Appendix B – Figures and sketches

21-20508-Sk101 Existing DA final landform plan

21-20508-SK102 Existing DA final landform slope analysis

21-23396-SK001 Proposed final landform (baseline)

21-23396-SK002 Proposed final landform (post-settlement)

21-23396-SK003 Proposed reprofiling staging plan

R5 settlement modelling (hand sketch)

LEGEND:

FINAL LANDFORM CONTOURS
FROM NECS 27 APRIL 1999

PRELIMINARY

rev	description	app'd	date
B	REVISED	AD	23.09.13
A	INITIAL ISSUE	L.R.	19.07.12

SITA AUSTRALA
LUCAS HEIGHTS RRP

EXISTING DA FINAL LANDFORM PLAN

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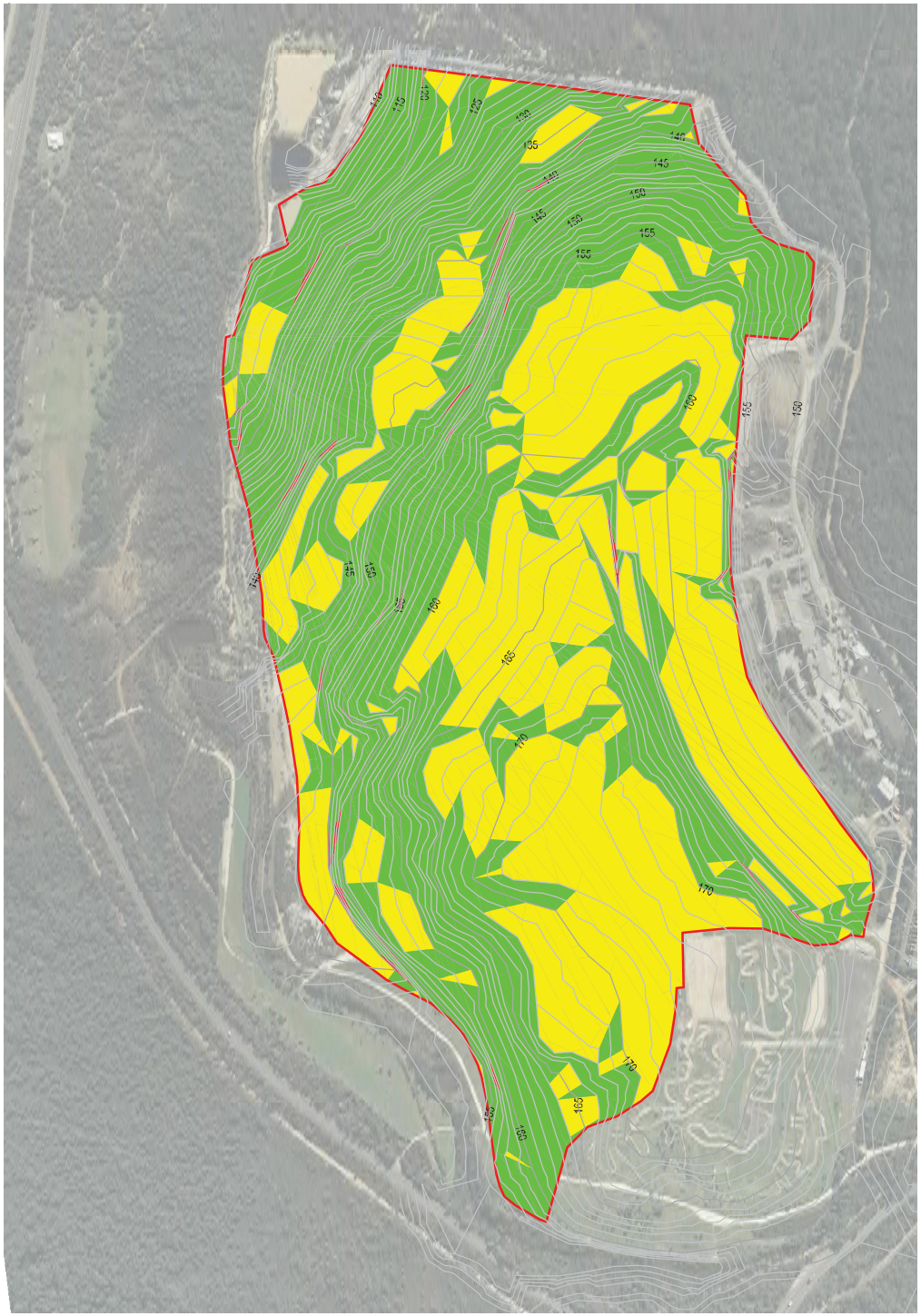
scale 1:3500 for A1 job no. 21-20508
date SEPT 2013 rev no. B

approved (PD) SK101

Plot Date: 24 September 2013 - 12:37 PM Plotted by: Alison Horlyck Cad File No: G:\21\20508\CADD\Drawings\21-20508-SK101.dwg



LEGEND:

- FINAL LANDFORM CONTOURS FROM NECS 27 APRIL 1999
- AREAS SHALLOWER THAN 5% FALL
- AREAS GRADED BETWEEN 5% & 1(V) IN 3(H)
- AREAS STEEPER THAN 1(V) IN 3(H)
- DA APPROVED BOUNDARY

PRELIMINARY

D	REVISED	AD	04.05.15
C	REVISED	AD	02.05.14
rev	description	app'd	date

SITA Australia
LHRRP

EXISTING DA FINAL LANDFORM SLOPE ANALYSIS

GHD

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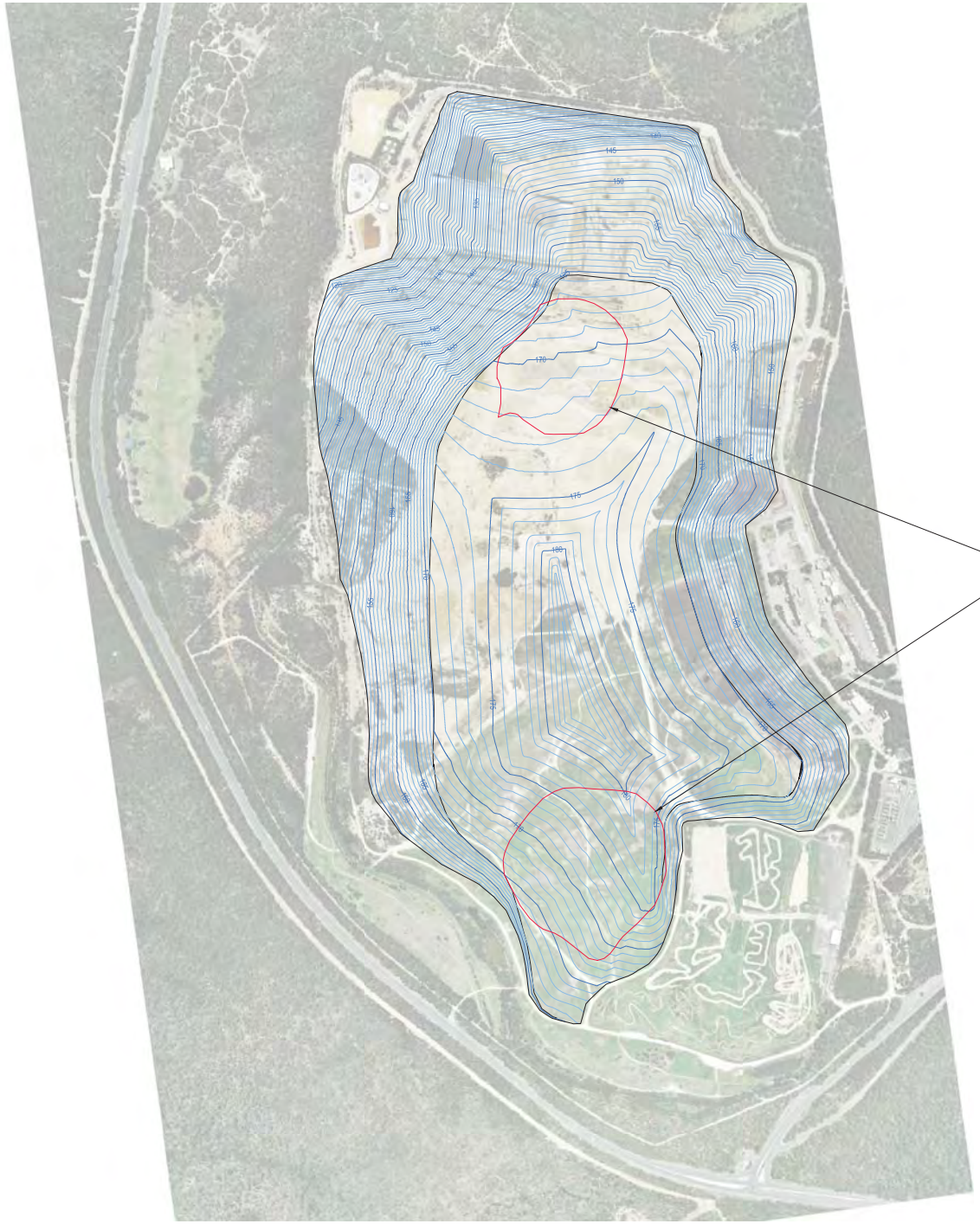
scale	1:3500 for A1	job no.	21-20508
date	MAY 2015	rev no.	D

approved (PD) SK102

Plot Date: 4 May 2015 - 4:40 PM Plotted by: Allison Hurlyck Cad File No: G:\21\20508\CADD\Drawings\21-20508-SK102.dwg



0 40 80 120 160 200m

SCALE 1:4000 AT ORIGINAL SIZE

PRELIMINARY

C	REVISED	AD	29.5.14
B	REVISED	AD	20.5.14
rev	description	app'd	date

SITA AUSTRALIA
LUCAS HEIGHTS RRP

PROPOSED FINAL LANDFORM (BASELINE)

