

Assessment of Nitoproof 410 to: AS 4654.1:2012 Waterproofing membranes for external above- ground use Part 1: Materials

Report number: SW8534 - 1st Revalidation AS4654.1

CSIRO Job No.: SW8534

Date of issue 31st May 2024

Client

Parchem Construction Supplies Pty Ltd

1956 Dandenong Rd

Clayton

VIC 3168

Australia

TERM OF VALIDITY

This CSIRO' report for Wet Area Membranes 1st Revalidation with date will lapse three years after of issue and assessment unless 2nd revalidation has been requested and granted.

The Report number SW8534-AS4654.1 valid until 30th May 2027

Commercial-in-confidence

Use of Reports

Use of Reports – Testing

This report is subject to binding obligations under which it was prepared. In particular, the Report must not be used:

- As a means of endorsement; or,
- In a company prospectus or notification to a Stock Exchange document for capital raising, without the prior written consent of CSIRO.

The Report may be published verbatim and in full, provided that a statement is included on the publication that it is a copy of the Report issued by CSIRO.

Excerpts of the Report may not be published.

Use of Reports – Consultancy

This report is subject to binding obligations under which it was prepared. In particular, the Report may only be used for the following purposes:

- The information in the Report may be used by the party that commissioned the Report for its internal business operations (but not licensing to third parties);
- The report may be copied for distribution within the organisation that commissioned the Report;
- Copies of the Report (or extracts of the Report) may be distributed to contractors and agents of the organisation that commissioned the Report who have a need for the Report for its internal business operations. Any extracts of the Report distributed for this purpose must clearly note that the extract is part of a larger Report held by the organisation that commissioned the Report and which has been prepared by CSIRO.

The name, trade mark or logo of the CSIRO must not be used without the prior written consent of CSIRO.

The Report must not be used as a means of endorsement without the prior written consent of CSIRO.

Copyright and disclaimer

© 2024 CSIRO To the extent permitted by law, all rights are reserved, and no part of this publication covered by copyright may be reproduced or copied in any form or by any means except with the written permission of CSIRO.

CSIRO advises that the information contained in this publication comprises observations based on test results. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, CSIRO (including its employees and consultants) excludes all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

The results reported herein relate only to the item(s) tested.

Contents

Introduction.....	Error! Bookmark not defined.
Test specimen description.....	8
Test Methodology	8
<i>ASTM E96/E96M – 16 Water Vapour Transmission of materials.....</i>	9
<i>AS4654.1-2012 Appendix B Resistance to cyclic movement</i>	9
<i>AS 4654.1-2012 Appendix A Durability of membrane and Temperature Resistance</i>	9
<i>ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants.....</i>	10
<i>AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings—Methods of test, Method 9: Determining thickness.....</i>	10
Results	11
<i>ATSM E96/E96M - 16 Water Vapour Transmission of materials</i>	11
<i>AS 4654.1:2012 Appendix B Resistance of waterproofing membranes to cyclic movement</i>	12
<i>AS 4654.1:2012 Appendix A Durability of membrane</i>	13
<i>ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants.....</i>	15
<i>AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings—Methods of test, Method 9: Determining thickness.....</i>	16
Comments	17

Figures

Figure 1 Top face of Nitoproof 410	Error! Bookmark not defined.
Figure 2 Underside of Nitoproof 410	Error! Bookmark not defined.
Figure 3 Images of test sample performing durability load / elongation test	14
Figure 4 Images OF test sample performing Adhesion-In-Peel.....	16

Tables

Table 1 Summary of test requirements and test specimen results for AS4654.1:2012.....	5
Table 2 Details of submitted test specimen.....	7
Table 3 Details of the schedule for testing of the submitted specimen	7
Table 4 Water Vapour Transmission test results	11
Table 5 Test sample holing during cyclic movement and test results.....	12
Table 6 Durability test results	13
Table 7 Adhesion-in-Peel Strength tests results	15
Table 8 Determining Thickness test results.....	16

1 Summary

Test Standard: Testing was conducted on a waterproofing membranes for external above-ground use with fully bonded membrane liquid non-exposed to assess its performance for: water vapour transmission; water absorption; acceptance of cycle movement; durability; bond strength and thickness. The external waterproofing membranes properties were tested in accordance to the Australian Standard AS4654.1:2012.

