EXECUTIVE DETERMINATION OF EMERGENCY, WAIVER FROM COMPETITIVE PROCUREMENT REQUIREMENTS FOR THE BALLARD SIPHON REPLACEMENT IN THE WASHINGTON SHIP CANAL

WHEREAS, the Washington Ship Canal is the only migratory path for fish entering and leaving Lake Washington, Lake Sammamish and the respective tributaries and is a significant and important environmental resource; and

WHEREAS, the existing Ballard Siphon in the Washington Ship Canal was built in 1935 and consists of two 36-inch diameter wood-stave pipes. Wood-stave pipes are shaped wood planks and are made by compressing wood stave into the cylindrical shape by means of tensioned steel bands or rods; and

WHEREAS, the existing Ballard Siphon on average conveys seven to eight million gallons per day across the Washington Ship Canal; and

WHEREAS, the Wastewater Treatment Division (WTD) has an extensive program to perform condition assessments on the 350 miles of pipes that makes up the wastewater conveyance system for King County; and

WHEREAS, the sonar technology to inspect wastewater pipes that are full of sewage became available to the WTD in November, 2005; and

WHEREAS, on December 15, 2005 the WTD received the sonar inspection report from Sonar Solution Inc. for the existing Ballard Siphon; and

WHEREAS, on January 17, 2006 the structural engineering consultant firm Roberts Engineering submitted a structural analysis report of the sonar inspection which concluded that the existing Ballard Siphon had exceeded its service life; is failing in multiple locations; and is in imminent danger of total collapse; and

WHEREAS, the WTD has determined that repair to the existing Ballard Siphon is not feasible and the condition of the Siphon warrants installing a temporary emergency bypass pipe to mitigate risks and reduce impacts from a total collapse; and

WHEREAS, the emergency temporary bypass does not eliminate overflows upon a total pipe collapse, but will reduce the amount of untreated sewage flowing into the Ship Canal from an average flow of seven to eight million gallons per day to an average flow of two to three million gallons per day; and

WHEREAS, the environmental, operations and maintenance concerns with placing the new siphons onto the canal floor may dictate using a specialized horizontal direction drilling technique to install new pipes under the Ship Canal; and

WHEREAS, the imminent risk of total collapse of the existing Siphon and the resultant large sewage overflows into the Ship Canal constitute an emergency that presents real threat to public health, safety, welfare, property and the environment; and

WHEREAS, an emergency declaration is the initial step that will allow the WTD to work with permitting agencies throughout the construction process so that permits can be issued after construction has been completed as opposed to prior to the commencement of construction; and

WHEREAS, the permitting process associated with the emergency declaration is necessary to assure the timely installation of the emergency bypass pipe and design, construction and installation of a new siphon and inlet and outlet structures; and

WHEREAS, an emergency waiver of competitive bidding and formal solicitation requirements of state and county law is necessary to assure the timely installation of the emergency bypass pipe and design, construction and installation of a new siphon and inlet and outlet structures; and

WHEREAS, the full costs of the Ballard Siphon Replacement Project is estimated to be between $12,000,000 and $13,000,000 to cover all costs and expenses associated with the design, construction and completion of the Project.

NOW THEREFORE THE KING COUNTY EXECUTIVE, RON SIMS, HEREBY DETERMINES AND DECLARES AS FOLLOWS:

SECTION 1: There is an emergency because a) the existing Ballard Siphon has surpassed its useful life span; b) there is imminent risk of total collapse of the siphon; and c) such total collapse would result is release of untreated sewage into the Ship Canal. Immediate steps must be taken to preserve the public health, safety, welfare, property and the environment.

SECTION 2: The requirements for competitive bidding and formal solicitation of construction, design and other required services, materials and equipment under chapters 36.32, 39.80 and 39.10 RCW and K.C.C. chapters 4.04, 4.16, 4.18, 12.16, 12.18 and 12.19 are hereby waived with reference to the actions or contracts relating to the Ballard Siphon Replacement. This waiver expires upon completion of this project.

King County Executive

3-29-2006

Date

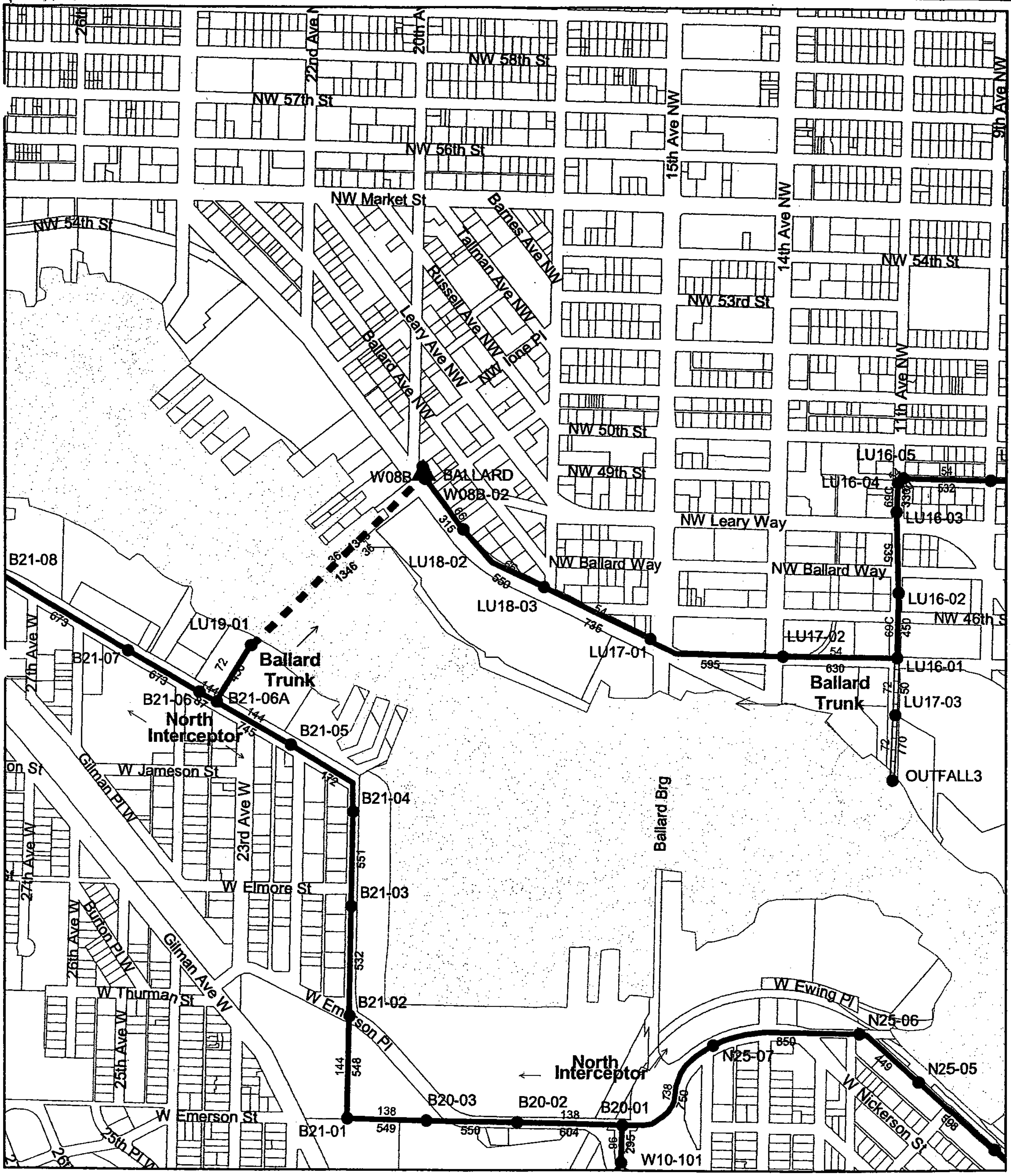
A1: Maps, pictures and diagrams of the Ballard Siphon/

A2: King County Report on Sonar Profiling Survey, Ballard Siphon, Seattle, WA. December 2005

A3: Letter from Roberts Engineering regarding Ballard Siphon sonar evaluation.

A4: Ballard Siphon Project emergency schedule

A 1



Ballard Trunk

WW*BALLARD

300 0 300 600 900 1200 Feet

N E S W

Map produced by GIS staff, Wastewater Treatment Division (WTD), King County Department of Natural Resources. WTD disclaims any warranty for use of this digital product beyond that for which it was designed. Neither this digital product, nor any portion thereof may be reproduced in any form or by any means without the expressed written authorization of WTD. This document includes data copyrighted by the Kroll Map Company and is being used with their permission. Use is restricted.

KING COUNTY

Sonar Inspections

Ballard Siphon

Ballard Regulator

Site Map

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N

September 28, 2005

8 0 8 16 24 32 40 Feet

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King County

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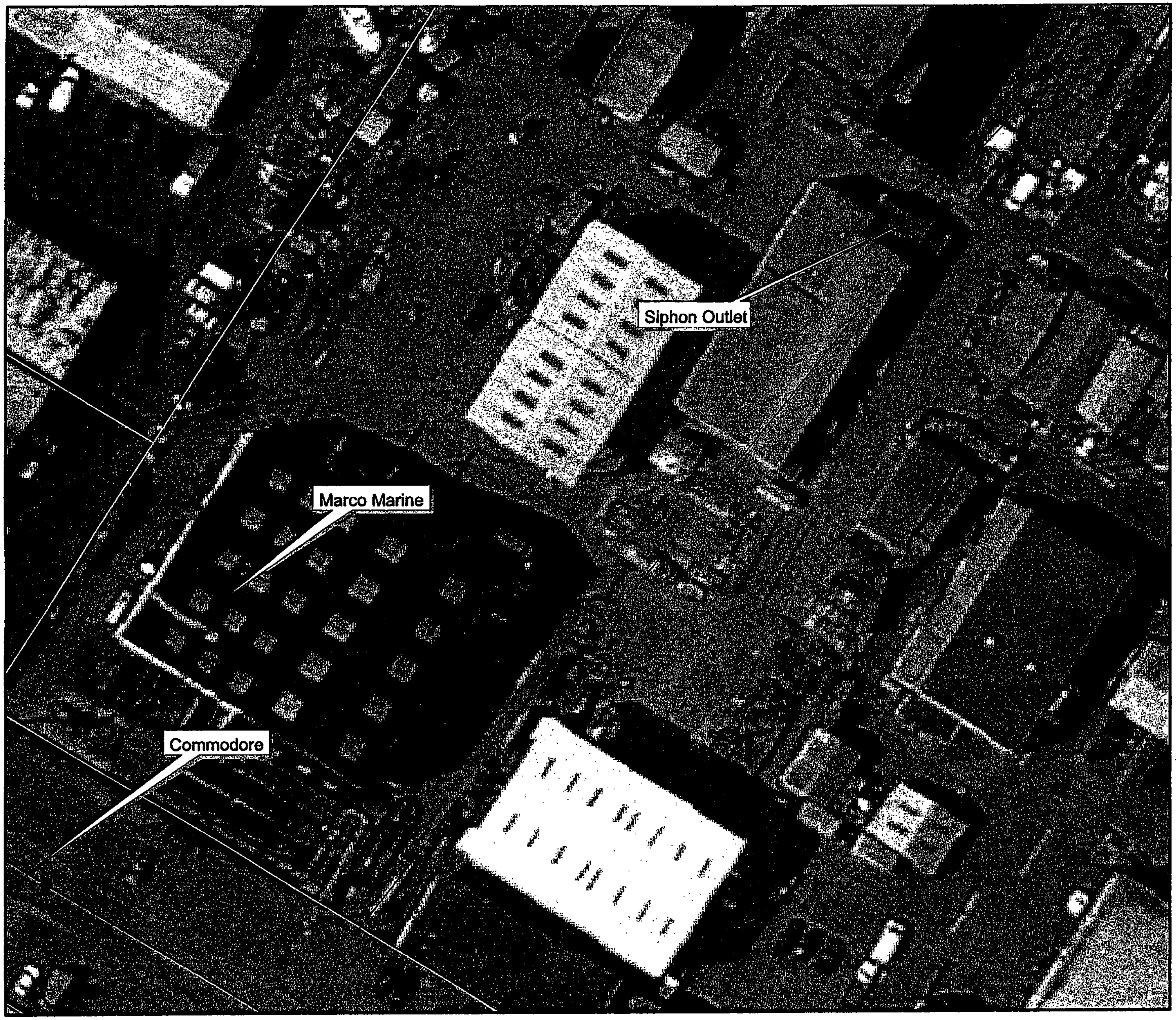
- Sewer.shp
- Kcsnstrt.shp



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August 15, 2005

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King County

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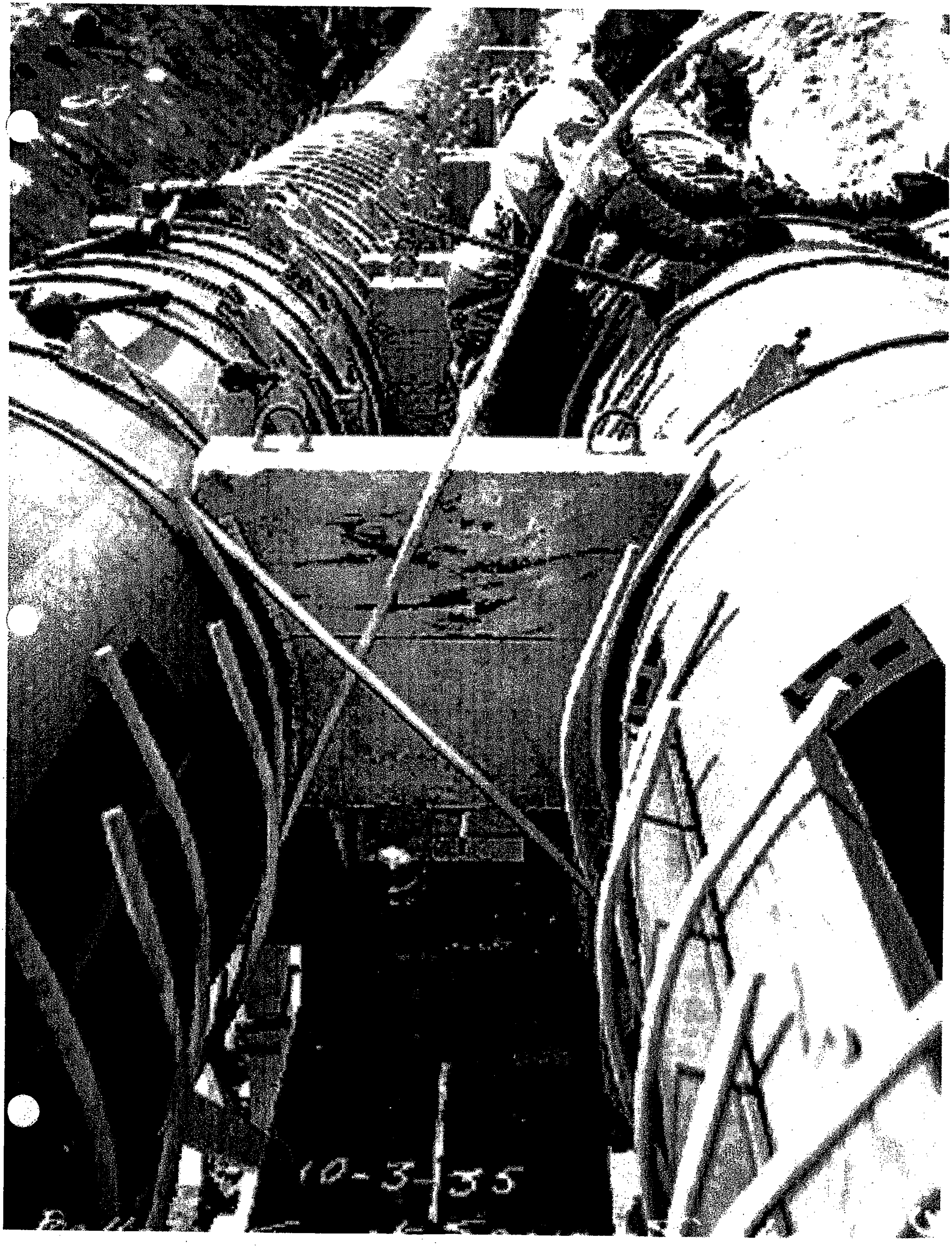
Sonar Inspections

