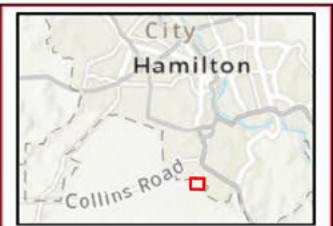


APPENDIX E

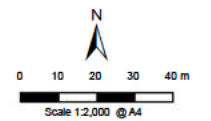
ARTIFICIAL WETLAND DRAWDOWN CONTOURS





LEGEND

- Drawdown Contours
- Artificial Wetland A

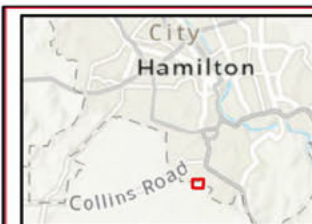


Coordinate System: NZGD 2000 Mount Eden Circuit

WGA

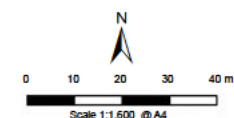
Figure E1
Southern Links Stage 1
Drawdown Contours For
Artificial Wetland A

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland B

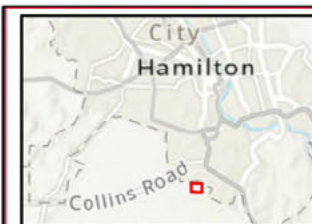


Coordinate System: NZGD 2000 Mount Eden Circuit

WGA
Figure E2

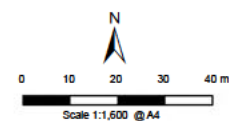
Southern Links Stage 1
Drawdown Contours For
Artificial Wetland B

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland C

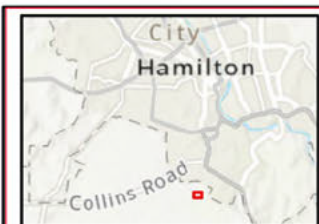


Coordinate System: NZGD 2000 Mount Eden Circuit

WGA
Figure E3

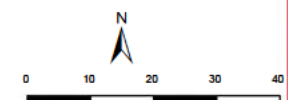
Southern Links Stage 1
Drawdown Contours for
Artificial Wetland C

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland D

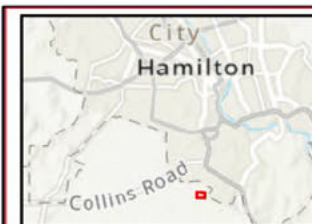


Coordinate System: NZGD 2000 Mount Eden Circuit

WGA
Figure E4

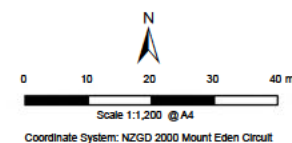
Southern Links Stage 1 Drawdown Contours for Artificial Wetland D

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland E



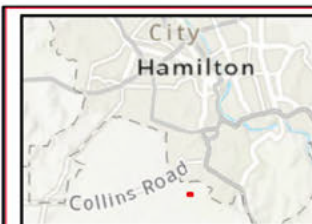
WGA

Figure E5

Southern Links Stage 1
Drawdown Contours
for Wetland E

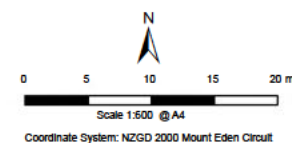
Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.

Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Drawdown Contours
- Artificial Wetland F

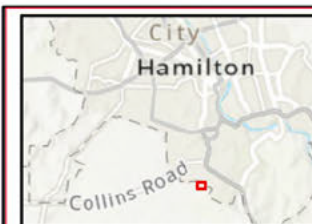


WGA

Figure E6

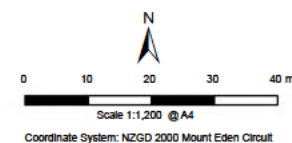
Southern Links Stage 1
Drawdown Contours for
Artificial Wetland F

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

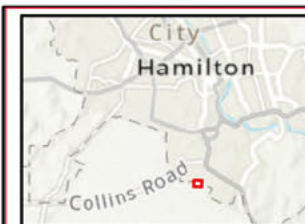
- Summer Drawdown Contours
- Artificial Wetland A