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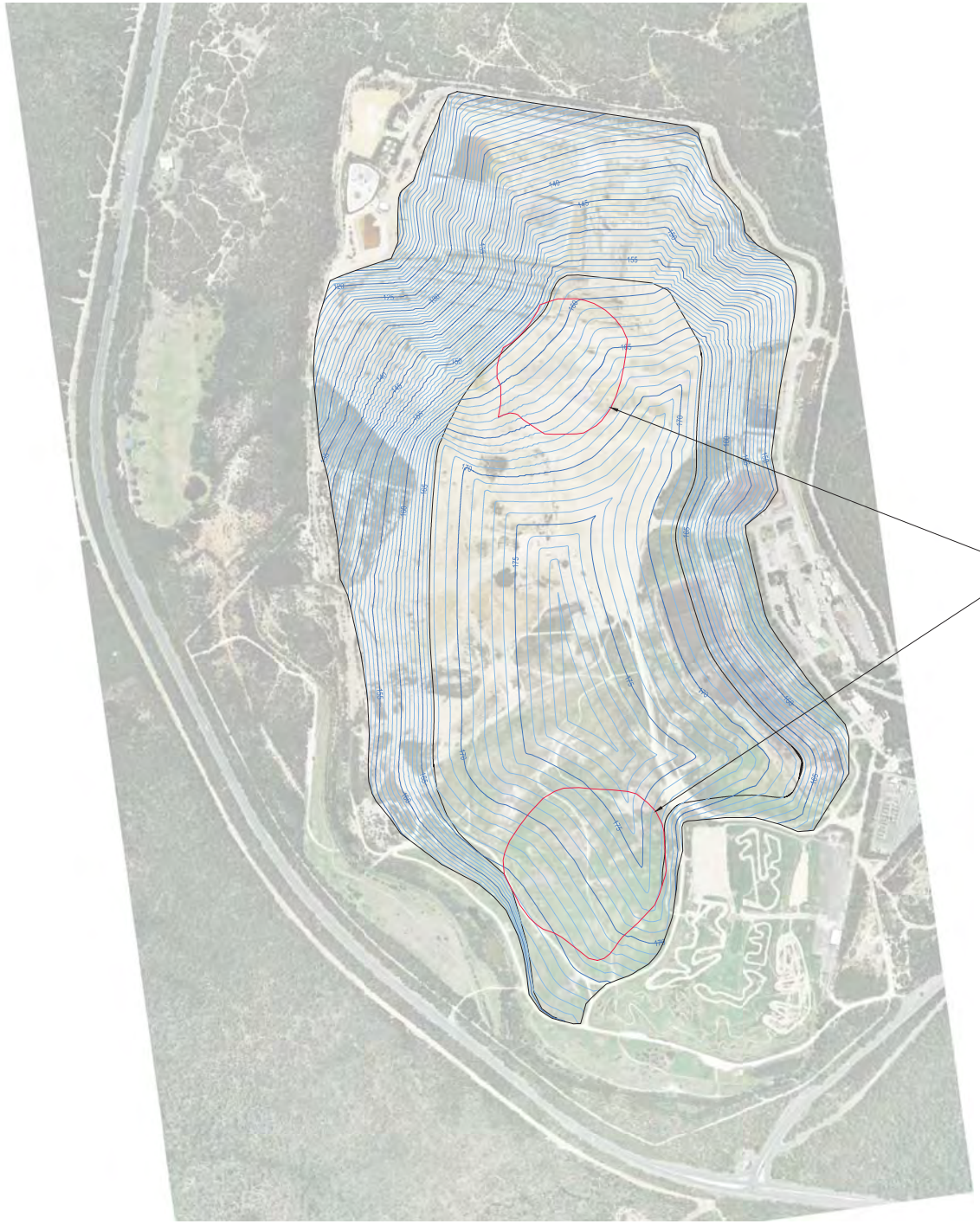
scale	1:4000 for A1	job no.	21-23396
date	MAY 2014	rev no.	C

approved (PD) SK001

Plot Date: 29 May 2014 - 11:25 AM Plotted by: Chris Nivison-Smith Cad File No: \\ghdnetghd\AU\Sydney\Projects\21\23396\CADD\Drawings\21-23396-SK001-002.dwg



0 40 80 120 160 200m

SCALE 1:4000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date
A	INITIAL ISSUE	AD	29.5.14

SITA AUSTRALIA
LUCAS HEIGHTS RRP

PROPOSED FINAL LANDFORM (POST-SETTLEMENT)

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scale	1:4000 for A1	job no.	21-23396
date	MAY 2014	rev no.	A

approved (PD) SK002

Plot Date: 29 May 2014 - 11:25 AM Plotted by: Chris Nivison-Smith Cad File No: \\ghdnet\ghd\AU\Sydney\Projects\21\23396\CADD\Drawings\21-23396-SK001-002.dwg

LEGEND:

PROPOSED STAGE BOUNDARY

ANSTO BOUNDARY

0 40 80 120 160 200m

SCALE 1:4000 AT ORIGINAL SIZE

PRELIMINARY

rev	description	app'd	date
C	REVISED STAGING		18.08.14
B	REVISED STAGING		16.07.14

SITA AUSTRALIA

LUCAS HEIGHTS RRP

PROPOSED REPROFILING STAGING PLAN

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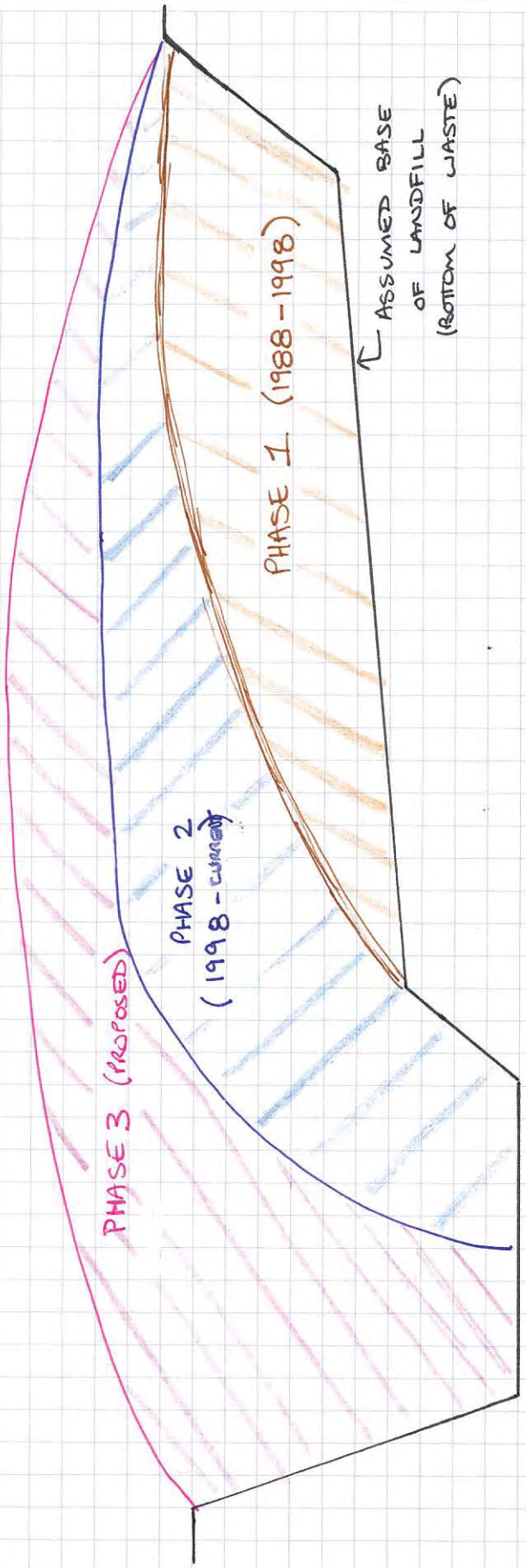
scale	1:100 for A1	job no.	21-23396
date	JUN 2014	rev no.	B

approved (PD) SK003

Plot Date: 18 August 2014 - 2:22 PM Plotted by: Alison Horlyck Cad File No: G:\21\23396\CADD\Drawings\21-23396-SK003.dwg

Client	SITA AUSTRALIA	Job no.	21/23396
Project	LUCAS HEIGHTS LANDFILL	Calcs by	Date
Subject	R5 SETTLEMENT MODELLING	Checked by	Date



INDICATIVE SECTION
NOT TO SCALE

Appendix C – Settlement model

Settlement Analysis

Client:	SITA Australia	**Job Number:**	21-23396	**Revision:**	A
Project:	Lucas Heights RRC Revised Landform - Settlement Modelling	**Calcs by:**	C Nivison-Smith	**Date of issue**	22-Jun-15
Subject:	Cover sheet	**Checked by:**	A Roberts	**Date of review:**	22-Jun-15

Purpose

This analysis estimates the settlement which will occur at the areas to be reprofiled at the Lucas Heights Resource Recovery Centre and will be used to produce the pre and post-settled final landform.