Ballard Siphon Outlet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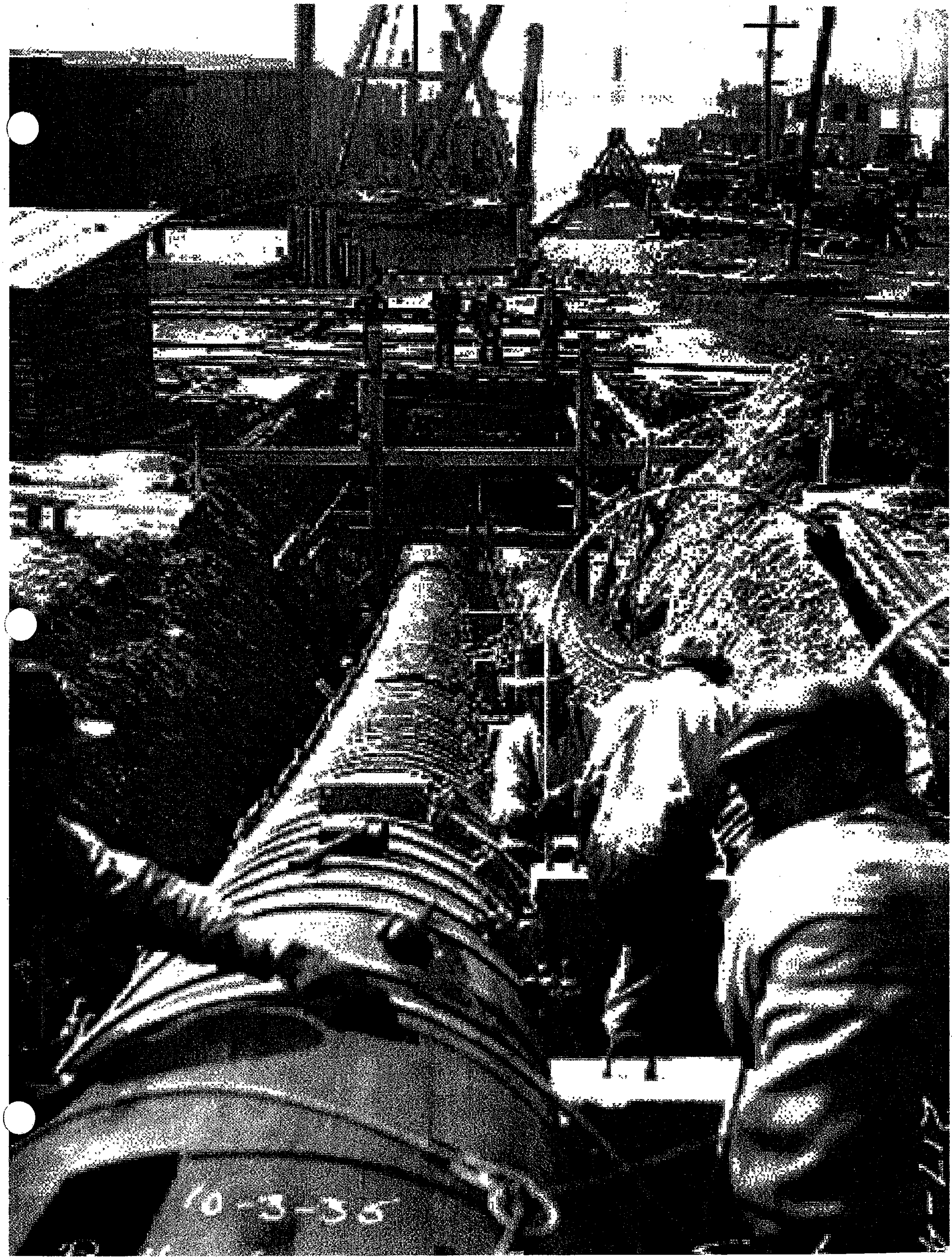
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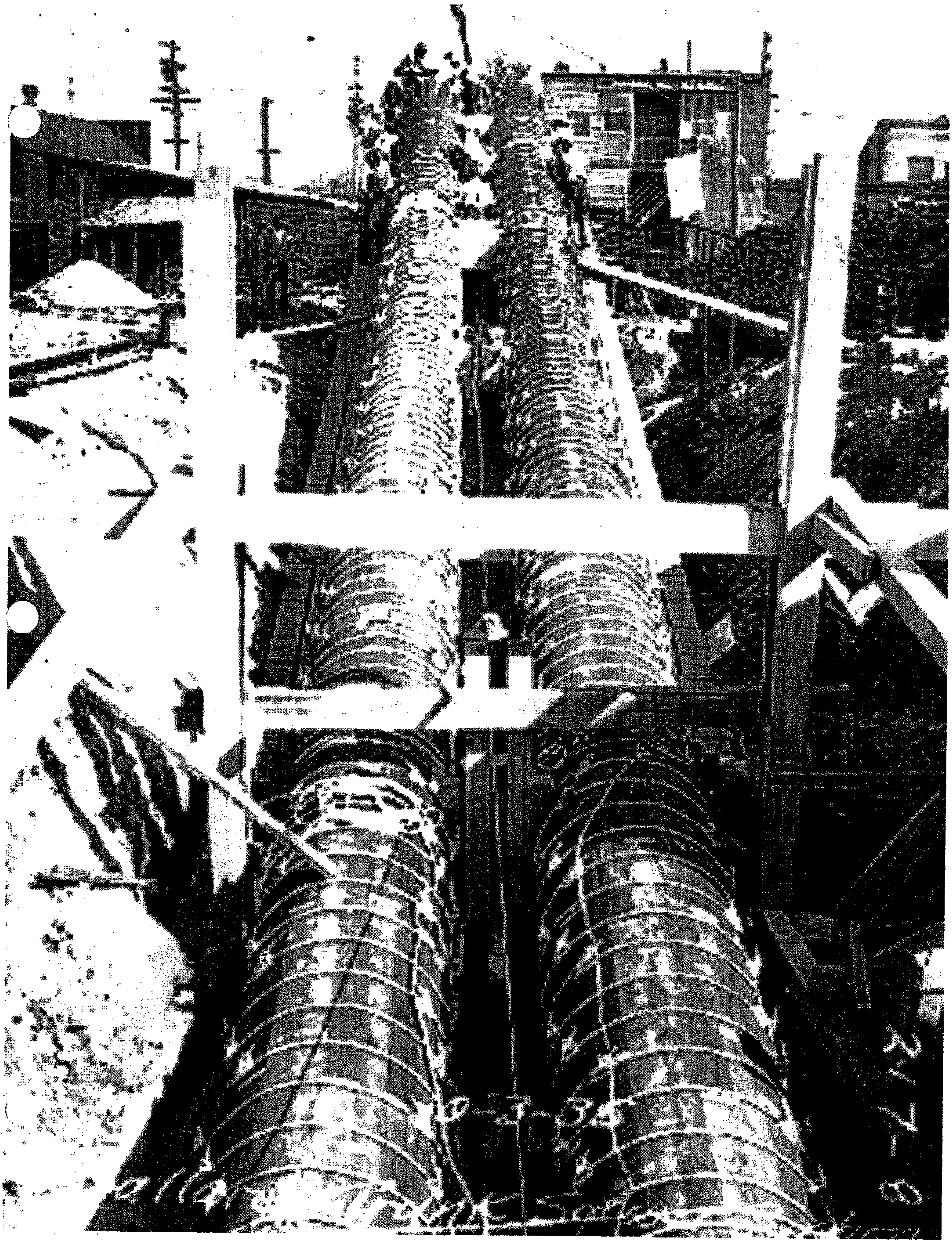

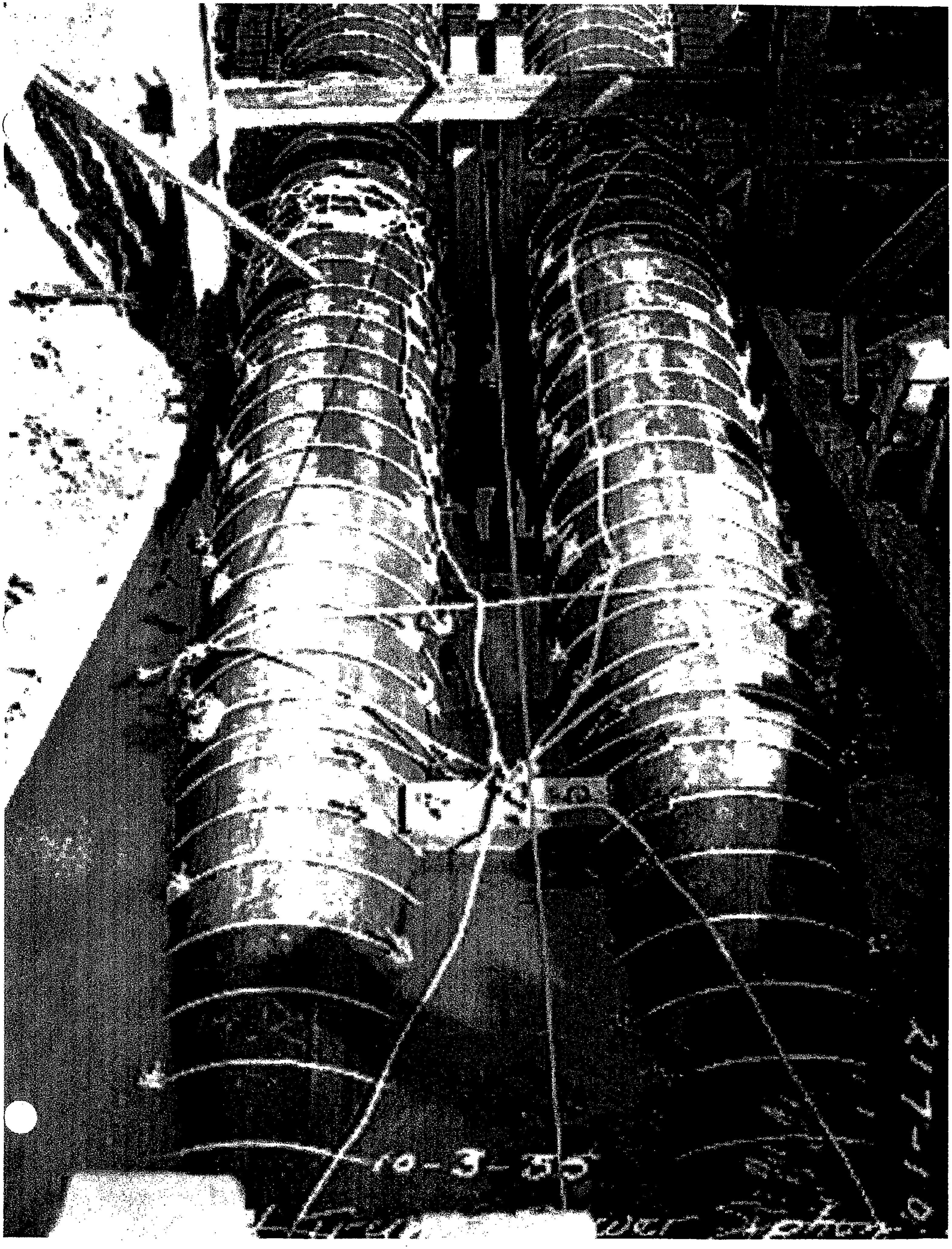
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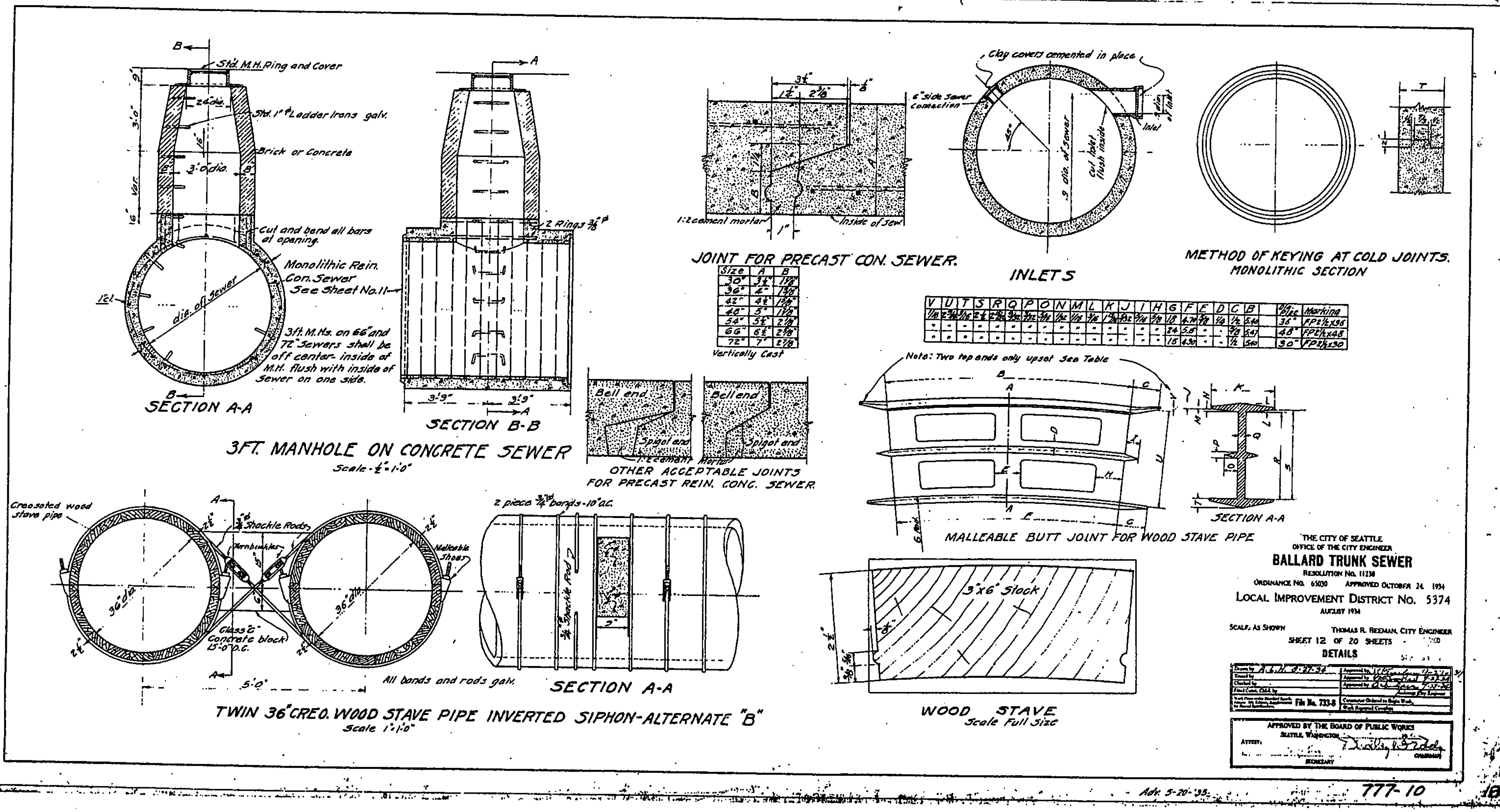

Size	A	B
30"	3 1/2"	1 1/8"
36"	4"	1 3/8"
42"	4 1/2"	1 5/8"
48"	5"	1 7/8"
54"	5 1/2"	2 1/8"
66"	6 1/2"	2 3/8"
72"	7"	2 7/8"

V	U	T	S	R	Q	P	O	N	M	L	K	J	I	H	G	F	E	D	C	B		Dia. Pipe	Marking
1/16	[illegible]	3/16	2 1/2	[illegible]	9/32	9/32	3/16	1/32	1/16	1/16	[illegible]	9/32	3/16	3/8	18	4.74	5/16	1/4	1/2	5.40		36"	FP2½x36
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	5.5	-	-	5/8	5.47		48"	FP2½x48
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15	4.30	-	-	1/2	5.40		30"	FP2½x30

A2

KING COUNTY

REPORT ON A

SONAR PROFILING SURVEY

BALLARD SIPHON

SEATTLE, WA

December, 2005 **FGI-838**

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Tel: 604.987.3037 Fax: 604.984.3074

Sonar Solutions International, Inc. 2445 NW 29th St., Corvallis, OR, 97330 USA
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CONTENTS

ILLUSTRATIONS

1. INTRODUCTION

The Ballard twin siphons were constructed in the mid-1930s using wood stave pipe. The pipe is comprised of 21 creosoted wood staves of 2 inch by 6 inch stock, resulting in a nominal 36 inch inside diameter, and a pipe wall thickness of 2.5 inches. A sonar survey was undertaken to provide detailed profiles of the two siphons. The survey was conducted from October 31st to November 3rd in 2005.