All methods were carried out according to Tables 2.1 under fully bonded membrane liquid non-exposed against the performance criteria of Tables A1, A3 and A4.

Test results: The waterproofing membrane presented for testing complied with the performance criteria set in AS4654.1:2012 waterproofing membrane for external above-ground, non-exposed. The following table shows the Nitoproof 410 performance as assessed from testing.

Table 1 Summary of test requirements and test specimen results for AS4654.1:2012

TEST	METHOD	REQUIREMENTS	RESULT	STATUS
(a) Moisture Transmission Rate	ASTM E 96 Desiccant method for Determining Water Vapour Transmission (WVT)	Record result	WVT 7.05 g/m ² /24hrs Permeance 48.44 ng/Pa.s.m ²	Complied
(b) Acceptance of movement	AS AS4654.1 Appendix B for assessment of cyclic movement of membrane	Pass or fail criteria by observing any cracking, rupture holing or extending through the thickness for more than 1 mm in from the edge of the specimen.	Class II	Complied
(c) Durability 1. Control 2. Water immersion 3. Detergent immersion 4. Heat ageing at 80°C 5. Temperature resistance at -15°C to +85°C	AS4654.1 Appendix A for assessment of membranes durability AS4654.2 temperature resistance section 2.4.2 (c)	Pass or fail criteria; compared to control samples: elongation at break shall be not less than 25 % for water and detergent immersion. Whereas, elongation at break shall be not less than 50 % for heat ageing samples.	1. Class II 2. Class II 3. Class II 4. Class II 5. Class II	Complied
(d) Bond strength to concrete substrate	ASTM C794 Standard test method for adhesion-in-peel of elastomeric joint sealants	Test samples exposed to dry conditions, then tested for adhesion-in-peel strength.	97.85N with 50% mesh failure and 50% cohesive failure loss for concrete.	Complied
(e) Membrane thickness	AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings.	The film thickness shall be measured at a minimum of five points and a maximum of 10 points, equally spaced across the strip	1.46mm	Complied

Note: The above is only a summary of the overall results and must be read in conjunction with the relevant sections of this report.

SUMMARY OF RESULTS

AS 4654.1:2012 Waterproofing membranes for external above-ground use, non-exposed:

Appendix A: Assessment of Durability of waterproof membranes

Test Report No.	8365	SW8534 – AS4654.1	
Year of test	2021	2024	
Control	154% (Class II)	103% (Class II)	
Water Immersion@56d	90%		PASS
Detergent Immersion@56d	62%		PASS
Heat Ageing @ 80 °C	142%		PASS
Temperature Resistance	126% @-15°C		PASS
	116% @+85°C		PASS

Parchem Construction Supplies Pty Ltd, test sample - the Nitoproof 410, Waterproofing Membrane achieves the performance requirements of AS 4654.1:2012 Waterproofing membranes for external above-ground use, Non-exposed, Class II membrane installation.

Appendix B: Assessment of resistance of waterproofing membranes to cyclic movement

Pass or Fail criteria by observing any cracking, rupture holing or extending through the thickness for more than 1 mm in from the edge of the specimen.

Result: No fatigue cracking exhibited. PASS

ASTM E96: Water Vapour Transmission of Materials

Result	7.05 g/m ² /24	PASS
AS 4347.9:2002	Thickness	1.46mm
ASTM C794:2015	Bond Strength – Concrete, Dry Condition	97.85 N

Note: The above is only a summary of the overall results and must be read in conjunction with the relevant sections of this report.

2 Introduction

CSIRO Services was engaged by Parchem Construction Supplies Pty Ltd to assess a waterproofing membrane for compliance against the AS4654.1:2012 according to Table 2.1 under fully bonded membrane liquid, non-exposed with compliance confirmed against the performance criteria of Tables A1, A3 and A4. The details for this assessment are listed in Table 3 below.