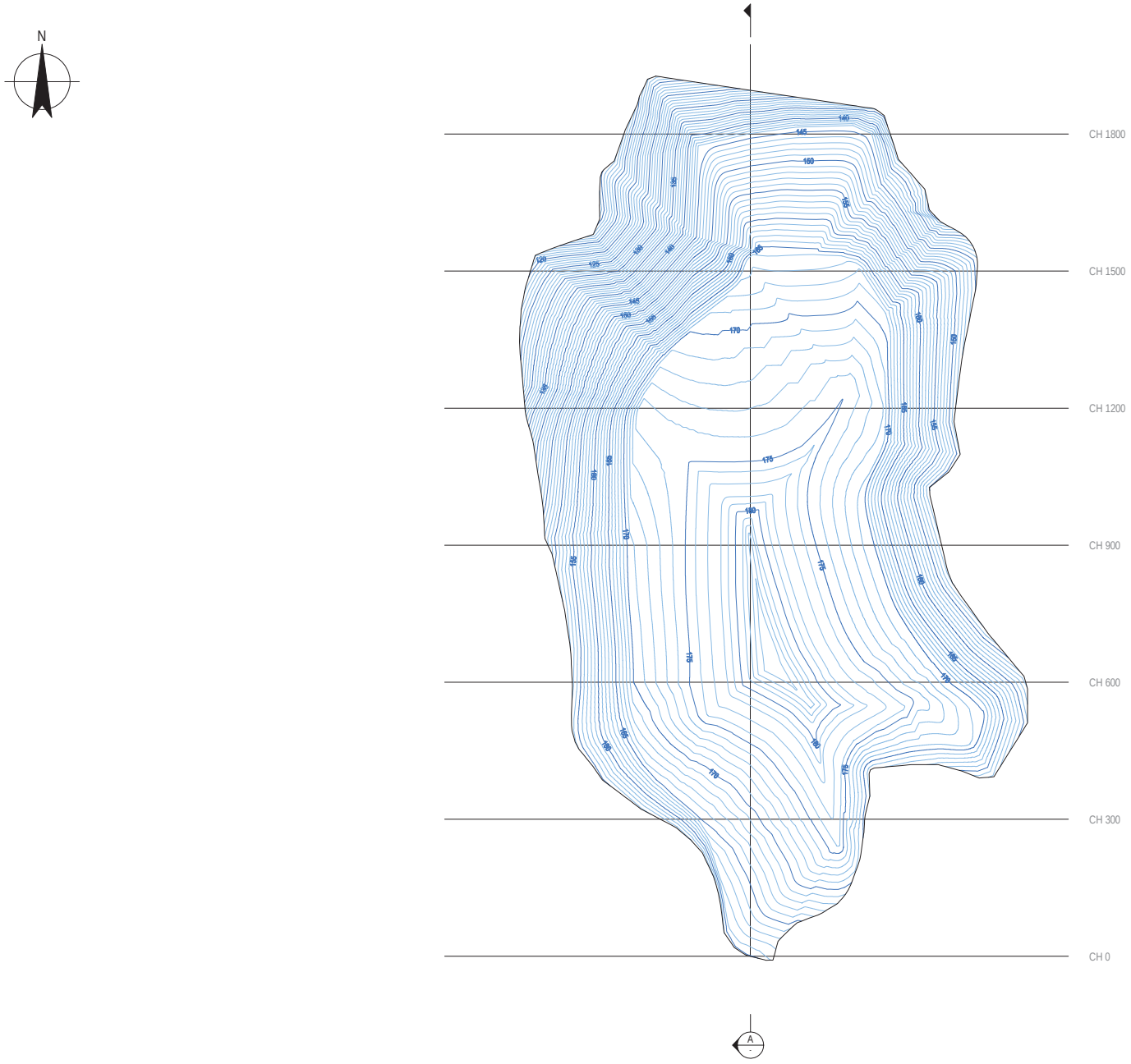
Sheet list		**Date of issue**	**Revision**
01	Inputs - waste heights - long section	22-Jun-15	A
02	Inputs - waste heights - cross sections	22-Jun-15	A
03	Settlement analysis - Section A-A (and graph)	22-Jun-15	A
04	Settlement analysis - Chainage 300 (and graph)	22-Jun-15	A
05	Settlement analysis - Chainage 600 (and graph)	22-Jun-15	A
06	Settlement analysis - Chainage 900 (and graph)	22-Jun-15	A
07	Settlement analysis - Chainage 1200 (and graph)	22-Jun-15	A
08	Settlement analysis - Chainage 1500 (and graph)	22-Jun-15	A
09	Settlement analysis - Chainage 1800 (and graph)	22-Jun-15	A

Modelling assumptions

- As described in the design memo associated with this analysis.

References

1. Qian, X, Koerner, R & Gray, D 2001. Geotechnical Aspects of Landfill Design and Construction, Prentice Hall, Sydney
2. Sowers G.F. 1973, 'Settlement of Waste Disposal Fills', Proc. 3rd International Conference on Soil Mechanics and Foundation Engineering, Vol. 2, 207–210
3. Lucas Heights Waste Management Centre Extension, Environmental Impact Statement, Landfill Technical Report, prepared by CMPS&F Pty Limited, dated December 1998
4. Lucas Heights Resource Recovery Park - preliminary settlement analysis and revised final landform design - design basis memo, prepared by GHD, dated April 2014
5. December 2013 site survey
6. 3D model of revised final landform (pre-settled)
7. Cell 5.3 design drawings, prepared by GHD
8. Landscape concept drawings prepared by Taylor Brammer, dated March 2014
9. Development consent
10. Lucas Heights annual reports (1984-2004)


N
CH 1800
CH 1500
CH 1200
CH 900
CH 600
CH 300
CH 0
A

Client:	SITA Australia	**Job Number:**	21-23396	**Revision:** A
Project:	Lucas Heights RRC Revised Landform - Settlement Modelling	**Calcs by:**	C Nivison-Smith	**Date of issue** 22-Jun-15
Subject:	Inputs - waste heights - long section	**Checked by:**	A Roberts	**Date of review:** 22-Jun-15

Statement of modelling procedure

This spreadsheet provides estimates of waste heights for each chainage for each section at different phases of the project.

Item	Description	Chainage						Unit	Notes
		300	600	900	1200	1500	1800		
Chainage stage									
D1.01	Long Section A-A	1C	2	3	4	5.1	5.3		Based on section sketch
Phase 0 - pre-landfilling									
D2.01	Long Section A-A depth	11.53	14.36	17.95	9.31	N/A	N/A	m	Estimated based on section area and estimated waste tonnages
Phase 1 - existing waste (pre-overtopping)									
D3.01	Long Section A-A level	158	156	145	120	N/A	N/A	m	Based on 1998 site survey provided in EIS
Phase 2 - existing waste (overtopping)									
D4.01	Long Section A-A level	165	168	165	163	128	93	m	Based on existing site survey (Dec 13)
Phase 3 - future waste (reprofiling)									
D5.01	Long Section A-A level	166.78	173.5	184.3	170.65	167.56	139.81	m	Based on final landform 3D model

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Inputs - waste heights - cross sections

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides estimates of waste heights for each chainage for each section at different phases of the project.

Item	Description	Inflection point						Unit	Notes
		1	2	3	4	5			
Inflection stage									
E1.01	Chainage 300	N/A	1C	1C	1C	N/A			Based on section sketch
E1.02	Chainage 600	N/A	2	2	1B	N/A			Based on section sketch
E1.03	Chainage 900	N/A	3	3	1B	N/A			Based on section sketch
E1.04	Chainage 1200	N/A	4	4	1B	N/A			Based on section sketch
E1.05	Chainage 1500	N/A	5.1	5.1	5.1	N/A			Based on section sketch
E1.06	Chainage 1800	N/A	N/A	5.3	N/A	N/A			Based on section sketch
Offset from centerline									
E2.01	Chainage 300	-164	-90	0	160	208			Based on section sketch
E2.02	Chainage 600	-325	-213	0	376	502			Based on section sketch
E2.03	Chainage 900	-404	-220	0	226	349			Based on section sketch
E2.04	Chainage 1200	-411	-201	0	242	374			Based on section sketch
E2.05	Chainage 1500	-401	-11	0	208	414			Based on section sketch
E2.06	Chainage 1800	-231	N/A	0	N/A	255			Based on section sketch
Phase 0 - pre-landfilling									
E3.01	Chainage 300	N/A	11.53	11.53	11.53	N/A		m	Estimated based on section area and estimated waste tonnages
E3.02	Chainage 600	N/A	14.36	14.36	13.65	N/A		m	Estimated based on section area and estimated waste tonnages
E3.03	Chainage 900	N/A	17.95	17.95	13.65	N/A		m	Estimated based on section area and estimated waste tonnages
E3.04	Chainage 1200	N/A	9.31	9.31	13.65	N/A		m	Estimated based on section area and estimated waste tonnages
E3.05	Chainage 1500	N/A	N/A	N/A	N/A	N/A		m	Estimated based on section area and estimated waste tonnages
E3.06	Chainage 1800	N/A	N/A	N/A	N/A	N/A		m	Estimated based on section area and estimated waste tonnages
Phase 1 - existing waste (pre-overtopping)									
E4.01	Chainage 300	N/A	158	158	160	N/A		m	Based on 1998 site survey provided in EIS
E4.02	Chainage 600	N/A	155	156	158	N/A		m	Based on 1998 site survey provided in EIS
E4.03	Chainage 900	N/A	151	145	154	N/A		m	Based on 1998 site survey provided in EIS
E4.04	Chainage 1200	N/A	119	120	122	N/A		m	Based on 1998 site survey provided in EIS
E4.05	Chainage 1500	N/A	105	105	105	N/A		m	Based on 1998 site survey provided in EIS
E4.06	Chainage 1800	N/A	N/A	N/A	N/A	N/A		m	Based on 1998 site survey provided in EIS
Phase 2 - existing waste (overtopping)									

E5.01	Chainage 300	N/A	159	165	169	N/A		m	Based on existing site survey (Dec 13)
E5.02	Chainage 600	N/A	157	168	159	N/A		m	Based on existing site survey (Dec 13)
E5.03	Chainage 900	N/A	157	165	157	N/A		m	Based on existing site survey (Dec 13)
E5.04	Chainage 1200	N/A	152	163	156	N/A		m	Based on existing site survey (Dec 13)
E5.05	Chainage 1500	N/A	129	129	145	N/A		m	Based on existing site survey (Dec 13)
E5.06	Chainage 1800	N/A	N/A	93	N/A	N/A		m	Based on existing site survey (Dec 13)
Phase 3 - future waste (reprofiling)									
E6.01	Chainage 300	N/A	165	169.12	173.83	N/A		m	Based on final landform 3D model
E6.02	Chainage 600	N/A	170	180.84	169.33	N/A		m	Based on final landform 3D model
E6.03	Chainage 900	N/A	170.64	183.39	170.02	N/A		m	Based on final landform 3D model
E6.04	Chainage 1200	N/A	174.63	172.98	172.13	N/A		m	Based on final landform 3D model
E6.05	Chainage 1500	N/A	166.6	166.91	168.33	N/A		m	Based on final landform 3D model
E6.06	Chainage 1800	N/A	N/A	144.25	N/A	N/A		m	Based on final landform 3D model

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Section A-A

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Section A-A based on the proposed inputs and model parameters.

