

26TH NOVEMBER, 1993

**BRISBANE CITY COUNCIL
DEPARTMENT OF WATER SUPPLY AND SEWERAGE
MECHANICAL AND ELECTRICAL BRANCH
ELECTROLYSIS SECTION
EAGLE FARM PUMPING STATION**

**OPERATING MANUAL FOR:
KARAWATHA HIGH LEVEL RESERVOIR CATHODIC PROTECTION SYSTEM.**

CLIENT:

**DEPARTMENT OF WATER SUPPLY AND SEWERAGE
WATER MAINTENANCE SECTION**

MANUAL CONTENTS

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DRAWINGS

- 486/6/8-TB1C0030E * External Pipework rectifier/termination board wiring diagram.
- 486/6/8-TB1C0029E * Cathodic protection general layout.
- (No Number) * Monthly Maintenance Program.
- 486/6/8-TB1C0005E Underground conduits and pit layout.
- 486/4/8-TB010P Scour overflow pipe details.
- 486/4/8-TB08P Pipework layout plan and details.

* denotes drawings included in manual.

(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 an 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.

(3.0) MAINS DETAILS

Size: Dia 750 – Dia 600 mild steel cement lined.

Coating: Low density fusion banded polyethylene outer coating.

Length: 0.1 km

Location: Karawatha High Level Reservoir Karawatha 4117 UBD 54 H6.

Construction Drawings: 486/4/8-TB08P to 486/4/8-TB010P

(4.0) **CATHODIC PROTECTION DETAILS**

- (4.1) Type of Cathodic Protection: Impressed Current.
- (4.2) Rectifier: Standard 32V Volt, 15 amp direct current output enclosed in a stainless steel switchboard. Rectifier has a 240V supply from the distribution switchboard. Rectifier is located on the first floor against the handrails.
- (4.3) Cathode: The cathode points are located on top of the pipe, reservoir side of the inlet and outlet valves, scour valve and overflow. The cathode point is where the cabling from the rectifier is attached to the structure under cathodic protection.
- (4.4) Anodes: One 1500 x 75mm silicone iron anode was installed approximately 29.0 metres from the inlet valve pit in a vertical bed. The anodes were first backfilled with cokebreeze thereby improving anode - ground resistance. The anodes are identified by a marker pit and label. Refer attached drawing.
- (4.5) Test Points: Test points are installed on cathodically protected structures to enable testing to ensure full protection of the mains. On these pipes, eight test points have been installed and brought back to the distribution switchboard. Refer to attached drawing.
- (4.6) Associated Drawings:
Cathodic Protection Details - 2/14.213
Cathodic Protection Test Point Details - 2/14.199
Standard Rectifier Wiring Diagram - JE02/104
- (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) Rectifier Loop Resistance.
- (6) Foreign Structure Interference Survey and Mitigation.
- (7) Final Potential Survey and Commissioning.

NOTE: Details of above testing have not been included in this manual but are available upon request.

(6.0) CONCLUSION

Full Cathodic protection has been achieved on this section of trunk mains. The cathodic protection system will be registered with the Queensland Electricity Commission.

(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.

12th October 1992
Electrical Workshop
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.

13th October 1992
Electrical Workshop
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.

13th October 1992
Electrical Workshop
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/ Pipcamp structure if applicable.
- 17/ Apply for "continue to operate" permit if applicable.

BRISBANE CITY COUNCIL

MEMORANDUM

To	File No.
From	Date 25/08/93
Subject KARAWATHA RESERVOIR	

$$\text{SOIL RESISTIVITY} \quad 2\text{m} : - 2\pi aR = 2 \times 3.1416 \times 2 \times 3.1 = 389.56 \Omega\text{m}$$

$$5\text{m} : - 2\pi aR = 2 \times 3.1416 \times 5 \times 10 = 314.16 \Omega\text{m}$$

