

25 Bunya Street Eagle Farm Q 4009 Ph. (07) 3403 1849 Fx. (07) 3403 1898

20th June 1997.

**OPERATING MANUAL FOR:** 

### ZILLMAN WATERHOLES 530 DIA RISING SEWER MAIN

(SANDGATE RD RISING MAIN)

**CATHODIC PROTECTION SYSTEM** 

CLIENT:

**BRISBANE WATER** SEWERAGE UTILITIES SERVICES

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### **DRAWINGS**

486/6/25-AA1C0021E Standard Rectifier Wiring Diagram

(No Number) Monthly Maintenance Program

#### (1.0) **INTRODUCTION**

Steel when immersed or covered in water has a tendency to corrode (or rust) as the oxidized form is more stable than the metal.

Because of this, precaution must be taken to stop or minimize the corrosion reaction to an acceptable level consistent with the design life of the structure. This is normally achieved by the use of protective coatings which control the corrosion reaction by isolating the steel from its surrounding environment.

However, it is not practical to achieve a perfect coating and coating damage will always occur with time. Because of this, corrosion may occur at imperfections in the paint coating, causing further deterioration in the coating as well as loss of metal.

As a result of this, the coating defects must be rectified by periodic maintenance or an additional method of protection used to prevent this deterioration and corrosion occurring. This additional protection is achieved by the cathodic protection system.

#### (2.0) CORROSION AND CATHODIC PROTECTION

Corrosion is an electrochemical process in that it is accompanied by a flow of electrical current.

Corrosion occurs on the surface of metals at active areas known as anodes, which are electrically continuous with less active or passive areas known as cathodes. The electric current flows from the anode through the electrolyte to the cathode, with the circuit being completed by the electrical continuity between the cathode and anode. In practice anodes and cathodes are generally part of the same metallic surface and individual anodic areas may be small.

In applying cathodic protection and external current is applied to the surface so that the entire surface to be protected acts as a cathode. This involves the use of an auxiliary anode and when the current flow from this anode is sufficient, no part of the structure acts as an anode.

An external source of direct current such as a transformer rectifier is used in conjunction with an anode consisting of material with a very slow corrosion rate.

While it is the flow of current which achieves the cathodic protection of the surface it is impractical to measure these currents over individual anodic areas to determine when cathodic protection has been achieved. However, with the flow of cathodic protection current, the structure becomes more negative with respect to the surrounding electrolyte. Because of this, it is possible to state values of metal/electrolyte potential at which corrosion does not occur. This metal/electrolyte potential is generally measured against a standard reference electrode which allows a reproducible potential at which corrosion does not occur to be quoted.

Cathodic Protection System - Zillman Waterholes - Sandgate Road - Sewer Rising Main - 530 mm - OM Manual (3.0) MAINS DETAILS

Size:

Dia 530 mm mild steel.

Coating:

Tar Epoxy

Length:

1.400 km

Location:

Cnr Sandgate Rd and Ferric St.to Sandgate Rd @ Downfall Rd

Construction

Zillman Waterholes 3006/2219,3006/2220

Active 21/07/2015

Drawings:

### (4.0) CATHODIC PROTECTION DETAILS

- (4.1) Type of Cathodic Protection: Impressed Current.
- (4.2) Rectifier: Special 32 Volt, 10 amp direct current output enclosed in a stainless steel switchboard. Rectifier has a 240V supply from the nearby Sandgate Rd. Submersible Sewerage Pumping Station SP 78.
- (4.3) Cathode: The cathode point is located on the risers to the header pipe inside the submersible pump station just above the delivery valve, on the riser pipe flange. The cathode point is where the cabling from the rectifier is attached to the structure under cathodic protection.
- (4.4) Anodes: Two 1500 x 75mm silicone iron anodes were installed approximately 30 metres from the trunk mains in a vertical bed. The anodes were firstly packaged with cokebreeze thereby improving anode ground resistance. The anodes are identified by a marker post and label.
- (4.5) Test Points: Test points are installed on cathodically protected structures to enable testing to ensure full protection of the mains. On these mains four test points have been installed for details see dwg no. Zillman Waterholes 3006/2219, 3006/2220.
- (4.6) Associated Drawings:

  Cathodic Protection Details 2/14.213

  Cathodic Protection Test Point Details 486/1/22-AA1T0001E

Standard Rectifier Wiring Diagram - 486/6/25-AA1C0021E Vertical Ground bed Details - 486/6/25-AA1C0024E

- (4.7) Associated Standards:
  AS 3000 1986 Australia Wiring Rules
  AS 2832.1 1985 Pipes, Cables, Ducts, Guide to Cathodic Protection,
  Part One.
- (4.8) Government Regulations:
  Queensland Electricity Acts and Regulations.

