapsed Time (minutes)	Flowmeter		Drawdown			Remarks
		Piezometer Head h (inches)	Q (gpm)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0900	0			0.00	0.00	0.00	start pump at 0900 hrs
0901	1	64.5	5,561	22.79	0.00	22.79	
0902	2	62.0	5,452	22.64	0.00	22.64	
0903	3	68.0	5,709	22.79	0.00	22.79	
0904	4	69.5	5,772	22.78	0.00	22.78	
0905	5	71.5	5,854	23.03	0.00	23.03	
0906	6			23.05	0.00	23.05	
0907	7			23.20	0.00	23.20	
0908	8			23.05	0.00	23.05	
0909	9			23.20	0.00	23.20	
0910	10	71.0	5,834	23.08	0.00	23.08	
0914	14			23.20	−0.01	23.19	
0915	15	73.0	5,916	23.59	−0.01	23.58	
0920	20	73.0	5,916	23.59	−0.01	23.58	
0925	25	74.0	5,956	23.54	−0.01	23.53	
0930	30	74.0	5,956	23.59	−0.02	23.57	
0940	40	74.0	5,956	23.54	−0.02	23.52	
0945	45	75.0	5,996	23.54	−0.03	23.51	
0950	50	74.0	5,956	23.54	−0.04	23.50	
0955	55	73.5	5,936	23.54	−0.04	23.50	
1000	60	73.5	5,936	23.50	−0.05	23.45	
1010	70			23.50	−0.06	23.44	

PUMPING TEST RECORD

Test: Pumping Out West I-5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 2 **of** 2

Record of: Pumping Rate and Drawdown in Pumping Well I-5
Measuring Point: Water depth from top of 20-inch flange (2.45 ft above concrete pad)

Time	t Elapsed Time (minutes)	Flowmeter		Drawdown			Remarks
		Piezometer Head h (inches)	Q (gpm)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1015	75	74.5	5,976	23.50	−0.07	23.43	
1025	85			23.50	−0.08	23.42	
1030	90	74.5	5,976				
1040	100			23.43	−0.10	23.33	
1045	105	75.0	5,996	23.50	−0.11	23.39	
1100	120	75.0	5,996	23.50	−0.13	23.37	
1115	135	75.0	5,996	23.50	−0.15	23.35	
1130	150	74.5	5,976	23.50	−0.18	23.32	
1145	165	74.5	5,976	23.50	−0.21	23.29	
1200	180	75.0	5,996	23.52	−0.24	23.28	
1215	195	74.5	5,976	23.50	−0.26	23.24	
1230	210	74.5	5,976				
1245	225	74.5	5,976	23.42	−0.30	23.12	
1300	240	75.0	5,996	23.36	−0.31	23.05	
1315	255	74.5	5,976	23.11	−0.33	22.96	
1334	274	74.0	5,956	23.14	−0.34	22.80	
1345	285	74.0	5,956	23.15	−0.35	22.80	
1400	300	74.0	5,956	23.05	−0.36	22.69	
1415	315	73.5	5,936	22.93	−0.36	22.57	
1429	329	73.0	5,916	23.09	−0.36	22.73	Pump off 1429 hrs

PUMPING TEST RECORD

Test: PUMP-OUT TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 1 of 2

Record of: PUMPING RATE
Measuring Point: ORIFICE METER (PIEZOMETER)

Time	t Elapsed Time (minutes)	PIEZO ~~Flowmeter~~ ~~Totalizer~~ (inches)	~~Indicator~~ Q (gpm)	Water Level	Δs (feet)	Remarks
0900	0					Start Pump
0901	1	64.5	5,561			
0902	2	62.0	5,452			
0903	3	68.0	5,709			
0904	4	69.5	5,772			
0905	5	71.5	5,854			
0910	10	71.0	5,834			
0915	15	73.0	5,916			
0920	20	73.0	5,916			
0925	25	74.0	5,956			
0930	30	74.0	5,956			
0935	35	74.0	5,956			
0940	40	74.0	5,956			
0945	45	75.0	5,996			
0950	50	74.0	5,956			
0955	55	73.5	5,936			
1000	60	73.5	5,936			
1015	75	74.5	5,976			
1030	90	74.5	5,976			
1045	105	75.0	5,996			
1100	120	75.0	5,996			
1115	135	75.0	5,996			

PUMPING TEST RECORD

Test: PUMP-OUT TEST I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 2 of 2

Record of: PUMPING RATE
Measuring Point: ORIFICE METER (PIEZOMETER)

Time	t Elapsed Time (minutes)	PIEZO ~~Flow~~meter		Water Level		Remarks
		h (inches) ~~Totalizer~~	~~Indicator~~ Q (gpm)		Δs (feet)	
1130	150	74.5	5,976			
1145	165	74.5	5,976			
1200	180	75.0	5,996			
1215	195	74.5	5,976			
1230	210	74.5	5,976			
1245	225	74.5	5,976			
1300	240	75.0	5,996			
1315	255	74.5	5,976			
1330	270	74.0	5,956			
1345	285	74.0	5,956			
1400	300	74.0	5,956			
1415	315	73.5	5,936			
1430	330	73.0	5,916			Shut down pump at 1431 hrs

Appendix 4.C-8
PUMP OUT TEST
PUMPING TEST RECORD
WATER LEVELS IN BZ-1

PUMPING TEST RECORD

Test: Pump-Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 1 **of** 2

Record of: Water Levels in Monitoring Well B-2-1
Measuring Point: 6" casing at 5.48 ft above land; 2" line at 6.08 ft above land

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0945		0.000	0.000	0.000	0.00	0.00	0.00	Start Pump at 0900 hrs
0900:10 sec	0.17	0.012	0.000	0.012	0.01	0.00	0.01	
0900:20 sec	0.33	0.045	0.000	0.045	0.00	0.00	0.00	
0900:30 sec	0.50	0.077	−0.001	0.078	0.00	0.00	0.00	
0900:40 sec	0.67	0.075	−0.001	0.076	0.01	0.00	0.01	
0900:50 sec	0.83	0.035	−0.001	0.036	0.01	0.00	0.01	
0901	1.0	−0.001	−0.001	−0.002	0.02	0.00	0.02	
0901:30 sec	1.5	0.075	−0.002	0.077	0.02	0.00	0.02	
0902	2.0	0.009	−0.002	0.007	0.03	0.00	0.03	
0902:30 sec	2.5	0.033	−0.002	0.035	0.03	0.00	0.03	
0903	3.0	0.020	−0.002	0.018	0.03	0.00	0.03	
0903:30 sec	3.5	0.055	−0.003	0.058	0.02	0.00	0.02	
0904	4.0	0.027	−0.003	0.024	0.02	0.00	0.02	
0904:30 sec	4.5	0.047	−0.003	0.044	0.02	0.00	0.02	
0905	5.0	0.036	−0.003	0.033	0.03	0.00	0.03	
0906	6	0.040	−0.003	0.037	0.02	0.00	0.02	
0907	7	0.042	−0.004	0.038	0.02	0.00	0.02	
0908	8	0.041	−0.004	0.037	0.02	0.00	0.02	
0910	10	0.043	−0.004	0.039	0.03	0.00	0.03	
0910	10	0.043	−0.004	0.039	0.03	0.00	0.03	
0911	11	0.045	−0.004	0.041	0.03	0.00	0.03	

PUMPING TEST RECORD

Test: Pump - Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 2 **of** 8

Record of: Water Levels in Monitoring Well SZ-1
Measuring Point: 4" casing at 5.43 ft above pad; 2" line at 4.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0912	12	0.045	−0.006	0.039	0.03	0.00	0.03	
0913	13	0.046	−0.007	0.039	0.03	0.00	0.03	
0914	14	0.047	−0.007	0.040	0.04	0.00	0.04	
0915	15	0.048	−0.008	0.040	0.04	0.00	0.04	
0916	16	0.050	−0.008	0.042	0.04	−0.01	0.03	
0917	17	0.050	−0.008	0.042	0.05	−0.01	0.04	
0918	18	0.051	−0.009	0.042	0.05	−0.01	0.04	
0919	19	0.051	−0.009	0.042	0.05	−0.01	0.04	
0920	20	0.052	−0.010	0.042	0.04	−0.01	0.04	
0921	21	0.053	−0.010	0.043	0.04	−0.01	0.03	
0922	22	0.054	−0.011	0.043	0.05	−0.01	0.04	
0923	23	0.055	−0.012	0.043	0.04	−0.01	0.03	
0924	24	0.056	−0.012	0.044	0.04	−0.01	0.03	
0925	25	0.057	−0.013	0.044	0.05	−0.01	0.04	
0926	26	0.060	−0.013	0.047	0.05	−0.01	0.04	
0927	27	0.061	−0.014	0.047	0.05	−0.01	0.04	
0928	28	0.062	−0.015	0.047	0.05	−0.01	0.04	
0929	29	0.062	−0.016	0.046	0.04	−0.02	0.02	
0930	30	0.063	−0.017	0.046	0.06	−0.02	0.04	
0931	31	0.063	−0.017	0.046	0.06	−0.02	0.04	
0932	32	0.064	−0.018	0.046	0.04	−0.02	0.02	

PUMPING TEST RECORD

Test: Pump-Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 3 **of** 8

Record of: Water Levels in Monitoring Well BZ-1
Measuring Point: 6" casing at 5.48 ft above land ; 2" line at 6.09 ft above land

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0933	33	0.065	−0.019	0.046	0.06	−0.02	0.04	
0934	34	0.066	−0.020	0.046	0.06	−0.02	0.04	
0935	35	0.069	−0.021	0.048	0.06	−0.02	0.04	
0936	36	0.070	−0.021	0.049	0.07	−0.02	0.05	
0937	37	0.072	−0.022	0.050	0.07	−0.02	0.05	
0938	38	0.073	−0.023	0.050	0.07	−0.02	0.05	
0939	39	0.074	−0.024	0.050	0.06	−0.02	0.04	
0940	40	0.075	−0.025	0.050	0.07	−0.03	0.04	
0941	41	0.076	−0.026	0.050	0.07	−0.03	0.04	
0942	42	0.077	−0.027	0.050	0.07	−0.03	0.04	
0943	43	0.078	−0.028	0.050	0.07	−0.03	0.04	
0944	44	0.079	−0.029	0.050	0.07	−0.03	0.04	
0945	45	0.080	−0.031	0.049	0.07	−0.03	0.04	
0946	46	0.081	−0.032	0.049	0.07	−0.03	0.04	
0947	47	0.081	−0.033	0.048	0.07	−0.03	0.04	
0948	48	0.081	−0.034	0.047	0.08	−0.03	0.05	
0949	49	0.082	−0.035	0.048	0.07	−0.03	0.04	
0950	50	0.084	−0.036	0.048	0.07	−0.04	0.03	
0951	51	0.083	−0.037	0.046				
0952	52	0.083	−0.038	0.045	0.08	−0.04	0.04	
1030	88	0.097	−0.052	0.045	0.09	−0.05	0.04	

PUMPING TEST RECORD

Test: [illegible] Test No. 5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19-20 **Sheet** 4 **of** 7

Record of: Water Levels in Monitoring Well B-1
Measuring Point: 6" casing at 5.48 ft above pad ; 2" line at 5.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1005	65	0.105	−0.055	0.050	0.09	−0.05	0.04	
1010	70	0.112	−0.061	0.051	0.10	−0.06	0.04	
1015	75	0.121	−0.070	0.051	0.11	−0.07	0.04	
1020	80	0.122	−0.077	0.045	0.11	−0.08	0.03	
1025	[illegible]	0.128	−0.082	0.046	0.11	−0.08	0.03	
1030	[illegible]	0.139	−0.090	0.049	0.12	−0.09	0.03	
1035	[illegible]	0.144	−0.097	0.047	0.13	−0.10	0.03	
1040	[illegible]	0.153	−0.104	0.049	0.12	−0.10	0.04	
1045	105	0.160	−0.111	0.049	0.15	−0.11	0.04	
1050	110	0.166	−0.118	0.048	0.15	−0.12	0.03	
1055	115	0.174	−0.124	0.050	0.16	−0.12	0.04	
1100	120	0.180	−0.132	0.048	0.17	−0.13	0.04	
1110	130	0.198	−0.148	0.050	0.18	−0.15	0.03	
1120	140	0.214	−0.165	0.049	0.20	−0.16	0.04	
1130	150	0.232	−0.183	0.049	0.22	−0.18	0.04	
1140	160	0.254	−0.205	0.049	0.25	−0.20	0.05	
1150	170	0.271	−0.223	0.048	0.26	−0.22	0.04	
1200	180	0.288	−0.239	0.049	0.28	−0.24	0.04	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.29	−0.26	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.31	−0.28	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.33	−0.30	[illegible]	