Table 2 Details of submitted test specimen

CSIRO Agreement No.:	SW8534
TEST SPONSOR:	Parchem Construction Supplies Pty Ltd
PRODUCT DESCRIPTION:	Nitoproof 410

Note: CSIRO accepts no responsibility for the selection of specimens. The results in this report apply to the specimens tested and may not be applicable to other specimens of the same product.

This report details the performance, testing conditions and outcomes of the specimen assessed in accordance with waterproofing membrane system for exterior use - above ground level. Table 3 details the sponsor’s specified schedule of tests for the product.

Table 3 Details of the schedule for testing of the submitted specimen.

CSIRO Agreement No.:	SW8534
TEST SCHEDULE:	<p>AS4654.1 Clause A2, A4 Tables A1, A3 & A4:</p> <ul style="list-style-type: none"> a) Moisture vapour transmission rate - ASTM Designation E96/E96M – 16, ‘Standard Test Methods for Water Vapour Transmission’. b) Acceptance of cyclic movement; Appendix B ‘Assessment of resistance of waterproofing membranes to cyclic movement’. c) Abrasion resistance AS 1580.403.2.1-2006 Paints and related materials. d) Durability - Appendix A ‘Assessment of durability of waterproofing membranes: <ul style="list-style-type: none"> Table A4 (a) Controls & 1st Revalidation. Table A4 (b) Water immersion Table A4 (c) Detergent immersion Table A1 & A4 (d) Heat aging at 80°C e) Temperature resistance at -15°C to +85°C f) Bond strength to concrete substrate - ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants. g) Membrane thickness – AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings.

3 Test specimen description.

The Fosroc Nitoproof 410 / Emer-Proof Quick Dry supplied by Parchem Construction Supplies Pty Ltd is a water based, fast drying, flexible two component, polymer modified cementitious waterproofing membrane. The nominal size of the membrane was 300 mm wide, 303 mm length and 1.55 mm thick.

The supplied specimen for assessment is shown below in Figures 1 and 2.



Figure 1 Top face of Nitoproof 410 for SW8534(1st revalidation)



Figure 2 Underside of Nitoproof 410 for SW8534(1st revalidation)



*Top face of Nitoproof 410 for 8365 (the main specimens' test)

4 Test Methodology

4.1 ASTM E96/E96M – 16 Water Vapour Transmission of materials

This Standard outlines the method for determining water vapour transmission (WVT) through the membrane using the desiccant and dummy sample method.

Four test samples were prepared by mechanical sealed using two neoprenes and a Teflon gasket placed onto the open side of the test cups. The test cups contain dried desiccant with the trafficable side facing up were placed in a climate-controlled environment with periodic weighing so that the rate of water vapour movement through the membrane to the desiccant can be determined.

The exposed area (test dish face) for each of the cups was 0.002827 m². The test cups (all except the dummy sample, no desiccant) had a 6 mm gap between the desiccant and the underside of the membrane.

All test assemblies were kept in a Steridium environmental where chamber temperature humidity are maintained at a temperature of 23 ±2°C and 60 ±5% relative humidity, for the 46 days duration. Measurements taken each afternoon (excluding weekends) over this period to determine the weight change and permeance of the membrane.

4.2 AS4654.1-2012 Appendix B Resistance to cyclic movement

This Standard outlines the method for determining resistance of membrane to cyclic movement set at 50% of the elongation a break.

A rectangular test sample of 65 mm x 25 mm x 1.51 mm was cut from the Nitoproof 410, then held in the test grips (70(w) x 45(l) x 20(t) mm), exposing a 25 x 2 mm central portion of the sample.

An Applied Test Systems Series 904 Vertical Sealant Tester was used for testing. The vertical sealant testing machine used software for cyclic movement control. The vertical testing machine was set to elongate the clamped test sample for the cycling is 50% of the elongation a break. Once the test piece reached full extension, it then returned to its original position, which completed one cycle of movement. The elongation and return was then repeated to complete a 50 cycle movement test, each cycle conducted over a nominal 2 hour period.

The test sample was inspected for signs of breakage or cracks and measured for any necking. A reduction in width of more than 1 mm inwards from the edge of the test sample constitutes a failure.