NATURAL POTENTIALS

INLET VALVE PIT:-

CATH. RET. C4 TO ZN REF. R4-2	+609 mV
CATH. RET. C4 TO CuSO ₄	-388 mV
CuSO ₄ TO ZN REF. R4-2	-1005 mV

CATH. C5 TO CATH. RET. C5	0.4 Ω
CATH. RET. C5 TO ZN REF. R5-1	+775 mV
CATH. RET. C5 TO CuSO ₄	-384 mV
CuSO ₄ TO ZN REF. R5-1	

CATH. C7 TO CATH. RET. C7	2.6 Ω
CATH. RET. C7 TO ZN REF. R7-1	+775 mV

CATH. C8 TO CATH. RET. C8	3.1 Ω
CATH. RET. C8 TO ZN REF. R8-1	+814 mV

CATH. C9 TO CATH. RET. C9	2.6 Ω
CATH. RET. C9 TO ZN REF. R9-1	+755 mV
CATH. C9B TO CATH. RET. C9B	2.6 Ω
CATH. RET. C9B TO ZN REF. R9-1B	+566 mV

Cathodic Protection System - Karawatha High Level Reservoir - OM Manual
BRISBANE CITY COUNCIL
MEMORANDUM

To	File No.
From	Date 25/08/93
Subject : KARAWATHA RESERVOIR	

NATURAL POTENTIALS

OUTLET VALVE PIT

CATH C6 TO CATH RET C6 7.5Ω
CATH RET C6 TO ZN REF R6-1 + 783 mV
CATH RET C6 TO CuSO₄ - 314 mV
CuSO₄ TO ZN REF R6-1 - 1095 mV

CATH C4 TO CATH RET C4 0.5Ω
CATH RET C4 TO ZN REF R4-1 + 869 mV
CATH RET C4 TO CuSO₄ - 317 mV
CuSO₄ TO ZN REF R4-1 - 1181 mV

Cathodic Protection System - Karawatha High Level Reservoir - OM Manual
 BRISBANE CITY COUNCIL
MEMORANDUM

To	File No.
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Subject KARAWATHA RESERVOIR	

ON POTENTIALS (NON-POLARIZED)

RECT SET AT 30 Volts 500 mA

INLET VALVE PIT:-

CATH RET C4 TO ZN REF R4-2 +156 mV

CATH RET C4 TO CuSO₄ -891 mV

CATH RET C4 TO ZN REF R4-2 -1049 mV

CATH RET C5 TO ZN REF R5-1 +329 mV

CATH RET C5 TO CuSO₄ -850 mV

CuSO₄ TO ZN REF R5-1 -1182 mV

CATH RET C7 TO ZN REF R7-1 +668 mV

CATH RET C8 TO ZN REF R8-1 +712 mV

CATH RET C9 TO ZN REF R9-1 +718 mV

CATH RET C9B TO ZN REF R9-1B +565 mV

OUTLET VALVE PIT:-

CATH RET C6 TO ZN REF R6-1 +494 mV

CATH RET C6 TO CuSO₄ -618 mV

CuSO₄ TO ZN REF R6-1 -1112 mV

CATH RET C4 TO ZN REF R4-1 +557 mV

CATH RET C4 TO CuSO₄ -629 mV

CuSO₄ TO ZN REF R4-1 -1136 mV

Cathodic Protection System - Karawatha High Level Reservoir - OM Manual
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MEMORANDUM

To	File No.
From	Date 2/09/93
Subject KARAWATHA RESERVOIR	

RECTIFIER SET AT 30V 500mA

LOOP RESISTANCES 18V 240mA
..... 20V 280mA
..... 22V 310mA
..... 24V 340mA
..... 26V 370mA
..... 28V 390mA

ANODE CURRENT 430mA

ON POTENTIALS - POLARIZED

INLET VALVE PTI:-

CATH RET C4 TO ZN REF R4-2 + 89 mV on + 294 mV off
CATH RET C4 TO CuSO₄ - 101.9 mV on - 64.3 mV off
CuSO₄ TO ZN REF R4-2 - 924 mV on - 924 mV off