The sonar system employed a 2.2 MHz rotating head sonar system equipped with a fast scan forward looking sonar and low light underwater CCTV camera with light. A gyro-stabilized attitude and acceleration navigation system was used to provide orientation and position data. The sonar system was pulled through the siphon using a sand line attached to a winch on the downstream (south) end of the siphon. Communication with the sonar and CCTV was carried via a fibre optic cable operated from a winch on the upstream (north) side of the siphon. A cable payout counter recorded the probe position as the instrument was moved through the siphon, and load cells monitored the amount of strain on each cable.

2. SCOPE OF WORK

The project entailed carrying out a sonar profiling inspection of the Ballard siphons. The purpose of the inspection is to assess the condition of the wood stave pipe and to ascertain the level of sediment in the pipe.

3. SURVEY METHODOLOGY

3.1 Instrumentation and Survey Operation

The instrumentation on the probe survey platform acquired sonar data in real time and transmitted this data to the operations trailer through a fibre optic cable. The probe instrumentation is contained within a high pressure water tight housing. Power for lights and electronics was transmitted on copper conductors incorporated into the fibre optic cable. Other telemetry information relayed back to the operations trailer included cable tension, system attitude, system acceleration, temperature and voltages in the probe. Telemetry from the control booth to the platform consisted of sonar control for both the rotating-head and the forward-looking sonar. The system includes the capability to transmit video images from a camera mounted on the probe, but due to the low visibility fluids in the fully charged siphon this was not used. The camera is a highly sensitive black and white camera that can operate at light levels of 0.0003 lux. The data was displayed on colour graphics displays for real time monitoring and stored on hard disk in the control booth.

A 2.2 MHz scanning narrow-beam profiling sonar with a rotating head and a forward looking 675 kHz fast scan sonar was used on the survey. The sonar is positioned under water and generates an acoustic pulse in a very narrow cone. Once the pulse hits a target, it bounces back and the echo appears as a data point. Settings for the sonar operation, based on local site conditions, are entered in the control software. Through the use of subsequent processing software, this data is translated into XYZ positions and can be plotted in a variety of formats.

The fiber optic winch is driven by a variable speed 5 HP motor/gearbox and can develop tensions of up to 5000 lbs. (22 kN). The cable is level wound onto the drum with an endless helical thread chain driven by the drum axle. The cable is terminated into a rotary fibre optic slip ring assembly The fibre optic cable contains a single-mode fibre optic strand that carries the video signals and the data/control signals. The power conductors carried alternating current of sufficient level to overcome the line losses. The cable communicates via a fibre optic modem at each end that that is capable of transmitting passes two channels of full video and six bi-directional serial data channels

For the north side, the fiber winch was set up approximately 40 feet south of the vault, with the command trailer to the east of the winch (Photo 1). A sand line was established through the siphon by Rivers Edge Services, and the ends were anchored for later use. The gates were lowered into place to direct all flow to the alternate to the pipe under inspection. The weir in the regulator structure forebay directs normal flow to the west pipe, with additional peak capacity provided by the east pipe. The east pipe was surveyed first.

Two square sectional aluminum beams with a mounted sheave wheel direct the cable down the shaft from the surface (Photo 3). The sheave beam also supports the payout counter/ load cell system. The fibre optic cable was then seated in the payout counter and load cell system, and the probe was lowered into the shaft. The survey was commenced after an offset measurement was calculated for the sonar head. The west pipe was surveyed in a similar manner with the draw works gear aligned with west pipe vault.

The fibre optic winch was located at the north end of the Ballard siphon, and a rope tow winch at the south end. The tow cable winch is driven by a variable speed 5 HP electric motor and worm gearbox (Photo 4). The sand line was attached to the tow winch at the south end, and to the sonar probe at the north end. The probe was then launched, controlled by the fiber optical cable upstream, and the inspection operation was underway.

At the north end, the sand line winch was operated at a constant torque, and the fibre optic winch is run at a constant speed. During the survey, the cable payout and winch load data from the north side of the siphon was relayed by radio to the control booth to provide operational information to the winch controller. The probe was equipped with floatation and skids (Photo 2) that provided approximately neutral buoyancy within the pipe. This produced excellent cross sectional data. The run was completed when a marker flag on the rope emerged from the south vault, and the projected measured distance had elapsed (1320 feet). The process was then reversed and the probe recovered at the north vault.

Photo 1: North Station Draw Works

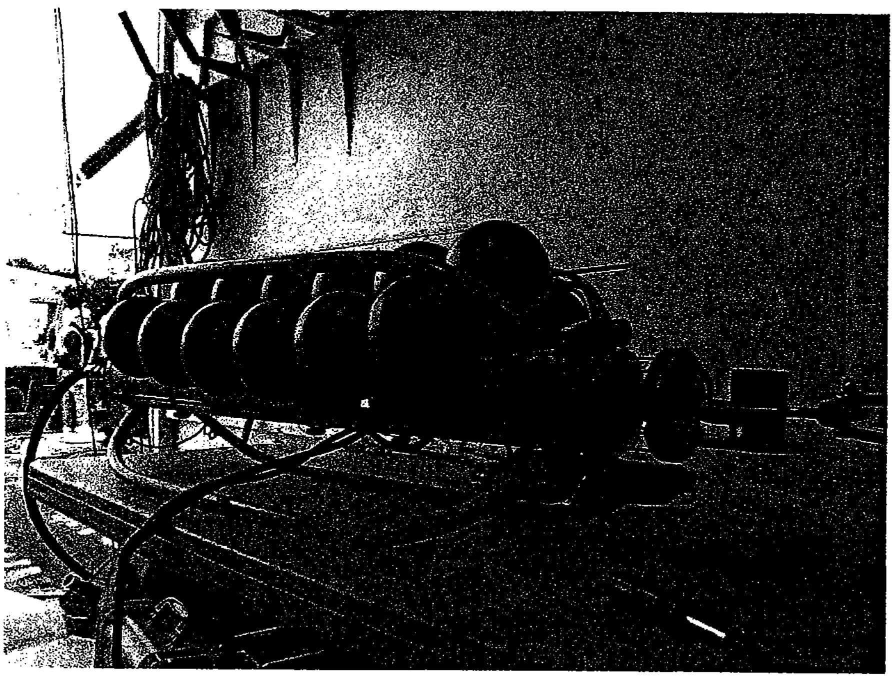


Photo 2: Sonar System Probe

Shown with floatation and skids, in the operations trailer

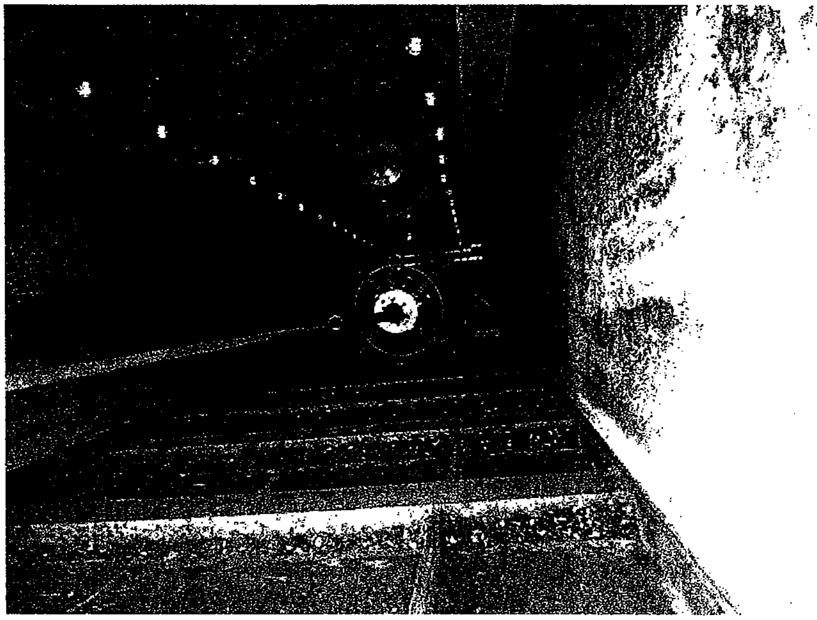


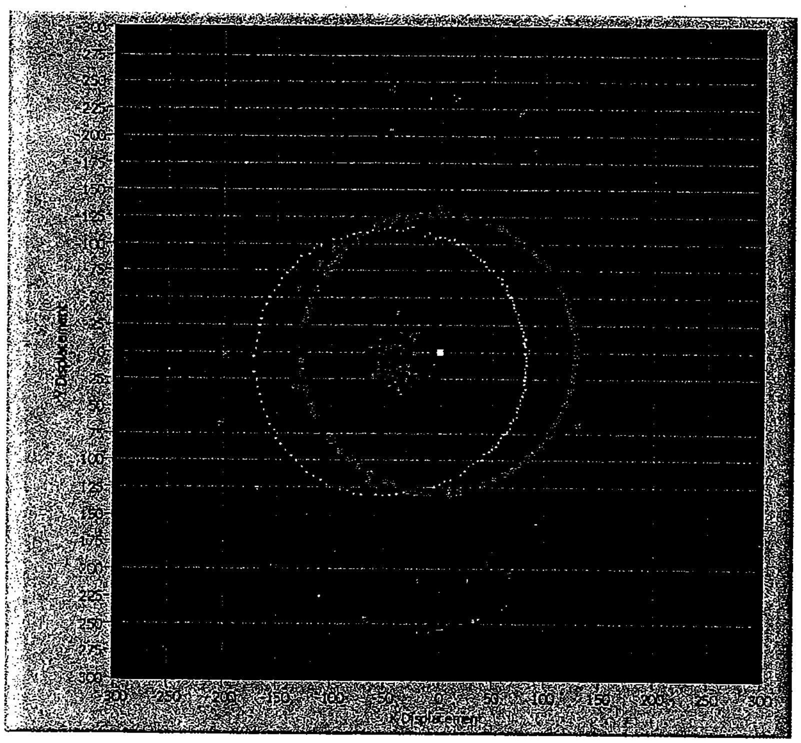
Photo 3: North Station Probe Launch
Showing down hole sheave mast and gate

Photo 4: Marco Marine (South) Station
Rope friction winch and take-up drum

3.2 Data Processing

The sonar data was processed in a number of stages. The first stage consisted of picking a reflection horizon from the Imagenex .81B sonar data file. An algorithm with a variable threshold and exclusion filter is used to define the pick distance, and the key reflector was then selected. A discrete chainage value for each sonar ping was then determined by performing a time-based interpolation between the points of the payout data records. This provides a more accurate record of the position for each ping. Data from the pitch roll and yaw sensors is then interpolated into the positional array from the ping data. The reflections are rotated back to a normal plane to correct for probe rotation in the pipe.

The data was then analyzed to determine the distance between the sonar, the side walls, and crown of the pipe. By combining this with data from the accelerometers, horizontal and vertical displacements for the sonar can be calculated for each data point. A spline fit through the displacements creates a probe path curve, and the XY position of each point is then shifted so that the sonar is reduced to the equivalent of pipe center. The data is then ready to be processed to provide cross-sections for display, and detailed measurement of percent area of the ideal pipe cross-section, as well as longitudinal sections and plan maps. If appropriate perspective views, or 3D solid model plots can be constructed.



Processing of Sonar Determined Pipe Radii

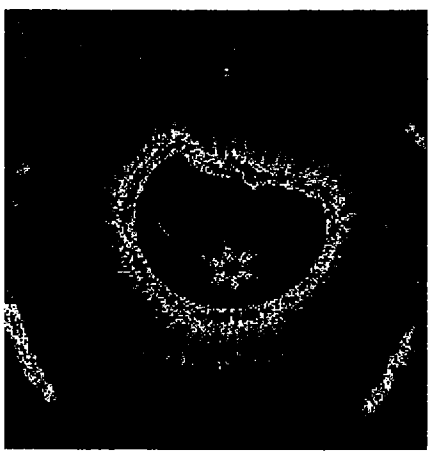
4. SURVEY RESULTS

4.1 General

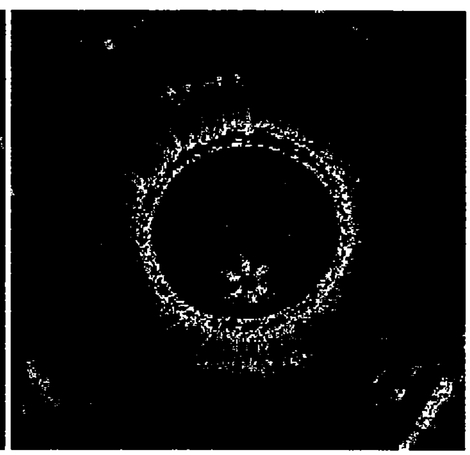
The processed sonar data for the west siphon is plotted in cross-section format on Drawings BW-SEC-1 to BW-SEC-5 for the west pipe and Drawings BE-SEC-1 to BE-SEC-5 for the east pipe, at a scale of 1 inch = 2.5 feet. As the traverse of the pipes was carried out with increasing station chainage to the south, the cross-sections are plotted looking south. These observed data is displayed as a red line, with a black circle indicating the nominal pipe section for comparison. The chainage zero was defined as the south face of the entry vault. The longitudinal section for the siphons is plotted on Drawing B-LONG-1.

4.2 West Siphon

The north section of the siphons was dry to a chainage of 50 feet. The sonar data begins with a partially filled pipe from 55 feet to 70 feet. A number of features were noted in the traverse of the pipes. The most prominent of these is seen as in the west pipe data as cross-section change extending from 100 feet to 150 feet. This appears to be a crown incursion, possibly related to failure of the wood stave structure of the pipe crown. The onset of the fault is fairly abrupt at the 100 foot mark with a tapering of the effect to a minor cross-section change at a distance of 150 feet. A peak value of 17.9 percent obstruction of the pipe over the nominal 36 inch equivalent is measured. An example sonogram at 103.9 feet is contrasted below with a normal pipe section at a cable payout distance of 152.9 feet. In these images the probe position appears as a diffraction star just above the pipe invert.

