

Appendix C Assessment of Existing Groundwater Conditions

C1 Environmental setting

C1.1 Geology

C1.1.1 Local geology

The published geological maps for the area^{42,43} indicate that the Redvale Landfill site to be underlain by Northland Allochthon deposits. The Northland Allochthon (formerly known as the Onerahi Chaos Breccia) was initially deposited as marine sediments in a deep sedimentary basin. When subduction began beneath Northland in the early Miocene, those marine sediments, along with parts of the ocean crust, were emplaced as thrust sheets on top of existing rocks to form the Northland Allochthon.

Waitemata Group sediments were deposited during the period of Allochthon emplacement and have been picked up and included within the Allochthon mass. The lateral displacement and thrusting endured by the materials during the Allochthon emplacement process has resulted in the generally extensive degree of shearing and distortion, particularly of the weaker units, and the overall structural complexity of the unit.

Published data indicates Northland Allochthon units below the Redvale Landfill site to comprise Mahurangi Limestone (forming the resource for the earlier quarrying works), and Hukerenui Mudstone. East Coast Bays Formation Siltstones and Sandstones, part of the Waitemata Group, are identified to the south-west of the landfill site. Overlying the site is a variable thickness of Pleistocene Sediments with localised Recent Alluvium likely originally present in stream channels and pond areas.

C1.1.2 Site specific geology

The geological setting of the Redvale Landfill East Property, and eastern half of the West Property, essentially comprises two closely spaced north-south trending lens-shaped masses of easterly dipping Northland Allochthon limestone contained within sheared Northland Allochthon mudstones and siltstones. To the west of those units is a further zone of limestone, with Northland Allochthon Autoclastic Breccia mudstone/siltstone and Waitemata Group sandstones and siltstones along the Western Property's, and overall landfill's, south-western boundary.

The principal stratigraphic units identified beneath and in the vicinity of the Redvale Landfill development comprise (refer to the Geotechnical Assessment Report for detailed descriptions of the geological units.):

- a Fill: Various types of engineered fill have been placed as part of the Landfill development. Such engineered fill comprises site-won materials derived principally from Northland Allochthon mudstones/siltstones and to a lesser extent limestone. High strength structural fill, generally corresponding to Type 1C high strength structural fill is the principal engineered fill type placed to date as part of the landfill construction.
- b Pleistocene Sediments: These were originally present over much of the area but have been selectively removed during ongoing landfill development.

⁴² Institute of Geological and Nuclear Sciences Ltd : 2001 : Geology of Auckland, 1 : 250,000. Sheet 3.

⁴³ Kermode L : 1992 : Geology of the Auckland Urban Area. 1: 50,000. Sheet R11. Institute of Geological and Nuclear Sciences Ltd.

- c Northland Allochthon: As part of the geological assessment and characterisation of the lithologies, the principal Northland Allochthon materials have been split into eight categories, i.e. Unit N1 to Unit N8, based on their general lithology. Those principal units comprise:
 - i (Mahurangi) Limestone (Unit N1).
 - ii Mudstone and Siltstone (Units N2 to N8), generally corresponding to the Hukerenui Mudstone.
 - iii Autoclastic Breccia, identified as a series of irregular bands below the Southern Highwall on the Western Property, and associated with the Thrust Fault separating the Northland Allochthon and Waitemata Group materials.
- d Waitemata Group: These are present at and beyond the extreme south-west boundary of the consented Landfill area and typically comprise Sandstones and Siltstones, often variously weathered to clayey silts and sands.

C1.2 Hydrogeology

C1.2.1 Regional hydrogeology

Redvale Landfill is located within the Rangitopuni Waitemata sub-aquifer zone⁹, part of the North Shore Waitemata Aquifer Zone. This aquifer is not a High-Use Aquifer or a Quality-Sensitive Aquifer⁴⁴. The site is also part of the Dairy Flat Stormwater catchment. The closest named stream to the site is the Rangitopuni Stream. A tributary to the Rangitopuni Stream flows eastwards close to the northern site boundary, discharging into the Rangitopuni Stream to the northeast of the site. A small unnamed stream also originates to the south west of the Class 2 footprint extension where it flows to the south and joins another tributary of the Rangitopuni Stream. The Rangitopuni Stream then flows southwards, close to the eastern boundary of the site.