PUMPING TEST RECORD

Test: [illegible] Dade Test Well 2

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 5 **of** 7

Record of: Water Levels in Monitoring Well BZ-1
Measuring Point: 6" casing at 5.48 ft above pad; 2" line at 3.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1300	240	0.362	−0.313	0.049	0.35	−0.31	0.04	
1315	255	0.377	−0.329	0.048	0.37	−0.33	0.04	
1330	270	0.389	−0.341	0.048	0.38	−0.34	0.04	
1345	285	0.395	−0.348	0.047	0.38	−0.35	0.03	
1400	300	0.404	−0.357	0.047	0.39	−0.36	0.03	
1415	315	0.410	−0.362	0.048	0.39	−0.36	0.03	
1430	330	0.410	−0.363	0.047	0.39	−0.036	0.03	Pump shut off at 1430 hrs
1431	Recovery 0	Recovery 0.000	0.000	Recovery 0.000	Recovery 0.00	0.00	0.00	Start recovery
1431:10 sec	0.17	0.006	0.000	0.006	0.00	0.00	0.00	
1431:20 sec	0.33	0.040	0.000	0.040	0.00	0.00	0.00	
1431:30 sec	0.50	0.075	0.000	0.075	−0.01	0.00	−0.01	
1431:40 sec	0.67	0.080	0.000	0.080	0.01	0.00	0.01	
1431:50 sec	0.83	0.050	0.000	0.050	0.01	0.00	0.01	
1432	1.00	0.008	0.000	0.008	0.01	0.00	0.01	
1432:20 sec	1.33	−0.002	0.000	−0.002	0.01	0.00	0.01	
1432:40 sec	1.67	0.076	0.000	0.076	0.01	0.00	0.01	
1433	2.0	0.004	0.000	0.004	0.01	0.00	0.01	
1433:30 sec	2.5	0.064	0.000	0.064	0.02	0.00	0.02	
1434	3.0	0.013	0.000	0.013	0.02	0.00	0.02	
1434:30 sec	3.5	0.042	0.000	0.042	0.02	0.00	0.02	
1435	4.0	0.035	0.000	0.035	0.02	0.00	0.02	

PUMPING TEST RECORD

Test: Pump-Out Test I-5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/14/99 **Sheet** 6 **of** 8

Record of: Water Levels in Monitoring Well EZ-1
Measuring Point: 6" casing at 5.48 ft above pad; 2" line at 6.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1435:30	4.5	0.047	0.000	0.047	0.02	0.00	0.02	
1436	5	0.028	0.000	0.028	0.02	0.00	0.02	
1437	6	0.035	0.000	0.035	0.02	0.00	0.02	
1438	7	0.039	0.000	0.039	0.03	0.00	0.03	
1439	8	0.036	0.000	0.036	0.02	0.00	0.02	
1440	9	0.036	0.000	0.036	0.02	0.00	0.02	
1441	10	0.040	0.000	0.040	0.02	0.00	0.02	
1442	11	0.040	0.000	0.040	0.02	0.00	0.02	
1443	12	0.038	0.000	0.038	0.02	0.00	0.02	
1444	13	0.036	0.000	0.036	0.02	0.00	0.02	
1445	14	0.039	0.000	0.039	0.02	0.00	0.02	
1446	15	0.040	0.000	0.040	0.01	0.00	0.01	
1447	16	0.042	0.000	0.042	0.03	0.00	0.03	
1448	17	0.041	0.000	0.041	0.02	0.00	0.02	
1449	18	0.042	0.000	0.042	0.02	0.00	0.02	
1450	19	0.043	−0.001	0.042	0.02	0.00	0.02	
1451	20	0.043	−0.001	0.042	0.03	0.00	0.03	
1452	21	0.044	−0.001	0.043	0.02	0.00	0.02	
1453	22	0.045	−0.002	0.043	0.02	0.00	0.02	
1454	23	0.046	−0.002	0.044	0.02	0.00	0.02	
1455	24	0.046	−0.002	0.044	0.02	0.00	0.02	

PUMPING TEST RECORD

Test: Pump – Dade Test T – 5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 7 **of** 8

Record of: Water Levels in Monitoring Well BZ-1
Measuring Point: 6" casing at 5.48 ft above pad ; 2" line at 6.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1456	25	0.046	– 0.002	0.044	0.03	0.00	0.03	
1457	26	0.046	– 0.003	0.043	0.03	0.00	0.03	
1458	27	0.046	– 0.003	0.043	0.03	0.00	0.03	
1459	28	0.045	– 0.003	0.042	0.03	0.00	0.03	
1500	29	0.047	– 0.004	0.043	0.03	0.00	0.03	
1501	30	0.047	– 0.004	0.043	0.03	0.00	0.03	
1506	35	0.047	– 0.005	0.042	0.03	0.00	0.03	
1511	40	0.050	– 0.008	0.042	0.03	– 0.01	0.02	
1516	45	0.052	– 0.010	0.042	0.03	– 0.01	0.02	
1521	50	0.056	– 0.013	0.043	0.04	– 0.01	0.03	
1526	55	0.060	– 0.017	0.043	0.04	– 0.02	0.02	
1531	60	0.063	– 0.019	0.044	0.04	– 0.02	0.02	
1536	65	0.066	– 0.023	0.043	0.05	– 0.02	0.03	
1541	70	0.070	– 0.027	0.043	0.05	– 0.03	0.02	
1551	80	0.090	– 0.037	0.053	0.06	– 0.04	0.02	
1601	90	0.092	– 0.049	0.043	0.06	– 0.04	0.02	
1611	105				0.09	– 0.05	0.04	
1626	115	0.100	– 0.057	0.043	0.11	– 0.06	0.05	
1636	125	0.118	– 0.074	0.044	0.13	– 0.08	0.05	
1646	135	0.134	– 0.090	0.044	0.15	– 0.09	0.06	
1656	145	0.152	– 0.108	0.044	0.16	– 0.11	0.05	

PUMPING TEST RECORD

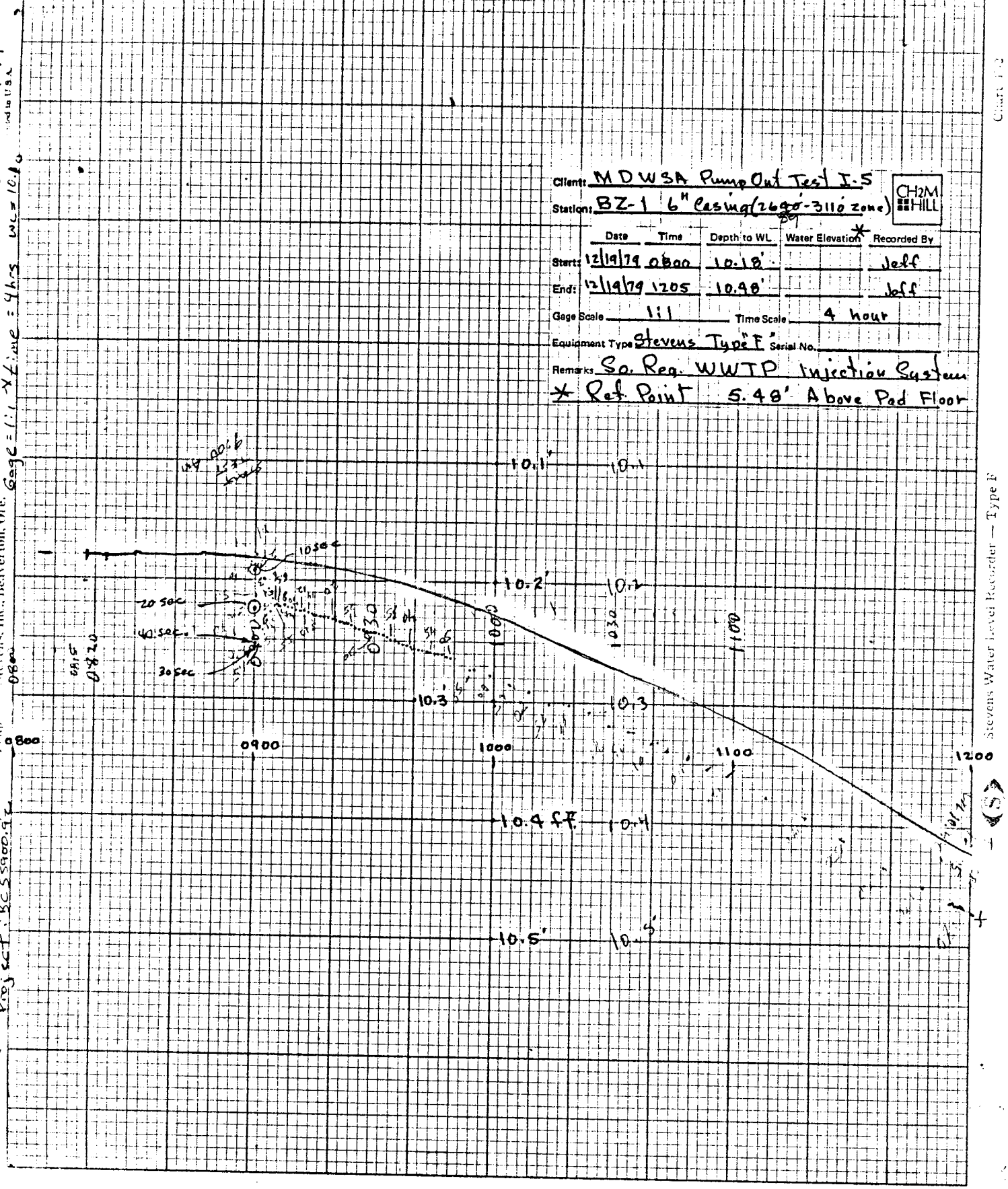
Test: Pumping Out Test I-5

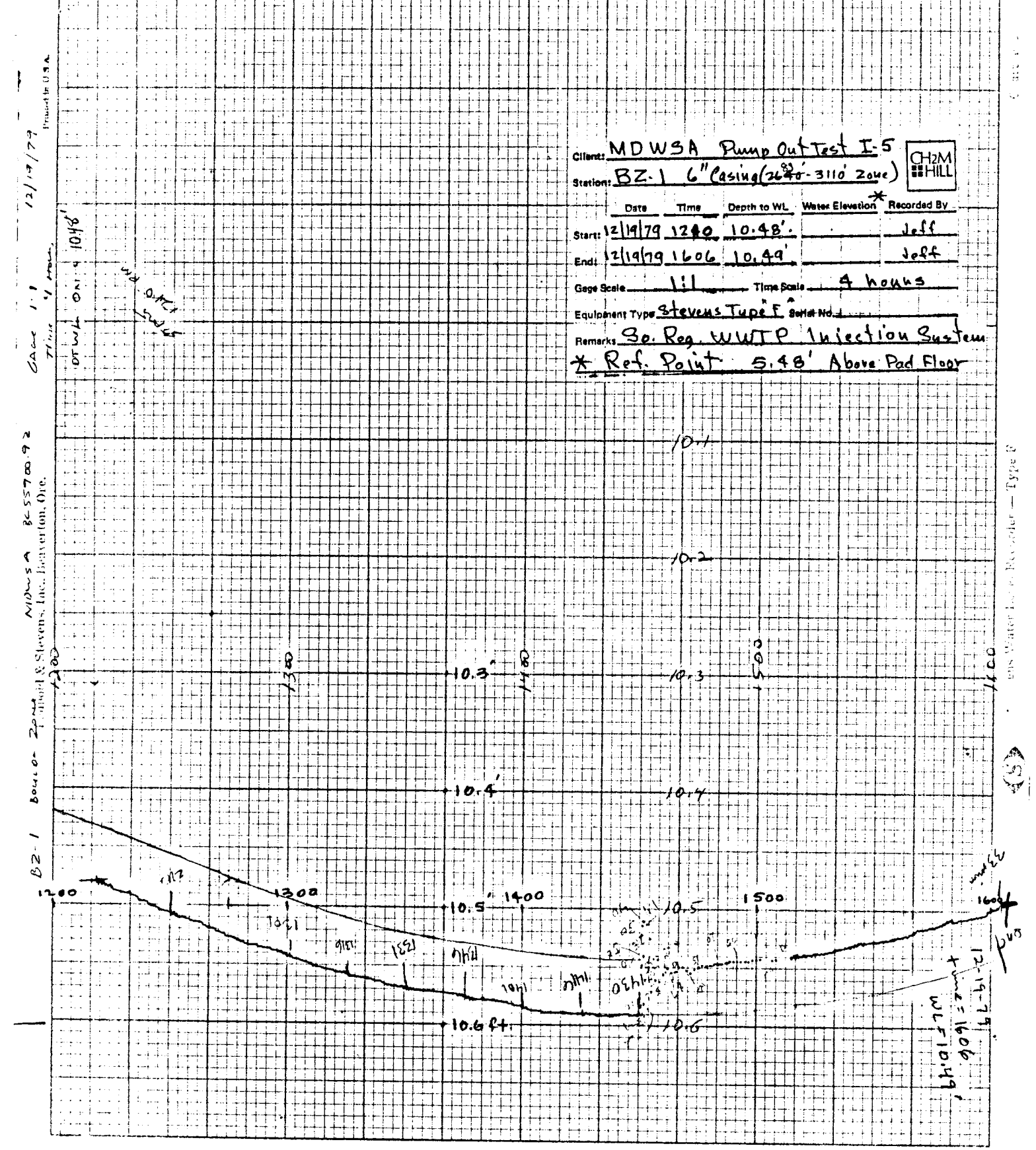
Disposal System for
Miami-Dade Water and Sewer Authority