WGA
Figure E7

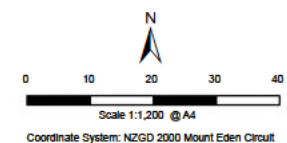
Southern Links Stage1
Summer Drawdown Contours
Artificial Wetland A

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028



LEGEND

- Summer Drawdown Contours
- Artificial Wetland B



WGA

Figure E8

Southern Links Stage1

Summer Drawdown

Artificial Wetland B

Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, no guarantee is given that the information portrayed is free from error or omission. Any reliance placed on such information shall be at the risk of the user.
Note: The information shown on this map is a copyright of WGA 2028

APPENDIX F

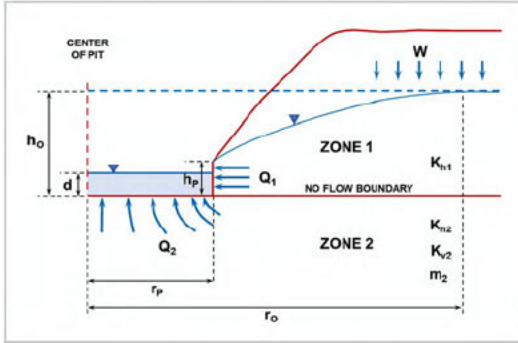
WASTEWATER INFRASTRUCTURE DRAWDOWN MODELLING



INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS A
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$A \quad h_o = \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]}$$

$$B \quad Q_1 = W \pi (r_o^2 - r_p^2)$$

$$C \quad Q_2 = 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d)$$

$$D \quad m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	2.18	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r_o calculated by iterating equation A

66 m

Known h_o

2.18 m

h_o calculated using Equation A

2.18 m

Q₁ 1.1E-04 m³/s
9.3E+00 m³/day

Inflow from Zone 2

Anisotropy parameter calculated using equation D

2.236068

Q₂ 2.0E-03 m³/s
1.7E+02 m³/day

Total Pit Inflow

Q_{TOT} 2.1E-03 m³/s
179.44 m³/day

Reference: Marinelli, F. & Niccoli W. L. 2000.
Simple analytical equations for estimating ground water inflow to a mine pit. Ground Water 38, no. 2: 311-314.

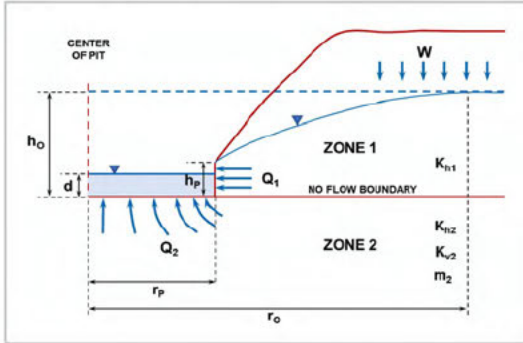
Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.
 Inflows from Zone 2 do not apply. This analysis is specific to Zone 1 only.
 Also note that if a sheet pile wall is used to support the excavation, the likely inflows through the pile wall will be much smaller than those calculated in this sheet.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS A
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone 2} = \frac{2(h_0 - d)}{\pi} \sin^{-1}\left(\frac{r_p}{r}\right)$$

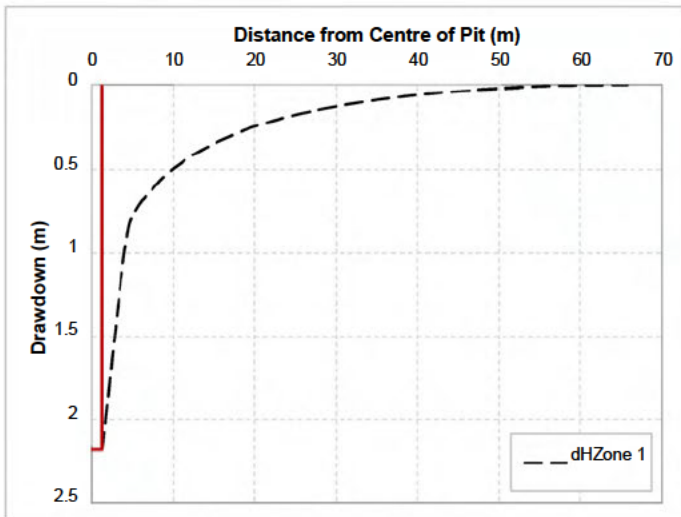
$$m_z = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h ₀	2.18	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r₀ is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence r₀ calculated by iterating equation A in analysis sheet 1