CATH RET C5 TO ZN REF RS-1 + 88 mV on + 305 mV off
CATH RET C5 TO CuSO₄ - 997 mV on - 657 mV off
CuSO₄ TO ZN REF RS-1 - 1085 mV on - 1062 mV off

CATH RET C7 TO ZN REF R7-1 + 462 mV on + 532 mV off

CATH RET C8 TO ZN REF R8-1 + 501 mV on + 592 mV off

CATH RET C9 TO ZN REF R9-1 + 503 mV on + 540 mV off

CATH RET C9B TO ZN REF R9-1B + 385 mV on + 365 mV off

MEMORANDUM

To	File No.
From	Date 2/09/93
Subject: KARAWATHA RESERVOIR	

ON POTENTIALS - POLARIZED

OUTLET VALVE PIT:-

CATH. RET. C6 TO ZN REF. R6-1 +422 mV on +530 mV off

CATH. RET. C6 TO CuSO₄ -544 mV on -382 mV off

CuSO₄ TO ZN REF. R6-1 -967 mV on -964 mV off

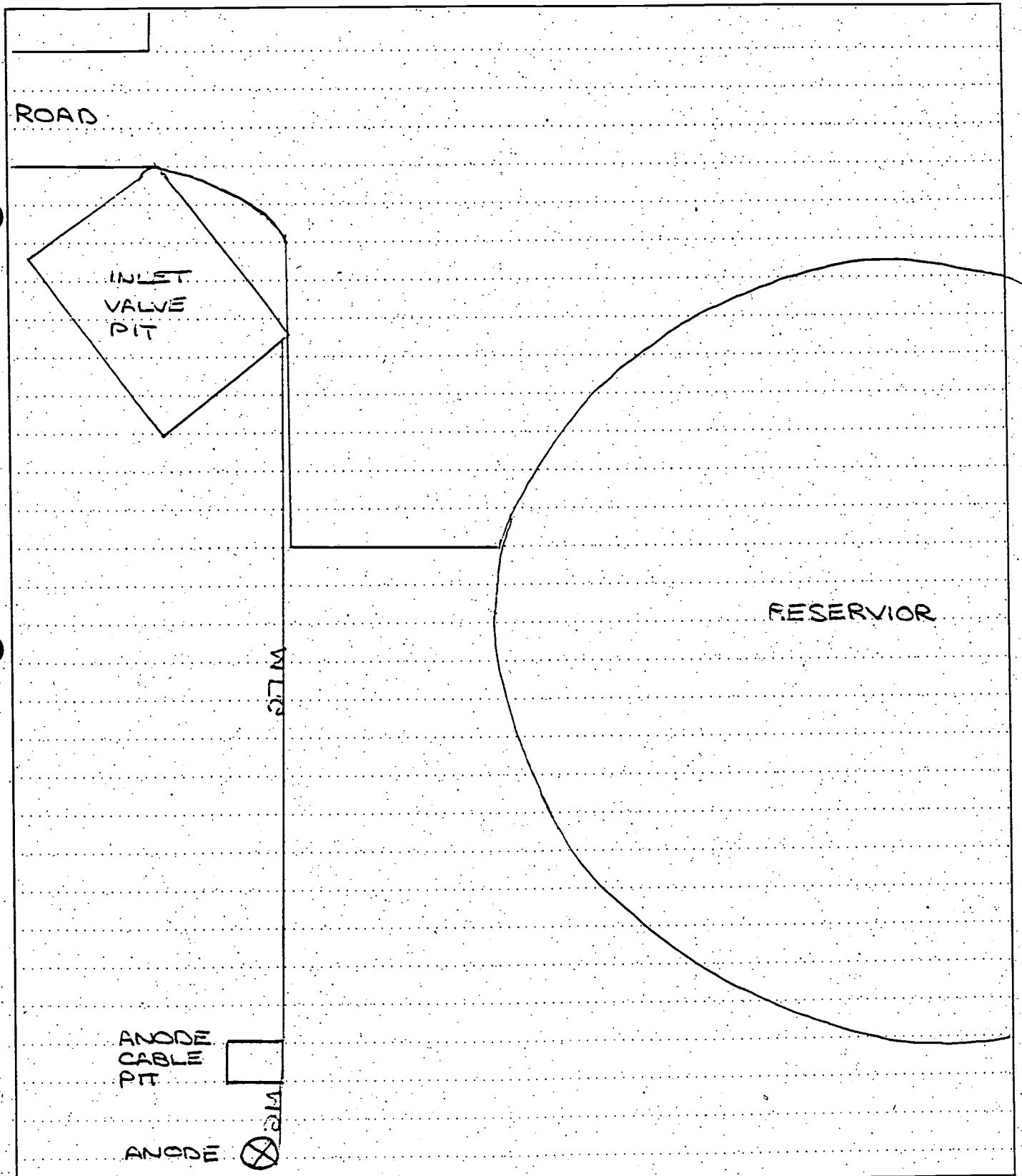
CATH. RET. C4 TO ZN REF. R4-1 +363 mV on +532 mV off