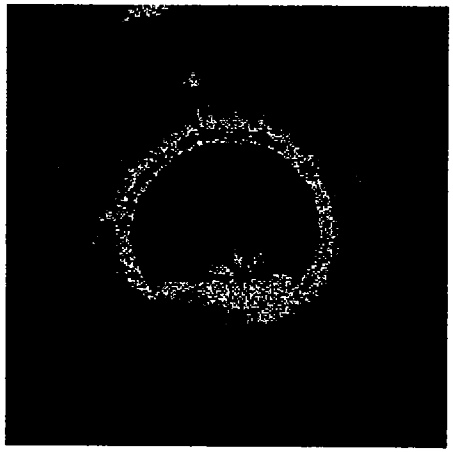


Distance: 103.9 feet



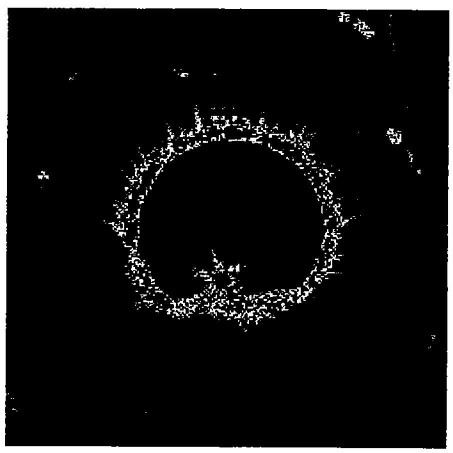
Distance: 152.9 feet

At a survey distances of 275 to 305 feet some sediment is detected, reaching a percent obstruction value of 10.8 percent. At the base of the descending section of the pipe a further deposit of debris is seen in the 425 to 480 range with a peak obstruction of 19.8 percent. An example sonogram showing the sediment at the pipe invert is shown below.



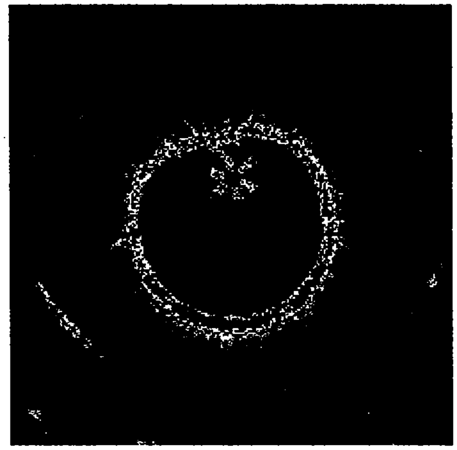
Distance: 152.9 feet

The longest section of sediment or debris in the pipe is observed in the 750 to 1035 foot range, along the central area of the horizontal section. In this section of the siphon the percent obstruction is typically in the 15 percent range, with a peak values in the 18 percent range. A typical sonagram from this section is shown below.



Distance: 1002.1 feet

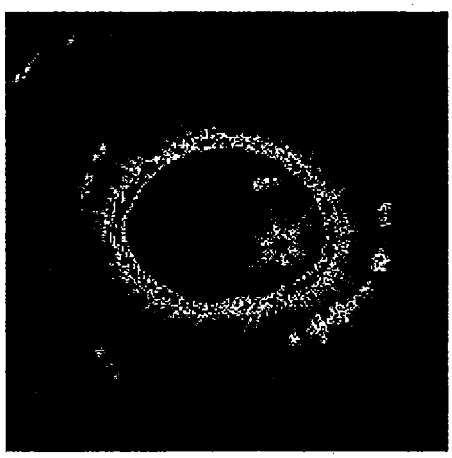
Overall, based on a comparison with an ideal 36 inch pipe, the total obstructed area observed in the west siphon results in a calculated sediment volume of 834 cubic feet. South of the 1080 foot distance the siphon ascends at a steeper gradient to the south afterbay. Approximately mid-point in this ascending segment the siphon shows a more subtle cross-section change in the 1205 to 1220 foot range. An example of the data from this area is displayed as follows.



Distance: 1205.7 feet

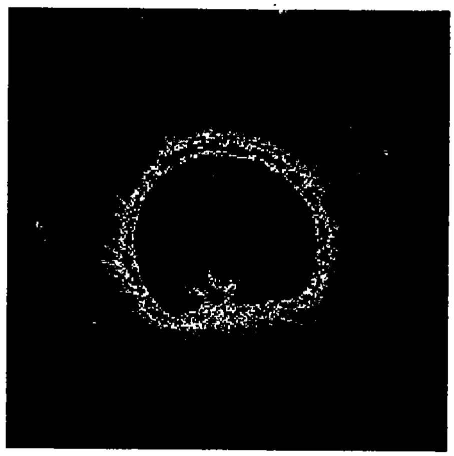
4.3 East Siphon

The east siphon shows similar variations to those observed in the west siphon. A section of the siphon from 115 to 210, overlapping the west pipe defect interval of 100 to 150 feet, shows changes in cross-section that are not nearly as pronounced as those of the west siphon. The siphon does not show the crown effects seen in the west pipe, but rather exhibits an oblate shape with the spring-line diameter slighty larger than the nominal 36 inch dimension. An example of the oblate east pipe is shown in the following image.



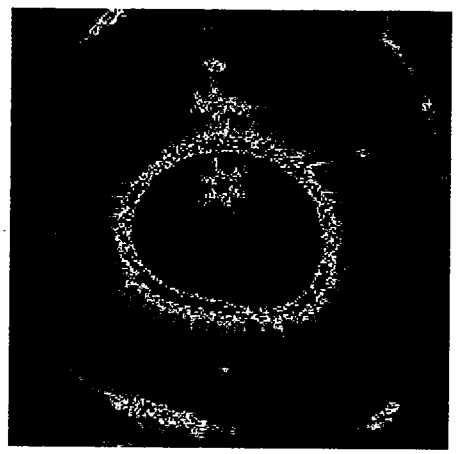
Distance: 128.7 feet

The central horizontal run in the east siphon shows some debris accumulation, but at reduced levels as compared to the west pipe. This may be due to the role of the east siphon in carrying only peak flows. The total obstructed area calculated sediment volume is 551 cubic feet for the east siphon. This is approximately 35% less than the west pipe. An example of the central sedimented zone is shown in the following sonogram.



Distance: 800.1 feet

Finally, a limited section of subtle cross-section change is observed that is coincident with a similar feature on the west siphon. Located in the range of 1195 to 1210 feet this zone is illustrated in the following image.



Distance: 1203.2 feet

5. LIMITATIONS

The distance to a given tunnel surface may be determined accurately based on the acoustic travel times, based on a water velocity that is dependent on water temperature and salinity. An underestimate of the velocity function would produce distances that are too close, and the reverse occurring with an overestimate of velocity. Some errors may also occur in gridding between interpreted data.

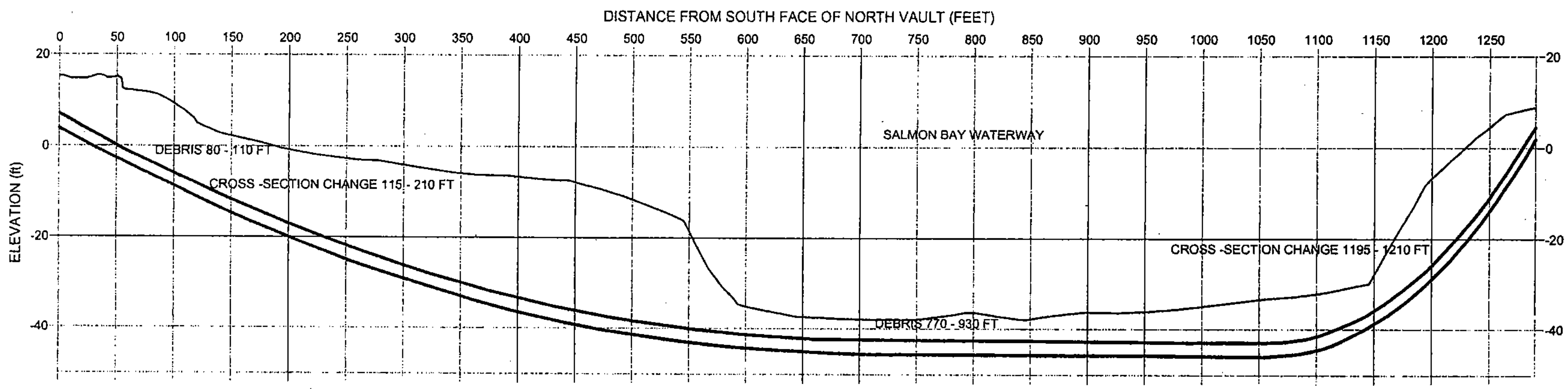
The nature and composition of features identified in sonar surveys cannot be absolutely determined by inspection of the data. Several indicators such as reflector strength, diffraction patterns, position, smoothness of reflectors and reflector relief may provide insight into composition.

The information in this report is based upon sonar measurements, field procedures, and our interpretation of the data. The information is based upon our estimate of conditions considering the geophysical and all other information available to us. The results are interpretative in nature and are considered to be a reasonably accurate presentation of the siphon conditions, within the limitations of the methodology employed.

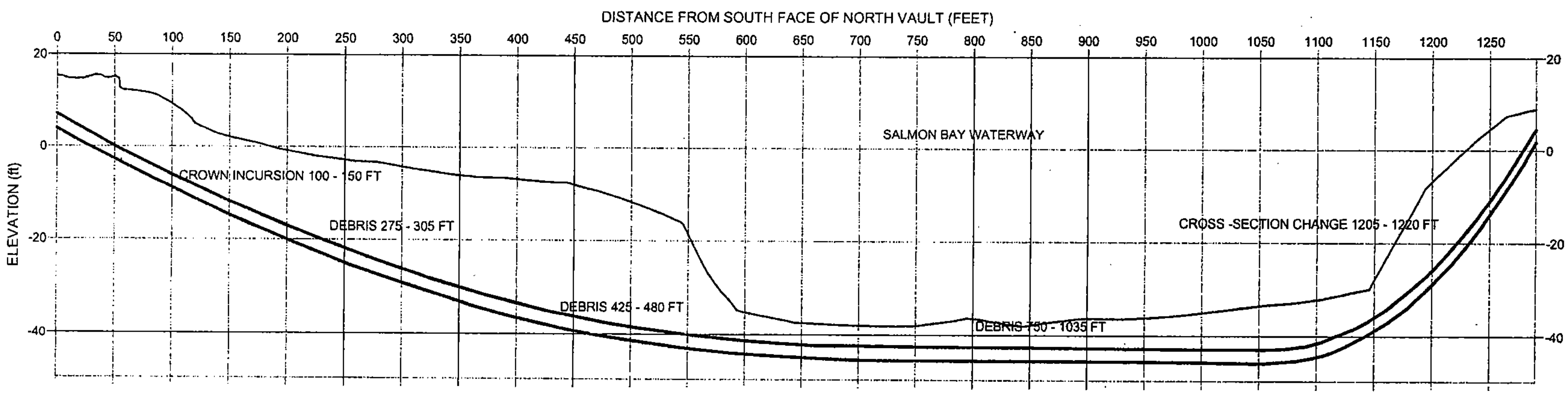
Respectfully submitted,

Sonar Solutions International Inc.

Frontier Geosciences Inc.



EAST WOOD STAVE PIPE (36 INCH)



WEST WOOD STAVE PIPE (36 INCH)

ELEVATIONS FROM
CITY OF SEATTLE DRAWING
BALLARD TRUNK SEWER
PLAN AND PROFILE
DATE 3-19-35

HORIZONTAL SCALE 1" = 100'
VERTICAL SCALE 1" = 25'