66 m



Drawdown curves

r	dH _{Zone 1}	dH _{Zone 2}
1.25	2.18	2.2
4.5	0.9	0.4
7.7	0.6	0.2
10.9	0.5	0.2
14.2	0.4	0.1
17.4	0.3	0.1
20.6	0.2	0.1
23.8	0.2	0.1
27.1	0.2	0.1
30.3	0.1	0.1
33.5	0.1	0.1
36.7	0.1	0.0
40.0	0.1	0.0
43.2	0.04	0.0
46.4	0.03	0.0
49.6	0.02	0.0
52.9	0.01	0.0
56.1	0.01	0.0
59.3	0.00	0.0
62.5	0.00	0.0
65.8	0.00	0.0

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water inflow
 to a mine pit. Ground Water 38, no. 2: 311-314.

Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

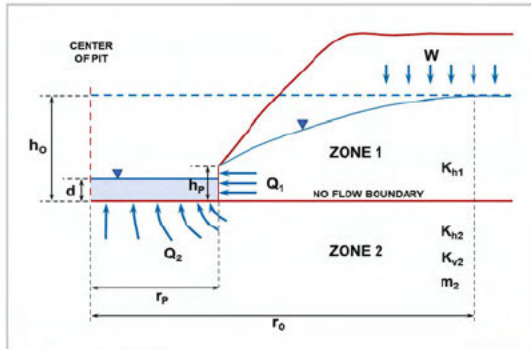
Notes: Drawdown projections are initial approximations only.

If a sheet pile wall is used to support the excavation, the likely inflows through the pile wall and consequent drawdown will be much smaller than that calculated in this sheet.

INFLOW TO OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS B
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$\begin{aligned} \text{A } h_o &= \sqrt{h_p^2 + \frac{W}{K_{h1}} \left[r_o^2 \ln \left(\frac{r_o}{r_p} \right) - \frac{(r_o^2 - r_p^2)}{2} \right]} \\ \text{B } Q_1 &= W \pi (r_o^2 - r_p^2) \\ \text{C } Q_2 &= 4 r_p \left(\frac{K_{h2}}{m_2} \right) (h_o - d) \\ \text{D } m_2 &= \sqrt{\frac{K_{h2}}{K_{v2}}} \end{aligned}$$

W	7.93E-09	m/s	recharge flux
K _{h1}	2.50E-05	m/s	horizontal hydraulic conductivity in Zone 1
K _{h2}	4.04E-04	m/s	horizontal hydraulic conductivity in Zone 2
K _{v2}	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h _o	0.507	m	initial saturated thickness above the base of Zone 1
h _p	0	m	saturated thickness at the pit wall
r _p	1.25	m	effective pit radius
d	0	m	depth of the pit lake

r_o is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Inflow from Zone 1

Radius of influence r _o calculated by iterating equation A	19	m
Known h _o	0.51	m
h _o calculated using Equation A	0.51	m
Q ₁	9.1E-06	m ³ /s
	7.9E-01	m ³ /day

Inflow from Zone 2

Anisotropy parameter calculated using equation D	2.236068	
Q ₂	4.6E-04	m ³ /s
	4.0E+01	m ³ /day

Total Pit Inflow

Q _{TOT}	4.7E-04	m ³ /s
	40.36	m ³ /day

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water
 inflow to a mine pit. Ground Water 38, no. 2: 311-314.

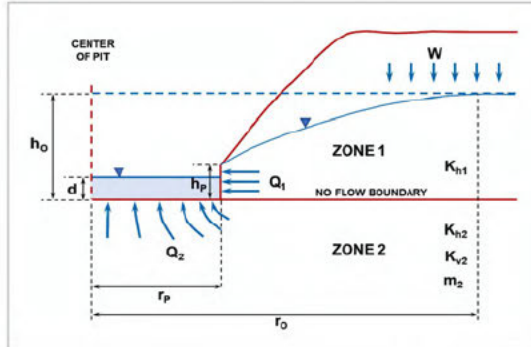
Analysed by: T Beisly 19/03/2026
Checked by: B Sinclair 19/03/2026

Notes: The hydraulic conductivity of 4.04E-04 used in this assessment is a minimum estimate.
 Inflows from Zone 2 do not apply. This analysis is specific to Zone 1 only.
 If a sheet pile wall is used to support the excavation, the likely inflows through the pile wall will be much smaller than those calculated in this sheet.