CATH. RET. C4 TO CuSO₄ -658 mV on -475 mV off

CuSO₄ TO ZN REF. R4-1 -1021 mV on -1010 mV off

Cathodic Protection System - Karawatha High Level Reservoir - OM Manual
BRISBANE CITY COUNCIL
MEMORANDUM

To	File No.
From:	Date
Subject KARAWATHA RESERVOIR ANODE LOCATION	



DEPARTMENT OF WATER SUPPLY AND SEWERAGEMECHANICAL AND ELECTRICAL BRANCHMETROPOLITAN DIVISIONEAGLE FARM PUMPING STATIONELECTRICAL WORKSHOPINSULATED JOINT TESTING DETAILS:DATE 26-08-93DESCRIPTION

MAINS DETAILS:-

LOCATIONS:- KARAWATHA RESERVOIR INLET

SIZE:- 600 MM

MATERIAL:- STEEL

COATING:- PVC

NUMBER:-

IN GROUND TESTINGBOLT TO FLANGE RESISTANCE:- $>200\Omega$

NUMBER OF BOLT:- 16 BOLTS PER FLANGE.

FLANGE TO FLANGE RESISTANCE:- 30Ω , 25Ω , 10Ω ACROSS FLANGE

INSULATION CHECKER MODEL 702:- O.K.