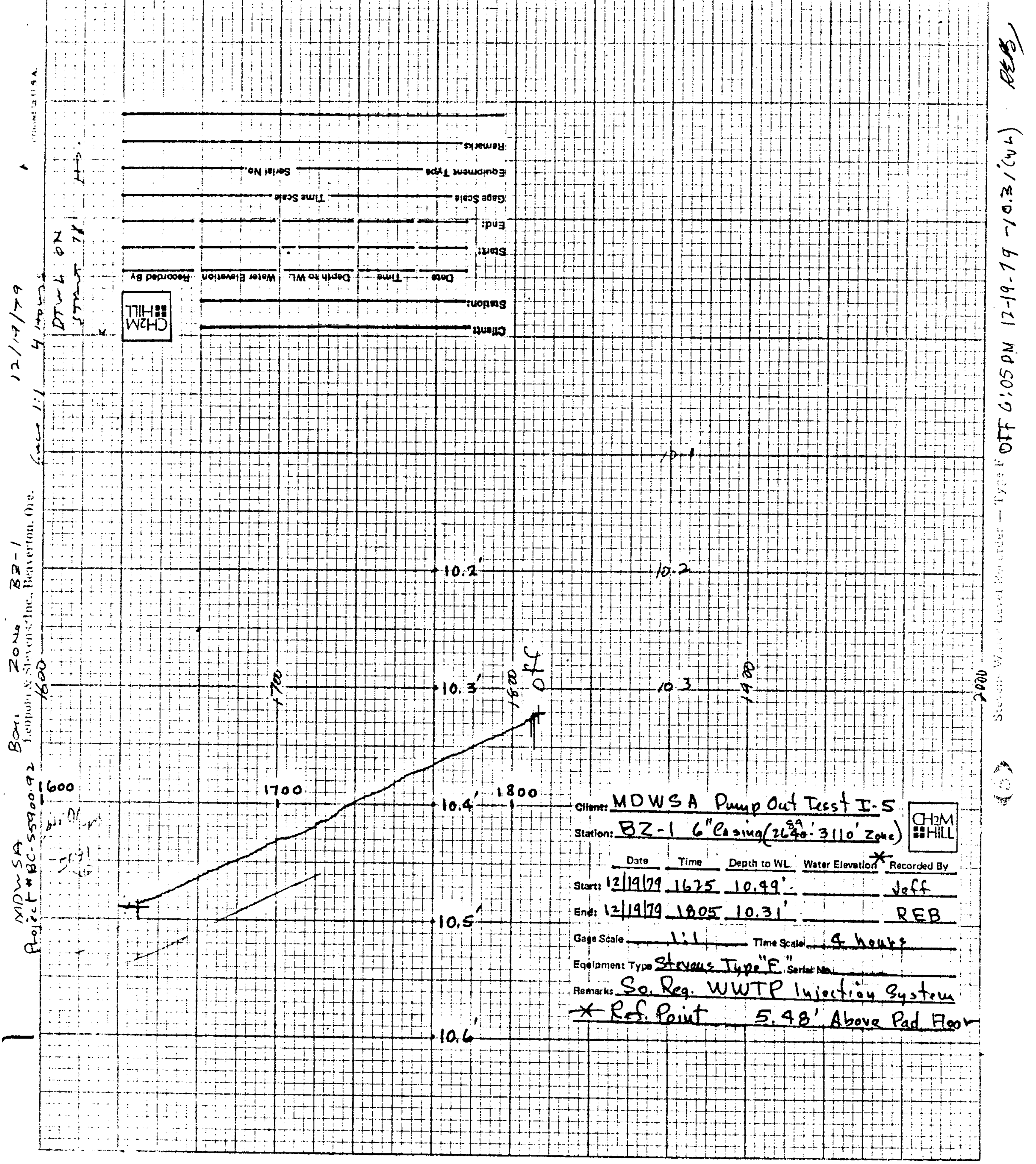
Project No.: BC55900.92
Date: 12/19/79 Sheet 8 of 8

Record of: Water Levels in Monitoring Well # I-1
Measuring Point: 6" casing at 5.48 ft above pad; 2" line at 6.08 ft above pad

Time	t Elapsed Time (minutes)	6": 2,689' - 3,110' Zone			2": 2,455' - 2,465' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1706	155	0.164	−0.122	0.044	0.17	−0.12	0.05	
1710	159	0.173	−0.129	0.044	0.17	−0.13	0.04	


Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2690'-3110' zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation * | Recorded By
Start: 12/19/79 0800 10.18' Jeff
End: 12/19/79 1205 10.98' Jeff
Gage Scale 1:1 Time Scale 4 hour
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref Point 5.48' Above Pad Floor
BZ-1 Boulder Zone Gage=1:1 XLine = 4 hrs
Start 0800 12-19-79
Miami-Dade Water & Sewer Dept.
Project 'BC 5500.92
Stevens Inc., Beaverton, Ore.
Stevens Water Level Recorder — Type F
10.1'
10.2'
10.3'
10.4 ft
10.5'
0800
0900
1000
1100
1200
20 sec
6 sec
30 sec


Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2640'-3110' Zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation * | Recorded By
Start: 12/19/79 | 1240 | 10.48' | | Jeff
End: 12/19/79 | 1606 | 10.49' | | Jeff
Gage Scale 1:1 Time Scale 4 hours
Equipment Type Stevens Type F Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 5.48' Above Pad Floor
10.1
10.2
10.3
10.4
10.5
10.6 ft.
1200
1300
1400
1500
1600
WL = 10.49'
12-19-79


MDWSA
Project # BC-55900.92
Box Zone BZ-1
12/17/79
OFF 6:05 PM 12-19-79 - 10.31' (WL)
REB
Leupold & Stevens Inc., Beaverton, Ore.
Stevens Water Level Recorder — Type F
1600
1700
1800
1900
2000
10.2'
10.3'
10.4'
10.5'
10.6'
10.2
10.3
Client: MDWSA Pump Out Test I-5
Station: BZ-1 6" Casing (2639-3110' Zone)
Date
Time
Depth to WL
Water Elevation
Recorded By
Start: 12/19/79 1625 10.49' Jeff
End: 12/19/79 1805 10.31' REB
Gage Scale 1:1
Time Scale 4 hours
Equipment Type Stevens Type "F"
Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 5.48' Above Pad Floor
CH2M HILL

Appendix 4.C-9
PUMP OUT TEST
PUMPING TEST RECORD
WATER LEVELS IN I-6

PUMPING TEST RECORD

Test: Pump-Out Zone I-5

Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 1 of 8

Record of: Water Levels in Observation (Injection) Well I-6

Measuring Point: 24" casing at 3.3± ft above pad; 24"/36" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0859		0.000	0.000	0.000	0.000	0.000	0.000	Static Water Level
0900	0	0.000	0.000	0.000	0.000	0.000	0.000	Start Pump
0901	1	0.011	−0.001	0.010	0.001	−0.001	0.000	
0902	2	0.013	−0.002	0.011	0.001	−0.001	0.000	
0903	3	0.014	−0.002	0.012	0.001	−0.001	0.000	
0904	4	0.015	−0.003	0.012	0.002	−0.002	0.000	
0905	5	0.016	−0.003	0.013	0.002	−0.002	0.000	
0906	6	0.017	−0.004	0.013	0.002	−0.002	0.000	
0907	7	0.017	−0.004	0.013	0.002	−0.002	0.000	
0908	8	0.018	−0.005	0.013	0.002	−0.002	0.000	
0909	9	0.019	−0.005	0.014	0.003	−0.003	0.000	
0910	10	0.019	−0.006	0.013	0.003	−0.003	0.000	
0911	11	0.020	−0.006	0.014	0.003	−0.003	0.000	
0912	12	0.020	−0.007	0.013	0.003	−0.003	0.000	
0913	13	0.021	−0.007	0.014	0.003	−0.003	0.000	
0914	14	0.022	−0.008	0.014	0.004	−0.004	0.000	
0915	15	0.023	−0.009	0.014	0.004	−0.004	0.000	
0916	16	0.024	−0.010	0.014	0.004	−0.004	0.000	
0917	17	0.025	−0.010	0.015	0.005	−0.005	0.000	
0918	18	0.026	−0.011	0.015	0.005	−0.005	0.000	
0919	19	0.027	−0.012	0.015	0.005	−0.005	0.000	

PUMPING TEST RECORD

Test: Pumping 24-Hour Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 2 **of** 8

Record of: Water Levels in Observation (Injection) Well I-6
Measuring Point: 24" casing at 5.36 ft above pad; 24"/36" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0920	20	0.028	−0.013	0.015	0.004	−0.004	0.000	
0921	21	0.029	−0.014	0.015	0.004	−0.004	0.000	
0922	22	0.030	−0.015	0.015	0.007	−0.007	0.000	
0923	23	0.031	−0.016	0.015	0.007	−0.007	0.000	
0924	24	0.032	−0.017	0.015	0.008	−0.008	0.000	
0925	25	0.033	−0.018	0.015	0.008	−0.008	0.000	
0926	26	0.034	−0.019	0.015	0.009	−0.009	0.000	
0927	27	0.035	−0.020	0.015	0.009	−0.009	0.000	
0928	28	0.037	−0.021	0.016	0.009	−0.009	0.000	
0929	29	0.038	−0.022	0.016	0.010	−0.010	0.000	
0930	30	0.039	−0.023	0.016	0.010	−0.010	0.000	
0931	31	0.040	−0.024	0.016	0.010	−0.010	0.000	
0932	32	0.041	−0.025	0.016	0.010	−0.010	0.000	
0933	33	0.042	−0.026	0.016	0.011	−0.011	0.000	
0934	34	0.042	−0.027	0.015	0.011	−0.011	0.000	
0935	35	0.043	−0.028	0.015	0.011	−0.011	0.000	
0936	36	0.044	−0.029	0.015	0.011	−0.011	0.000	
0937	37	0.046	−0.030	0.016	0.011	−0.011	0.000	
0938	38	0.047	−0.032	0.015	0.012	−0.012	0.000	
0939	39	0.048	−0.033	0.016	0.012	−0.012	0.000	
0940	40	0.050	−0.034	0.016	0.012	−0.012	0.000	

PUMPING TEST RECORD

Test: Pump-Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 3 **of** 8

Record of: Water Levels in Observation (Injection) Well I-6
Measuring Point: 24" casing at 5.36 ft above pad; 24"/34" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
0941	41	0.051	−0.035	0.016	0.012	−0.012	0.000	
0942	42	0.052	−0.036	0.016	0.012	−0.012	0.000	
0943	43	0.052	−0.037	0.015	0.013	−0.013	0.000	
0944	44	0.053	−0.038	0.015	0.013	−0.013	0.000	
0945	45	0.054	−0.039	0.015	0.013	−0.013	0.000	
0946	46	0.055	−0.040	0.015	0.013	−0.013	0.000	
0947	47	0.056	−0.041	0.015	0.014	−0.014	0.000	
0948	48	0.057	−0.042	0.015	0.014	−0.014	0.000	
0949	49	0.058	−0.043	0.015	0.015	−0.015	0.000	
0950	50	0.059	−0.044	0.015	0.015	−0.015	0.000	
0951	51	0.060	−0.045	0.015	0.015	−0.015	0.000	
0952	52	0.062	−0.046	0.016	0.016	−0.016	0.000	
0953	53	0.063	−0.047	0.016	0.016	−0.016	0.000	
0954	54	0.065	−0.049	0.016	0.017	−0.017	0.000	
0955	55	0.066	−0.050	0.016	0.017	−0.017	0.000	
0956	56	0.068	−0.052	0.016	0.017	−0.017	0.000	
0957	57	0.070	−0.053	0.017	0.018	−0.018	0.000	
0958	58	0.071	−0.055	0.016	0.018	−0.018	0.000	
0959	59	0.072	−0.056	0.016	0.019	−0.019	0.000	
1000	60	0.073	−0.057	0.016	0.019	−0.019	0.000	
1001	61	0.079	−0.063	0.016	0.021	−0.021	0.000	

PUMPING TEST RECORD

Test: Pump-Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/14/79 **Sheet** 4 **of** x

Record of: Water Levels in Observation (Injection) Well I-5
Measuring Point: 24" casing at 5.36 ft above pad; 24"/34" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1010	70	0.085	−0.069	0.016	0.023	−0.023	0.000	
1015	75	0.091	−0.075	0.016	0.025	−0.025	0.000	
1020	80	0.098	−0.082	0.016	0.026	−0.026	0.000	
1025	85	0.102	−0.087	0.015	0.028	−0.028	0.000	
1030	90	0.110	−0.094	0.016	0.029	−0.029	0.000	
1035	95	0.118	−0.102	0.016	0.032	−0.032	0.000	
1040	100	0.126	−0.110	0.016	0.035	−0.035	0.000	
1050	110	0.140	−0.124	0.016	0.041	−0.041	0.000	
1100	120	0.155	−0.139	0.016	0.048	−0.048	0.000	
1110	130	0.171	−0.155	0.016	0.056	−0.056	0.000	
1120	140	0.188	−0.172	0.016	0.063	−0.063	0.000	
1130	150	0.206	−0.190	0.016	0.077	−0.077	0.000	
1140	160	0.240	−0.223	0.017	0.090	−0.090	0.000	
1150	170	0.252	−0.236	0.016	0.097	−0.097	0.000	
1200	180	0.270	−0.253	0.017	0.105	−0.105	0.000	
1210	190	0.279	−0.263	0.016	0.111	−0.111	0.000	
1220	200	0.290	−0.275	0.014	0.118	−0.118	0.000	
1230	210	0.310	−0.293	0.017	0.127	−0.127	0.000	
1240	220	0.320	−0.304	0.016	0.137	−0.137	0.000	
1250	230	0.335	−0.319	0.016	0.146	−0.146	0.000	
1300	240	0.343	−0.327	0.016	0.153	−0.153	0.000	