Item	Description	Symbol	Chainage						Unit	Notes
			300	600	900	1200	1500	1800		
Phase 1 - existing waste (pre-overtopping)										
F1.01	Unit weight of solid waste		11	11	11	11	N/A	N/A	kN/m^3	Taken from Qian (2002)
F1.02	Initial average thickness of waste layer	H_0	12	14	18	9	N/A	N/A	m	D2.01
F1.03	Previously applied pressure in the waste layer (initial compaction)		60	60	60	60	N/A	N/A	kN/m^2	Based on historical compaction machinery used
F1.04	Previously applied pressure in the waste layer (existing layer)		63.42	79	99	51	N/A	N/A	kN/m^2	0.5 x F1.01 x F1.02
F1.05	Previously applied pressure in the waste layer (existing overtopping)		77	132	220	473	N/A	N/A	kN/m^2	F2.01 x F2.02
F1.06	Total previously applied pressure in the waste layer	σ_0	200.42	271	379	584	N/A	N/A	kN/m^2	F1.04 + F1.05
F1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	20	61	212	84	N/A	N/A	kN/m^2	F3.01 x F3.02 + F4.01 x F4.02
F1.08	Modified primary compression index	C'_C	0.2	0.2	0.2	0.2	N/A	N/A		Taken from Qian (2002)
F1.09	Modified secondary compression index	C'_α	0.055	0.055	0.055	0.055	N/A	N/A		Taken from Qian (2002)
F1.10	Primary settlement	ΔH_C	0.09	0.25	0.69	0.11	N/A	N/A	m	Based on Sower's formula provided in Qian (2002)
F1.11	Starting time of secondary settlement	t_1	25	21	19	18	N/A	N/A		2014 - B1.13
F1.12	Ending time of secondary settlement	t_2	30	30	30	30	N/A	N/A		Estimate
F1.13	Secondary settlement	ΔH_α	0.05	0.12	0.20	0.11	N/A	N/A	m	Based on Sower's formula provided in Qian (2002)
F1.14	Total phase settlement	ΔH	0.14	0.37	0.89	0.22	N/A	N/A	m	F1.10 + F1.13
F1.15	Total phase settlement		1%	3%	5%	2%	N/A	N/A	m/m	
Phase 2 - existing waste (overtopping)										
F2.01	Unit weight of solid waste		11	11	11	11	N/A	N/A	kN/m^3	Taken from Qian (2002)
F2.02	Initial average thickness of waste layer	H_0	7	12	20	43	N/A	N/A	m	D4.01 - D3.01
F2.03	Previously applied pressure in the waste layer (initial compaction)		60	60	60	60	N/A	N/A	kN/m^2	Based on historical compaction machinery used
F2.04	Previously applied pressure in the waste layer (existing layer)		39	66	110	237	N/A	N/A	kN/m^2	0.5 x F2.01 x F2.02
F2.05	Previously applied pressure in the waste layer (existing overtopping)		0	0	0	0	N/A	N/A	kN/m^2	N/A
F2.06	Total previously applied pressure in the waste layer	σ_0	98.50	126	170	297	N/A	N/A	kN/m^2	F2.04 + F2.05

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Section A-A

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Section A-A based on the proposed inputs and model parameters.

Item	Description	Symbol	Chainage						Unit	Notes
			300	600	900	1200	1500	1800		
F2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	20	61	212	84	N/A	N/A	kN/m^2	F3.01 x F3.02 + F4.01 x F4.02
F2.08	Modified primary compression index	C'_C	0.2	0.2	0.2	0.2	N/A	N/A		Taken from Qian (2002)
F2.09	Modified secondary compression index	C'_α	0.055	0.055	0.055	0.055	N/A	N/A		Taken from Qian (2002)
F2.10	Primary settlement	ΔH_C	0.11	0.41	1.41	0.93	N/A	N/A	m	Based on Sower's formula provided in Qian (2002)
F2.11	t_1	t_1	14	12	9	6	N/A	N/A		2014 - B2.17
F2.12	t_2	t_2	30	30	30	30	N/A	N/A		Estimate
F2.13	Secondary settlement	ΔH_α	0.13	0.26	0.58	1.65	N/A	N/A	m	Based on Sower's formula provided in Qian (2002)
F2.14	Total phase settlement	ΔH	0.24	0.67	1.98	2.59	N/A	N/A	m	F2.10 + F2.13
F2.15	Total phase settlement		3%	6%	10%	6%	N/A	N/A	m/m	
Phase 3 - future waste (reprofiling)										
F3.01	Unit weight of solid waste		11	11	11	11	11	11	kN/m^3	Taken from Qian (2002)
F3.02	Initial average thickness of waste layer	H_0	2	6	19	8	40	47	m	D5.01 - D4.01
F3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	60	60	60	60	60	60	kN/m^2	Based on predicted future compaction machinery
F3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	9.79	30	106	42	218	257	kN/m^2	0.5 x E4.01 x E4.02
F3.05	Modified primary compression index	C'_C	0.2	0.2	0.2	0.2	0.2	0.2		Taken from Qian (2002)
F3.06	Modified secondary compression index	C'_α	0.055	0.055	0.055	0.055	0.055	0.055		Taken from Qian (2002)
F3.07	Primary settlement	ΔH_C	0.00	0.00	0.96	0.00	4.43	5.92	m	Based on Sower's formula provided in Qian (2002)
F3.08	t_1	t_1	1	1	1	1	1	1		From date of placement
F3.09	t_2	t_2	30	30	30	30	30	30		Estimate
F3.10	Secondary settlement	ΔH_α	0.14	0.45	1.57	0.62	3.21	3.80	m	Based on Sower's formula provided in Qian (2002)
F3.11	Total phase settlement	ΔH	0.14	0.45	2.52	0.62	7.64	9.72	m	F4.07 + F4.10
F3.12	Total phase settlement		8%	8%	13%	8%	19%	21%	m/m	
All phases										
F4.01	Total settlement		0.53	1.49	5.40	3.43	7.64	9.72	m	F1.14 + F2.14 + F3.11 + F4.11
F4.02	Total settlement		0.03	5%	9%	6%	0.19	0.21	m	
F4.03	Baseline RL		166.78	173.50	184.30	170.65	167.56	139.81	m	
F4.04	Post-settled RL		166.25	172.01	178.90	167.22	159.92	130.09	m	

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 300

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 300 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
Phase 1 - existing waste (pre-overtopping)										
G1.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
G1.02	Initial average thickness of waste layer	H_0	N/A	12	12	12	N/A		m	E3.01
G1.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
G1.04	Previously applied pressure in the waste layer (existing layer)		N/A	63	63	63	N/A		kN/m^2	0.5 x G1.01 x G1.02
G1.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	11	77	99	N/A		kN/m^2	G2.01 x G2.02
G1.06	Total previously applied pressure in the waste layer	σ_0	N/A	134	200	222	N/A		kN/m^2	G1.04 + G1.05
G1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	66	45	53	N/A		kN/m^2	G3.01 x G3.02 + G4.01 x G4.02
G1.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
G1.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
G1.10	Primary settlement	ΔH_C	N/A	0.40	0.20	0.21	N/A		m	Based on Sower's formula provided in Qian (2002)
G1.11	t_1	t_1	N/A	25	25	25	N/A			2014 - B1.13
G1.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
G1.13	Secondary settlement	ΔH_α	N/A	0.05	0.05	0.05	N/A		m	Based on Sower's formula provided in Qian (2002)
G1.14	Total phase settlement	ΔH	N/A	0.45	0.25	0.26	N/A		m	G1.10 + G1.13
G1.15	Total phase settlement		N/A	4%	2%	2%	N/A		m/m	
Phase 2 - existing waste (overtopping)										
G2.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
G2.02	Initial average thickness of waste layer	H_0	N/A	1	7	9	N/A		m	E5.01 - E4.01
G2.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
G2.04	Previously applied pressure in the waste layer (existing layer)		N/A	6	39	50	N/A		kN/m^2	0.5 x G2.01 x G2.02
G2.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	0	0	0	N/A		kN/m^2	N/A
G2.06	Total previously applied pressure in the waste layer	σ_0	N/A	66	99	110	N/A		kN/m^2	G2.04 + G2.05
G2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	66	45	53	N/A		kN/m^2	G3.01 x G3.02 + G4.01 x G4.02
G2.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
G2.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)

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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 300 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
G2.10	Primary settlement	ΔH_C	N/A	0.06	0.23	0.31	N/A		m	Based on Sower's formula provided in Qian (2002)
G2.11	t_1	t_1	N/A	14	14	14	N/A			2014 - B2.17
G2.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
G2.13	Secondary settlement	ΔH_α	N/A	0.02	0.13	0.16	N/A		m	Based on Sower's formula provided in Qian (2002)
G2.14	Total phase settlement	ΔH	N/A	0.08	0.36	0.47	N/A		m	F2.10 + F2.13
G2.15	Total phase settlement		N/A	8%	5%	5%	N/A		m/m	
Phase 3 - future waste (reprofiling)										
G3.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
G3.02	Initial average thickness of waste layer	H_0	N/A	6	4	5	N/A		m	E7.01 - E6.01
G3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	N/A	60	60	60	N/A		kN/m^2	Based on predicted future compaction machinery
G3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	33	23	27	N/A		kN/m^2	0.5 x G4.01 x G4.02
G3.05	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
G3.06	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
G3.07	Primary settlement	ΔH_C	N/A	0.00	0.00	0.00	N/A		m	Based on Sower's formula provided in Qian (2002)
G3.08	t_1	t_1	N/A	1	1	1	N/A			From date of placement
G3.09	t_2	t_2	N/A	30	30	30	N/A			Estimate
G3.10	Secondary settlement	ΔH_α	N/A	0.49	0.33	0.39	N/A		m	Based on Sower's formula provided in Qian (2002)
G3.11	Total phase settlement	ΔH	N/A	0.49	0.33	0.39	N/A		m	G4.07 + G4.10
G3.12	Total phase settlement		N/A	8%	8%	8%	N/A		m/m	
All phases										
G4.01	Total settlement		N/A	1.02	0.95	1.13	N/A		m	G1.14 + G2.14 + G3.11 + G4.11
G4.02	Total settlement		N/A	5%	4%	4%	N/A		m	
G4.03	Baseline RL		156.00	165.00	169.12	173.83	170.00		m	
G4.04	Post-settled RL		156.00	163.98	168.17	172.70	170.00		m	

Client: SITA Australia
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Subject: Settlement analysis - Chainage 600