Based on our understanding of the site-specific groundwater monitoring investigations, the geotechnical site investigations and previously published reports and maps of the area, we infer that the groundwater system beneath and surrounding the landfill is unconfined. In addition, we infer that groundwater within the Waitemata Group rocks and Northland Allochthon rocks are hydraulically connected and acting as one groundwater system, part of the regional Rangitopuni Waitemata sub-aquifer zone⁹. In this sub-aquifer zone, Auckland Council³⁸ has calculated that there is groundwater available for allocation.

Groundwater level contour maps (Section 4.3) of recently measured groundwater levels surrounding the site indicate that groundwater recharge in the immediate vicinity of the site occurs on the higher ground to the west-southwest of the landfill, likely through rainfall recharge. This shallower groundwater, part of the regional groundwater system, flows toward the north and east-southeast, discharging through losses to the Rangitopuni Stream, which passes around the northwest-north and eastern boundaries of the landfill property. This local shallower groundwater flow and discharge is illustrated on Figure Appendix C.1 (groundwater subsystem 1). Regionally, the groundwater in the Rangitopuni Waitemata sub-aquifer zone is recharged primarily on higher ground within the defined catchment, through rainfall infiltration. The regional groundwater flow is toward the south and locally the Rangitopuni Stream, discharging to the Rangitopuni Stream (groundwater subsystem 2 on Figure Appendix C.1) and ultimately to the Waitemata Harbour (groundwater system 3 on Figure Appendix C.1).

⁴⁴ Auckland Council, The Auckland Unitary Plan Operative in part - Updated 11 April 2025: <https://unitaryplanmaps.aucklandcouncil.govt.nz/upviewer/>. Accessed May 2025.