PUMPING TEST RECORD

Test: Pump-Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 5 of 8

Record of: Water Levels in Observation (Injection) Well I-6
Measuring Point: 24" casing at 6.36 ft above pad; 24"/34" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1310	250	0.355	−0.338	0.017	0.160	−0.160	0.000	
1320	260	0.363	−0.348	0.015	0.165	−0.165	0.000	
1330	270	0.369	−0.354	0.015	0.172	−0.172	0.000	
1340	280	0.374	−0.359	0.015	0.177	−0.177	0.000	
1350	290	0.379	−0.364	0.015	0.180	−0.180	0.000	
1400	300	0.387	−0.372	0.015	0.190	−0.190	0.000	
1410	310	0.390	−0.375	0.015	0.194	−0.194	0.000	
1420	320	0.390	−0.375	0.015	0.200	−0.200	0.000	
1430	330	0.390	−0.375	0.015	0.202	−0.202	0.000	Pump shut off at 1431 hrs
1431	Recovery 0	Recovery 0.000	Recovery 0.000	Recovery 0.000	Recovery 0.000	0.000	0.000	Start recovery
1432	1	0.013	−0.002	0.011	0.000	0.000	0.000	
1433	2	0.015	−0.003	0.012	0.000	0.000	0.000	
1434	3	0.017	−0.004	0.013	0.000	0.000	0.000	
1435	4	0.018	−0.004	0.014	0.000	0.000	0.000	
1436	5	0.019	−0.005	0.014	0.000	0.000	0.000	
1437	6	0.019	−0.005	0.014	0.000	0.000	0.000	
1438	7	0.020	−0.006	0.014	0.000	0.000	0.000	
1439	8	0.020	−0.006	0.014	0.000	0.000	0.000	
1440	9	0.020	−0.006	0.014	0.000	0.000	0.000	
1441	10	0.021	−0.007	0.014	0.000	0.000	0.000	
1442	11	0.021	−0.007	0.014	0.000	0.000	0.000	

PUMPING TEST RECORD

Test: Pump-Out Well I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 6 **of** 8

Record of: Water Levels in Observation (Injection) Well I-6
Measuring Point: 24" casing at 6.36 ft above pad ; 24"/36" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1443	12	0.022	−0.008	0.014	0.000	0.000	0.000	
1444	13	0.022	−0.008	0.014	0.000	0.000	0.000	
1445	14	0.023	−0.009	0.014	0.000	0.000	0.000	
1446	15	0.023	−0.009	0.014	0.000	0.000	0.000	
1447	16	0.024	−0.009	0.015	0.000	0.000	0.000	
1448	17	0.024	−0.009	0.015	0.000	0.000	0.000	
1449	18	0.024	−0.010	0.014	0.001	−0.001	0.000	
1450	19	0.025	−0.010	0.014	0.001	−0.001	0.000	
1451	20	0.025	−0.010	0.015	0.001	−0.001	0.000	
1452	21	0.026	−0.011	0.015	0.001	−0.001	0.000	
1453	22	0.026	−0.011	0.015	0.001	−0.001	0.000	
1454	23	0.027	−0.012	0.015	0.001	−0.001	0.000	
1455	24	0.027	−0.012	0.015	0.001	−0.001	0.000	
1456	25	0.028	−0.013	0.015	0.001	−0.001	0.000	
1457	26	0.028	−0.013	0.015	0.001	−0.001	0.000	
1458	27	0.028	−0.013	0.015	0.001	−0.001	0.000	
1459	28	0.029	−0.014	0.015	0.000	0.000	0.000	
1500	29	0.029	−0.014	0.015	0.000	0.000	0.000	
1501	30	0.029	−0.014	0.015	0.000	0.000	0.000	
1502	31	0.030	−0.014	0.016				
1503	32	0.030	−0.015	0.015				

PUMPING TEST RECORD

Test: Pump-Out Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 **Sheet** 7 **of** 8

Record of: Water Levels in Observation (Injection) Well I-6
Measuring Point: 24" casing at 5.36 ft above pad; 24"/34" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1504	33	0.030	−0.015	0.015	−0.001	+0.001	0.000	
1505	34	0.030	−0.015	0.015	−0.001	+0.001	0.000	
1506	35	0.030	−0.015	0.015	−0.001	+0.001	0.000	
1507	36	0.030	−0.016	0.014	−0.001	+0.001	0.000	
1508	37	0.031	−0.016	0.015	−0.001	+0.001	0.000	
1509	38	0.031	−0.017	0.014	−0.002	+0.002	0.000	
1510	39	0.032	−0.017	0.015	−0.002	+0.002	0.000	
1515	44	0.034	−0.019	0.015	−0.002	+0.002	0.000	
1520	49	0.038	−0.022	0.016	−0.001	+0.001	0.000	
1525	54	0.042	−0.026	0.016	−0.001	+0.001	0.000	
1530	59	0.046	−0.031	0.015	−0.001	+0.001	0.000	
1535	64	0.047	−0.033	0.014	−0.001	+0.001	0.000	
1540	69	0.052	−0.037	0.015	0.000	0.000	0.000	
1545	74	0.059	−0.044	0.015	0.001	−0.001	0.000	
1550	79	0.062	−0.048	0.014	0.002	−0.002	0.000	
1555	84	0.068	−0.053	0.015	0.003	−0.003	0.000	
1600	89	0.071	−0.057	0.014	0.004	−0.004	0.000	
1610	99	0.085	−0.070	0.015	0.010	−0.010	0.000	
1620	109	0.101	−0.086	0.015	0.015	−0.015	0.000	
1630	119	0.115	−0.101	0.014	0.032	−0.032	0.000	
1640	129	0.132	−0.117	0.015	0.030	−0.030	0.000	

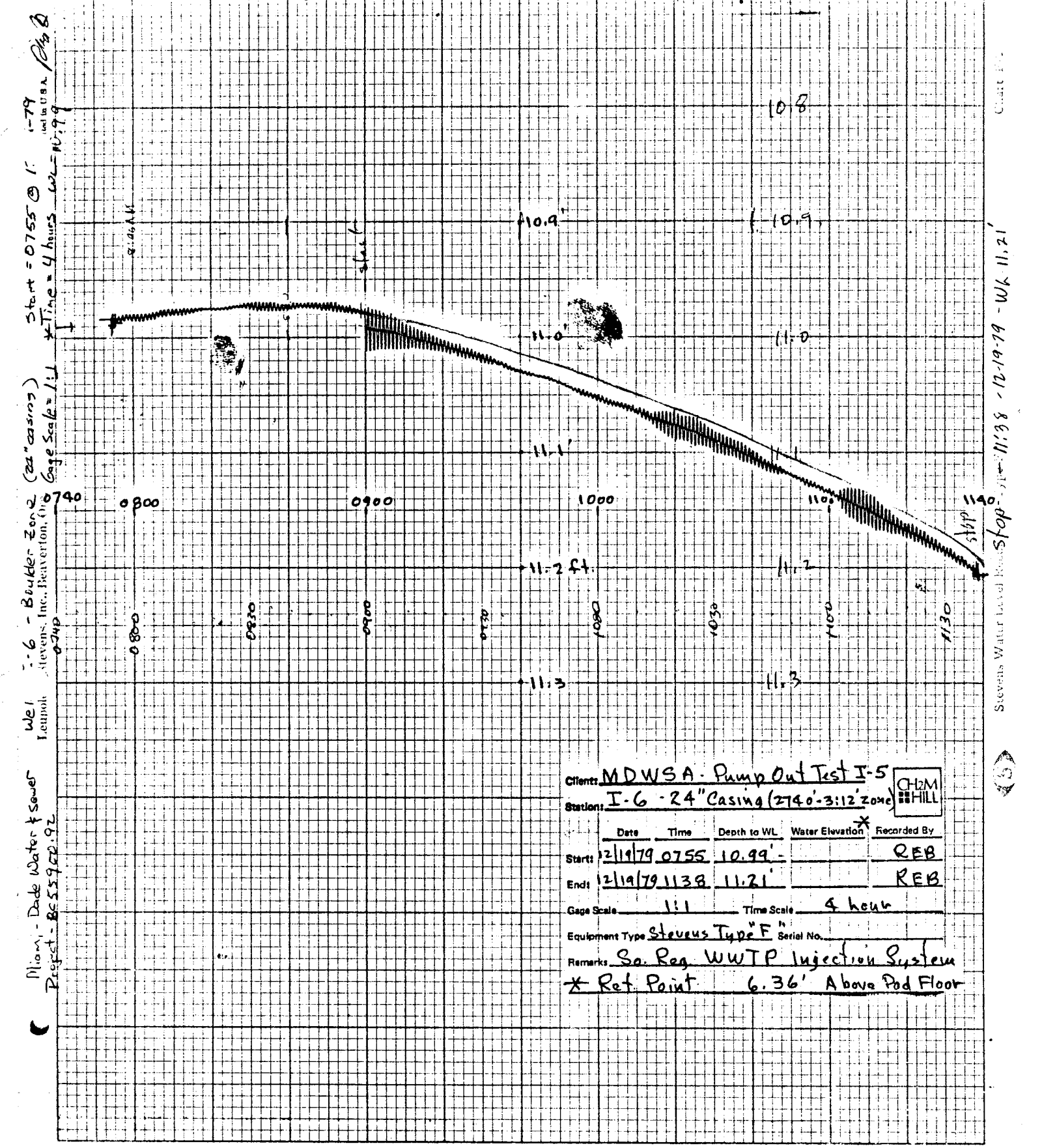
PUMPING TEST RECORD

Test: Final Pump Test I-5
Disposal System for
Miami-Dade Water and Sewer Authority

Project No.: BC55900.92
Date: 12/19/79 Sheet 8 of 8

Record of: Water Levels in Observation (Injection) Well I-6
Measuring Point: 24" casing at 6.36 ft above pad; 24"/36" annulus at 4.79 ft above pad

Time	t Elapsed Time (minutes)	24": 2,740' - 3,112' Zone			Annulus: 2,294' - 1,800' Zone			Remarks
		Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	Δs (feet)	Adjustment (feet)	Adjusted Δs (feet)	
1650	139	0.148	−0.133	0.015	0.036	−0.036	0.000	
1700	149	0.166	−0.151	0.015	0.044	−0.044	0.000	
1710	159	0.179	−0.165	0.014	0.054	−0.054	0.000	
1720	169	0.198	−0.183	0.015	0.062	−0.062	0.000	


Start = 0755 @ 12-19-79 WL = 10.99'
*Time = 4 hours
Gage Scale = 1:1
I-6 - Boulder Zone (24" casing)
Stevens Inc., Beaverton, Ore.
Well
Miami - Dade Water & Sewer
Project - 865592.92
10.8
10.9'
11.0'
11.1'
11.2 ft.
11.3'
0740
0800
0830
0900
0930
1000
1030
1100
1130
1140
Stop - 1138 - 12-19-79 - WL 11.21'
Stevens Water Level Recorder
Clients: MDWSA - Pump Out Test I-5
Station: I-6 - 24" Casing (2740'-3:12' zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation* | Recorded By
Start: 12/19/79 | 0755 | 10.99' | | REB
End: 12/19/79 | 1138 | 11.21' | | REB
Gage Scale 1:1 Time Scale 4 hour
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 6.36' Above Pad Floor

Well I-6
Boulder Zone

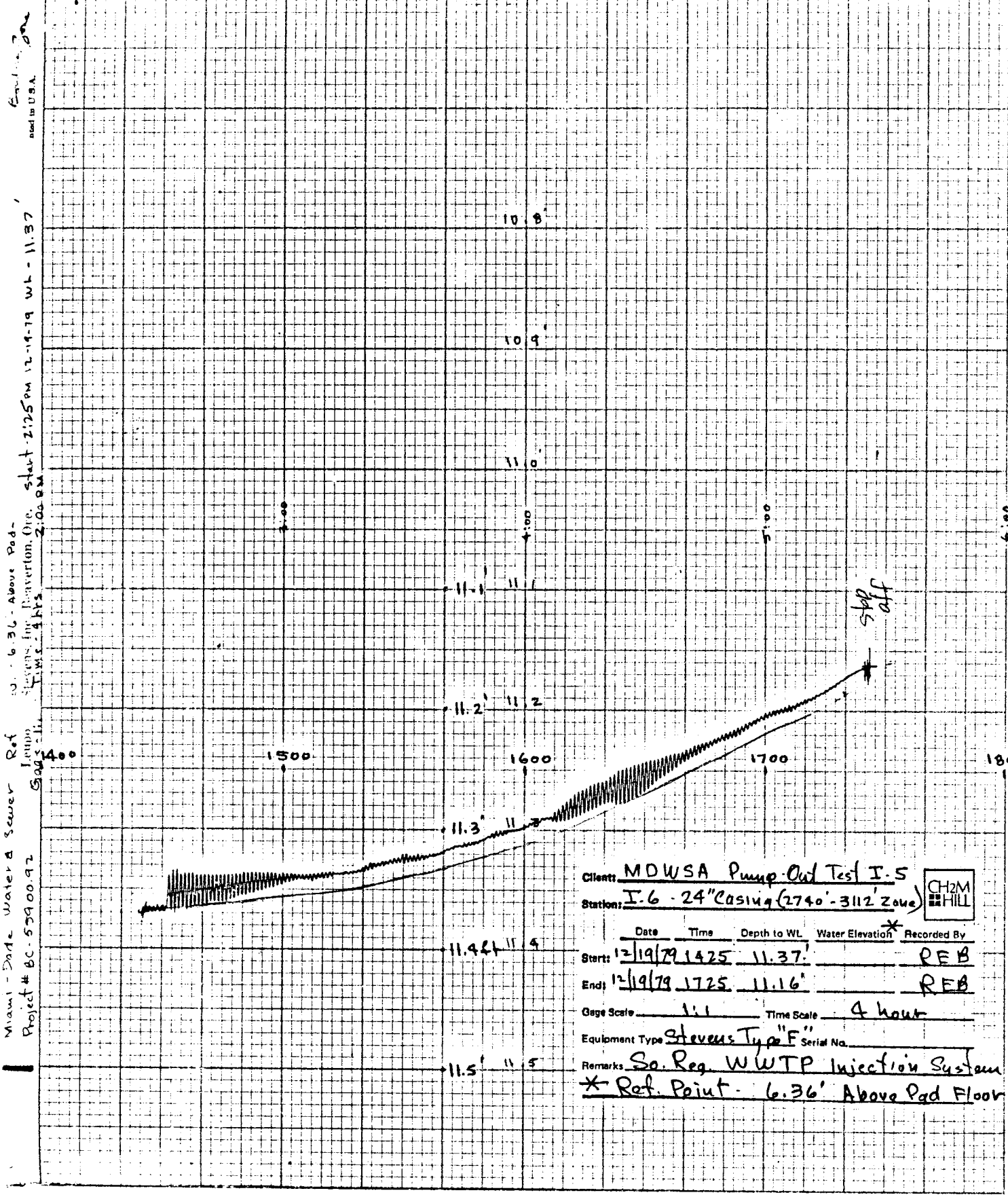
Client: MDWSA - Pump Out Test I-5
Station: I-6 - 24" Casing (2740'-3112' zone)