#### (5.0) **PERFORMED TESTING**

- (1) Natural Potential Survey.
- (2) Testing of Insulated Flanges, Joints.
- (3) Soil Resistance Testing.
- (4) Current Drain Survey.
- (5) Pipe Coating Anomaly Survey.
- (6) Rectifier Loop Resistance.
- (7) Foreign Structure Interference Survey and Mitigation.
- (8) Final Potential Survey and Commissioning.

#### (6.0) CONCLUSION

Full Cathodic protection has been achieved on this section of trunk mains. The cathodic protection system is registered with the Electricity Regulator Department of Minerals and Energy and has approval to operate.

#### (7.0) MAINTENANCE

The cathodic protection system is maintained on a monthly basis after commissioning. These checks involve testing rectifier operation and recording of pipe to soil potentials.

Cathodic Protection System - Zillman Waterholes - Sandgate Road - Sewer Rising Main - 530 mm - OM Manual 20 th June 1997,

Electrical Engineering Unit

Cathodic Protection

CPS Monthly Maintenance Details.

#### Required:

- 1/ Notify plant operator and/or sign entry logs where necessary.
- 2/ Have appropriate keying.

#### Labour:

One tradesperson, one vehicle. 20 minutes per site.

#### Procedure:

- 1/ Identify installation.
- 2/ Check system for operation.
- 3/ Record voltmeter.
- 4/ Record ammeter.
- 5/ Comments.
- 6/ Log entry.

Cathodic Protection System - Zillman Waterholes - Sandgate Road - Sewer Rising Main -  $530\,\mathrm{mm}$  - OM Manual  $20\,\mathrm{th}$  June 1997,

**Electrical Engineering Unit** 

Cathodic Protection

#### CPS 6 Monthly Maintenance Details.

#### Required:

- 1/ Notify plant operator and/or sign entry logs where necessary.
- 2/ Have appropriate keying.
- 3/ Set of tools. (Electricians)
- 4/ Multimeter.
- 5/ DC clampmeter.
- 6/ Copper sulphate reference cell and leads.
- 7/ Cleaning equipment.
- 8/ Gatic cover lifters.

#### Labour:

One tradesperson electrical, one laborer, one vehicle. Two hours per site.

#### Procedure:

- 1/ Identify system.
- 2/ Check system for operation.
- 3/ Record voltmeter.
- 4/ Record ammeter.
- 5/ Record "on" potentials for all test points.
- 6/ Record "instant off" potentials for all test points.
- 7/ Record "off" potentials for all test points.
- 8/ Perform loop resistance and record.
- 9/ Check and record anode string currents.
- 10/ Comments.
- 11/Log entry.

Cathodic Protection System - Zillman Waterholes - Sandgate Road - Sewer Rising Main - 530 mm - OM Manual 20 th June 1997,

Electrical Engineering Unit

Cathodic Protection

#### CPS 60 Monthly Maintenance Details.

#### Required:

- 1/ Notify plant operator and/or sign entry logs where necessary.
- 2/ Have appropriate keying.
- 3/ Set of tools. (Electricians)
- 4/ Multimeter.
- 5/ DC clampmeter.
- 6/ Copper sulphate reference cell and leads.
- 7/ Cleaning equipment.
- 8/ Gatic cover lifters.
- 9/ Rectifier load bank.
- 10/ PCS2000 Detection Equipment.

#### Labour:

One tradesperson electrical, one laborer, one vehicle. Eight hours per site.

#### Procedure:

- 1/ Identify system.
- 2/ Check system for operation.
- 3/ Record voltmeter.
- 4/ Record ammeter.
- 5/ Record "on" potentials for all test points.
- 6/ Record "instant off" potentials for all test points.
- 7/ Record "off" potentials for all test points.
- 8/ Perform loop resistance and record.
- 9/ Check and record anode string currents.
- 10/ Load test rectifier for 10 minutes.
- 11/ Check all switchboard and testpoint terminals for tightness.
- 12/ Check all switchboard and testpoints are labelled and I.D. tags attached.
- 13/ Check plans are correctly drawn and modify if necessary.
- 14/ Remove and inspect anodes.
- 15/ Recheck all interference (CPS) bleeds.
- 16/ Pipecamp structure if applicable.
- 17/ Apply to reregister system, if applicable.



□ Electrical □ Mechanical □ Water Meters
25 Bunya Street Eagle Farm Q 4009
Ph. (07) 3403 1849
Fx. (07) 3403 1898

4 th July 1997

Subject: Coating defect survey for Sandgate Rd rising sewer main.

Equipment used: Pipecamp PCS 2000 coating anomaly equipment.

Length Of Mains: Aprox. 1400 Metres.