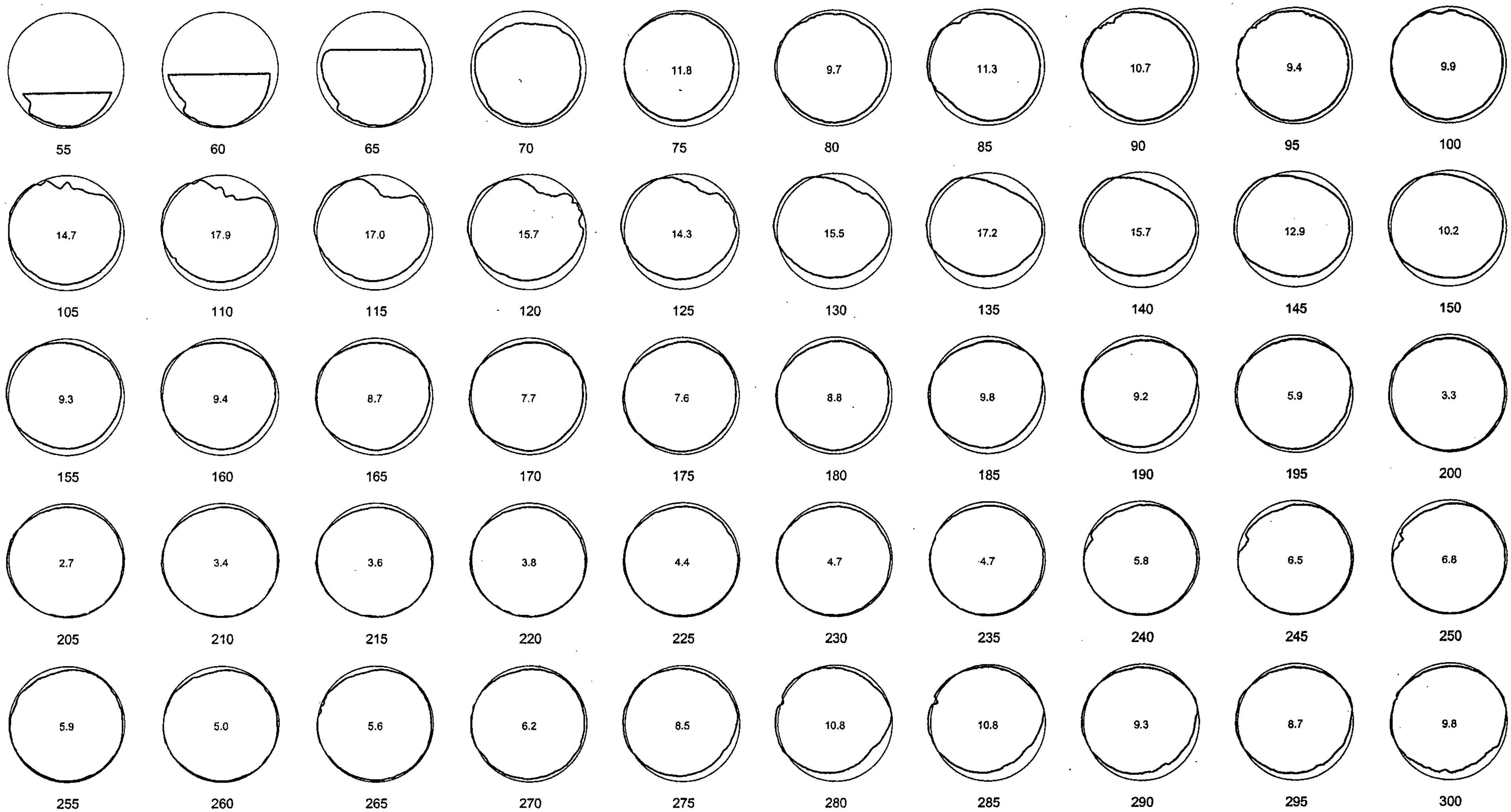
KING COUNTY
BALLARD SIPHON

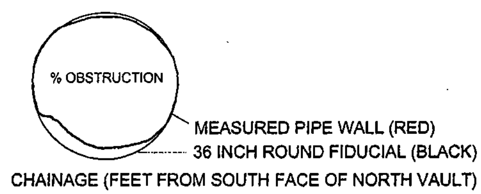
SEWER INSPECTION SURVEY

BALLARD WOOD STAVE PIPES
LONGITUDINAL SECTIONS

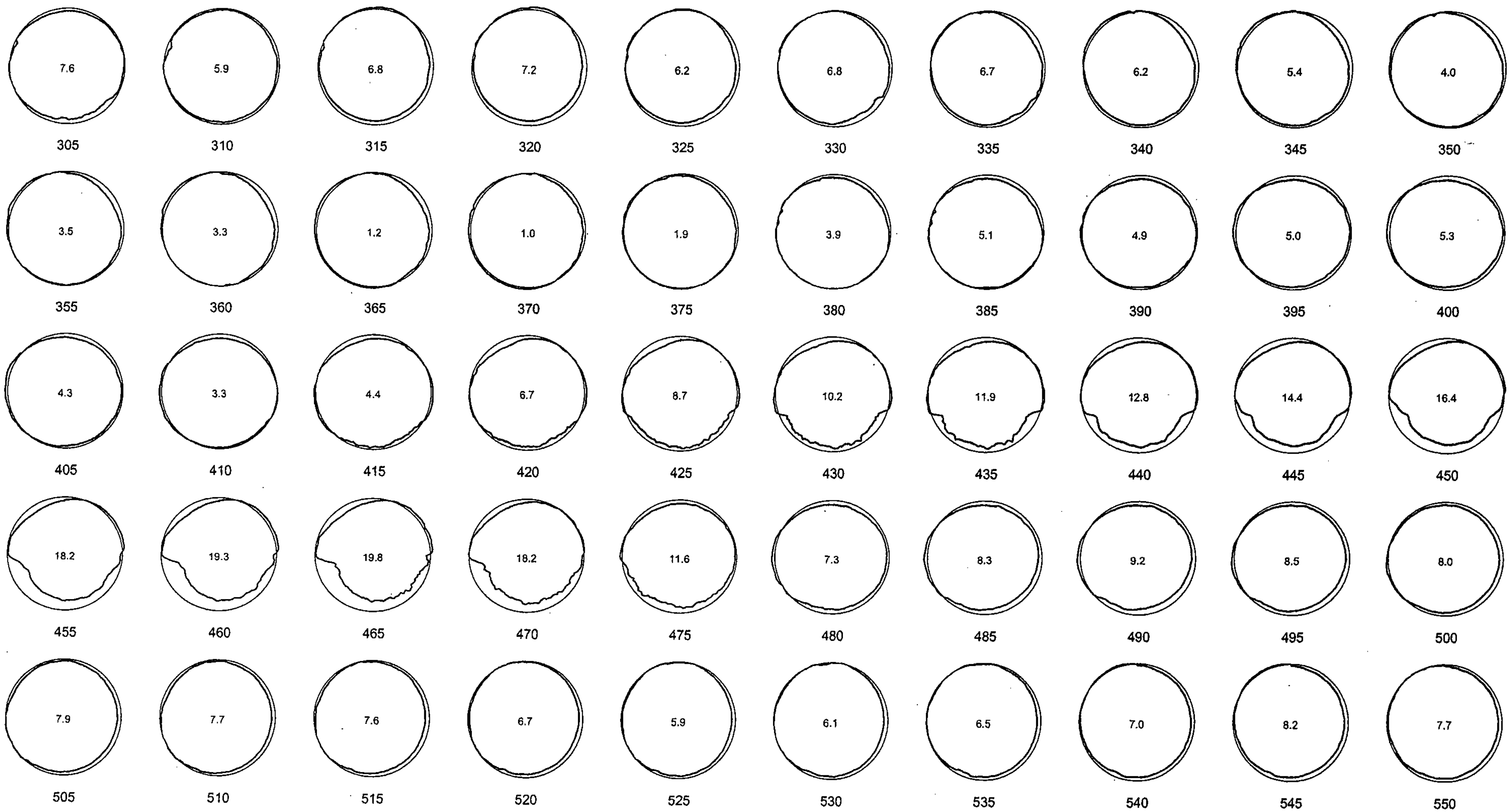
FRONTIER GEOSCIENCES INC.

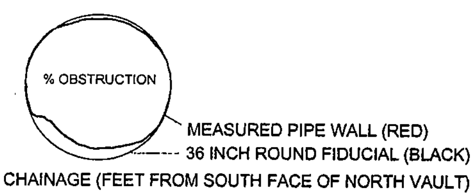
DATE: NOV 2005 | DWG: B-LONG-1





KING COUNTY BALLARD SIPHON		
SEWER INSPECTION SURVEY		
BALLARD WEST WOOD STAVE PIPE CROSS SECTIONS 55 - 300		
FRONTIER GEOSCIENCES INC.		
DATE: NOV 2005	SCALE 1 IN = 2.5 FT	DWG: BW-SEC-1





0 1 2 3 4
FEET

KING COUNTY
BALLARD SIPHON

SEWER INSPECTION SURVEY

BALLARD WEST WOOD STAVE PIPE
CROSS SECTIONS 305 - 550

FRONTIER GEOSCIENCES INC.

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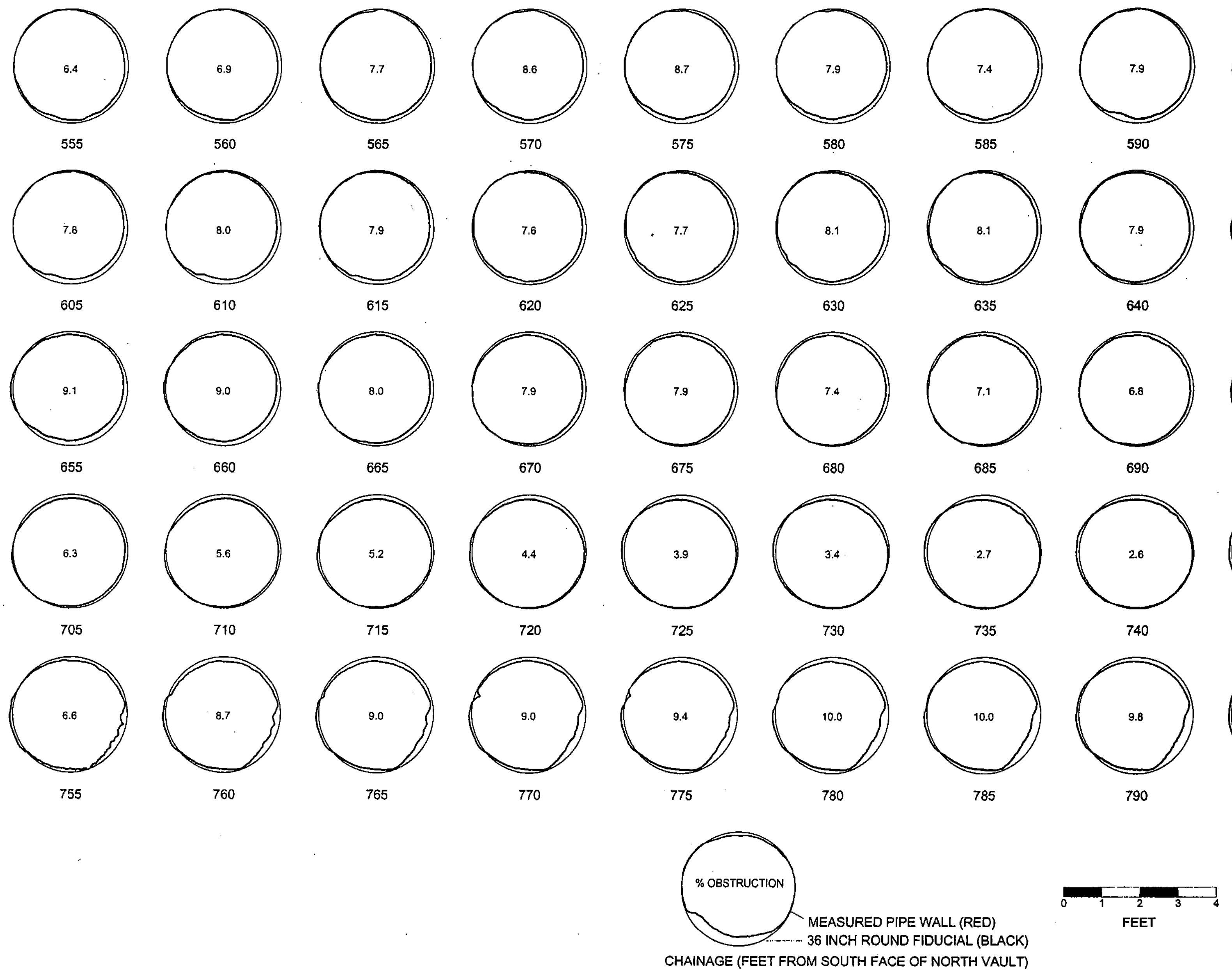

KING COUNTY
BALLARD SIPHON

SEWER INSPECTION SURVEY

BALLARD WEST WOOD STAVE PIPE
CROSS SECTIONS 555 - 800

FRONTIER GEOSCIENCES INC.

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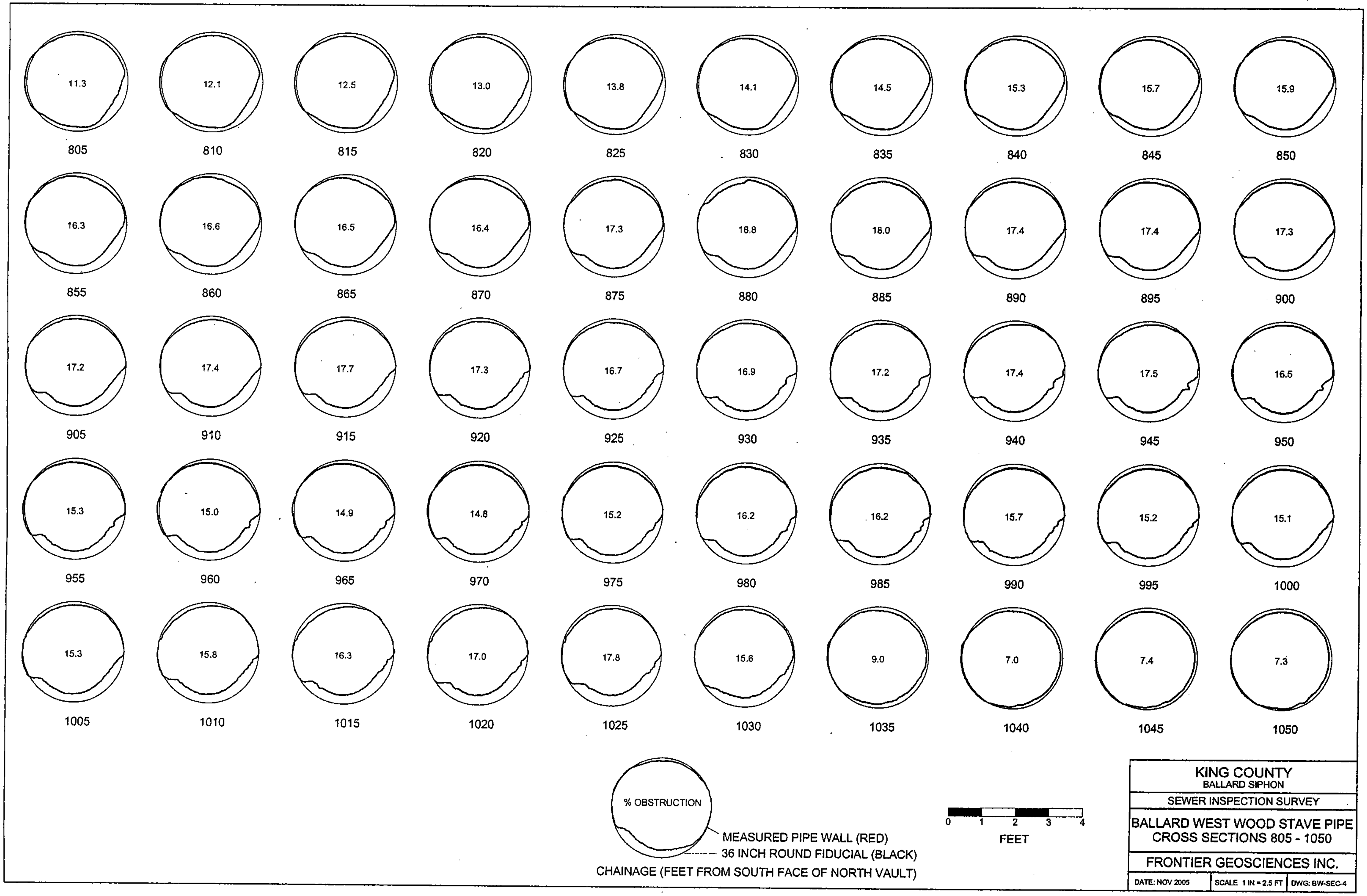
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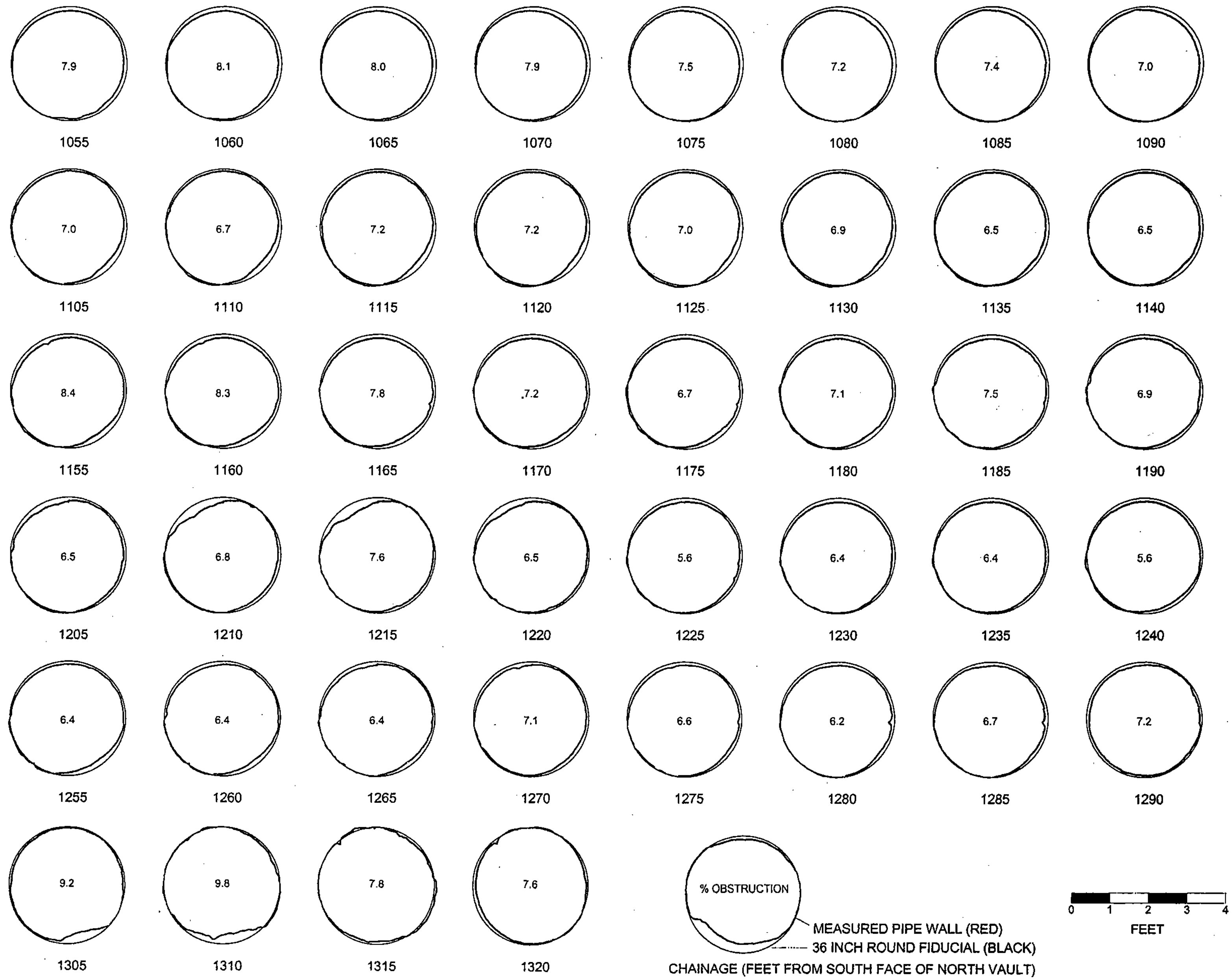
16.3 16.6 16.5 16.4 17.3 18.8 18.0 17.4 17.4 17.3
855 860 865 870 875 880 885 890 895 900
17.2 17.4 17.7 17.3 16.7 16.9 17.2 17.4 17.5 16.5
905 910 915 920 925 930 935 940 945 950
15.3 15.0 14.9 14.8 15.2 16.2 16.2 15.7 15.2 15.1
955 960 965 970 975 980 985 990 995 1000
15.3 15.8 16.3 17.0 17.8 15.6 9.0 7.0 7.4 7.3
1005 1010 1015 1020 1025 1030 1035 1040 1045 1050
% OBSTRUCTION
MEASURED PIPE WALL (RED)
36 INCH ROUND FIDUCIAL (BLACK)
CHAINAGE (FEET FROM SOUTH FACE OF NORTH VAULT)
0 1 2 3 4
FEET
KING COUNTY
BALLARD SIPHON
SEWER INSPECTION SURVEY
BALLARD WEST WOOD STAVE PIPE
CROSS SECTIONS 805 - 1050
FRONTIER GEOSCIENCES INC.
DATE: NOV 2005
SCALE 1 IN = 2.5 FT
DWG: BW-SEC-4