POTENTIAL DIFFERENCE TO REFERENCE CELL

PROTECTED SIDE:- RESERVOIR -686 mV

UNPROTECTED SIDE:- TRUNK MAIN -635 mV

ABOVE TESTING

BOLT TO FLANGE RESISTANCE:-

NUMBER OF BOLTS:-

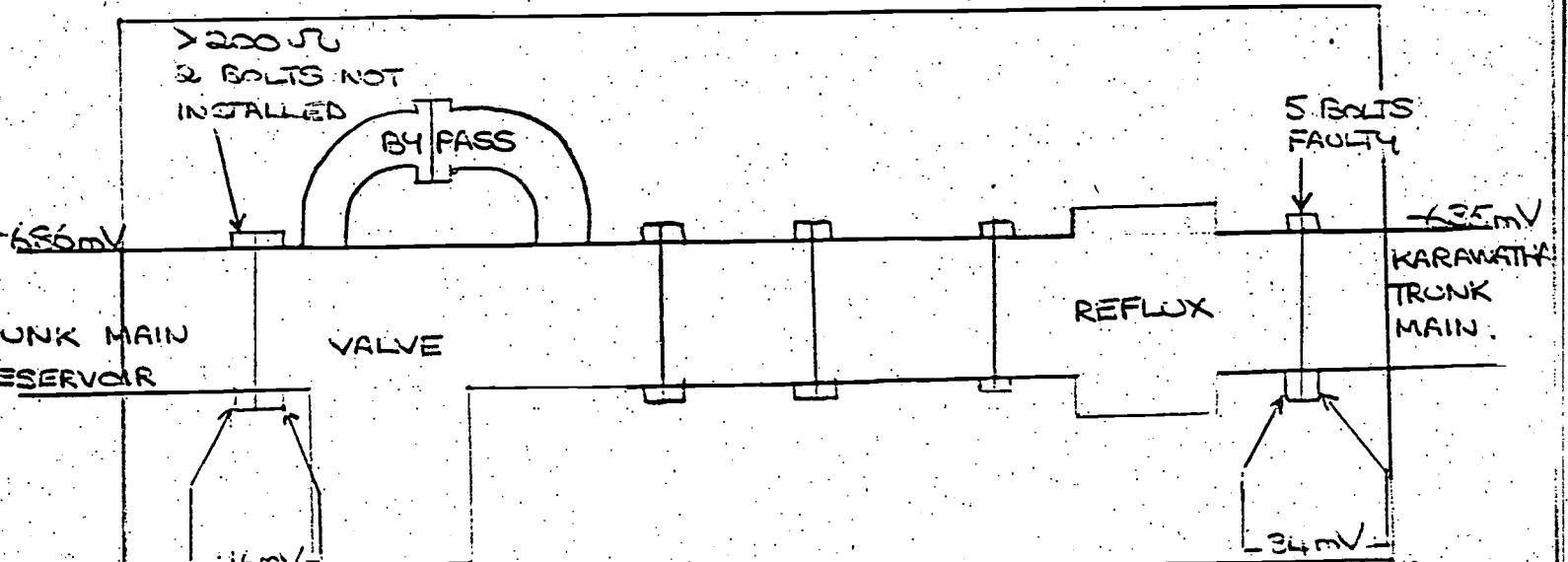
FLANGE TO FLANGE RESISTANCE:-

COMMENTS

INSULATED BOLTS REPLACED BY DARRA WATER SUPPLY

TESTED BY

M. M' CORMICK



DEPARTMENT OF WATER SUPPLY AND SEWERAGE
MECHANICAL AND ELECTRICAL BRANCH
METROPOLITAN DIVISION
EAGLE FARM PUMPING STATION

ELECTRICAL WORKSHOP

INSULATED JOINT TESTING DETAILS:

DATE 24-08-93

DESCRIPTION

MAINS DETAILS:-

LOCATIONS:- KARAWATHA RESERVOIR

SIZE:- 600 MM

MATERIAL:- STEEL

COATING:- PVC

NUMBER:-

IN GROUND TESTING

BOLT TO FLANGE RESISTANCE:- >300 Ω

NUMBER OF BOLT:- 16 BOLTS PER FLANGE

FLANGE TO FLANGE RESISTANCE:- 50Ω, 20Ω

INSULATION CHECKER MODEL 702:- O.K

POTENTIAL DIFFERENCE TO REFERENCE CELL

PROTECTED SIDE:- RESERVOIR -187 mV

UNPROTECTED SIDE:- TRUNK MAIN -633 mV

ABOVE TESTING

BOLT TO FLANGE RESISTANCE:-

NUMBER OF BOLTS:-

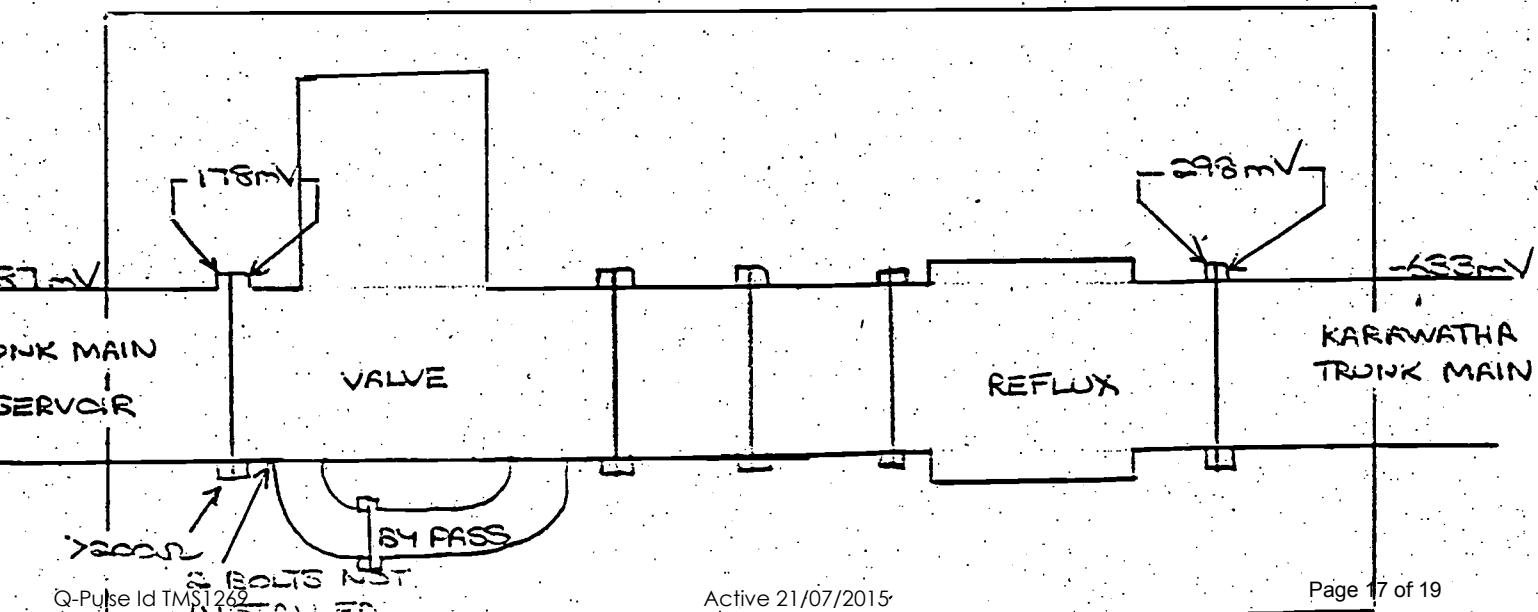
FLANGE TO FLANGE RESISTANCE:-

COMMENTS

INSULATED BOLTS REPLACED BY DARRA WATER SUPPLY

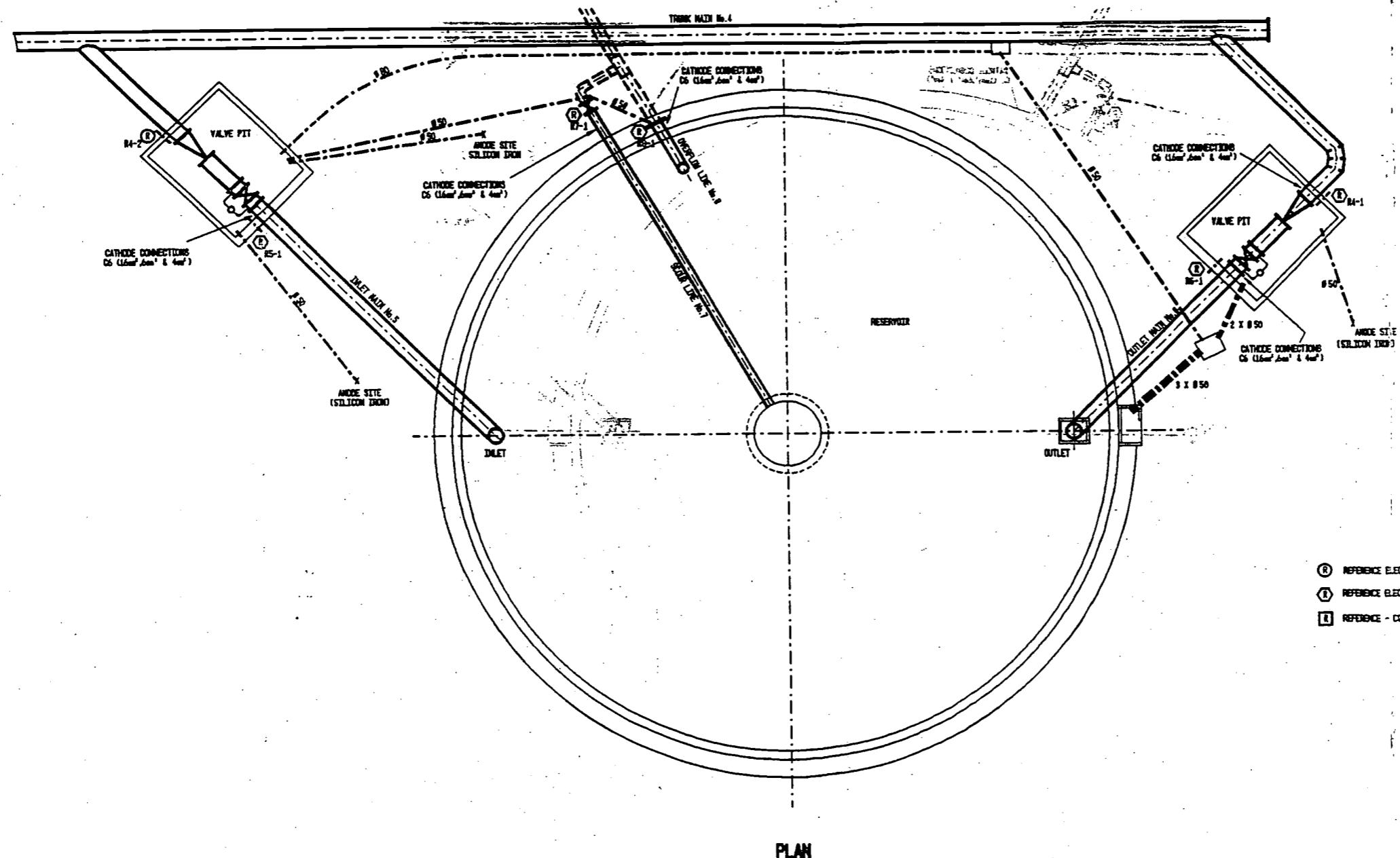
TESTED BY

M. M' CORMICK



NOTES

1. REFER TO FIG. 486/8/8-TB1C0029E FOR