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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 600 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
Phase 1 - existing waste (pre-overtopping)										
H1.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
H1.02	Initial average thickness of waste layer	H_0	N/A	14	14	14	N/A		m	E3.02
H1.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
H1.04	Previously applied pressure in the waste layer (existing layer)		N/A	79	79	75	N/A		kN/m^2	0.5 x H1.01 x H1.02
H1.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	22	132	11	N/A		kN/m^2	H2.01 x H2.02
H1.06	Total previously applied pressure in the waste layer	σ_0	N/A	161	271	146	N/A		kN/m^2	H1.04 + H1.05
H1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	143	141	114	N/A		kN/m^2	H3.01 x H3.02 + H4.01 x H4.02
H1.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
H1.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
H1.10	Primary settlement	ΔH_C	N/A	0.79	0.52	0.68	N/A		m	Based on Sower's formula provided in Qian (2002)
H1.11	t_1	t_1	N/A	21	21	22	N/A			2014 - B1.13
H1.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
H1.13	Secondary settlement	ΔH_α	N/A	0.12	0.12	0.10	N/A		m	Based on Sower's formula provided in Qian (2002)
H1.14	Total phase settlement	ΔH	N/A	0.92	0.65	0.78	N/A		m	H1.10 + H1.13
H1.15	Total phase settlement		N/A	6%	4%	6%	N/A		m/m	
Phase 2 - existing waste (overtopping)										
H2.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
H2.02	Initial average thickness of waste layer	H_0	N/A	2	12	1	N/A		m	E5.02 - E4.02
H2.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
H2.04	Previously applied pressure in the waste layer (existing layer)		N/A	11	66	6	N/A		kN/m^2	0.5 x H2.01 x H2.02
H2.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	0	0	0	N/A		kN/m^2	N/A
H2.06	Total previously applied pressure in the waste layer	σ_0	N/A	71	126	66	N/A		kN/m^2	H2.04 + H2.05
H2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	143	141	114	N/A		kN/m^2	H3.01 x H3.02 + H4.01 x H4.02
H2.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
H2.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)

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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 600 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
H2.10	Primary settlement	ΔH_C	N/A	0.19	0.78	0.09	N/A		m	Based on Sower's formula provided in Qian (2002)
H2.11	t_1	t_1	N/A	12	12	14	N/A			2014 - B2.17
H2.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
H2.13	Secondary settlement	ΔH_α	N/A	0.04	0.26	0.02	N/A		m	Based on Sower's formula provided in Qian (2002)
H2.14	Total phase settlement	ΔH	N/A	0.24	1.05	0.11	N/A		m	H2.10 + H2.13
H2.15	Total phase settlement		N/A	12%	9%	11%	N/A		m/m	
Phase 3 - future waste (reprofiling)										
H3.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
H3.02	Initial average thickness of waste layer	H_0	N/A	13	13	10	N/A		m	E7.02 - E6.02
H3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	N/A	60	60	60	N/A		kN/m^2	Based on predicted future compaction machinery
H3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	72	71	57	N/A		kN/m^2	0.5 x H4.01 x H4.02
H3.05	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
H3.06	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
H3.07	Primary settlement	ΔH_C	N/A	0.20	0.18	0.00	N/A		m	Based on Sower's formula provided in Qian (2002)
H3.08	t_1	t_1	N/A	1	1	1	N/A			From date of placement
H3.09	t_2	t_2	N/A	30	30	30	N/A			Estimate
H3.10	Secondary settlement	ΔH_α	N/A	1.06	1.04	0.84	N/A		m	Based on Sower's formula provided in Qian (2002)
H3.11	Total phase settlement	ΔH	N/A	1.25	1.22	0.84	N/A		m	H4.07 + H4.10
H3.12	Total phase settlement		N/A	10%	10%	8%	N/A		m/m	
All phases										
H4.01	Total settlement		N/A	2.40	2.92	1.73	N/A		m	H1.14 + H2.14 + H3.11 + H4.11
H4.02	Total settlement		N/A	8%	7%	7%	N/A		m	
H4.03	Baseline RL		153.00	170.00	180.84	169.33	157.00		m	
H4.04	Post-settled RL		153.00	167.60	177.92	167.60	157.00		m	

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 900

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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 900 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
Phase 1 - existing waste (pre-overtopping)										
I1.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
I1.02	Initial average thickness of waste layer	H_0	N/A	18	18	14	N/A		m	E3.03
I1.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
I1.04	Previously applied pressure in the waste layer (existing layer)		N/A	99	99	75	N/A		kN/m^2	0.5 x I1.01 x I1.02
I1.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	66	220	33	N/A		kN/m^2	I2.01 x I2.02
I1.06	Total previously applied pressure in the waste layer	σ_0	N/A	225	379	168	N/A		kN/m^2	I1.04 + I1.05
I1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	150	202	143	N/A		kN/m^2	I3.01 x I3.02 + I4.01 x I4.02
I1.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
I1.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
I1.10	Primary settlement	ΔH_C	N/A	0.80	0.67	0.73	N/A		m	Based on Sower's formula provided in Qian (2002)
I1.11	t_1	t_1	N/A	19	19	22	N/A			2014 - B1.13
I1.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
I1.13	Secondary settlement	ΔH_α	N/A	0.20	0.20	0.10	N/A		m	Based on Sower's formula provided in Qian (2002)
I1.14	Total phase settlement	ΔH	N/A	0.99	0.86	0.83	N/A		m	I1.10 + I1.13
I1.15	Total phase settlement		N/A	6%	5%	6%	N/A		m/m	
Phase 2 - existing waste (overtopping)										
I2.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
I2.02	Initial average thickness of waste layer	H_0	N/A	6	20	3	N/A		m	E5.03 - E4.03
I2.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
I2.04	Previously applied pressure in the waste layer (existing layer)		N/A	33	110	17	N/A		kN/m^2	0.5 x I2.01 x I2.02
I2.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	0	0	0	N/A		kN/m^2	N/A
I2.06	Total previously applied pressure in the waste layer	σ_0	N/A	93	170	77	N/A		kN/m^2	I2.04 + I2.05
I2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	150	202	143	N/A		kN/m^2	I3.01 x I3.02 + I4.01 x I4.02
I2.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
I2.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)

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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 900 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
I2.10	Primary settlement	ΔH_C	N/A	0.50	1.36	0.27	N/A		m	Based on Sower's formula provided in Qian (2002)
I2.11	t_1	t_1	N/A	9	9	14	N/A			2014 - B2.17
I2.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
I2.13	Secondary settlement	ΔH_α	N/A	0.17	0.58	0.05	N/A		m	Based on Sower's formula provided in Qian (2002)
I2.14	Total phase settlement	ΔH	N/A	0.67	1.94	0.33	N/A		m	I2.10 + I2.13
I2.15	Total phase settlement		N/A	11%	10%	11%	N/A		m/m	
Phase 3 - future waste (reprofiling)										
I3.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
I3.02	Initial average thickness of waste layer	H_0	N/A	14	18	13	N/A		m	E7.03 - E6.03
I3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	N/A	60	60	60	N/A		kN/m^2	Based on predicted future compaction machinery
I3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	75	101	72	N/A		kN/m^2	0.5 x I4.01 x I4.02
I3.05	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
I3.06	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
I3.07	Primary settlement	ΔH_C	N/A	0.26	0.83	0.20	N/A		m	Based on Sower's formula provided in Qian (2002)
I3.08	t_1	t_1	N/A	1	1	1	N/A			From date of placement
I3.09	t_2	t_2	N/A	30	30	30	N/A			Estimate
I3.10	Secondary settlement	ΔH_α	N/A	1.11	1.49	1.06	N/A		m	Based on Sower's formula provided in Qian (2002)
I3.11	Total phase settlement	ΔH	N/A	1.37	2.33	1.26	N/A		m	I3.07 + I3.10
I3.12	Total phase settlement		N/A	10%	13%	10%	N/A		m/m	
All phases										
I4.01	Total settlement		N/A	3.04	5.13	2.42	N/A		m	I1.14 + I2.14 + I3.11 + I4.11
I4.02	Total settlement		N/A	8%	9%	8%	N/A		m	
I4.03	Baseline RL		147.00	170.64	183.39	170.02	151.00		m	
I4.04	Post-settled RL		147.00	167.60	178.26	167.60	151.00		m	

Client: SITA Australia
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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 1200 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
Phase 1 - existing waste (pre-overtopping)										
J1.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
J1.02	Initial average thickness of waste layer	H_0	N/A	9	9	14	N/A		m	E3.04
J1.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
J1.04	Previously applied pressure in the waste layer (existing layer)		N/A	51	51	75	N/A		kN/m^2	0.5 x J1.01 x J1.02
J1.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	363	473	374	N/A		kN/m^2	J2.01 x J2.02
J1.06	Total previously applied pressure in the waste layer	σ_0	N/A	474	584	509	N/A		kN/m^2	J1.04 + J1.05
J1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	249	110	177	N/A		kN/m^2	J3.01 x J3.02 + J4.01 x J4.02
J1.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
J1.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
J1.10	Primary settlement	ΔH_C	N/A	0.34	0.14	0.35	N/A		m	Based on Sower's formula provided in Qian (2002)
J1.11	t_1	t_1	N/A	18	18	22	N/A			2014 - B1.13
J1.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
J1.13	Secondary settlement	ΔH_α	N/A	0.11	0.11	0.10	N/A		m	Based on Sower's formula provided in Qian (2002)
J1.14	Total phase settlement	ΔH	N/A	0.45	0.25	0.46	N/A		m	J1.10 + J1.13
J1.15	Total phase settlement		N/A	5%	3%	3%	N/A		m/m	
Phase 2 - existing waste (overtopping)										
J2.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
J2.02	Initial average thickness of waste layer	H_0	N/A	33	43	34	N/A		m	E5.04 - E4.04
J2.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
J2.04	Previously applied pressure in the waste layer (existing layer)		N/A	182	237	187	N/A		kN/m^2	0.5 x J2.01 x J2.02
J2.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	0	0	0	N/A		kN/m^2	N/A
J2.06	Total previously applied pressure in the waste layer	σ_0	N/A	242	297	247	N/A		kN/m^2	J2.04 + J2.05
J2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	249	110	177	N/A		kN/m^2	J3.01 x J3.02 + J4.01 x J4.02
J2.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
J2.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 1200