Size of mains: 530 mm Dia mild steel cement lined.

**Operator:** John Taylor

Date of survey: 4th, July 1997.

Procedure: Equipment was set up as per operation manual while operator traversed Pipeline

route. Potentials were measured at each test point and no defects were noted.

Evaluation: Over the length of the main no notable defects were found.

Conclusion: The coating is still of reasonable condition and no further action is needed other

than the CP System.

John Taylor Electrical Engineering Unit

CP Form No. 27

Electrical Engineering Unit

Cathodic Protection Interference Survey Results Form

Project Sandgate hd.

Unit Reading 1.5 Volts 4.8 A. Date 17-6-97

	Reading	Test Point	Location	Swing
		I. D.	C. J. J. P.J	
On	2390	Rect.	Sandgate Rd.	<i>t</i> 3
Off	-395	Earth	Pump Station	
On_	-425	main	sandgate Rd.	40
Off	-433	Earth	Pump Station	+8
On	-466	Dist	Ferric St	-34
Off	-432	Trans		J#
On	-640	Fence	Council Depot	
Off	-587			-53
On	-639	Fence	BCC Depot	-14
Off	-625			
On	-454	Sewer	Ferric St	Wone
Off	-454			
On	-486	Water	Ferric st	_
Off	-486	Valve		Nove
On	-507	Water	Ferric ST	None
Off	-507	Tap		
On	-477	Light	Ferric St	
Off	-468	441230		- 9
On	-630	Gas	Car Ferric Lathe sts.	44
Off	630			None
On	-286	Water	Car Ferric Lathests	- 3
Off	-283			
On	-495	Light	car Ferric Lathe Sts	-9
Off	-486	441231		
On	-468	Light	Ferric St.	10
Off	-449	441229	<u> </u>	-19
On	-504	Light	Ferric St	-54
Off	-450	441228		
On	-487	Light	Ferric ST	-26
Off	-461	441227		

TESTED BY .....

CP Form No. 27

Electrical Engineering Unit

Cathodic Protection Interference Survey Results Form

Project Sandgate Rd Unit Reading 1.5V 4.8 A

Date 17-6-97

	Reading	Test Point I. D.	Location	Swing
On	-372	Power	Sandgates Ferric st	
Off	-372	Pole	45203	NIL
On	-457	Light	A. Mart	
Off	-457	Pole	Sandgate Rd	NIL
On	-242	Brigade		
Off	-242		Sandgate Rd	NIL
On	-1286	H.P.	Pritchard Rd.	
Off	-1286	Gas	,	NIL
On	-1329	H-P	OPP Ferric St	
Off	-1309	Gas	Sandgate Rd.	-21
On	-297	SWING	Eatery Center	
Off	-292		Sandgate Rd.	- 5
On	-854	Guard.	by creek	, .
Off	-854	Rail	Sandgate Rd.	NIL
On	-700	Light	by Creek	
Off	-700	15659	- Sandgate Rd	NIL
On	-1071	Light	by Creek	
Off	-1071	15660	Sandgate Rd	NIL
On	-891	Guard	by Creek	
Off	-891	Rail	Sandgate Rd	NIL
On	- 333	Pipe	creek	
Off	-333	Bridge	Sandgate Rd	NIL
On	-441	Power	Sundgate Rd.	
Off	-436	Pole	·	-8
On				
Off			-	_
On				
Off				
On				
Off_				

CP Form No. 23

**Electrical Engineering Unit** 

### **Cathodic Protection System Potential Recording Form**

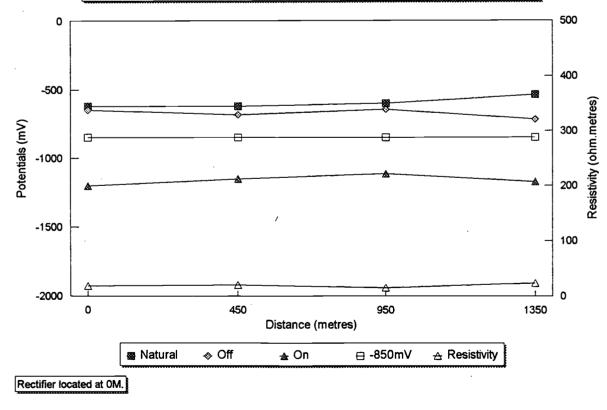
**Project** 

Sandgate Rd. Rising Sewer Main

Date 20th June 1997

Test Point	Distances	Potentials to CuSO4			Resistivities
number	to T.P.	Natural	Off	On	at 2 metres
	(metres)	(mV)	(mV)	(mV)	(ohm.metres)
1	0	-621	-648	-1203	18.4
2	450	-621	-684	-1150	20.1
3	950	-600	-644	-1114	15.1
4	1350	-538	-719	-1171	23.8
5					1.2
6				•	· .
7					
8					
9					
10					
11					
12					
13					
14					