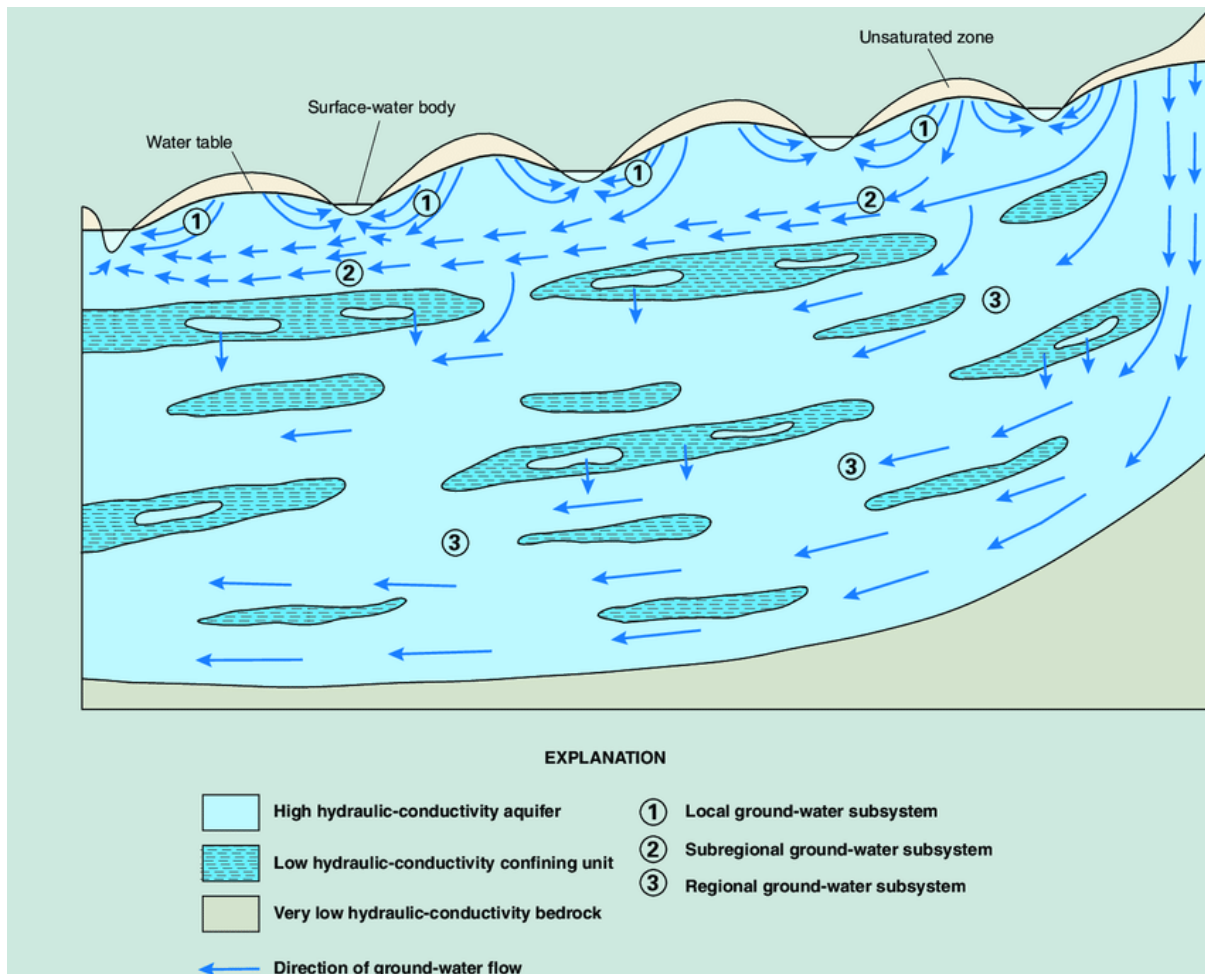


Figure Appendix C.1: Schematic figure of groundwater flow. Source: https://pubs.usgs.gov/circ/circ1186/html/gen_facts.html.

C1.2.2 Groundwater allocation and neighbouring water users

Regional aquifer use

The proposed Class 2 footprint extension and Redvale Landfill are within the Rangitopuni Waitemata sub-aquifer zone⁹. Groundwater allocation information provided by Auckland Council on 26 November 2025 indicates that there is over 354,000 m³/year of water available for allocation, as summarised in the following table.

Table Appendix C.1: Groundwater allocation and availability for the Rangitopuni Waitemata sub-aquifer zone

Management level (m ³ /yr)	Percent allocated (%)	Groundwater available for allocation (m ³ /year)
530,000	31	354,027

Neighbouring groundwater and surface water users

There are very few groundwater take consents issued within 2 km of Redvale Landfill, consistent with the majority of the site geology having very low hydraulic conductivity making it difficult to obtain economic quantities of water.

On 19 February 2025, Auckland Council provided a summary of all records held by the council relating to borehole installations, consented groundwater and surface water takes and permitted activity (PA) groundwater and surface water takes within a 2 km radius of the approximate centre of Redvale Landfill. The council SAP consenting system provides the number of consents in a specified area, whereas the OAS Legacy database contains information from pre-2017. There is some overlap in the two databases, but minimal details about groundwater takes and bores drilled post-2017 on the SAP consenting system.

Table Appendix C.2 summarises the details of neighbouring bores and consented groundwater and surface water takes and permitted activity (PA) takes within a 2 km radius of the approximate centre of Redvale Landfill (refer to Figure Appendix C.2 for a map with locations). Only those bores drilled for groundwater take purposes have been listed (all others were for geotechnical or monitoring purposes) and only granted consents that have not expired or been surrendered/cancelled are listed. We note that none of the neighbouring bores listed as being drilled for taking groundwater have associated groundwater take consents or PA information.

Table Appendix C.2: Details of neighbouring bores and groundwater and surface water consents and PAs within 2 km of the approximate centre of Redvale Landfill

Bore ID/Consent or PA no.	Bore owner/consent holder	Type of take	Use	Approximate Distance and direction from approximate centre of Redvale Landfill	Comment
PA 51758	Waste Management NZ Limited	Surface water take from Rangitopuni Stream	Stock drinking water for 4 'lifestyle' block stock troughs. Total of 5 horses (50L/horse/day) and 15 cows (90L/cow/day).	800 m NW	
PA 52694/ WAT60277342		Surface water take from Rangitopuni Stream	To take water from an off-stream dam for irrigation of 0.56ha of Greenhouse tomatoes.	1.3 km SE – this is for the distance to the property; the location of the dam is unknown	
Bore 2294		Groundwater from Waitemata		680 m NNE	Total depth 85 m.
Bore 2284		Groundwater from Waitemata	Drilled pre-1987 for WRIGHT by BRAMLEY.	800 m NW	Total depth 85 m.
LUC60362821		Drill a bore – issued 14/10/2020	Consent to construct a bore to take water for use in domestic and animal drinking	2 km NNE	No additional information is provided in the data.