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 1200 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
J2.10	Primary settlement	ΔH_C	N/A	2.03	1.18	1.60	N/A		m	Based on Sower's formula provided in Qian (2002)
J2.11	t_1	t_1	N/A	6	6	14	N/A			2014 - B2.17
J2.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
J2.13	Secondary settlement	ΔH_α	N/A	1.27	1.65	0.62	N/A		m	Based on Sower's formula provided in Qian (2002)
J2.14	Total phase settlement	ΔH	N/A	3.30	2.83	2.22	N/A		m	J2.10 + J2.13
J2.15	Total phase settlement		N/A	10%	7%	7%	N/A		m/m	
Phase 3 - future waste (reprofiling)										
J3.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
J3.02	Initial average thickness of waste layer	H_0	N/A	23	10	16	N/A		m	E7.04 - E6.04
J3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	N/A	60	60	60	N/A		kN/m^2	Based on predicted future compaction machinery
J3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	124	55	89	N/A		kN/m^2	0.5 x J4.01 x J4.02
J3.05	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
J3.06	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
J3.07	Primary settlement	ΔH_C	N/A	1.43	0.00	0.55	N/A		m	Based on Sower's formula provided in Qian (2002)
J3.08	t_1	t_1	N/A	1	1	1	N/A			From date of placement
J3.09	t_2	t_2	N/A	30	30	30	N/A			Estimate
J3.10	Secondary settlement	ΔH_α	N/A	1.84	0.81	1.31	N/A		m	Based on Sower's formula provided in Qian (2002)
J3.11	Total phase settlement	ΔH	N/A	3.27	0.81	1.86	N/A		m	J3.07 + J3.10
J3.12	Total phase settlement		N/A	14%	8%	12%	N/A		m/m	
All phases										
J4.01	Total settlement		N/A	7.03	3.89	4.53	N/A		m	J1.14 + J2.14 + J3.11 + J4.11
J4.02	Total settlement		N/A	11%	6%	7%	N/A		m	
J4.03	Baseline RL		129.00	174.63	172.98	172.13	146.00		m	
J4.04	Post-settled RL		129.00	167.60	169.09	167.60	146.00		m	

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 1500

Job Number: 21-23396
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Revision: A
Date of issue 22-Jun-15
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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 1500 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
Phase 1 - existing waste (pre-overtopping)										
K1.01	Unit weight of solid waste		N/A	N/A	N/A	N/A	N/A		kN/m^3	Taken from Qian (2002)
K1.02	Initial average thickness of waste layer	H_0	N/A	N/A	N/A	N/A	N/A		m	E3.05
K1.03	Previously applied pressure in the waste layer (initial compaction)		N/A	N/A	N/A	N/A	N/A		kN/m^2	Based on historical compaction machinery used
K1.04	Previously applied pressure in the waste layer (existing layer)		N/A	N/A	N/A	N/A	N/A		kN/m^2	0.5 x K1.01 x K1.02
K1.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	N/A	N/A	N/A	N/A		kN/m^2	K2.01 x K2.02
K1.06	Total previously applied pressure in the waste layer	σ_0	N/A	N/A	N/A	N/A	N/A		kN/m^2	K1.04 + K1.05
K1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	N/A	N/A	N/A	N/A		kN/m^2	K3.01 x K3.02 + K4.01 x K4.02
K1.08	Modified primary compression index	C'_C	N/A	N/A	N/A	N/A	N/A			Taken from Qian (2002)
K1.09	Modified secondary compression index	C'_α	N/A	N/A	N/A	N/A	N/A			Taken from Qian (2002)
K1.10	Primary settlement	ΔH_C	N/A	N/A	N/A	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
K1.11	t_1	t_1	N/A	N/A	N/A	N/A	N/A			2014 - B1.13
K1.12	t_2	t_2	N/A	N/A	N/A	N/A	N/A			Estimate
K1.13	Secondary settlement	ΔH_α	N/A	N/A	N/A	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
K1.14	Total phase settlement	ΔH	N/A	N/A	N/A	N/A	N/A		m	K1.10 + K1.13
K1.15	Total phase settlement		N/A	N/A	N/A	N/A	N/A		m/m	
Phase 2 - existing waste (overtopping)										
K2.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
K2.02	Initial average thickness of waste layer	H_0	N/A	24	24	40	N/A		m	E5.05 - E4.05
K2.03	Previously applied pressure in the waste layer (initial compaction)		N/A	60	60	60	N/A		kN/m^2	Based on historical compaction machinery used
K2.04	Previously applied pressure in the waste layer (existing layer)		N/A	132	132	220	N/A		kN/m^2	0.5 x K2.01 x K2.02
K2.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	0	0	0	N/A		kN/m^2	N/A
K2.06	Total previously applied pressure in the waste layer	σ_0	N/A	192	192	280	N/A		kN/m^2	K2.04 + K2.05
K2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	414	417	257	N/A		kN/m^2	K3.01 x K3.02 + K4.01 x K4.02
K2.08	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
K2.09	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 1500

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
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Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 1500 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
K2.10	Primary settlement	ΔH_C	N/A	2.39	2.41	2.26	N/A		m	Based on Sower's formula provided in Qian (2002)
K2.11	t_1	t_1	N/A	5	5	5	N/A			2014 - B2.17
K2.12	t_2	t_2	N/A	30	30	30	N/A			Estimate
K2.13	Secondary settlement	ΔH_α	N/A	1.03	1.03	1.71	N/A		m	Based on Sower's formula provided in Qian (2002)
K2.14	Total phase settlement	ΔH	N/A	3.42	3.43	3.97	N/A		m	K2.10 + K2.13
K2.15	Total phase settlement		N/A	14%	14%	10%	N/A		m/m	
Phase 3 - future waste (reprofiling)										
K3.01	Unit weight of solid waste		N/A	11	11	11	N/A		kN/m^3	Taken from Qian (2002)
K3.02	Initial average thickness of waste layer	H_0	N/A	38	38	23	N/A		m	E7.05 - E6.05
K3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	N/A	60	60	60	N/A		kN/m^2	Based on predicted future compaction machinery
K3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	207	209	128	N/A		kN/m^2	0.5 x K4.01 x K4.02
K3.05	Modified primary compression index	C'_C	N/A	0.2	0.2	0.2	N/A			Taken from Qian (2002)
K3.06	Modified secondary compression index	C'_α	N/A	0.055	0.055	0.055	N/A			Taken from Qian (2002)
K3.07	Primary settlement	ΔH_C	N/A	4.04	4.10	1.54	N/A		m	Based on Sower's formula provided in Qian (2002)
K3.08	t_1	t_1	N/A	1	1	1	N/A			From date of placement
K3.09	t_2	t_2	N/A	30	30	30	N/A			Estimate
K3.10	Secondary settlement	ΔH_α	N/A	3.05	3.08	1.90	N/A		m	Based on Sower's formula provided in Qian (2002)
K3.11	Total phase settlement	ΔH	N/A	7.10	7.18	3.44	N/A		m	K3.007 + K3.10
K3.12	Total phase settlement		N/A	19%	19%	15%	N/A		m/m	
All phases										
K4.01	Total settlement		N/A	10.52	10.61	7.41	N/A		m	K1.14 + K2.14 + K3.11 + K4.11
K4.02	Total settlement		N/A	17%	17%	12%	N/A		m	
K4.03	Baseline RL		118.00	166.60	166.91	168.33	144.00		m	
K4.04	Post-settled RL		118.00	156.08	156.30	160.92	144.00		m	

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 1800

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 1500 cross-section based on the proposed inputs and model parameters.

Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
Phase 1 - existing waste (pre-overtopping)										
L1.01	Unit weight of solid waste		N/A	N/A	N/A	N/A	N/A		kN/m^3	Taken from Qian (2002)
L1.02	Initial average thickness of waste layer	H_0	N/A	N/A	N/A	N/A	N/A		m	E3.06
L1.03	Previously applied pressure in the waste layer (initial compaction)		N/A	N/A	N/A	N/A	N/A		kN/m^2	Based on historical compaction machinery used
L1.04	Previously applied pressure in the waste layer (existing layer)		N/A	N/A	N/A	N/A	N/A		kN/m^2	0.5 x L1.01 x L1.02
L1.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	N/A	N/A	N/A	N/A		kN/m^2	L2.01 x L2.02
L1.06	Total previously applied pressure in the waste layer	σ_0	N/A	N/A	N/A	N/A	N/A		kN/m^2	L1.04 + L1.05
L1.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	N/A	N/A	N/A	N/A		kN/m^2	L3.01 x L3.02 + L4.01 x L4.02
L1.08	Modified primary compression index	C'_C	N/A	N/A	N/A	N/A	N/A			Taken from Qian (2002)
L1.09	Modified secondary compression index	C'_α	N/A	N/A	N/A	N/A	N/A			Taken from Qian (2002)
L1.10	Primary settlement	ΔH_C	N/A	N/A	N/A	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
L1.11	t_1	t_1	N/A	N/A	N/A	N/A	N/A			2014 - B1.13
L1.12	t_2	t_2	N/A	N/A	N/A	N/A	N/A			Estimate
L1.13	Secondary settlement	ΔH_α	N/A	N/A	N/A	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
L1.14	Total phase settlement	ΔH	N/A	N/A	N/A	N/A	N/A		m	L1.10 + L1.13
L1.15	Total phase settlement		N/A	N/A	N/A	N/A	N/A		m/m	
Phase 2 - existing waste (overtopping)										
L2.01	Unit weight of solid waste		N/A	N/A	N/A	N/A	N/A		kN/m^3	Taken from Qian (2002)
L2.02	Initial average thickness of waste layer	H_0	N/A	N/A	N/A	N/A	N/A		m	E5.06 - E4.06
L2.03	Previously applied pressure in the waste layer (initial compaction)		N/A	N/A	N/A	N/A	N/A		kN/m^2	Based on historical compaction machinery used
L2.04	Previously applied pressure in the waste layer (existing layer)		N/A	N/A	N/A	N/A	N/A		kN/m^2	0.5 x L2.01 x L2.02
L2.05	Previously applied pressure in the waste layer (existing overtopping)		N/A	N/A	N/A	N/A	N/A		kN/m^2	N/A
L2.06	Total previously applied pressure in the waste layer	σ_0	N/A	N/A	N/A	N/A	N/A		kN/m^2	L2.04 + L2.05
L2.07	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	N/A	N/A	N/A	N/A		kN/m^2	L3.01 x L3.02 + L4.01 x L4.02
L2.08	Modified primary compression index	C'_C	N/A	N/A	N/A	N/A	N/A			Taken from Qian (2002)
L2.09	Modified secondary compression index	C'_α	N/A	N/A	N/A	N/A	N/A			Taken from Qian (2002)

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform - Settlement Modelling
Subject: Settlement analysis - Chainage 1800

Job Number: 21-23396
Calcs by: C Nivison-Smith
Checked by: A Roberts

Revision: A
Date of issue 22-Jun-15
Date of review: 22-Jun-15

Statement of modelling procedure

This spreadsheet provides the results of the settlement analysis for Chainage 1500 cross-section based on the proposed inputs and model parameters.