RECTIFIER / TERMINATION BOARD KITTING DIAGRAM.

ADDITIONAL 4mm COUPON
CATHODIC CONNECTIONS

C	8.92	AS CONSTRUCTED	J.A.F.
		ADDITIONAL 4mm COPPER CATHODE CONNECTIONS	G.L.P.
A	11.91	ISSUED FOR APPROVAL	SIGNED
M	DATE	AMENDMENT / ISSUE TO / ISSUE FOR	DIGITALS

APPROVING & SIGNING RECORD SHEET

NUMBER: DIRECTOR OF PLANNING & DESIGN

DATE:

DIRECTOR OF CONSTRUCTION

DATE:

DIRECTOR OF M&E SERVICES

DATE:

DIRECTOR OF SEL.
OPERATIONS / M.S.
DISTRIBUTION

DATE:

DESIGN J.S. 26.11.81 ENGINEER IN CHARGE

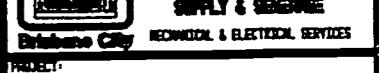
DRAWN G.L.P. 27.11.81 SUPERVISOR H.JAMES

TRACED

CHECKED J.S. 11.12.81

SHEET NO.

68C028C



PROJECT:

KARAWATHA RESERVOIR

TITLE:

CATHODIC PROTECTION
GENERAL LAYOUT

SCALE: 1 : 100 NO. OF SHEETS

DRAWING NO. 486/8/8-TB1C0029E

C