Bore ID/Consent or PA no.	Bore owner/consent holder	Type of take	Use	Approximate Distance and direction from approximate centre of Redvale Landfill	Comment
			purposes. Depth of the bore will be 80 m and the diameter will be 100 mm.		



Figure Appendix C.2: Neighbouring bores and groundwater and surface water consents and PAs listed in Table Appendix C.2. Landfill boundary includes the proposed Class 2 footprint extension. Source: LINZ (cc-BY-4.0).

C2 Groundwater level monitoring

C2.1 Groundwater levels across wider site

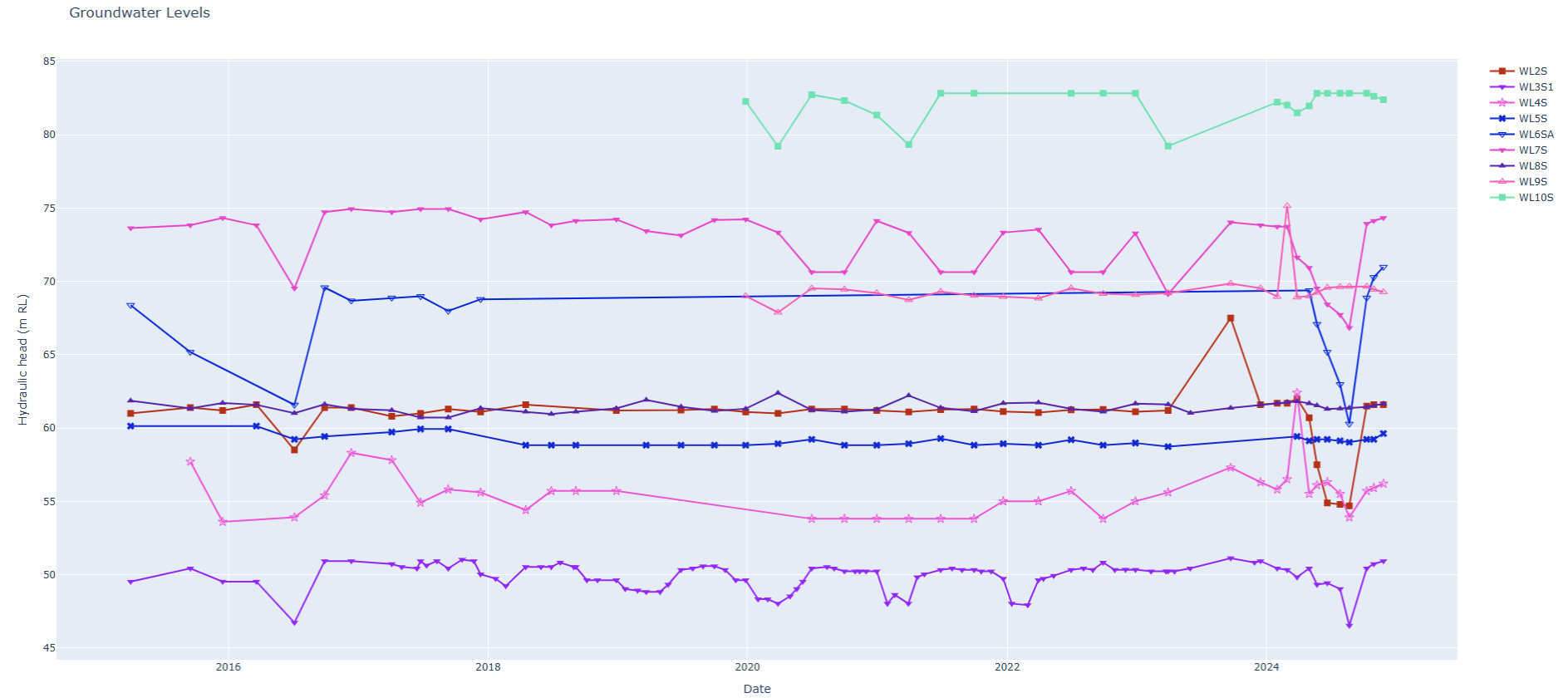


Figure Appendix C.3: Groundwater levels measured over time in shallow wells with recent monitoring (as provided to T+T).