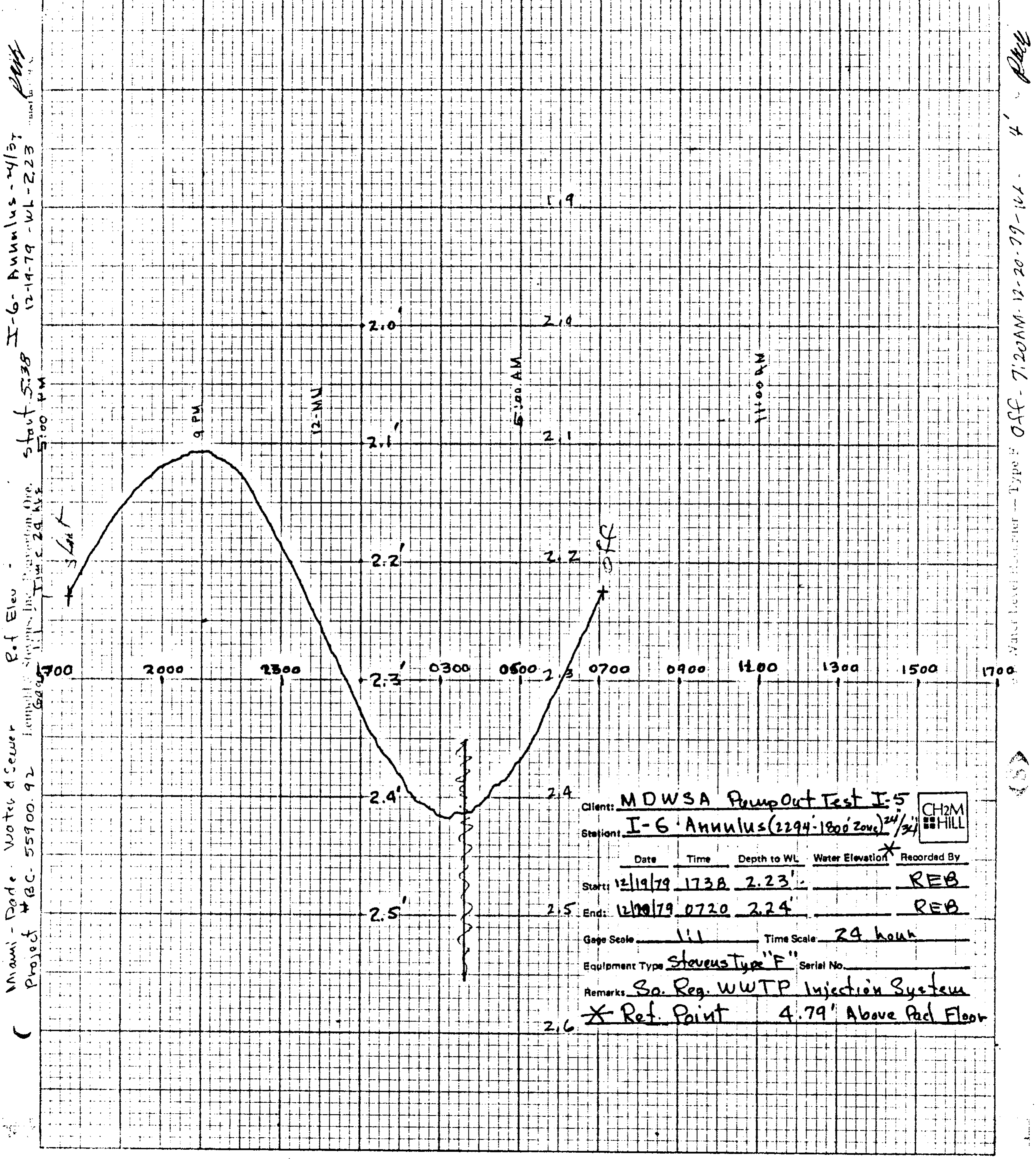
CH2M HILL

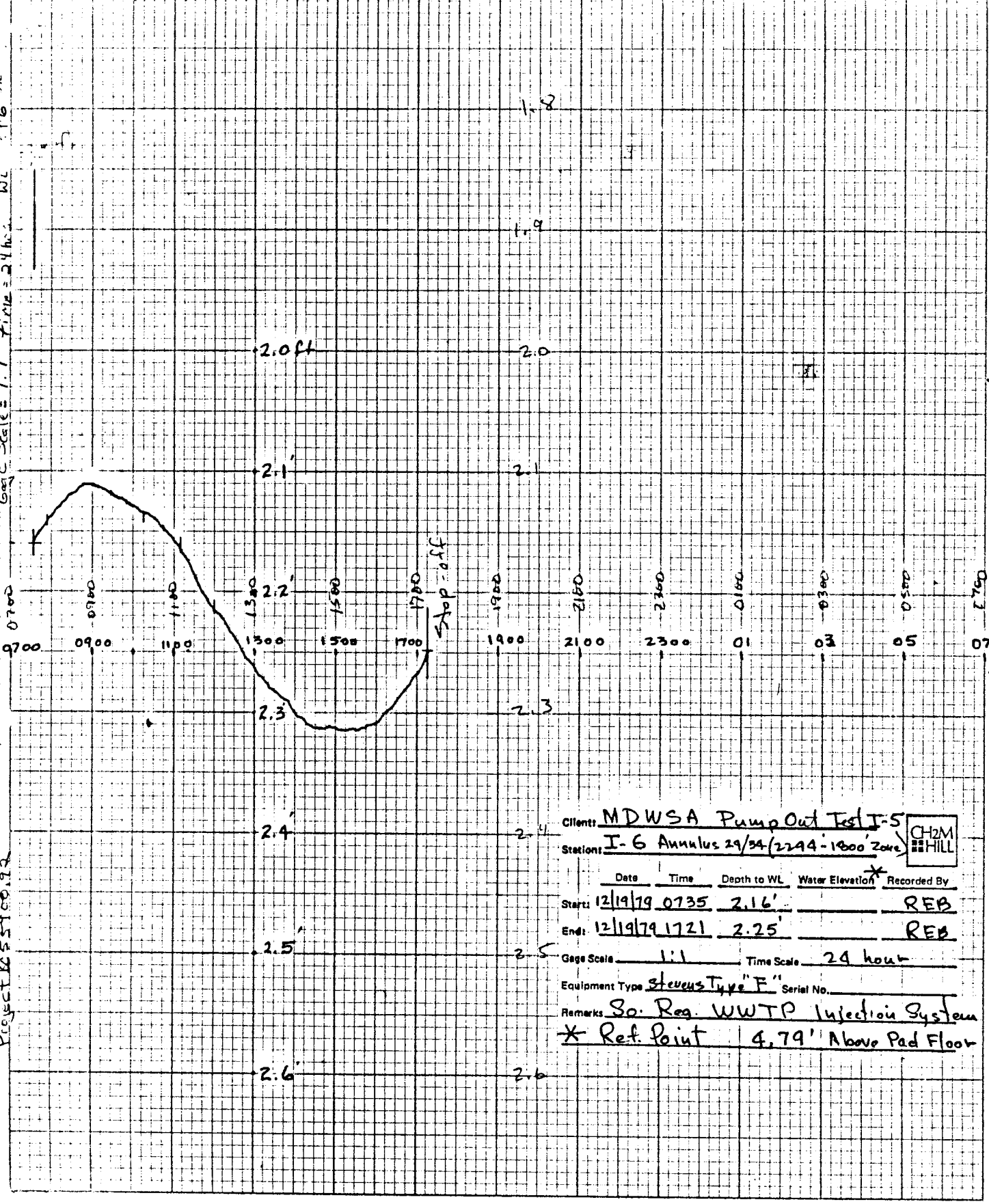
	Date	Time	Depth to WL	Water Elevation *	Recorded By
Start:	12/19/79	1140	11.22'		REB
End:	12/19/79	1420	11.38'		REB

Gage Scale 1:1 Time Scale 4 hour
Equipment Type Stevens type "F" Serial No.
Remarks So. Reg. WWTP - Injection System
* Ref. Point 6.36' Above Pad Floor

11.2'
11.3'
11.4 ft
11.5'
1140
1200
1300
1400
1500
Stop
Start 1140 12-19-79 WL-11.22'
Stop 1420 12-19-79 WL-11.38'
WELL I-6 Boulder Zone
6.36' Above Pad
Miami-Dade Water & Sewer
Project # RC-55700.92
Printed in U.S.A.


Miami-Dade Water & Sewer Ref
Project # BC-5900.92
Stevens Water Level Recorder — Type F
Stevens Inc. Beaverton, Ore.
Time: 4 hrs
Gage Line
Made in U.S.A.
Start 2:25 PM 12-19-79 WL - 11.37'
2:00 PM
6.36' - Above Pad -
OFF - 5:25 PM 12-19-79 - WL - 11.16'
10.8'
10.9'
11.0'
11.1'
11.2'
11.3'
11.4'
11.5'
1400
1500
1600
1700
1800
4:00
5:00
6:00
Stops
Client: MDWSA Pump Out Test I.5
Station: I-6 - 24" Casing (2740' - 3112' zone)
CH2M HILL
Date Time Depth to Wt. Water Elevation * Recorded By
Start: 12/19/79 1425 11.37' REB
End: 12/19/79 1725 11.16' REB
Gage Scale 1:1 Time Scale 4 hour
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point - 6.36' Above Pad Floor


Miami-Dade Water & Sewer
Project #BC-55900.92
Ref Elev -
Time 24 hrs
start 5:38
5:00 PM
I-6 Annulus - 24/34
12-19-79 - WL - 2.23
Off - 7:20AM 12-20-79 - WL - 4'
9 PM
12-MN
5:00 AM
11:00 AM
Start
Off
1.9
2.0'
2.0
2.1'
2.1
2.2'
2.2
2.3'
2.3
2.4'
2.4
2.5'
2.5
2.6
1700
2000
2300
0300
0500
0700
0900
1100
1300
1500
1700
Client: MDWSA Pump Out Test I-5
Station: I-6 Annulus (2294'-1800' Zone) 24"/34"
CH2M HILL
Date
Time
Depth to WL
Water Elevation*
Recorded By
Start: 12/19/79 1738 2.23' REB
End: 12/20/79 0720 2.24' REB
Gage Scale 1:1
Time Scale 24 hour
Equipment Type Stevens Type "F"
Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 4.79' Above Pad Floor


Start 0735 @ 12.19' WL
Time = 24 hrs
Gage Scale = 1:1
Stevens Inc. Recorder, Dia.
all I-6 Annulus
Miami - Dade Water + Sewer Dept.
Project #559000.92
Temp
1:8
1:9
2.0 ft
2.0
2.1'
2.1
2.2'
2.2
2.3'
2.3
2.4'
2.4
2.5'
2.5
2.6'
2.6
0700
0900
1100
1300
1500
1700
1900
2100
2300
01
03
05
07
Stop - off
Client: MDWSA Pump Out Test I-5
Station: I-6 Annulus 29/34 (2294-1800' Zone)
CH2M HILL
Date | Time | Depth to WL | Water Elevation * | Recorded By
Start: 12/19/79 | 0735 | 2.16' | | REB
End: 12/19/79 | 1721 | 2.25' | | REB
Gage Scale 1:1 Time Scale 24 hour
Equipment Type Stevens Type "F" Serial No.
Remarks So. Reg. WWTP Injection System
* Ref. Point 4.79' Above Pad Floor
OFF - 5:21 PM - 12-19-79 WL - 2.25'

Appendix 4.C-10
WATER QUALITY DATA

CH2M HILL
Engineers

Page No.: ____

Client: Miami-Dade Water and Sewer Authority
Project No.: BC55900.92

Injection and Monitoring Wells for
South District Regional WWTP
Well No.: I-5

WATER QUALITY DATA FROM ~~EXPLORATORY HOLE DRILLING~~ PUMP-OUT TEST ON I-5

Date	Time	Depth (ft)	Temperature ~~(°C)~~ °F	Specific Gravity	Specific Conductance (µmhos/cm)	Chloride (mg/l)	Remarks	Observer's Initials
12/19/92	0915	Boulder Zone	65.5	1.0270	41,000	20,400	Start test (pump on at 0900 hrs)	WRS
"	1000	"	65.5	1.0265	46,000			WRS
"	1100	"	66.0	1.0265	47,000			WRS
"	1200	"	66.0	1.0263	47,000			WRS
"	1300	"	66.0	1.0268	48,000			WRS
"	1400	"	66.0	1.0270	49,000			WRS
"	1429	"	66.0	1.0265	47,000	20,600	Pump shut off at 1430 hrs.	WRS