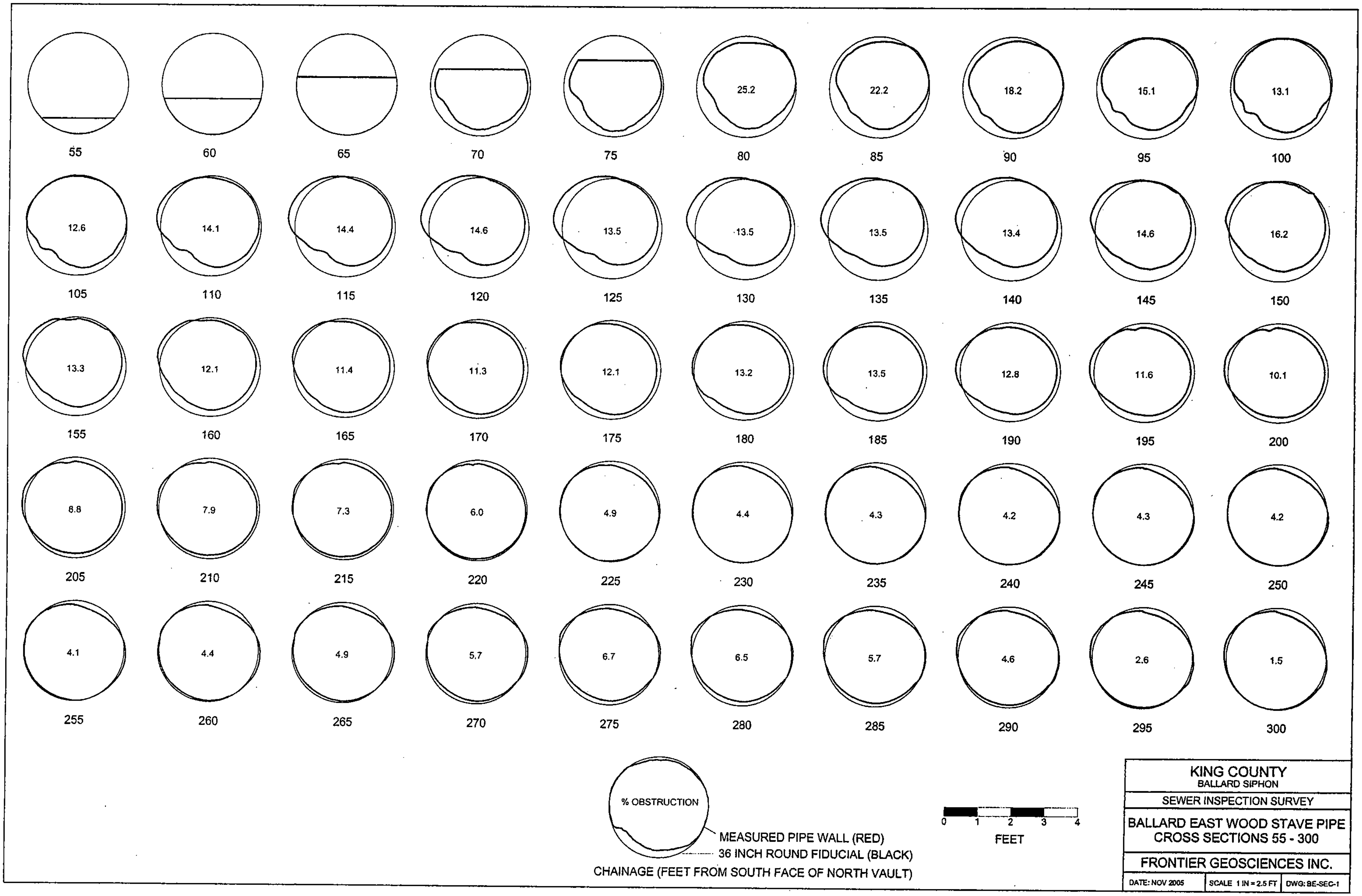
KING COUNTY
BALLARD SIPHON

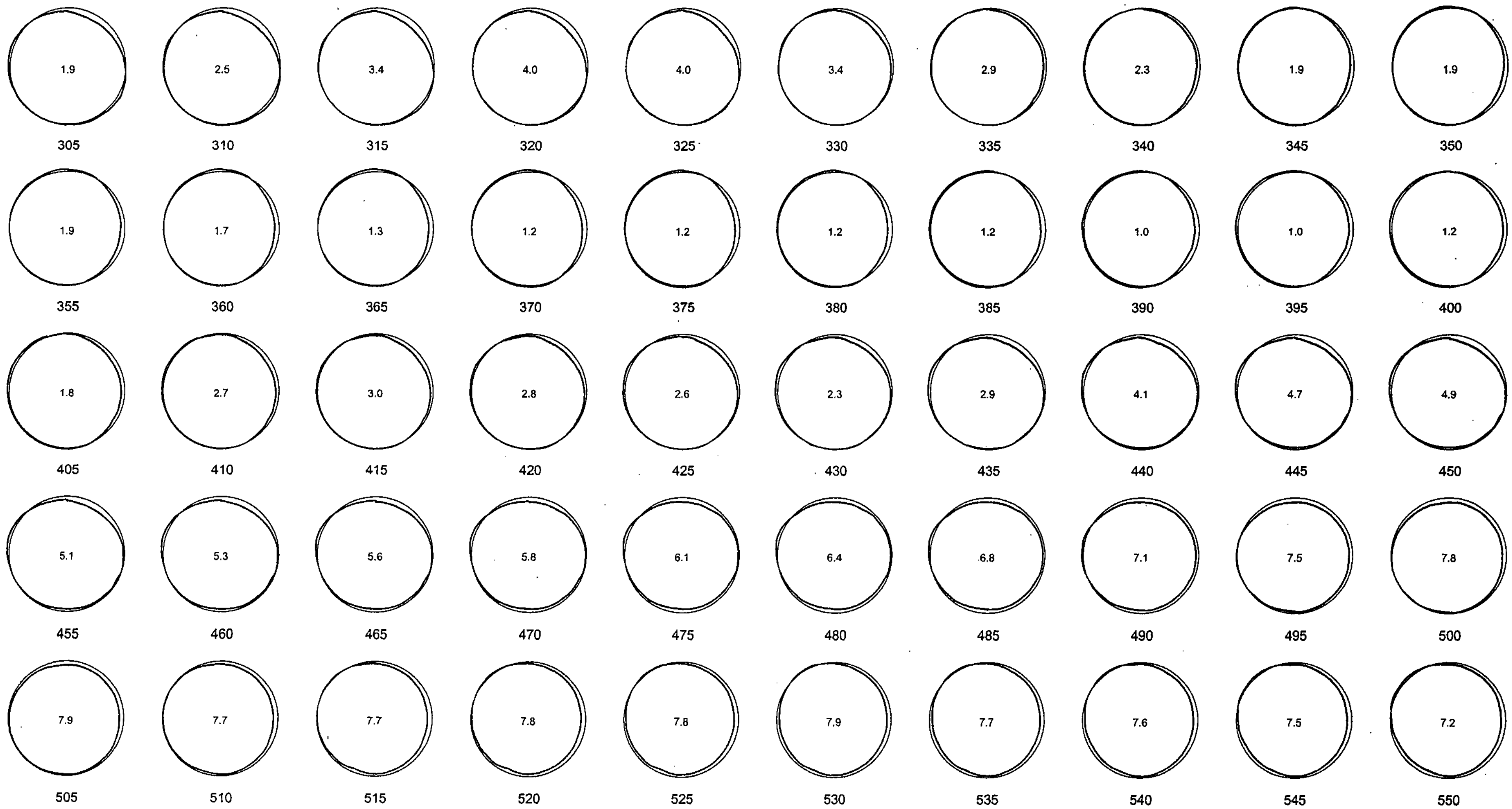
SEWER INSPECTION SURVEY

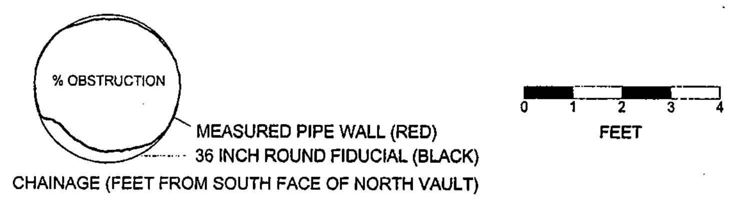
BALLARD WEST WOOD STAVE PIPE
CROSS SECTIONS 1055 - 1320

FRONTIER GEOSCIENCES INC.

DATE: NOV 2005	SCALE 1 IN = 2.5 FT	DWG: BW-SEC-5


25.2
22.2
18.2
15.1
13.1
55
60
65
70
75
80
85
90
95
100
12.6
14.1
14.4
14.6
13.5
13.5
13.5
13.4
14.6
16.2
105
110
115
120
125
130
135
140
145
150
13.3
12.1
11.4
11.3
12.1
13.2
13.5
12.8
11.6
10.1
155
160
165
170
175
180
185
190
195
200
8.8
7.9
7.3
6.0
4.9
4.4
4.3
4.2
4.3
4.2
205
210
215
220
225
230
235
240
245
250
4.1
4.4
4.9
5.7
6.7
6.5
5.7
4.6
2.6
1.5
255
260
265
270
275
280
285
290
295
300
% OBSTRUCTION
MEASURED PIPE WALL (RED)
36 INCH ROUND FIDUCIAL (BLACK)
CHAINAGE (FEET FROM SOUTH FACE OF NORTH VAULT)
0 1 2 3 4
FEET
KING COUNTY
BALLARD SIPHON
SEWER INSPECTION SURVEY
BALLARD EAST WOOD STAVE PIPE
CROSS SECTIONS 55 - 300
FRONTIER GEOSCIENCES INC.
DATE: NOV 2005
SCALE 1 IN = 2.5 FT
DWG: BE-SEC-1





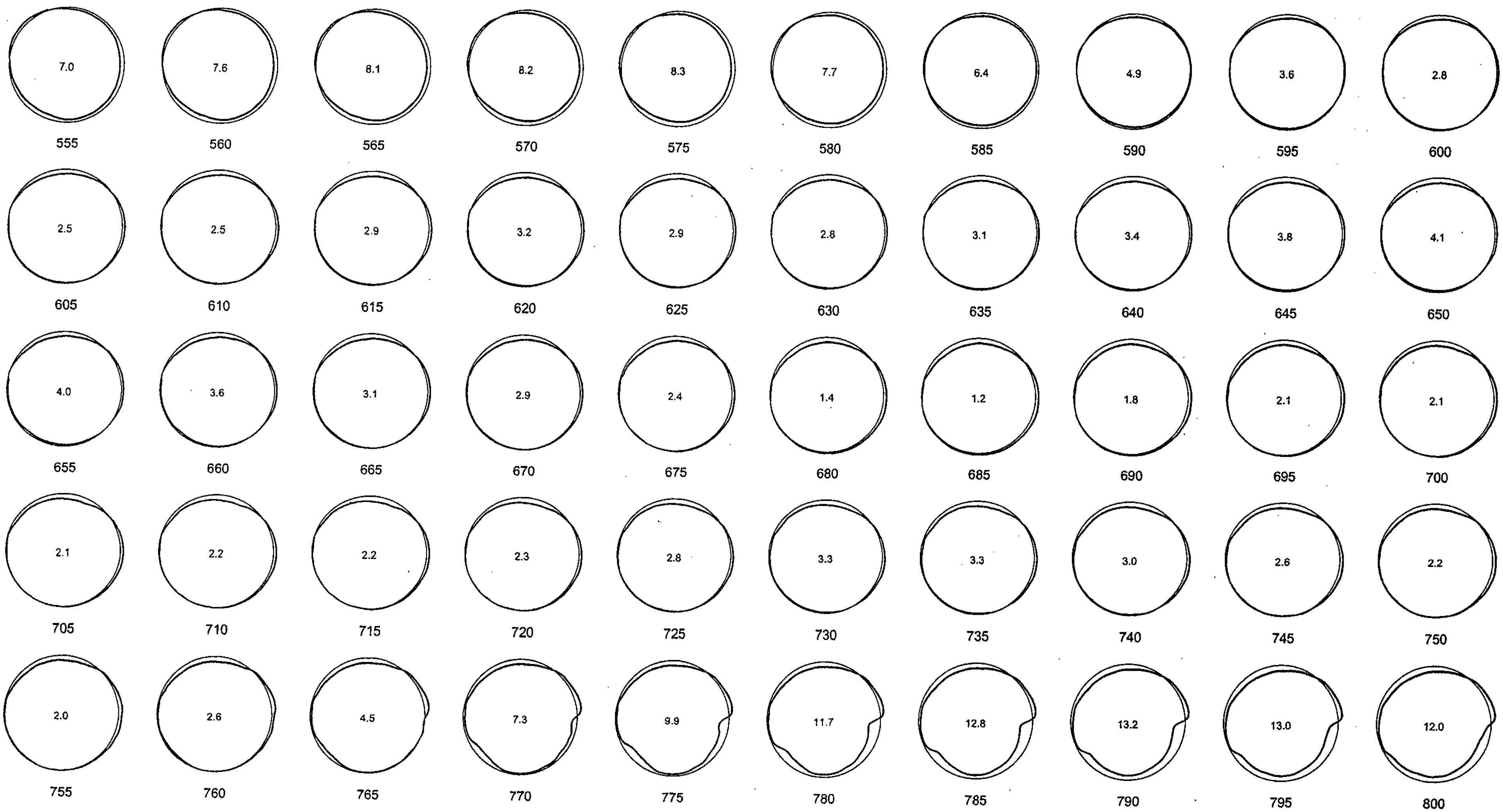
KING COUNTY
BALLARD SIPHON

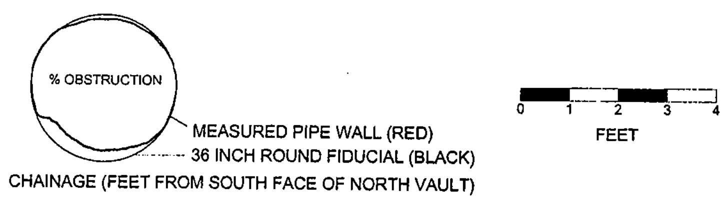
SEWER INSPECTION SURVEY

BALLARD EAST WOOD STAVE PIPE
CROSS SECTIONS 305 - 550

FRONTIER GEOSCIENCES INC.