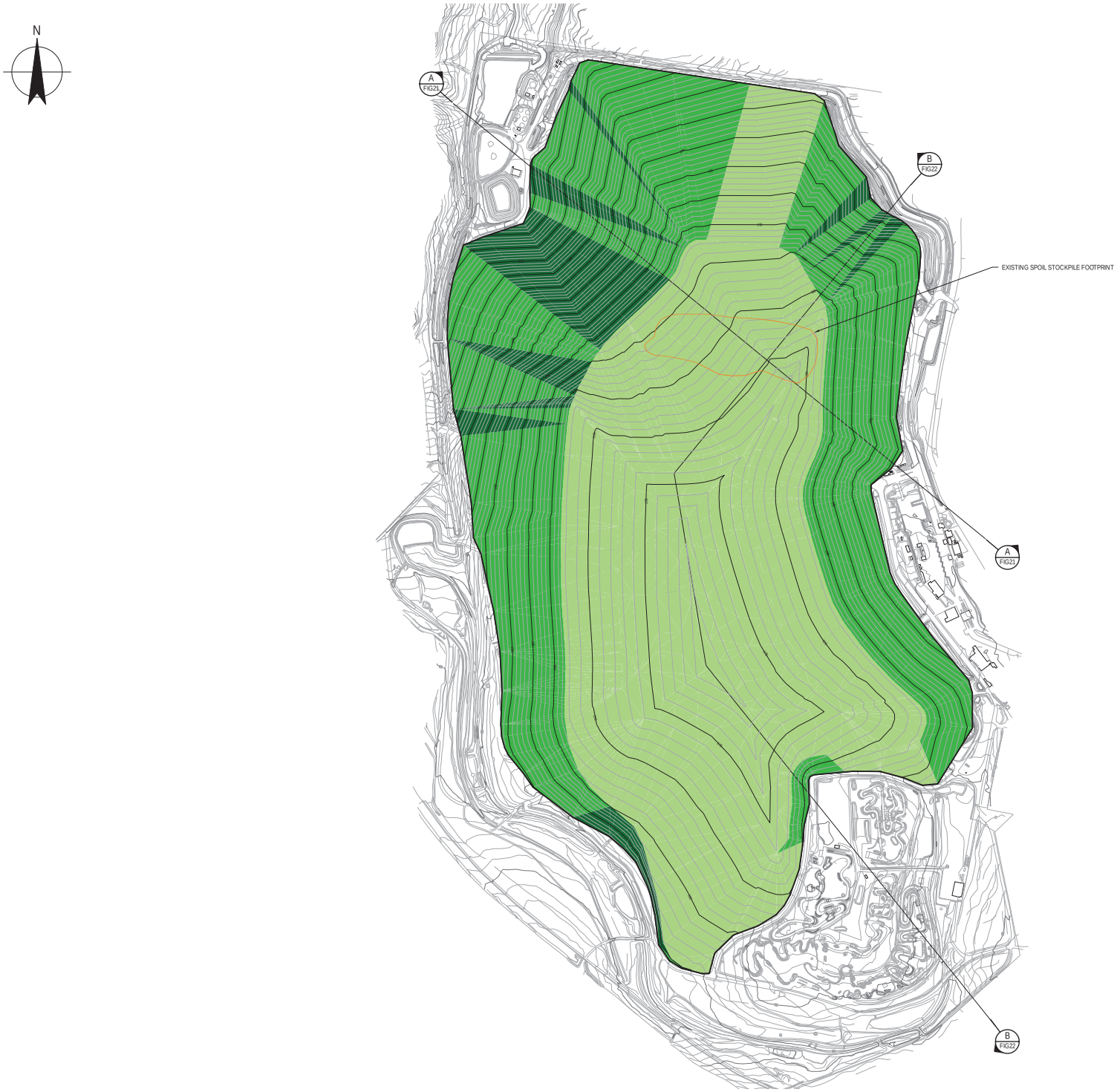
Item	Description	Symbol	Inflection point						Unit	Notes
			1	2	3	4	5			
L2.10	Primary settlement	ΔH_C	N/A	N/A	N/A	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
L2.11	t_1	t_1	N/A	N/A	N/A	N/A	N/A			2014 - B2.17
L2.12	t_2	t_2	N/A	N/A	N/A	N/A	N/A			Estimate
L2.13	Secondary settlement	ΔH_α	N/A	N/A	N/A	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
L2.14	Total phase settlement	ΔH	N/A	N/A	N/A	N/A	N/A		m	L2.10 + L2.13
L2.15	Total phase settlement		N/A	N/A	N/A	N/A	N/A		m/m	
Phase 4 - future waste (reprofiling)										
L3.01	Unit weight of solid waste		N/A	N/A	11	N/A	N/A		kN/m^3	Taken from Qian (2002)
L3.02	Initial average thickness of waste layer	H_0	N/A	N/A	51	N/A	N/A		m	E7.06 - E6.06
L3.03	Previously applied pressure in the waste layer (initial compaction)	σ_0	N/A	N/A	60	N/A	N/A		kN/m^2	Based on predicted future compaction machinery
L3.04	Total overburden pressure applied at the mid-level of the waste layer	σ_i	N/A	N/A	282	N/A	N/A		kN/m^2	0.5 x L4.01 x L4.02
L3.05	Modified primary compression index	C'_C	N/A	N/A	0.2	N/A	N/A			Taken from Qian (2002)
L3.06	Modified secondary compression index	C'_α	N/A	N/A	0.055	N/A	N/A			Taken from Qian (2002)
L3.07	Primary settlement	ΔH_C	N/A	N/A	6.89	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
L3.08	t_1	t_1	N/A	N/A	1	N/A	N/A			From date of placement
L3.09	t_2	t_2	N/A	N/A	30	N/A	N/A			Estimate
L3.10	Secondary settlement	ΔH_α	N/A	N/A	4.16	N/A	N/A		m	Based on Sower's formula provided in Qian (2002)
L3.11	Total phase settlement	ΔH	N/A	N/A	11.05	N/A	N/A		m	L3.07 + L3.10
L3.12	Total phase settlement		N/A	N/A	22%	N/A	N/A		m/m	
All phases										
L4.01	Total settlement		N/A	N/A	11.05	N/A	N/A		m	L1.14 + L2.14 + L3.11 + L4.11
L4.02	Total settlement		N/A	N/A	22%	N/A	N/A		m	
L4.03	Baseline RL			111.00	144.25	135.00			m	
L4.04	Post-settled RL			111.00	133.20	135.00			m	

Appendix D – Final landform slope analysis

21-23482-SK020 Proposed final landform slope analysis

21-23482-FIG021 Cross sections

21-23482-FIG022 Cross sections



LEGEND:

PROPOSED LANDFORM CONTOURS - POST SETTLEMENT

SLOPE ANALYSIS:

- 5% - 10%; ; 1(V):20(H) TO 1(V):10(H)
- 10% - 18%; ; 1(V):10(H) TO 1(V):5.6(H)
- 18% - 25%; 1(V):5.6(H) TO 1(V):4(H)

NOTE
THE FINAL LANDFORM HAS BEEN MODELLED TO A CONCEPTUAL LEVEL ONLY.

PRELIMINARY

rev	description	app'd	date
C	REVISED	AD	08.05.15
B	REVISED	AD	01.05.15

SITA Australia
LUCAS HEIGHTS RRP

PROPOSED FINAL LANDFORM SLOPE ANALYSIS

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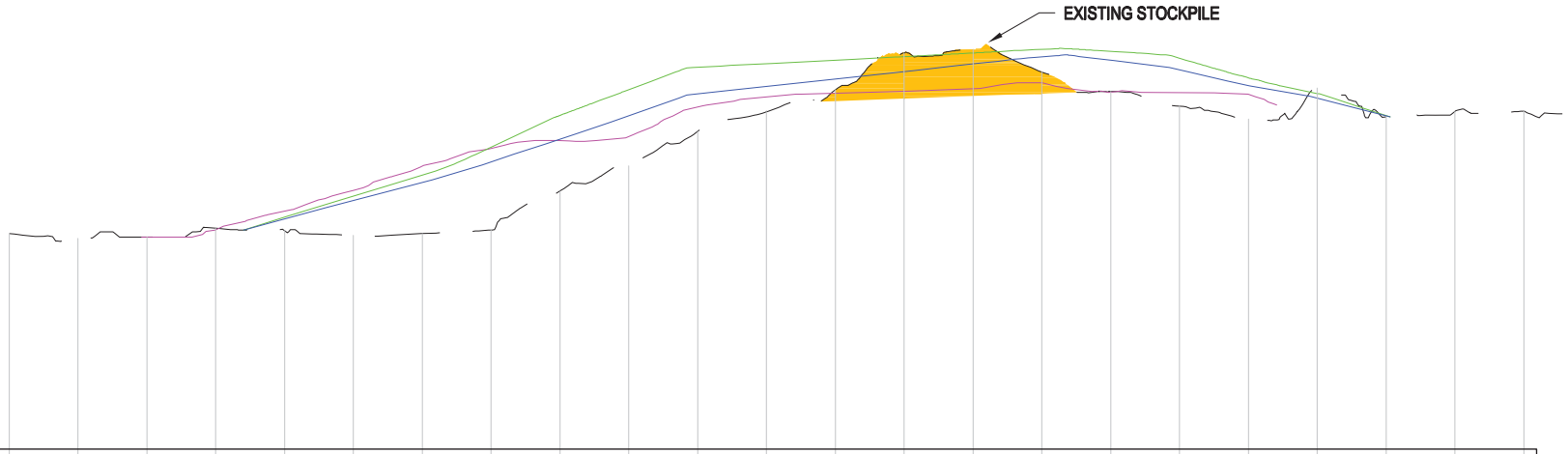
scale	1:3500 for A1	job no.	21-23482
date	MAY 2015	rev no.	C

approved (PD) SK020

Plot Date: 8 May 2015 - 1:50 PM Plotted by: Alison Horlyck Cad File No: G:\21\23482\CADD\Drawings\21-23482-SK020.dwg