BC&E
CH2M HILL

ENVIRONMENTAL LABORATORIES
7201 N.W. Eleventh Place
P.O. Drawer 1647
Gainesville, Florida 32602
904/377-2442

Sample No. 13254

WATER ANALYSIS REPORT

Client MDWSA — Project No. BC55900.92

Attention [redacted] — Received 12-26-79

Address — Reported 1-16-80

Description:
Groundwater - pump out test Well I-5
Collected by Bob Batey 12-19-79 @ 09:15 hrs.
Temperature 65.5°F

Substance		milligrams per liter MCL	milligrams per liter present	Substance		milligrams per liter as $CaCO_3$	milligrams per liter as substance
Arsenic	As	0.05		P-Alkalinity		0.0	
Barium	Ba	1		M-Alkalinity		122	
Cadmium	Cd	0.01		Bicarbonates	HCO_3^-	122	149
Chloride	Cl^-	250	19,600	Carbonates	$CO_3^=$	0.0	0.0
Chromium	Cr	0.05		Hydroxides	OH^-	0.0	0.0
Copper	Cu	1		Total hardness		6,590	
Fluoride	F^-	*	0.70	Carbonate hardness		122	
Foaming agents	MBAS	0.5		Noncarbonate hardness		6,470	
Hydrogen sulfide	H_2S	0.05		Calcium	Ca	1,150	460
Iron	Fe	0.3	0.24	Magnesium	Mg	24,000	11,000
Lead	Pb	0.05		Sodium	Na	22	9.5
Manganese	Mn	0.05		Carbon dioxide	CO_2		
Mercury	Hg	0.002		Dissolved solids (est. by cond.) 32,100 mg/l			
Nitrate (as N)	NO_3^-	10		Temperature (field)			° C
Selenium	Se	0.01		pH (field) [6.5-8.5]			
Silver	Ag	0.05		pH (laboratory) 7.40			
Sulfate	$SO_4^=$	250	2,680	Odor [MCL 3] none		TON =	
Total dissolved solids @103° C		500		Conductivity 49,400		$\frac{\mu mhos}{cm}$ @ 25° C	
Zinc	Zn	5		Turbidity [MCL 1-5] 2.0		NTU	
				Color [MCL 15] 0		APHA units	
				pH_s @ ° C			
				Stability index (2 pH_s-pH)			
				Saturation index (pH-pH_s)			

*MCL 1.4-2.4—depends upon avg. daily max. air temp..
To obtain grains per gallon, multiply milligrams per liter by 0.0584.
Milligrams per liter = parts per million.
MCL means maximum contaminant level.
< means less than.

Respectfully submitted,

Roger A. Yorton Chemist

BC&E
CH2M HILL
ENVIRONMENTAL LABORATORIES
7201 N.W. Eleventh Place
P.O. Drawer 1647
Gainesville, Florida 32602
904/377-2442

WATER ANALYSIS REPORT

Client MDWSA — Project No. BC55900.92

Attention Udai Singh — Received 12-26-79

Address — Reported 1-16-80

Description: Groundwater - pump out test well I-5
Collected by Bob Batey 12-19-79 @ 14:25 hrs.
Temperature 66°F

Substance		milligrams per liter MCL	milligrams per liter present	Substance		milligrams per liter as $CaCO_3$	milligrams per liter as substance
Arsenic	As	0.05		P-Alkalinity		0.0	
Barium	Ba	1		M-Alkalinity		122	
Cadmium	Cd	0.01		Bicarbonates	HCO_3^-	122	149
Chloride	Cl^-	250	19,600	Carbonates	$CO_3^=$	0.0	0.0
Chromium	Cr	0.05		Hydroxides	OH^-	0.0	0.0
Copper	Cu	1		Total hardness		6,500	
Fluoride	F^-	*	0.72	Carbonate hardness		122	
Foaming agents	MBAS	0.5		Noncarbonate hardness		6,380	
Hydrogen sulfide	H_2S	0.05	0.35	Calcium	Ca	1,150	460
Iron	Fe	0.3	0.53	Magnesium	Mg	5,350	1,300
Lead	Pb	0.05		Sodium	Na	24,100	11,100
Manganese	Mn	0.05		Carbon dioxide	CO_2	22	9.5
Mercury	Hg	0.002		Dissolved solids (est. by cond.) 32,200 mg/l			
Nitrate (as N)	NO_3^-	10		Temperature (field)			° C
Selenium	Se	0.01		pH (field) [6.5-8.5]			
Silver	Ag	0.05		pH (laboratory) 7.40			
Sulfate	$SO_4^=$	250	2,740	Odor [MCL 3] none		TON =	
Total dissolved solids @103° C		500		Conductivity 49,500			$\frac{\mu mhos}{cm}$ @ 25° C
Zinc	Zn	5		Turbidity [MCL 1-5] 1.2			NTU
				Color [MCL 15] 0			APHA units
				pH_s @ ° C			
				Stability index (2 pH_s-pH)			
				Saturation index (pH-pH_s)			

*MCL 1.4-2.4—depends upon avg. daily max. air temp..
To obtain grains per gallon, multiply milligrams per liter by 0.0584.
Milligrams per liter = parts per million.
MCL means maximum contaminant level.
< means less than.

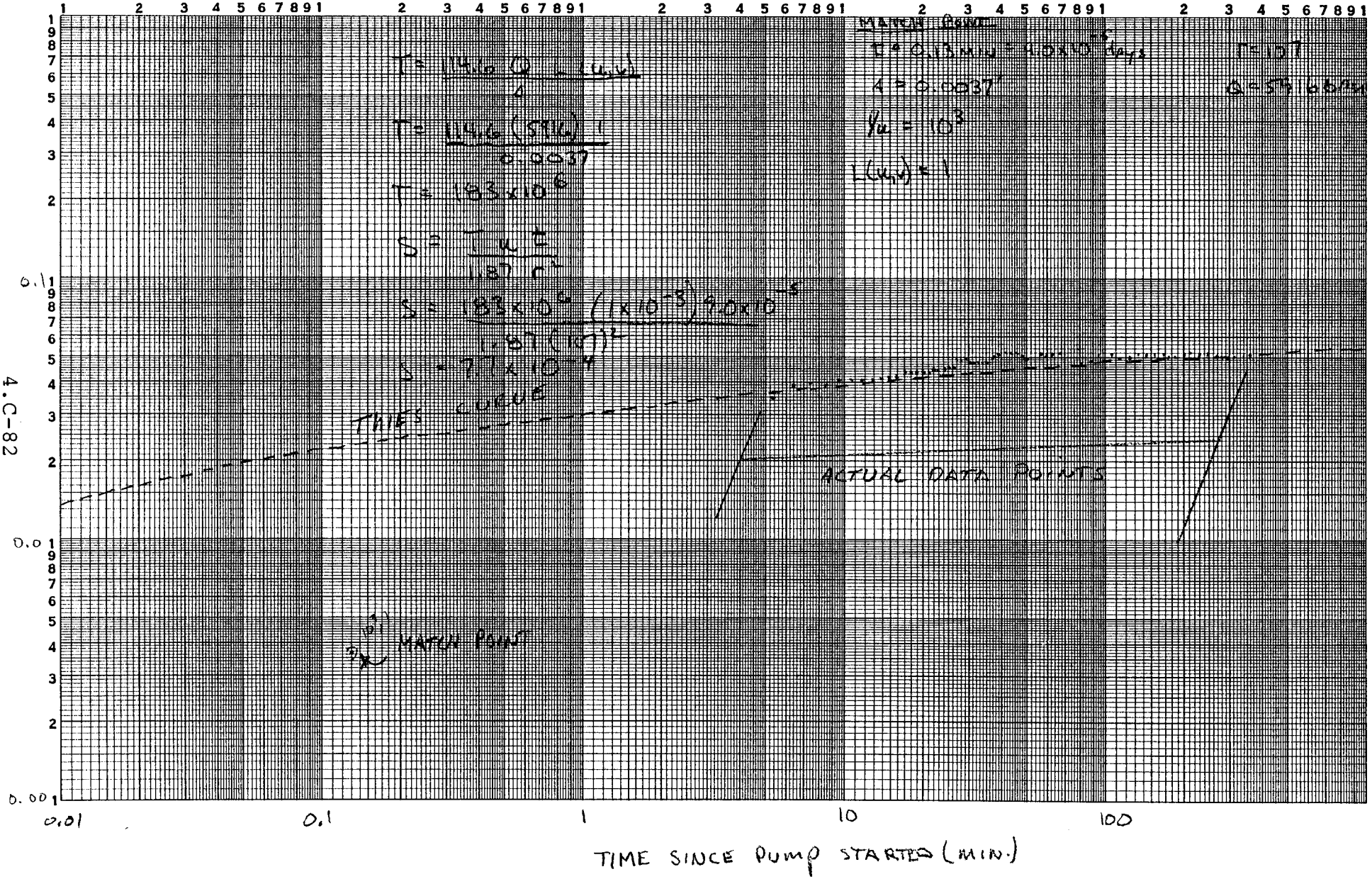
Respectfully submitted,

Roger A. Torton — Chemist

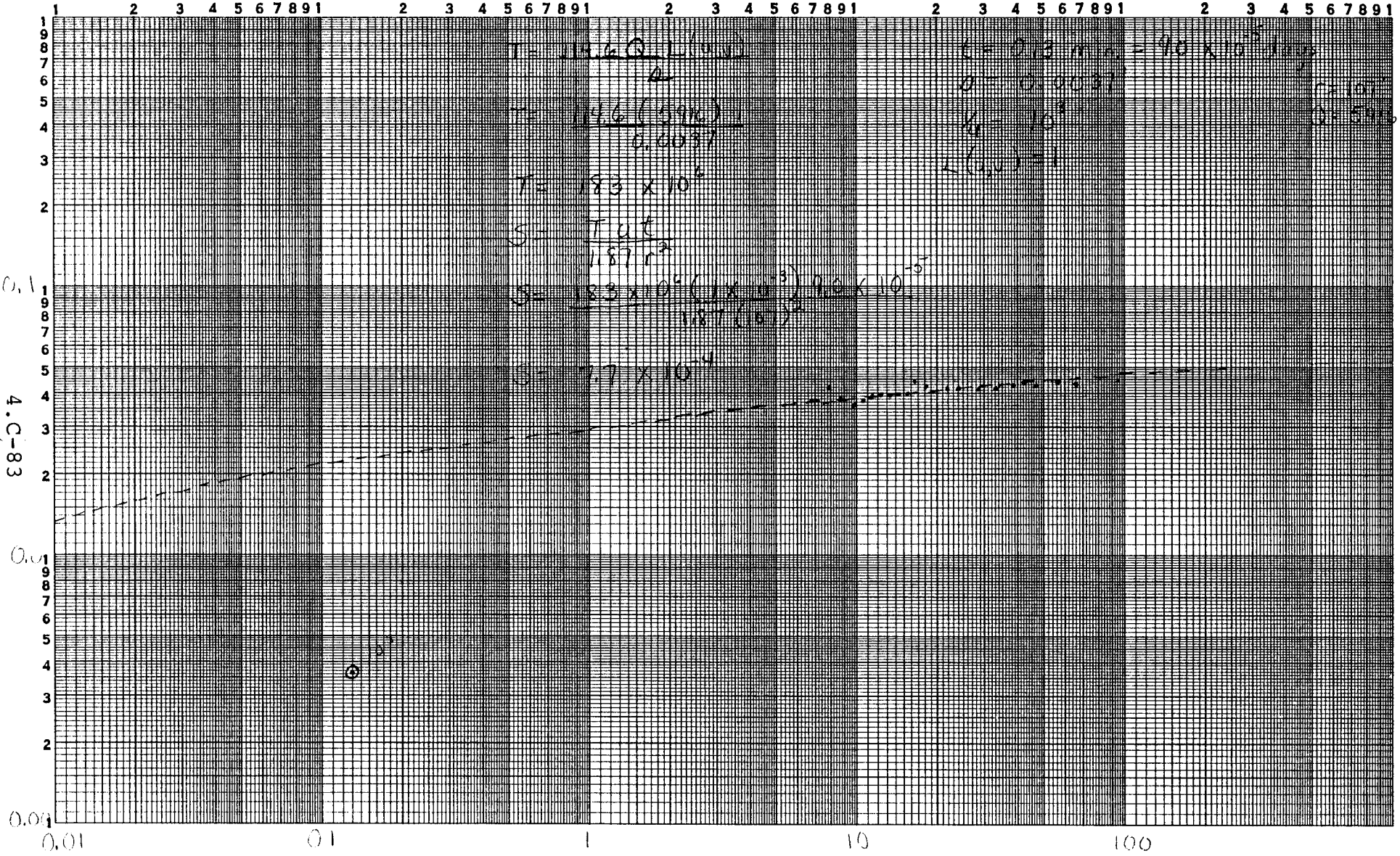
Appendix 4.C-11
ANALYSIS OF DATA

NO. 340-L35 DIETZGEN GRAPH PAPER
LOGARITHMIC
3 CYCLES X 5 CYCLES

DIETZGEN CORPORATION
MADE IN U.S.A.