4.3 AS 4654.1-2012 Appendix A Durability of membrane and Temperature Resistance

This Standard outlines the method for determining resistance of the membrane's durability after conditioning in various solutions over set periods, then assessed against an unconditioned material.

Testing of the Nitoproof 410 was in accordance with Appendix A4.2 Durability of membranes. As specified in A2.2.1 the membrane test samples were prepared in accordance with AS 1145.3-2001, Type 2, strip samples 10mm width with a 50mm gauge length. Test samples were exposed and conditioned to those requirements specified in Table A1, A4 & Temperature Resistance of AS4654.1-2012.

In accordance with A4.2.2.2 Testing, a universal testing machine, fitted with a calibrated 5kN load cell, was used to record the elongation at break and tensile strength. The elongation at break of the immersed test samples were compared to the control test samples.

4.4 ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants

This test method consists of preparing four strip test specimens of 25mm width and 250mm in length by embedding a wire mesh screen between two thin layers of Nitoproof 410 from mixing of part A and B components together to form a polymer modified cementitious waterproofing membrane per manufacturer's procedure. For each coating, remix briefly before applying strips only 100mm in length on to the surface of concrete substrate to ensure good initial bond. All test specimens were kept in a conditioning room maintained at a temperature of $23 \pm 2^\circ\text{C}$ and $60 \pm 5\%$ relative humidity, for the 21 days duration. Then the specimens were placed in a tension-testing machine in such a way the test sample is peeled back from the substrates at 180° to the face of the sample. The exerted force was measured as well as the mode of failure of the membrane from both substrates at the test rate of 50mm/min for 1 minute.

4.5 AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings—Methods of test, Method 9: Determining thickness.

This Standard sets out a means to determining the thickness of polyethylene film. All three rectangular test strips of 290 mm x 50 mm was cut across middle width of supplied sheets. The sheet thickness measured a three points, equally spaced across the strip. The specimens were tested in a conditioning room maintained at a temperature of $23 \pm 2^\circ\text{C}$ and $60 \pm 5\%$ relative humidity.

5 Results

5.1 ATSM E96/E96M - 16 Water Vapour Transmission of materials.

The periodic measurements of the membrane test samples were recorded as shown in Table 4, below.

Date of test: 22 February 2021 – 9 April 2021

Table 4 Water Vapour Transmission test results

Product	Samples	Weight change	Water Vapour Transmission	Permeance
		G/t = g / s	(G/t)/A = g / m ² 24hr	WVT/S(R1-R2) = ng/Pa.s.m ²
Nitoproof 410	8365/66	2.4 x 10 ⁻⁷	7.20	49.42
	8365/67	2.2 x 10 ⁻⁷	6.84	46.99
	8365/68	2.3 x 10 ⁻⁷	7.12	48.89
	Average	2.3 x 10 ⁻⁷	7.05	48.44

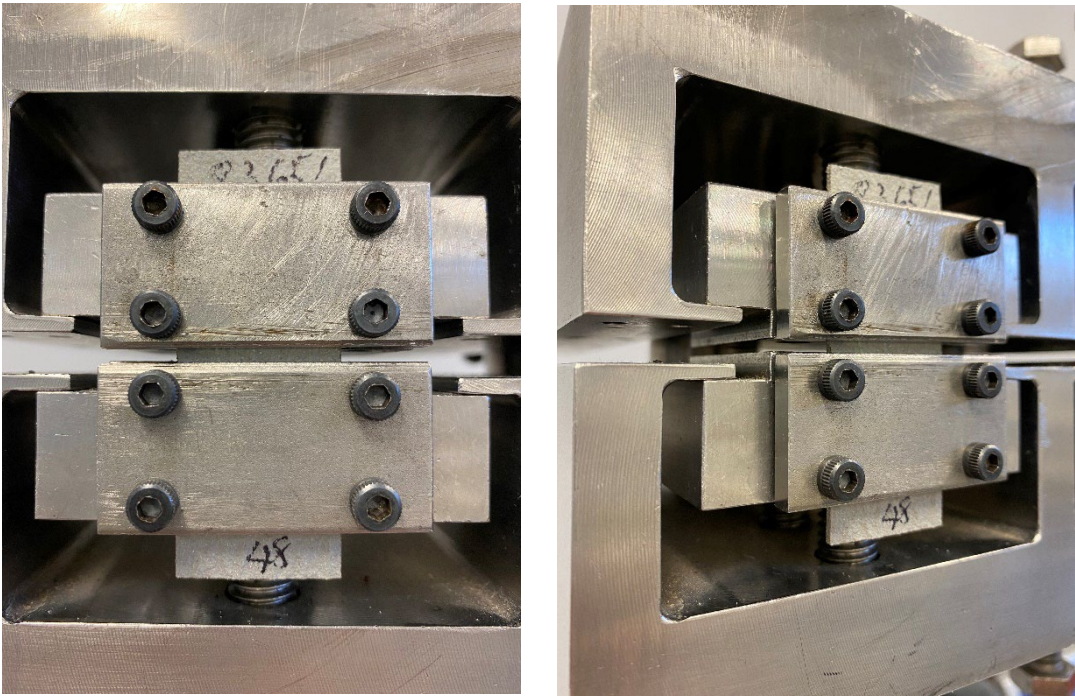
The performance criteria set out in AS4654.1 – 2012, Table A3 to record result, specifies a water vapour transmission rate shall determine if material is a moisture suppressant coating.