DATE: NOV 2005	SCALE 1 IN = 2.6 FT	DWG: BE-SEC-2





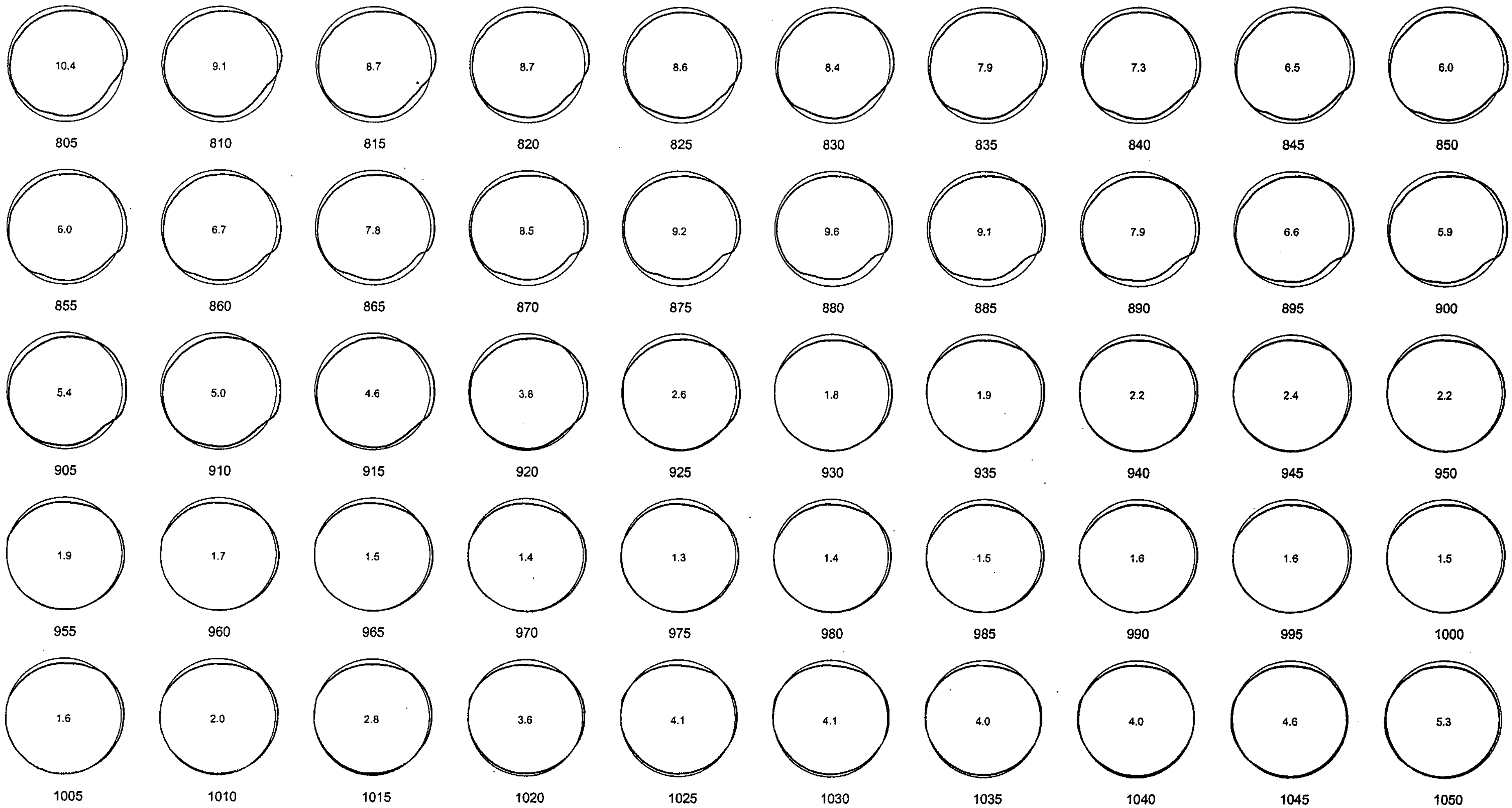
KING COUNTY
BALLARD SIPHON

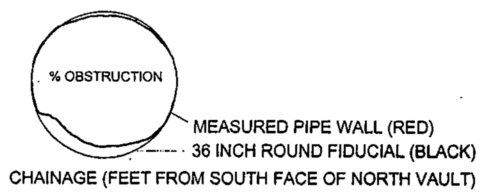
SEWER INSPECTION SURVEY

BALLARD EAST WOOD STAVE PIPE
CROSS SECTIONS 555 - 800

FRONTIER GEOSCIENCES INC.

DATE: NOV 2005	SCALE 1 IN = 2.5 FT	DWG: BE-SEC-3





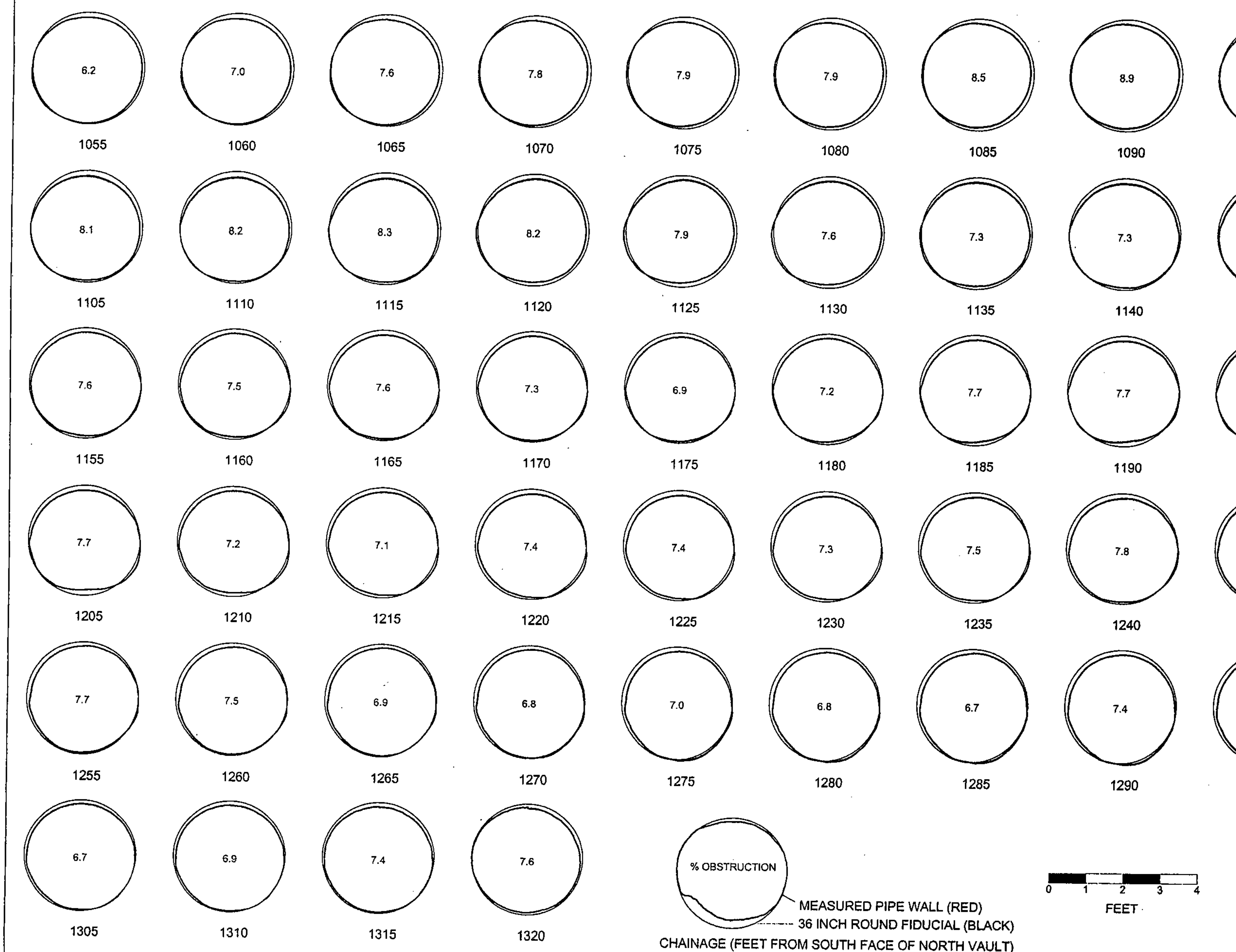
KING COUNTY
BALLARD SIPHON

SEWER INSPECTION SURVEY

BALLARD EAST WOOD STAVE PIPE
CROSS SECTIONS 805 - 1050

FRONTIER GEOSCIENCES INC.

DATE: NOV 2005	SCALE 1 IN = 2.5 FT	DWG: BE-SEC-4



KING COUNTY BALLARD SIPHON		
SEWER INSPECTION SURVEY		
BALLARD EAST WOOD STAVE PIPE CROSS SECTIONS 1055 - 1320		
FRONTIER GEOSCIENCES INC.		
DATE: NOV 2005	SCALE 1 IN = 2.5 FT	DWG: BE-SEC-6

A 3

ROBERTS ENGINEERING
17503 NE 137TH STREET
REDMOND, WA 98052-2182

January 23, 2006

Mr. Ade Franklin
King County DNR/Parks WTD
Project Manager
201 S Jackson St Rm 507
Seattle, WA 98104-3855

Dear Mr. Franklin:

Subject: Ballard Siphon

As requested, I reviewed the Draft Report of the Sonar Profiling of the Ballard Siphon dated December 2005. The following summarizes my assessment of the condition of the two timber stave pipes based on the sonar images contained in the Draft Report.

East Siphon Sonar Image Evaluation

- Approximately 95 feet of pipe (East Pipe Sonar Images 115 to 210) indicate pronounced changes "squashing" of the pipe shape but do indicate a breach in the pipe wall.
- Approximately 130 feet of pipe (East Pipe Sonar Images 770 to 900) indicate noticeable changes in shape with an apparent discontinuity in the pipe wall. This discontinuity might involve a breach in the pipe wall at the springline for approximately 30 feet (particularly noticeable in images 770 to 800)
- Approximately 15 feet of pipe (East Pipe Sonar Images 1195 to 1210) show less pronounced changes in shape.
- The calculated volume of debris in the East Siphon is 551 cubic feet.

West Siphon Sonar Image Evaluation

- Approximately 50 feet of pipe (West Pipe Sonar Images 100 to 150) indicate pronounced changes of the pipe shape. Approximately 10 feet (West Pipe Sonar Images 115 to 125) indicate a probable breach in the crown of the pipe. The following image, taken at 104 feet into the pipe, is representative of the changes in the pipe shape.

- Approximately 10 feet of pipe (West Pipe Sonar Images 240 to 250) indicate an apparent discontinuity in the pipe wall just above the springline with a possible small breach of the pipe wall.
- Approximately 10 feet of pipe (West Pipe Sonar Images 280 to 290) indicate a small change in shape and an apparent discontinuity in the pipe wall just above the springline.

PHONE: (425) 556-0300 FAX: (425) 895-0736 RON@RONROBERTS.NET

- Approximately 40 feet of pipe (West Pipe Sonar Images 430 to 470) indicate a small change in shape. Discontinuities exist near the spring line but the depth of the debris masks the pipe wall so the nature of the discontinuity is uncertain.
- Approximately 100 feet of pipe (West Pipe Sonar Images 755 to 855) indicate noticeable changes of the pipe shape with the wall deflecting inward in the lower right quadrant of the pipe. It does not appear to involve a breach of the pipe wall.
- Approximately 15 feet of pipe (West Pipe Sonar Images 1205 to 1220) indicate noticeable changes of the pipe shape with the wall deflecting inward in the upper left quadrant of the pipe. It does not appear to involve a breach of the pipe wall.
- The calculated volume of debris in the East Siphon is 834 cubic feet.

Engineering Assessment

First a disclaimer. My knowledge of timber stave pipe design is limited to my recent research of historical publications addressing the subject and an extrapolation of present day practices used in the design of flexible pipes. There are a few engineers still practicing the art of timber stave pipe design and it might be necessary to retain their services to assist with the design of repairs should King County decide to proceed with a repair option.

Flexible pipe design is based on the work published by Spangler, et al in the 1940's. This work has been adapted to the design of various plastic pipes, thin wall steel pipes, corrugated steel and aluminum pipes and culverts. Rigid pipe design (vitrified clay, asbestos cement, reinforced and nonreinfoced concrete, ductile and cast iron) employ a different design methodology. I believe that a timber stave pipe is more closely related to the flexible pipes and my assessment will be developed accordingly.

Most flexible pipe design procedures assume that the pipe will "squish" slightly and bulge outwardly until they develop sufficient pressures on the side of the pipe to reach a stable geometry. As a rule of thumb, flexible pipes are designed for a maximum "out-of-roundness" of 5% of the pipe cross section, although mortar lined steel pipes are typically limited to 2% out-of-roundness to avoid damage to the mortar lining. Depending on the pipe material and wall thicknesses most flexible pipes can tolerate 10% to 20% out-of-roundness before destructive buckling and collapse of the crown of the pipe occurs. Less frequently but still possible, with insufficient backfill over the top of the pipe, soil pressures applied to the side of the pipe can cause the pipe to squish inward horizontally and bulge up at the crown until a similar catastrophic buckling at the springline of the pipe occurs.

Based a visual assessment of the sonar data plots, it's my opinion that the areas that I discussed in the **Sonar Image Evaluations** have approached and, in some areas, exceeded the 5% out-of-roundness criteria. Of more concern are those areas where pipe wall breaches are suspected. Continuing and possibly abrupt loss of pipe integrity are possible in the regions where the pipe walls have buckled. Even if the pipe does not collapse, the water tightness of the pipe is most certainly lost as the joints between the wood staves have failed. Depending on the difference in pressure between the ship canal water and the pressure head in the siphon, water could be flowing into or out of the siphon through these breaches. The fact that the west siphon has 51% more calculated debris volume than the east siphon might be attributed to material entering the pipe through pipe wall breaches which appear to be more pronounced in the west pipe than the east pipe.