4.C-82



4.C-83

Appendix 4.C-12
COMPUTER RUN OF STEP-DRAWDOWN ANALYSIS

TEP DRAWDOWN TEST OF MIAMI-DADE INJECTION WELL I-5 CASE

DISCHARGE, Q(GPM)	DRAWDOWN, S(FT)
2077.00	4.33
3855.00	11.41
5956.00	23.57

OPTIMAL P	B	C	MINIMUM ERROR
0.193E+01	0.959E-03	0.925E-06	0.169E-07

$$S = BQ + CQ^{**}P$$

where

B = aquifer loss coefficient

C = well loss coefficient

P = exponent indicating severity of well loss

```
DDDDDDDD          AAAAAA        DDDDDDDD        EEEEEEEEEE          11
DDDDDDDD          AAAAAA        DDDDDDDD        EEEEEEEEEE          11
DD       DD      AA      AA     DD       DD     EE                1111
DD       DD      AA      AA     DD       DD     EE                1111
DD       DD      AA      AA     DD       DD     EE                  11
DD       DD      AA      AA     DD       DD     EE                  11
DD       DD      AA      AA     DD       DD     EEEEEEEE            11
DD       DD      AA      AA     DD       DD     EEEEEEEE            11
DD       DD      AAAAAAAAAA     DD       DD     EE                  11
DD       DD      AAAAAAAAAA     DD       DD     EE                  11
DD       DD      AA      AA     DD       DD     EE                  11
DD       DD      AA      AA     DD       DD     EE                  11
DDDDDDDD         AA      AA     DDDDDDDD        EEEEEEEEEE        111111
DDDDDDDD         AA      AA     DDDDDDDD        EEEEEEEEEE        111111


RRRRRRRR         PPPPPPPP       TTTTTTTTTT
RRRRRRRR         PPPPPPPP       TTTTTTTTTT
RR       RR      PP      PP         TT
RR       RR      PP      PP         TT
RR       RR      PP      PP         TT
RR       RR      PP      PP         TT
RRRRRRRR         PPPPPPPP           TT
RRRRRRRR         PPPPPPPP           TT
RR  RR           PP                 TT
RR  RR           PP                 TT
RR    RR         PP                 TT
RR    RR         PP                 TT
RR      RR       PP                 TT
RR      RR       PP                 TT


 *START* User GNV AQUIFER [20077,15265]  Job  DADE1 Seq. 5524 Date 08-Feb-80 06:
Monitor CH2M HILL KL10/603A.VM B *START*
File: DSKB:DADE1.RPT<155>[20077,15265] Created: 08-Feb-80 06:14:00
         Printed: 08-Feb-80 06:14:53
QUEUE Switches:  /FILE:FORT /COPIES:1
        /SPACING:1 /LIMIT:24 /FORMS:P1
```

Appendix 4.D-1
BOULDER ZONE POTENTIOMETRIC SURFACE
January 1981
DENSITY ADJUSTMENTS WITH TIME/TEMPERATURE CORRECTIONS

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-1

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10							
	100	70.4	1.2	71.6	22.0	1.0244133	6.3952378×10^3
110							
	40	70.4	1.2	71.6	22.0	1.0244133	2.5580951×10^3
150							
	410	70.5	1.1	71.6	22.0	1.0244133	2.6220475×10^4
560							
	170	70.2	1.0	71.2	21.78	1.0244748	1.0872557×10^4
730							
	135	70.2	1.0	71.2	21.78	1.0244748	8.6340892×10^3
865							
	135	70.3	1.0	71.3	21.83	1.0244609	8.6339717×10^3
1000							
	180	70.2	.9	71.1	21.72	1.0244915	1.1512307×10^4
1180							
	180	70.1	.8	70.9	21.61	1.0245221	1.151265×10^4
1360							
	240	69.8	.7	70.5	21.39	1.0245828	1.5351111×10^4
1600							
	440	69.2	.5	69.7	20.94	1.0247057	2.8147083×10^4
2040							
	170	69.0	.3	69.3	20.72	1.0247655	1.0875641×10^4
2210							
	270	68.5	.1	68.6	20.33	1.0248701	1.7274841×10^4
2480							
	245	67.8	-	67.8	19.89	1.0249866	1.5677101×10^4
2725							
	25	67.3	-	67.3	19.61	1.0250599	1.5998185×10^3
2750							
	50	67.0	-	67.0	19.44	1.0251041	3.199775×10^3
2800							
						TOTAL PSF =	1.7846475×10^5

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-3

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10							
	10	70.4	1.4	71.8	22.11	1.0243452	6.3948124×10^{2}
20							
	70	70.9	1.4	72.3	22.39	1.0242661	4.4760233×10^{3}
90							
	40	70.7	1.4	72.1	22.28	1.0242973	2.5578053×10^{3}
130							
	70	70.4	1.4	71.8	22.11	1.0243452	4.4763686×10^{3}
200							
	200	70.6	1.4	72.0	22.22	1.0243142	1.2789238×10^{4}
400							
	200	70.5	1.2	71.7	22.06	1.0243592	1.27898×10^{4}
600							
	350	70.3	1.1	71.4	21.89	1.0244068	2.2383319×10^{4}
950							
	120	70.2	1.1	71.3	21.83	1.0244236	7.6743622×10^{3}
1070							
	120	70.5	1.1	71.6	22.00	1.0243761	7.6740061×10^{3}
1190							
	210	70.3	1.0	71.3	21.83	1.0244236	1.3430134×10^{4}
1400							
	100	69.9	.9	70.8	21.56	1.0244986	6.39577×10^{3}
1500							
	90	69.8	.9	70.7	21.50	1.0245152	5.7562862×10^{3}
1590							
	260	69.1	.8	69.9	21.06	1.0246359	1.6631231×10^{4}
1850							
	190	68.3	.6	68.9	20.50	1.0247873	1.2155387×10^{4}
2040							
	200	68.4	.5	68.9	20.50	1.0247873	1.2795144×10^{4}
2240							
	110	68.5	.5	69.0	20.56	1.0247712	7.0372189×10^{3}
2350							
	75	68.3	.5	68.8	20.44	1.0248033	4.7982543×10^{3}
2425							
	85	67.5	.3	67.8	19.89	1.0249492	5.4387953×10^{3}
2510							
	90	67.2	.1	67.3	19.61	1.0250224	5.7591363×10^{3}
2600							
	45	67.2		67.2	19.56	1.0250355	2.8796047×10^{3}
2645							

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-3

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
2645							
	85	66.6	-	66.6	19.22	1.0251234	5.43972×10^3
2730							
	50	66.9		66.9	19.39	1.0250796	3.1996984×10^3
2780							
	20	66.8		66.8	19.33	1.0250951	1.2798987×10^3
2800							
						TOTAL PSF =	1.7845655×10^5

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-6

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10							
	10	72.0	-.5	71.5	21.94	1.0244028	6.3951718×10^2
20							
	60	72.4	.5	71.9	22.17	1.0243382	3.8368612×10^3
80							
	100	72.6	.5	72.1	22.28	1.0243072	6.394575×10^3
180							
	270	72.8	.5	72.3	22.39	1.024276	1.7264828×10^4
450							
	140	72.7	.5	72.2	22.33	1.024293	8.9522814×10^3
590							
	110	726	.5	72.1	22.28	1.0243072	7.0340325×10^3
700							
	110	72.4	.5	71.9	22.17	1.0243382	7.0342455×10^3
810							
	90	72.3	.5	71.8	22.11	1.0243551	5.7553867×10
900							
	180	72.0	.5	71.5	21.94	1.0244028	1.1511309×10^4
1080							
	170	71.9	.5	71.4	21.89	1.0244167	1.087194×10^4
1250							
	350	71.5	.4	71.1	21.72	1.0244641	2.2384442×10^4
1600							
	60	71.1	.4	70.7	21.50	1.0245251	3.8375612×10^3
1660							
	140	70.9	.3	70.6	21.44	1.0245416	8.9544542×10^3
1800							
	20	70.7	.3	70.4	21.33	1.0245719	1.2792456×10^3
1820							
	70	70.4	.3	70.1	21.17	1.0246158	4.4775511×10^3
1890							
	30	70.3	.3	70.0	21.11	1.0246322	1.9189812×10^3
1920							
	70	70.1	.3	69.8	21.00	1.0246622	4.4777538×10^3
1990							
	90	69.8	.3	69.5	20.83	1.0247083	5.7573713×10^3
2080							
	70	69.7	.2	69.5	20.83	1.0247083	4.4779554×10
2150							
	90	69.3	.2	69.1	20.61	1.0247677	5.7577048×10^3
2240							

DENSITY ADJUSTMENT
WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-6

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
2240							
	120	68.3	-.2	68.1	20.06	1.0249143	7.6780382×10^{3}
2360							
	75	67.6	.2	67.4	19.67	1.0250167	4.7992535×10^{3}
2435							
	55	67.1	.1	67.0	19.44	1.0250766	3.5196558×10^{3}
2490							
	160	66.7	.1	66.6	19.22	1.0251333	1.0239572×10^{4}
2650							
	115	66.2	-	66.2	19.00	1.0251897	7.3600974×10^{3}
2765							
	35	65.6	-	65.6	18.67	1.0252735	2.2402128×10^{3}
2800							
					TOTAL PSF =		1.7845483×10^{5}

DENSITY ADJUSTMENT
WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-8

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10							
	10	76.0	2.5	78.5	25.83	1.0228967	6.3857699×10^2
20							
	60	76.0	2.7	78.7	25.94	1.0228626	3.8313341×10^3
80							
	50	74.0	2.7	76.7	24.83	1.0232027	3.1938401×10^3
130							
	70	70.0	3.0	73.0	22.78	1.0238056	4.4740106×10^3
200							
	130	70.1	2.9	73.0	22.78	1.0238056	8.3086767×10^3
330							
	270	69.9	2.7	72.6	22.56	1.0238683	1.7257955×10^4
600							
	350	69.6	2.6	72.2	22.33	1.0239334	2.2372846×10^4
950							
	150	69.3	2.6	71.9	22.17	1.0239785	9.5887647×10^3
1100							
	240	69.2	2.6	71.8	22.11	1.0239953	1.5342308×10^4
1340							
	360	68.9	2.5	71.4	21.89	1.0240569	2.3014844×10^4
1700							
	80	68.6	2.5	71.1	21.72	1.0241041	5.114646×10^3
1780							
	70	68.7	2.3	71.0	21.67	1.024118	4.4753758×10^3
1650							
	30	68.8	2.2	71.0	21.67	1.024118	1.9180182×10^3
1880							
	50	68.6	2.1	70.7	21.50	1.0241649	3.1968436×10^3
1930							
	70	68.4	2.0	70.4	21.33	1.0242117	4.4757852×10^3
2000							
	80	68.2	2.0	70.2	21.22	1.0242418	5.1153334×10^3
2080							
	60	68.1	2.2	70.3	21.28	1.0242254	3.8364386×10^3
2140							
	50	68.0	2.0	700	21.11	1.0242718	3.1971771×10^3
2190							
	40	67.8	1.9	69.7	20.94	1.024318	2.5578857×10
2230							
	50	67.5	1.6	69.1	20.61	1.0244069	$3.1975[illegible] \times 10^3$
2280							

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-8

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
2280							
	70	67.0	1.5	68.5	20.28	1.024495	4.4770233×10^3
2350							
	100	66.3	1.0	67.3	19.61	1.024671	6.3968462×10^3
2450							
	55	65.8	.9	66.7	19.28	1.0247563	3.5185582×10^3
2505							
	55	66.0	.8	66.8	19.33	1.0247434	3.5185141×10^3
2560							
	140	66.1	.5	66.6	19.22	1.0247717	8.9564647×10^3
2700							
	70	66.1	.4	66.5	19.17	1.0247845	4.4782884×10^3
2770							
	30	66.0	.4	66.4	19.11	1.0247996	1.9192952×10^3
2800							
						TOTAL PSF =	1.7837344×10^5

DENSITY ADJUSTMENT
WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-9

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10							
	25	77.6	.5	78.1	25.61	1.22977562	$1.596568625 \times 10^{3}$
35							
	15	74.8	.5	75.3	24.06	1.0234459	9.5837976×10^{2}
50							
	25	71.8	.5	72.3	22.39	1.0239294	1.5980542×10^{3}
75							
	175	72.0	.5	72.5	22.50	1.0238982	1.1186039×10^{4}
250							
	140	72.1	.4	72.5	22.50	1.0238982	8.9448831×10^{3}
390							
	210	72.0	.4	72.4	22.44	1.0239152	1.3423469×10^{4}
600							
	175	71.9	.35	72.25	22.36	1.0239379	1.1186472×10^{4}
775							
	55	71.8	.35	72.15	22.31	1.023952	3.5157967×10^{3}
830							
	110	71.7	.35	72.05	22.25	1.0239689	7.0317097×10^{3}
940							
	80	71.6	.3	71.9	22.17	1.0239914	5.1140831×10^{3}
1020							
	60	71.7	.3	72.0	22.22	1.0239774	3.8355096×10^{3}
1080							
	160	71.6	.3	71.9	22.17	1.0239914	1.0228166×10^{4}
1240							
	330	71.5	.3	71.8	22.11	1.0240083	2.109594×10^{4}
1570							
	150	71.3	.2	71.5	21.94	1.0240558	9.589509×10^{3}
1720							
	80	71.2	.15	71.35	21.86	1.0240781	5.1145162×10^{3}
1800							
	60	71.4	.15	71.55	21.97	1.0240475	3.8357722×10^{3}
1860							
	130	71.3	.1	71.4	21.89	1.0240698	8.311021×10^{3}
1990							
	70	70.9	.1	71.0	21.67	1.0241309	4.4754223×10^{3}
2060							
	80	70.7	0	70.7	21.50	1.0241779	5.1150143×10^{3}
2140							
	140	70.3	-	70.3	21.28	1.0242383	8.9518032×10^{3}
2280							