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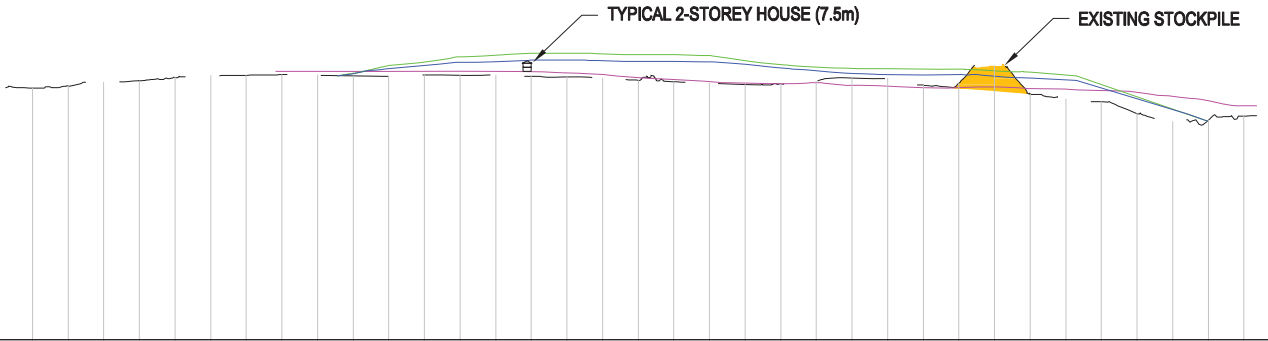

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CHAINAGE	0	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500	1550	1600	1650	1700
EXISTING SURFACE LEVEL (JUN 2014)	160.39	161.81	164.39	165.59	167.89	169.26	169.2	169.81	169.67	168.9	168.62	168.86	169.27	169.52	168.65	168.27	167.2	165.75	164.72	163.82	162.89	163.42	165.14	167.43	167.32	162.44	163.77	175.47	156.22	152.77	150.75	142.57	136.86	137.88	140.81
EXISTING APPROVED FINAL LANDFORM								172	172	172	172	172	172	172	171.96	171.15	170.04	167.61	166.37	164.86	163.97	163.47	164.09	162.16	161.79	160.88	160.81	161.34	159.98	159.57	158.72	157.33	154.59	151.49	148
PROPOSED FINAL LANDFORM - BASELINE										170.71	170.31	178.5	182.32	183.43	184.9	184.9	184.39	183.8	183.77	183.17	179.59	176.81	174.87	174.22	173.83	173.71	173.65	172.52	171.54	169.58	162.87	154.2	145.54	136.87	
PROPOSED FINAL LANDFORM - POST-SETTLEMENT										170.51	173.91	178.23	178.47	178.98	179.9	179.9	179.58	179.21	179.19	178.84	176.86	174.51	172.5	170.66	169.76	169.54	169.7	168.78	167.35	166.05	160.37	152.86	145.56	136.9	

B SK020 SECTION
HORIZONTAL SCALE 1 : 7500
VERTICAL SCALE 1 : 3750

N

SITA AUSTRALIA
LUCAS HEIGHTS RRP

CROSS SECTIONS

Job Number 21-23482
Revision E
Date MAY 2015

Figure 22

Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com W www.ghd.com

Plot Date: 20 May 2015 - 10:21 AM Plotted by: Alison Horlyck Cad File No: G:\21\23482\CADD\Drawings\21-23482-SK021-RB.dwg

Appendix E – Staging plans

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform
Subject: Future capacity

Job Number: 21-23396
Calcs by: A Horlyck
Checked by:

Revision: J
Date of issue 28-Jul-15
Date of review:

Statement of modelling procedure

This spreadsheet provides an estimate of the capacity for waste in each stage

Item	Description	Area									Unit	Notes
		E	D	B	A	C	F	I	H	G		
A1.01	Boundary length A	139	441	323	147	0	0	0	389	0	m	Based on stage boundaries
A1.02	Boundary length B	293	0	306	0	0	0	0	0	0	m	Based on stage boundaries
A1.03	Boundary length C	238	297	0	0	214	294	644	0	0	m	Based on stage boundaries
A1.04	Boundary length D	564	0	0	0	0	0	0	0	0	m	
A1.05	Average height	10	10	8	7	10	11	35	10	0	m	Based on final landform 3D model
A1.06	Capacity loss due to batter A	20,850	66,090	30,998	10,775	0	0	0	58,365	0	m^3	A1.01 x A1.05^2 x 1.5
A1.07	Capacity loss due to batter B	43,980	0	29,395	0	0	0	0	0	0	m^3	A1.02 x A1.05^2 x 1.5
A1.08	Capacity loss due to batter C	35,760	44,610	0	0	32,040	53,307	1,182,799	0	0	m^3	A1.03 x A1.05^2 x 1.5
A1.09	Capacity loss due to batter D	84,645	0	0	0	0	0	0	0	0	m^3	A1.04 x A1.05^2 x 1.5
A1.10	Bulk airspace (to top of pre-settled R5)	1,195,064	973,137	897,487	453,991	1,012,097	728,033	5,417,457	2,203,586	1,196,146	m^3	Based on final landform 3D model
A1.11	Available airspace (to top of pre-settled R5)	1,009,829	906,417	924,033	474,214	1,020,228	749,089	4,330,287	3,328,020	1,334,881	m^3	A1.10 considering capacity loss due to batters
A1.12	Cap surface area change due to batter A	4,170	13,218	7,750	3,079	0	0	0	11,673	0	m^2	A1.01 x A1.05 x 3
A1.13	Cap surface area change due to batter B	8,796	0	7,349	0	0	0	0	0	0	m^2	A1.02 x A1.05 x 3
A1.14	Cap surface area change due to batter C	7,152	8,922	0	0	6,408	9,692	67,589	0	0	m^2	A1.03 x A1.05 x 3
A1.15	Cap surface area change due to batter D	16,929	0	0	0	0	0	0	0	0	m^2	A1.04 x A1.05 x 3
A1.16	Bulk capping area of final landform	99,903	92,296	101,775	89,490	137,242	71,766	223,187	78,721	107,218	m^2	Based on final landform 3D model
A1.17	Available capping area of final landform	62,856	78,952	104,065	94,161	141,261	76,947	173,755	134,636	134,965	m^2	A1.16 considering surface area change due to batters
A1.18	Existing capped area	690	13,833	94,322	89,196	121,676	28,466	0	0	35,376	m^2	Based on information provided by SITA
A1.19	Estimated capping depth	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	m	Taken from design basis memo
A1.20	Capacity gained from stripping of existing capping	897	17,983	122,619	115,954	158,179	37,005	0	0	45,989	m^3	A1.18 x A1.19
A1.21	Existing covered area	99,078	78,105	7,108	0	243	20,055	132,219	85,027	70,510	m^2	Based on information provided by SITA
A1.22	Estimated cover depth	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	m	Taken from design basis memo
A1.23	Capacity gained from stripping of existing cover	14,862	11,716	1,066	0	36	3,008	19,833	12,754	10,577	m^3	A1.20 x A1.21
A1.24	Lining volume of Cell 5.3 (including leachate drainage layer)	0	0	0	0	0	0	80,258	0	0	m^3	Based on GHD design drawings
A1.25	Proposed capping depth	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	1.75	m	Taken from design basis memo
A1.26	Capping material required	109,999	138,165	182,114	164,782	247,207	134,657	304,071	235,613	236,188	m^3	A1.17 x A1.25
A1.27	Additional capping material required in mounded areas	11,314	14,211	18,732	16,949	25,427	13,850	31,276	24,235	24,294	m^3	Estimate based on 0.75m x area on TB drawings
A1.28	Landfilling capacity	915,589	797,950	865,605	425,387	931,236	654,446	3,965,791	3,105,161	1,155,258	m^3	Based on existing site survey (Dec 13)

Client: SITA Australia
Project: Lucas Heights RRC Revised Landform
Subject: Future waste tonnages

Job Number: 21-23396
Calcs by: A Horlyck
Checked by:

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Statement of modelling procedure

This spreadsheet provides an estimate of waste (tonnes) to be landfilled in each stage in each year. Assunmes 1 tonne waste per m3.

Item	Description	Area										Unit	Notes
		E	D	B	A	C	F	I	H	G	Total		
Phase 3 - future waste (reprofiling)													
C1.01	2014 waste tonnage							164,651	164,651		329,301	t	SITA projections
C1.02	2015 waste tonnage							193,736	193,736		387,472	t	SITA projections
C1.03	2016 waste tonnage	335,718						167,859	167,859		671,435	t	SITA projections
C1.04	2017 waste tonnage	579,872	270,128								850,000	t	SITA projections
C1.05	2018 waste tonnage		527,821	322,179							850,000	t	SITA projections
C1.06	2019 waste tonnage			543,426	306,574						850,000	t	SITA projections
C1.07	2020 waste tonnage				118,813	731,187					850,000	t	SITA projections
C1.08	2021 waste tonnage					200,048	649,952				850,000	t	SITA projections
C1.09	2022 waste tonnage						4,494	845,506			850,000	t	SITA projections
C1.10	2023 waste tonnage							850,000			850,000	t	SITA projections
C1.11	2024 waste tonnage							850,000			850,000	t	SITA projections
C1.12	2025 waste tonnage							850,000			850,000	t	SITA projections
C1.13	2026 waste tonnage							44,040	805,960		850,000	t	SITA projections
C1.14	2027 waste tonnage								850,000		850,000	t	SITA projections
C1.15	2028 waste tonnage								850,000		850,000	t	SITA projections
C1.16	2029 waste tonnage								72,956	77,044	150,000	t	SITA projections
C1.17	2030 waste tonnage									150,000	150,000	t	SITA projections
C1.18	2031 waste tonnage									150,000	150,000	t	SITA projections
C1.19	2032 waste tonnage									150,000	150,000	t	SITA projections
C1.20	2033 waste tonnage									150,000	150,000	t	SITA projections
C1.21	2034 waste tonnage									148,215	148,215	t	SITA projections
C1.22	2035 waste tonnage									120,000	120,000	t	SITA projections
C1.23	2036 waste tonnage									120,000	120,000	t	SITA projections
C1.24	2037 waste tonnage									90,000	90,000	t	SITA projections
C1.32	Total waste landfilled	915,589	797,950	865,605	425,387	931,236	654,446	3,965,791	3,105,161	1,155,259	12,816,423	t	
C1.33	Start date	Jun-16	Aug-17	Jul-18	Jul-19	Jan-20	Feb-21	Nov-21	Dec-25	Jun-29			
C1.34	End date	Aug-17	Jul-18	Jul-19	Jan-20	Feb-21	Nov-21	Dec-25	Jun-29	Dec-37			
C1.35	Months to fill	14	11	12	6	13	9	49	42	102		months	Excludes filling prior to moving to Area E

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Document Status

Rev No.	Author	Reviewer		Approved for Issue		
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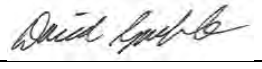
3	A Horlyck	A Dixon		D Gamble		28/09/15

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