# Graph of potentials and resistivity vs pipelength



Revision 06/26/97

CP Form No. 24

#### **Electrical Engineering Unit**

#### Cathodic Protection System Loop Resistance

Date: 20th JUNE 1997

Cathodic Protection System: System Operating Volts:

Sandgate Rd. Virginia Rising Sewer Main

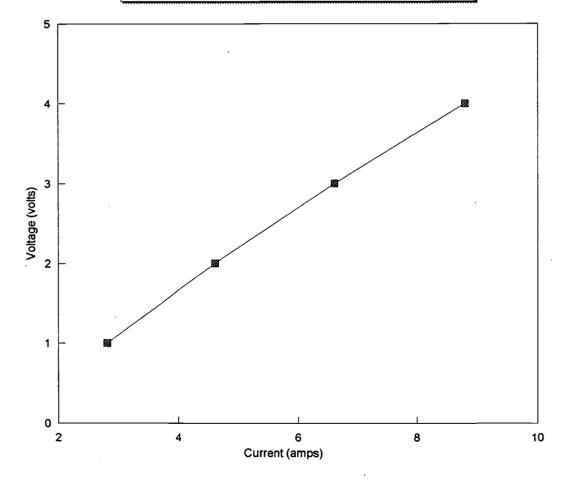
System Operating amps

4

Test Volta	est Voltage:		nt:
(volts)		(amps)	
1		2.8	
2		4.6	
3		4.6 6.6	
4		8.8	

Loop Resistance		
(ohms)		
	-	
0.454545		

# Graph of System voltage vs current.



06/26/97 LOPSAND.WK4

Brisbane Water Engineering Service	S CP Form No.18
Electrical Engineering Unit	
Standard Cathodic Protection Test Point Data C	Gathering Form
Project Sandgate Rds R.M. Virginia	Date 26-6-97
TP Location Sandgate Rd Virginia	TP No/
Mains Size 530 mm MS	TP Type
POTENTIAL TESTING	- 
CATHODE TO CATHODE RETURN (RESISTA ZINC REFERENCE TO PIPE CuSo4 REFERENCE TO PIPE ZINC TO CuSo4	ANCE) 0.016 2 -045 mV -1203 mV -1158 mV
EARTH TESTING  TEST NO. 1  PIN SPACING  MEGGER READING  1.5	RESISTIVITY 18-4 2m
COMMENTS / LOCATION DRAWING	
Pump Station Rectifier  18m  Ferric St.	TP/
	Radley
Sandgate Rd.	

Cathodic Protection System - Zillman Waterholes - Sandgate Roa Brisbane Water Engineering Services	
Electrical Engineering Unit	
Standard Cathodic Protection Test Point Data G	Sathering Form
Project Sandgata Rd R/M Virginia	Date 2 6 - 6 - 9.7.
•	TP No3
Mains Size 530 mm M S	ТР Туре <i>В</i>
POTENTIAL TESTING	
CATHODE TO CATHODE RETURN (RESISTA ZINC REFERENCE TO PIPE CuSo4 REFERENCE TO PIPE ZINC TO CuSo4	NCE) 0.015 12 -1 mV -1114 mV -1110 mV
EARTH TESTING  TEST NO. 1  PIN SPACING  MEGGER READING  1 2	RESISTIVITY 15 2 m
COMMENTS / LOCATION DRAWING  18m  18m	Golf. Links
Pritchard st.	
Sandgate Rd.	
INSTALLED BY	Y

**INSTALLED BY** 

Brisbane Water Engineering Servi	CP Form No. 17
Electrical Engineering Unit	
Cathodic Protection Anode Bed Testing	
Project Sandgate Rd	Date
ANODE MATERIAL: Silicone Iron	BURIAL: Verticle  TEST POINT TYPE: 2.13 ohm mtr.
ANODE SIZE/WEIGHT: 1.5m x 75mm	TEST POINT TYPE: 2.13 ohm mtr.
ANODE PACKAGING: Canister	SOILRESISTIVITY: 5 m 1 R = 31.4 am
ANODE DEPTH:	SIGNAGE: L Post against Fence
RESISTANCE TO GROUND:	ANODE CURRENT
ANODE NO.1	ANODE No.1
TOTAL 0-44 2	TOTAL. 4 A.
BCC Property	Pump  Rectifier  Station  Coupon Pit  A  STATE  STA
Anode x2 N Anode run dot 10.8 m  kerb  FERRIC	ST
ZANIC	TESTED BY Jaylon

Revision 09/28/95