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. I-9

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
2280							
	50	69.5	-	69.5	20.83	1.0243607	3.1974545×10^3
2330							
	50	68.8	-	68.8	20.44	1.0244654	3.1977813×10^3
2380							
	80	68.3	-	68.3	20.17	1.0245371	5.1168084×10^3
2460							
	10	68.0	-	68.0	20.0	1.024582	6.3962905×10^2
2470							
	130	67.4	-	67.4	19.67	1.0246683	8.3158787×10^3
2600							
	150	67.0	-	67.0	19.44	1.024728	9.5958034×10^3
2750							
	50	66.9	-	66.9	19.39	1.0247409	3.1986414×10^3
2800							
					TOTAL PSF =		1.7837408×10^5

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. BZ-1

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10							
	10		72.0		22.22	1.024359 08	6.394899 $\times 10^2$
20							
	10		73.6		23.11	1.0241048	6.393312 $\times 10^2$
30							
	15		74.1		23.39	1.0240235	9.58892063 $\times 10^2$
45							
	30		74.7		23.72	1.02392689	1.9176603 $\times 10^3$
75							
	5		75.4		24.11	1.02381159	3.1957406 $\times 10^2$
80							
	20		74.9		23.83	1.02389449	1.2783997 $\times 10^3$
100							
	60		74.6		23.67	1.02394159	3.8353756 $\times 10^3$
160							
	25		74.9		23.83	1.02389449	1.597999 $\times 10^3$
185							
	5		75.0		23.89	1.02387678	3.1959441 $\times 10^2$
190							
	150		74.8		23.78	1.0239092	9.5881361 $\times 10^3$
340							
	90		74.7		23.72	1.02392689	5.752981 $\times 10^3$
430							
	40		74.6		23.67	1.0239416	2.556917 $\times 10^3$
470							
	60		74.5		23.61	1.0239592	3.835442 $\times 10^3$
530							
	140		74.3		23.50	1.0239914	8.9496452 $\times 10^3$
670							
	50		74.2		23.44	1.02400893	3.1963566 $\times 10^3$
720							
	80		74.0		23.33	1.024004099	5.1143306 $\times 10^3$
800							
	100		73.8		23.22	1.02407295	6.3931128 $\times 10^3$
900							
	100		73.8		23.22	1.02407295	6.3931128 $\times 10^3$
1000							
	30		73.8		23.22	1.02407295	1.9179338 $\times 10$
1030							
	5		73.7		23.17	1.024087 45	3.1966017 $\times 10^2$
1035							

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. BZ-1

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
1035							
	15		73.7		23.17	1.02408745	$9.58980496 \times 10^{}$
1050							
	50		73.6		23.11	1.0241048	3.1966559×10^{3}
1100							
	50		73.5		2306	1.0241193	3.1967009×10^{3}
1150							
	70		73.4		23.00	1.0241366	4.475457×10^{3}
1220							
	80		73.2		22.89	1.0241683	5.1149662×10^{3}
1300							
	240		72.8		22.67	1.0242313	1.5345844×10^{4}
1540							
	40		72.3		22.39	1.0243110	2.5578396×10^{3}
1580							
	20		72.1		22.28	1.0243421	1.2789587×10^{3}
1600							
	40		71.9		22.17	1.02437318	2.5579948×10^{3}
1640							
	120		71.6		22.00	1.02442095	7.6743424×10^{3}
1760							
	50		71.2		21.78	1.0244824	3.1978346×10^{3}
1810							
	50		71.1		21.72	1.0244991	3.1978867×10^{3}
1860							
	150		70.6		21.44	1.0245767	9.594386×10^{3}
2010							
	165		69.8		21.00	1.0246972	1.0555067×10^{4}
2175							
	255		68.7		20.39	1.0248617	1.6314994×10^{4}
2430							
	30		67.8		19.89	1.0249942	1.9196593×10^{3}
2460							
	40		67.5		19.72	1.0250388	2.559657×10^{3}
2500							
	40		67.2		19.56	1.02508055	2.5597612×10^{3}
2540							
	100		67.0		19.44	1.0251117	6.3995977×10^{3}
2640							
	40		66.8		19.33	1.02514017	2.559910×10^{3}
2680							

DENSITY ADJUSTMENT WITH TIME/TEMPERATURE CORRECTIONS

WELL NO. BZ-1

Depth (ft)	Length of Column (ft)	Temp. Log °F	Temp. °F Adj.	Temp. °F Total	Equivalent Temp. °C	Density (g/cm³)	Adjusted Column (psf)
2680							
	35		66.7		19.28	1.02515308	2.2397496×10^3
2715							
	25		66.4		19.11	1.02519678	$1.6000 3218 \times 10^3$
2740							
	25		66.1		18.94	1.02524024	1.6001000×10^3
2765							
	35		66.0		18.89	1.02525298	2.2401678×10^3
2800							
						TOTAL PSF =	1.7842072×10^5

Appendix 4.D-2
BOULDER ZONE POTENTIOMETRIC SURFACE
March 1981
DENSITY ADJUSTMENTS WITH EQUILIBRIUM TEMPERATURE PROFILES

DENSITY ADJUSTMENT
EQUILIBRIUM TEMPERATURE PROFILE

WELL NO. I-1

Depth Interval (ft)	Length of Column (ft)	Temp. °C	Density (g/cm^3)	Adjusted Column (psf)
10 - 75	65	23.69	1.0239281	4.1549357×10^3
75 - 200	125	23.85	1.023881	7.9898932×10^3
200 - 600	400	23.87	1.0238751	2.5567511×10^4
600 - 1000	400	23.64	1.0239428	2.5569201×10^4
1000 - 1200	200	23.43	1.0240043	1.2785368×10^4
1200 - 1400	200	23.18	1.024077	1.2786276×10^4
1400 - 1600	200	22.91	1.0241549	1.2787249×10^4
1600 - 1800	200	22.44	1.0242892	1.2788926×10^4
1800 - 1900	100	22.17	1.0243656	6.3949396×10^3
1900 - 2000	100	21.90	1.0244413	6.3954126×10^3
2000 - 2100	100	21.56	1.0245359	6.396003×10^3
2100 - 2200	100	21.30	1.0246076	6.3964504×10^3
2200 - 2300	100	20.98	1.024695	6.3969964×10^3
2300 - 2400	100	20.56	1.0248086	6.397705×10^3
2400 - 2485	85	20.20	1.0249047	5.4385594×10^3
2485 - 2520	35	19.91	1.0249813	2.2395743×10^3
2520 - 2600	80	19.67	1.0250442	5.1193411×10^3
2600 - 2700	100	19.33	1.0251325	6.3997276×10^3
2700 - 2780	80	18.98	1.0252224	5.1202309×10^3
2780 - 2800	20	18.85	1.0252555	1.2800991×10^3

TOTAL PSF = 1.7840441×10^5

DENSITY ADJUSTMENT
EQUILIBRIUM TEMPERATURE PROFILE

WELL NO. I-3

Depth Interval (ft)	Length of Column (ft)	Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10 - 75	65	23.69	1.023891	4.1547848×10^3
75 - 200	125	23.85	1.0238438	7.9896032×10^3
200 - 600	400	23.87	1.0238379	2.5566583×10^4
600 - 1000	400	23.64	1.0239056	2.5568273×10^4
1000 - 1200	200	23.43	1.0239671	1.2784904×10^4
1200 - 1400	200	23.18	1.0240398	1.2785811×10^4
1400 - 1600	200	22.91	1.0241177	1.2786784×10^4
1600 - 1800	200	22.44	1.024252	1.2788461×10^4
1800 - 1900	100	22.17	1.0243283	6.394707×10^3
1900 - 2000	100	21.90	1.024404	6.3951798×10^3
2000 - 2100	100	21.56	1.0244986	6.39577×10^3
2100 - 2200	100	21.30	1.0245703	6.3962174×10^3
2200 - 2300	100	20.98	1.0246577	6.3967633×10^3
2300 - 2400	100	20.56	1.0247712	6.3974717×10^3
2400 - 2485	85	20.20	1.0248673	5.4383609×10^3
2485 - 2520	35	19.91	1.0249439	2.2394925×10^3
2520 - 2600	80	19.67	1.0250068	5.1191541×10^3
2600 - 2700	100	19.33	1.0250951	6.3994937×10^3
2700 - 2780	80	18.98	1.0251849	5.1200436×10^3
2780 - 2800	20	18.85	1.025218	1.2800522×10^3

TOTAL PSF = 1.7839791×10^5

DENSITY ADJUSTMENT
EQUILIBRIUM TEMPERATURE PROFILE

WELL NO. I-6

Depth Interval (ft)	Length of Column (ft)	Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10 - 75	65	23.69	1.0239008	4.1548248 X10³
75 - 200	125	23.85	1.0238537	7.9896802 X10³
200 - 600	400	23.87	1.0238478	2.5566829 X10⁴
600 - 1000	400	23.64	1.0239155	2.5568519 X10⁴
1000 - 1200	200	23.43	1.0239769	1.2785027 X10⁴
1200 - 1400	200	23.18	1.0240496	1.2785934 X10⁴
1400 - 1600	200	22.91	1.0241276	1.2786908 X10⁴
1600 - 1800	200	22.44	1.0242619	1.2788584 X10⁴
1800 - 1900	100	22.17	1.0243382	6.3947687 X10³
1900 - 2000	100	21.90	1.0244139	6.3952416 X10³
2000 - 2100	100	21.56	1.0245085	6.3958318 X10³
2100 - 2200	100	21.30	1.0245802	6.3962792 X10³
2200 - 2300	100	20.98	1.0246676	6.3968251 X10³
2300 - 2400	100	20.56	1.0247811	6.3975336 X10³
2400 - 2485	85	20.20	1.0248772	5.4384136 X10³
2485 - 2520	35	19.91	1.0249538	2.2395142 X10³
2520 - 2600	80	19.67	1.0250167	5.1192038 X10³
2600 - 2700	100	19.33	1.025105	6.3995557 X10³
2700 - 2780	80	18.98	1.0251948	5.1200933 X10³
2780 - 2800	20	18.85	1.0252279	1.2800647 X10³

TOTAL PSF = 1.7839963 X10⁵

DENSITY ADJUSTMENT
EQUILIBRIUM TEMPERATURE PROFILE

WELL NO. I-8

Depth Interval (ft)	Length of Column (ft)	Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10 - 75	65	23.69	1.0235421	1.1533691 $\times 10^3$
75 - 200	125	23.85	1.0234951	7.9868815 $\times 10^3$
200 - 600	400	23.87	1.0234892	2.5557874 $\times 10^4$
600 - 1000	400	23.64	1.0235567	2.555956 $\times 10^4$
1000 - 1200	200	23.43	1.023618	1.2780546 $\times 10^4$
1200 - 1400	200	23.18	1.0236906	1.2781451 $\times 10^4$
1400 - 1600	200	22.91	1.0237683	1.2782422 $\times 10^4$
1600 - 1800	200	22.44	1.0239023	1.2784095 $\times 10^4$
1800 - 1900	100	22.17	1.0239785	6.3925234 $\times 10^3$
1900 - 2000	100	21.90	1.0240545	6.392995 $\times 10^3$
2000 - 2100	100	21.56	1.0241484	6.3935638 $\times 10^3$
2100 - 2200	100	21.30	1.0242199	6.3940302 $\times 10^3$
2200 - 2300	100	20.98	1.0243071	6.3945747 $\times 10^3$
2300 - 2400	100	20.56	1.0244203	6.3952815 $\times 10^3$
2400 - 2485	85	20.20	1.0245162	5.4364979 $\times 10^3$
2485 - 2520	35	19.91	1.0245926	2.238725 $\times 10^3$
2520 - 2600	80	19.67	1.0246554	5.117399 $\times 10^3$
2600 - 2700	100	19.33	1.0247434	6.3972983 $\times 10^3$
2700 - 2780	80	18.98	1.024833	5.1182861 $\times 10^3$
2780 - 2800	20	18.85	1.024866	1.2796127 $\times 10^3$

TOTAL PSF = 1.7833701 $\times 10^5$

DENSITY ADJUSTMENT
EQUILIBRIUM TEMPERATURE PROFILE

WELL NO. I-9

Depth Interval (ft)	Length of Column (ft)	Temp. °C	Density (g/cm³)	Adjusted Column (psf)
10 - 75	65	23.69	1.0235555	4.1534214 x10³
75 - 200	125	23.85	1.0235098	7.9869821 x10³
200 - 600	400	23.87	1.0235021	2.5558185 x10⁴
600 - 1000	400	23.64	1.0235696	2.5559882 x10⁴
1000 - 1200	200	23.43	1.0236309	1.2780797 x10⁴
1200 - 1400	200	23.18	1.0238035	1.2786612 x10⁴
1400 - 1600	200	22.91	1.0237812	1.2782584 x10⁴
1600 - 1800	200	22.44	1.0239452	1.2784257 x10⁴
1800 - 1900	100	22.17	1.0239914	6.3926038 x10³
1900 - 2000	100	21.90	1.0240847	6.3930750 x10³
2000 - 2100	100	21.56	1.0241613	6.3936646 x10³
2100 - 2200	100	21.30	1.0242328	6.3941121 x10³
2200 - 2300	100	20.98	1.0243201	6.3946556 x10³
2300 - 2400	100	20.56	1.0244333	6.3953624 x10³
2400 - 2485	85	20.20	1.0245292	5.4365668 x10³
2485 - 2520	35	19.91	1.0246056	2.2387534 x10³
2520 - 2600	80	19.67	1.0246683	5.1174638 x10³
2600 - 2700	100	19.33	1.0247564	6.3973794 x10³
2700 - 2780	80	18.98	1.0248476	5.1183514 x10³
2780 - 2800	20	18.85	1.0248879	1.2796294 x10³

TOTAL PSF = 1.7833926 x10⁵