5.2 AS 4654.1:2012 Appendix B Resistance of waterproofing membranes to cyclic movement

The test result for cyclic movement of the waterproofing membrane test sample is shown in Table 5 below. The test sample completed 50 cycles for the nominal 2 hour period.

Date of test: 30 April 2021 – 04 May 2021

Table 5 Test sample holing during cyclic movement and test results

Specimen:	Nitoproof 410
Test sample and elongation at break:	Test sample 65 (l) mm x 25 (w) mm x 1.51 (t) mm section; Maximum strain used for the cycling shall be 50% of the elongation a break – Class II.
Clamped test sample of cyclic test:	
Observation and measurement:	<p><u>Observations:</u> At test completion the specimen showed no signs of rupture holing or cracking.</p>

The performance criteria set out in AS4654.1:2012, Table A3 and section B4, pass or fail criteria by observing any cracking, rupture or necking of more than 1 mm down from original width.

5.3 AS 4654.1:2012 Appendix A Durability of membrane

The tensile strength and elongation at break were recorded for the control and immersed test samples. Criteria for pass or failure of the immersed test samples were then compared to the control samples. AS 4654.1:2012 Table A2 joint movement bond breaker was also referenced in Table 6, below.

Date of test: 1st Revalidation **24th of May 2024** & 09-12 March 2021, 15 March 2021, 01 April 2021, 09 April 2021, and 30 April 2021.

Table 6 Durability test results

Nitoproof 410			Tensile Strength and Elongation		
Control samples	Break Force (N)	Thickness (mm)	Tensile strength (F/A) (MPa)	Elongation at break (mm) & (%)	Passed/Failed
SW8534/01	18.16	1.56	1.16	59.03 & 118	
SW8534/02	17.04	1.58	1.08	53.26 & 107	
SW8534/03	16.93	1.55	1.09	48.93 & 98	
SW8534/04	17.81	1.54	1.16	48.58 & 97	
SW8534/05	17.30	1.50	1.15	48.31 & 97	
Average	17.45	1.55	1.13	51.62 & 103	Class II
8365/01	15.91	1.48	1.08	76.57 & 153	-
8365/02	14.68	1.47	1.00	77.74 & 155	-
8365/03	17.35	1.56	1.11	78.64 & 157	-
8365/04	16.11	1.53	1.05	85.27 & 171	-
8365/05	15.52	1.52	1.02	67.29 & 135	-
Average	15.91	1.51	1.05	77.10 & 154	-
Tensile Strength	15.91	1.51	1.05	77.10 & 154	-
Water Immersion	Average (N)		Average (MPa)	Average (mm) & (%)	-
7 day period	7.34	1.43	0.51	56.37 & 113	Passed*
28 day period	8.16	1.46	0.56	45.05 & 90	Passed*
56 day period	12.47	1.50	0.83	45.12 & 90	Passed*
Detergent Immersion	Average (N)		Average (MPa)	Average (mm) & (%)	-
7 day period	8.17	1.51	0.54	43.12 & 86	Passed*
28 day period	7.05	1.52	0.47	29.68 & 59	Passed*
56 day period	9.55	1.43	0.67	31.24 & 62	Passed*
Heat Ageing @ 80°C	Average (N)		Average (MPa)	Average (mm) & (%)	-
14 day period	24.03	1.45	1.66	71.13 & 142	Passed**
Temperature Resistance	Average (N)		Average (MPa)	Average (mm) & (%)	
7 Days @-15°C	22.66	1.52	1.50	63.18 & 126	Passed*
7 Days @+85°C	24.74	1.50	1.65	57.86 & 116	Passed*
Table A4: Pass / Fail and Criteria compared with control samples.			*Passed – Elongation at break was above the 25% limit; and all immersed samples were above the 25% criteria for elongation at break Control samples. Class I and II of Table A1.		