I think it's reasonable to conclude that the pipes have exceeded their service lives and are failing at multiple locations. Repair or replacement are necessary to ensure that total collapse of the pipe in those areas where the crown has failed, does not occur. Careful consideration must be given to the method of repair selected. I caution against the obvious repair methods of pipe bursting or slip lining due to the fact that the out-of-roundness of the pipes will result in substantial forces being applied to the pipe as the slip lining is dragged through. These large forces could precipitate a pipe failure during the repair activities. This concern is compounded by the fact that figure 8 shaped steel bands are used to strap the pipes together, the bands being spaced at 15 feet on center over the length of the pipes. Loads imposed on one siphon during slip lining could be transmitted to the other siphon through these figure 8 steel bands causing crushing or buckling in the pipe that wasn't in the process of being repaired.

It would be helpful to get more data from the Sonar people. If possible I would like to obtain the data representative of the pipe cross sectional dimensions in tabular form (as opposed to the graphic form in the Draft Report). This would make it easier to calculate the measured out-of-roundness at the various measurement points rather than having to rely solely on the old "eyeball" method of interpreting the degree of squish.

If you have any questions or desire further assistance with this matter, please feel free to call at your convenience. I will continue to investigate alternatives for repairing the pipe and when I have further information I will report it to you.

Sincerely,

Ronald M. Roberts, P.E.
Structural Engineer
Roberts Engineering

RONALD M. ROBERTS
STATE OF WASHINGTON
20403
REGISTERED
PROFESSIONAL ENGINEER

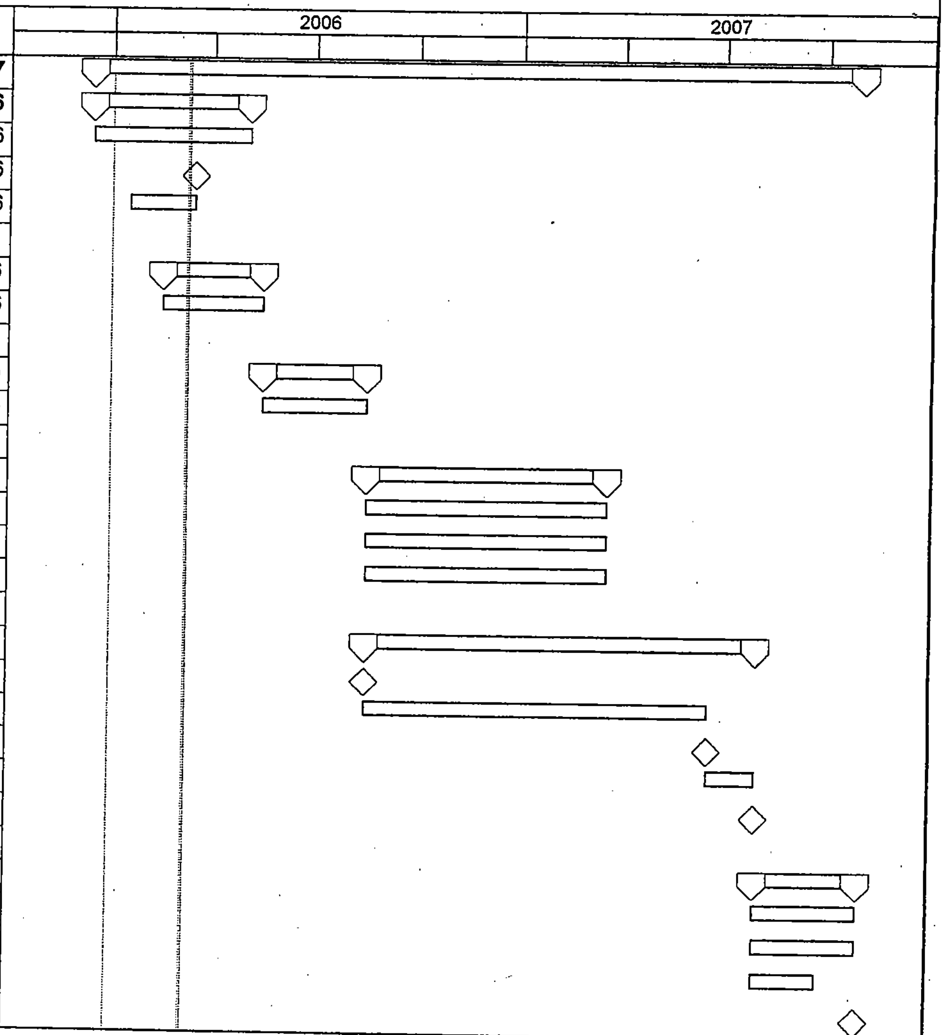
EXPIRES 12/23/2007

A 4

Ballard Siphon Project
Emergency Schedule

Wastewater Treatment Division

ID	Task Name	Start	Finish
1	**Ballard Siphon Emergency Schedule**	**12/15/05**	**10/31/07**
2	**Phase 1 Planning**	**12/15/05**	**5/3/06**
3	Develop Initial Scope/Schedule/Budget	12/15/05	5/3/06
4	Initial Plan Completed	3/16/06	3/16/06
5	Procure Consultant if Needed	1/17/06	3/15/06
6			
7	**Phase 2 Predesign**	**2/16/06**	**5/16/06**
8	Develop 30% alternative recommendations	2/16/06	5/16/06
9			
10	**Proposal Bid/Award**	**5/17/06**	**8/17/06**
11	Proposal advertisement, preparation, evaluation, selection	5/17/06	8/17/06
12			
13	**Phase 3 Final Design**	**8/18/06**	**3/19/07**
14	Complete Final Design	8/18/06	3/19/07
15	Acquire Easements/ROWs	8/18/06	3/19/07
16	Acquire Permits	8/18/06	3/19/07
17			
18	**Phase 4 Implementation**	**8/17/06**	**7/31/07**
19	Issue Construction NTP	8/17/06	8/17/06
20	Construct/Implement the Project (10 mo)	8/18/06	6/18/07
21	Issue Substantial Completion	6/18/07	6/18/07
22	Complete Start-up, Punchlist, Admin. Records	6/19/07	7/31/07
23	Issue Contract Final Acceptance Letter	7/31/07	7/31/07
24			
25	**Phase 5 Close-out**	**8/1/07**	**10/31/07**
26	Complete As-Builts/O&M Manuals, etc	8/1/07	10/31/07
27	Complete Retainage Release Process	8/1/07	10/31/07
28	Conduct Project Lessons Learned	8/1/07	9/26/07
29	Close IBIS Project Number	10/31/07	10/31/07



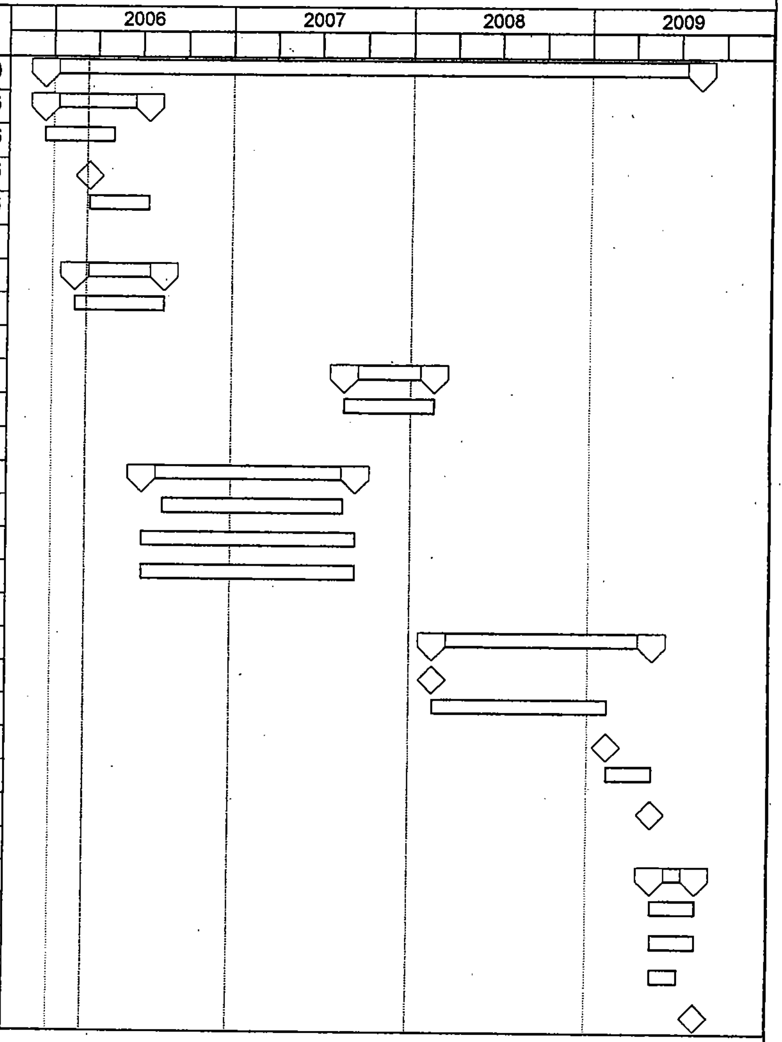
Date: 3/9/06

Task | Progress | Milestone | Summary | Summary Progress

Ballard Siphon Project
Accelerated Schedule

Wastewater Treatment Division

ID	Task Name	Accelerated Start	Accelerated Finish
1	**Ballard Siphon Accelerated Schedule**	**12/15/05**	**8/10/09**
2	**Phase 1 Planning**	**12/15/05**	**7/14/06**
3	Develop Initial Scope/Schedule/Budget	12/15/05	5/3/06
4	Initial Plan Completed	3/16/06	3/16/06
5	Procure Consultant if Needed	3/16/06	7/14/06
6			
7	**Phase 2 Predesign**	**2/16/06**	**8/16/06**
8	Develop 30% alternative recommendations	2/16/06	8/16/06
9			
10	**Proposal Bid/Award**	**8/20/07**	**2/18/08**
11	Proposal advertisement, preparation, evaluation, selection	8/20/07	2/18/08
12			
13	**Phase 3 Final Design**	**7/5/06**	**9/11/07**
14	Complete Final Design	8/17/06	8/17/07
15	Acquire Easements/ROWs	7/5/06	9/11/07
16	Acquire Permits	7/5/06	9/11/07
17			
18	**Phase 4 Implementation**	**2/18/08**	**5/11/09**
19	Issue Construction NTP	2/18/08	2/18/08
20	Construct/Implement the Project (10 mo)	2/19/08	2/9/09
21	Issue Substantial Completion	2/9/09	2/9/09
22	Complete Start-up, Punchlist, Admin. Records	2/10/09	5/11/09
23	Issue Contract Final Acceptance Letter	5/11/09	5/11/09
24			
25	**Phase 5 Close-out**	**5/12/09**	**8/10/09**
26	Complete As-Builts/O&M Manuals, etc	5/12/09	8/10/09
27	Complete Retainage Release Process	5/12/09	8/10/09
28	Conduct Project Lessons Learned	5/12/09	7/6/09
29	Close IBIS Project Number	8/10/09	8/10/09



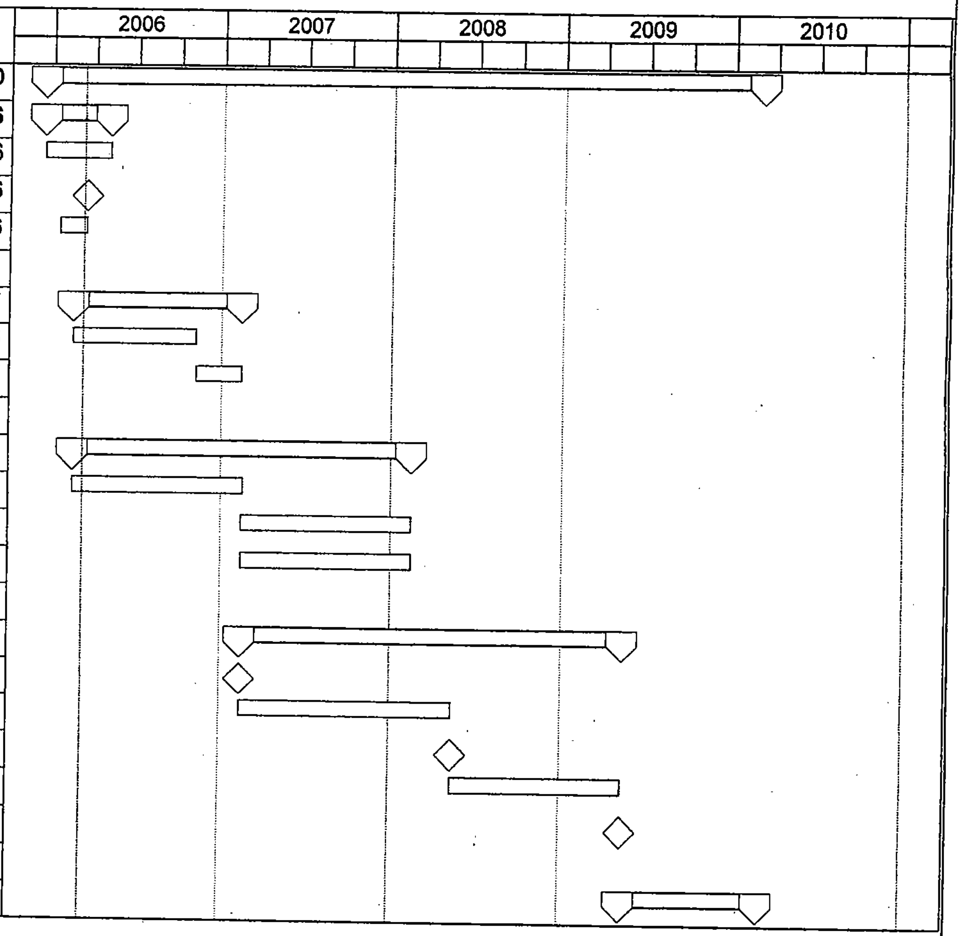
Date: 3/9/06

Task | Summary | Milestone
Progress | Summary Progress

Ballard Siphon Project
Typical Design-Bid-Build Schedule

Wastewater Treatment Division

ID	Task Name	Start	Finish
1	**Typical Design-Bid-Build Schedule**	**12/15/05**	**3/3/10**
2	**Phase 1 Planning**	**12/15/05**	**5/3/06**
3	Develop Initial Scope/Schedule/Budget	12/15/05	5/3/06
4	Initial Plan Completed	3/16/06	3/16/06
5	Procure Consultant if Needed	1/17/06	3/15/06
6			
7	**Phase 2 Predesign**	**2/16/06**	**2/12/07**
8	Develop 30% alternative recommendations	2/16/06	11/6/06
9	Proposal Bid/Award	11/7/06	2/12/07
10			
11	**Phase 3 Final Design**	**2/16/06**	**2/14/08**
12	Complete Final Design	2/16/06	2/16/07
13	Acquire Easements/ROWs	2/13/07	2/14/08
14	Acquire Permits	2/13/07	2/14/08
15			
16	**Phase 4 Implementation**	**2/12/07**	**5/13/09**
17	Issue Construction NTP	2/12/07	2/12/07
18	Construct/Implement the Project (15 mo)	2/13/07	5/13/08
19	Issue Substantial Completion	5/13/08	5/13/08
20	Complete Start-up, Punchlist, Admin. Records	5/14/08	5/13/09
21	Issue Contract Final Acceptance Letter	5/13/09	5/13/09
22			
23	**Phase 5 Close-out**	**5/14/09**	**3/3/10**



Date: 3/9/06

Task — Summary — Progress — Summary Progress — Milestone