GROUNDWATER DRAWDOWN AROUND OPEN PIT - APPROXIMATION

WGA

CLIENT: Barker & Associates
 PROJECT: Southern Links - Southern Block
 Project #: WGA242463
 Location: WWPS B
 Date: Friday, 13 March 2026
 Document #: WGA242463-RP-HG-0003_A



$$dH_{Zone 1} = h_0 - \sqrt{h_p^2 + \frac{W}{k_{h1}} \left[r_0^2 \ln\left(\frac{r}{r_p}\right) - \frac{(r^2 - r_p^2)}{2} \right]}$$

$$dH_{Zone 2} = \frac{2(h_0 - d)}{\pi} \sin^{-1}\left(\frac{r_p}{r}\right)$$

$$m_2 = \sqrt{\frac{K_{h2}}{K_{v2}}}$$

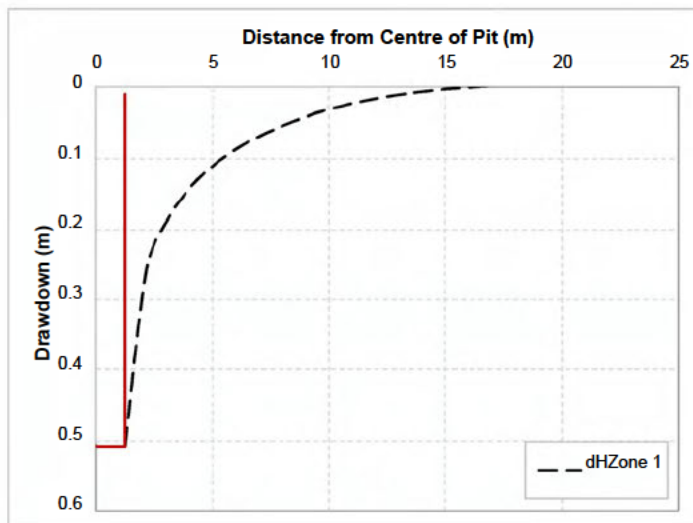
W	7.93E-09	m/s	recharge flux
Kh1	0.000025	m/s	horizontal hydraulic conductivity in Zone 1
Kh2	0.000404	m/s	horizontal hydraulic conductivity in Zone 2
Kv2	8.08E-05	m/s	vertical hydraulic conductivity in Zone 2
h0	0.507	m	initial saturated thickness above the base of Zone 1
hp	0	m	saturated thickness at the pit wall
rp	1.25	m	effective pit radius
d	0	m	depth of the pit lake

ro is the radius of influence measured from the center of the pit beyond which groundwater drawdown is nil.

Radius of influence ro calculated by iterating equation A in analysis sheet 1

19 m

Drawdown curves



r	dHZone 1	dHZone 2
1.25	0.507	0.5
2.1	0.3	0.2
3.0	0.2	0.1
3.9	0.1	0.1
4.8	0.1	0.1
5.7	0.1	0.1
6.6	0.1	0.1
7.5	0.1	0.1
8.4	0.0	0.0
9.3	0.0	0.0
10.2	0.0	0.0
11.1	0.0	0.0
12.0	0.0	0.0
12.9	0.01	0.0
13.8	0.01	0.0
14.7	0.00	0.0
15.6	0.00	0.0
16.5	0.00	0.0
17.4	0.00	0.0
18.3	0.00	0.0
19.2	0.00	0.0

Reference: Marinelli, F. & Niccoli W. L. 2000.
 Simple analytical equations for estimating ground water
 inflow to a mine pit. Ground Water 38, no. 2: 311-314.

Analysed by: T Beisly 19/03/2026
 Checked by: B Sinclair 19/03/2026

Notes: Drawdown projections are initial approximations only.

If a sheet pile wall is used to support the excavation, the likely inflows through the pile wall and consequent drawdown will be much smaller than that calculated in this sheet.



FOR FURTHER INFORMATION CONTACT:

Joanne Ferry
Senior Hydrogeologist

T
M
E



WGA.COM.AU
WGANZ.CO.NZ