** Passed – Elongation at break for heat ageing at 80°C shall be not less than 50% of the results recorded for the controls.

The performance criteria set out in AS 4654.1:2012, Table A4 specifies a comparison of the immersed test samples to the unconditioned (control) test samples shall be greater than 25% elongation at break.



Figure 3 Images of test sample performing durability load / elongation test

5.4 ASTM C794:2018 Standard test method for adhesion-in-peel of elastomeric joint sealants

The measured dimensions of the test samples placed in the test rig stand are shown in Table 7, below.

Date of test: 17 May 2021 – 07 June 2021

Table 7 Adhesion-in-Peel Strength tests results

Product	Samples	Length and Width of test samples	Concrete		
			Peel Adhesion strength in Dry condition	Cohesive Failure Loss	Mesh Failure Loss
		mm	N	%	%
Nitoproof 410	8365/52	25x250	121.07	50	50
	8365/53	25x250	100.11	50	50
	8365/54	25x250	79.61	40	60
	8365/55	25x250	90.59	60	40
			Average = 97.85 N	50%	50%



FIGURE 3 IMAGES OF TEST SAMPLE PERFORMING ADHESION-IN-PEEL

5.5 AS/NZS 4347.9:1995 (Reconfirmed) 2014 Damp-proof courses and flashings—Methods of test, Method 9: Determining thickness

The sheet thickness measured at three points, equally spaced across the strip. The specimens tested in a conditioning room maintained at a temperature of 23 ±2°C and 60 ±5% relative humidity are shown in Table 8, below.

Date of test: 05 May 2021

Table 8 Determining Thickness test results

Product	Samples	Length and Width of test samples	Thickness
		mm	mm
Nitoproof 410	8365/49	290 x 50	1.53
	8365/49	290 x 50	1.46
	8365/49	290 x 50	1.44
	8365/50	290 x 50	1.42
	8365/50	290 x 50	1.47
	8365/50	290 x 50	1.43
	8365/51	290 x 50	1.49
	8365/51	290 x 50	1.44
	8365/51	290 x 50	1.48
		Average	1.46

6 Comments

The Nitoproof 410, as described herein, when subjected to the test methods of AS 4654.1:2012 the properties of (a) moisture vapour transmission, (b) cyclic movement (Class II), (c) durability (Class II), (d) Bond strength to concrete substrate and (e) membrane thickness met the performance criteria to AS 4654.1:2012 Waterproofing membranes for external above-ground use Part 1: Materials.

- 1st Revalidation test performed on Control specimens with Strain 103%: Class II.
- The surface of specimens provided for 1st Revalidation was smooth than the surface of the specimens of the original report # 8365.

	Author	Reviewer
Name	Ahmed Menisi	Ms Money Arora
Position	Technical Officer- Materials Performance	Team leader- Materials Performance
Date	30 May 2024	31 May 2024
		

CSIRO Science Connect

Infrastructure Technologies

Materials Performance

Gate 5, 2 Normanby Road

CLAYTON, VIC

AUSTRALIA 3168

Ph.: +61 (0)3 9545 8774

Web: <https://www.csiro.au/>

Fax: +61 (0)3 9544 1128

End of report