Groundwater Levels

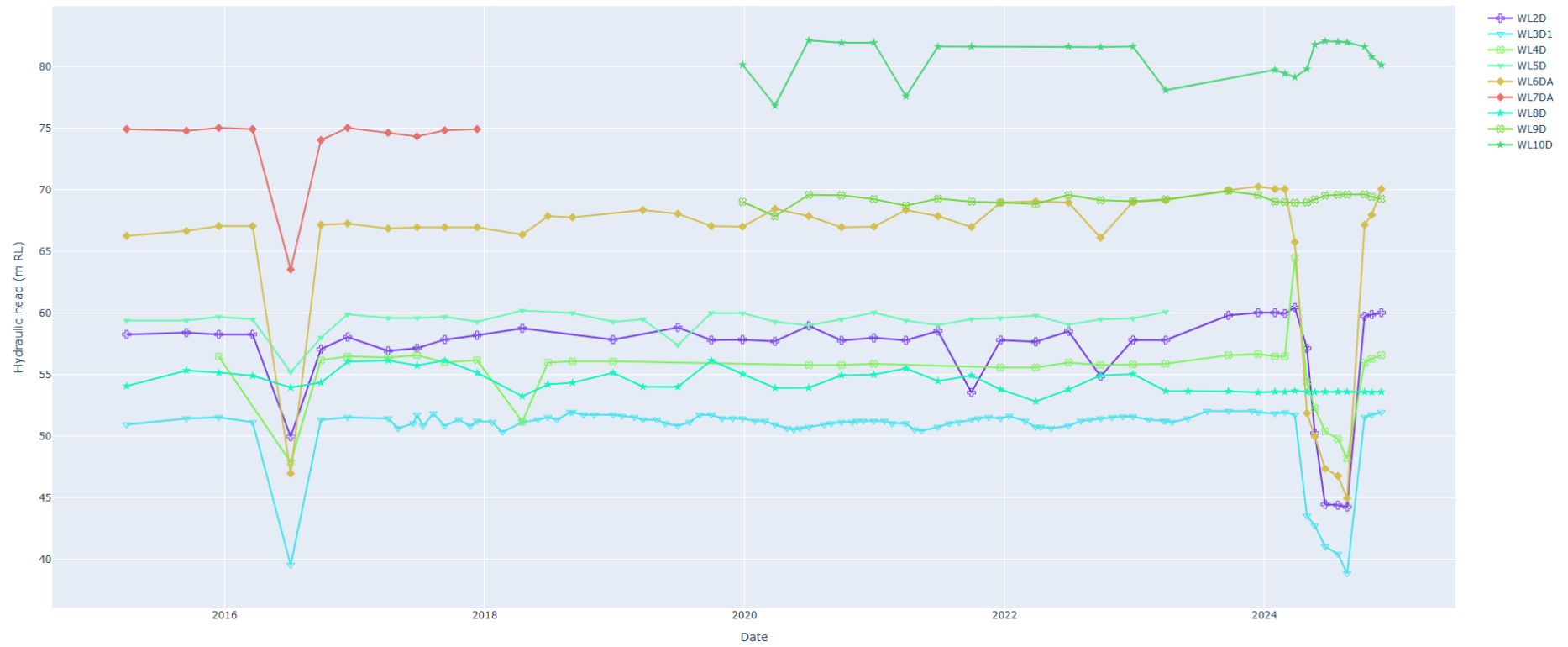


Figure Appendix C.4: Groundwater levels measured over time in deep wells with recent monitoring (as provided to T+T).

C2.2 Groundwater levels in proposed Class 2 footprint extension

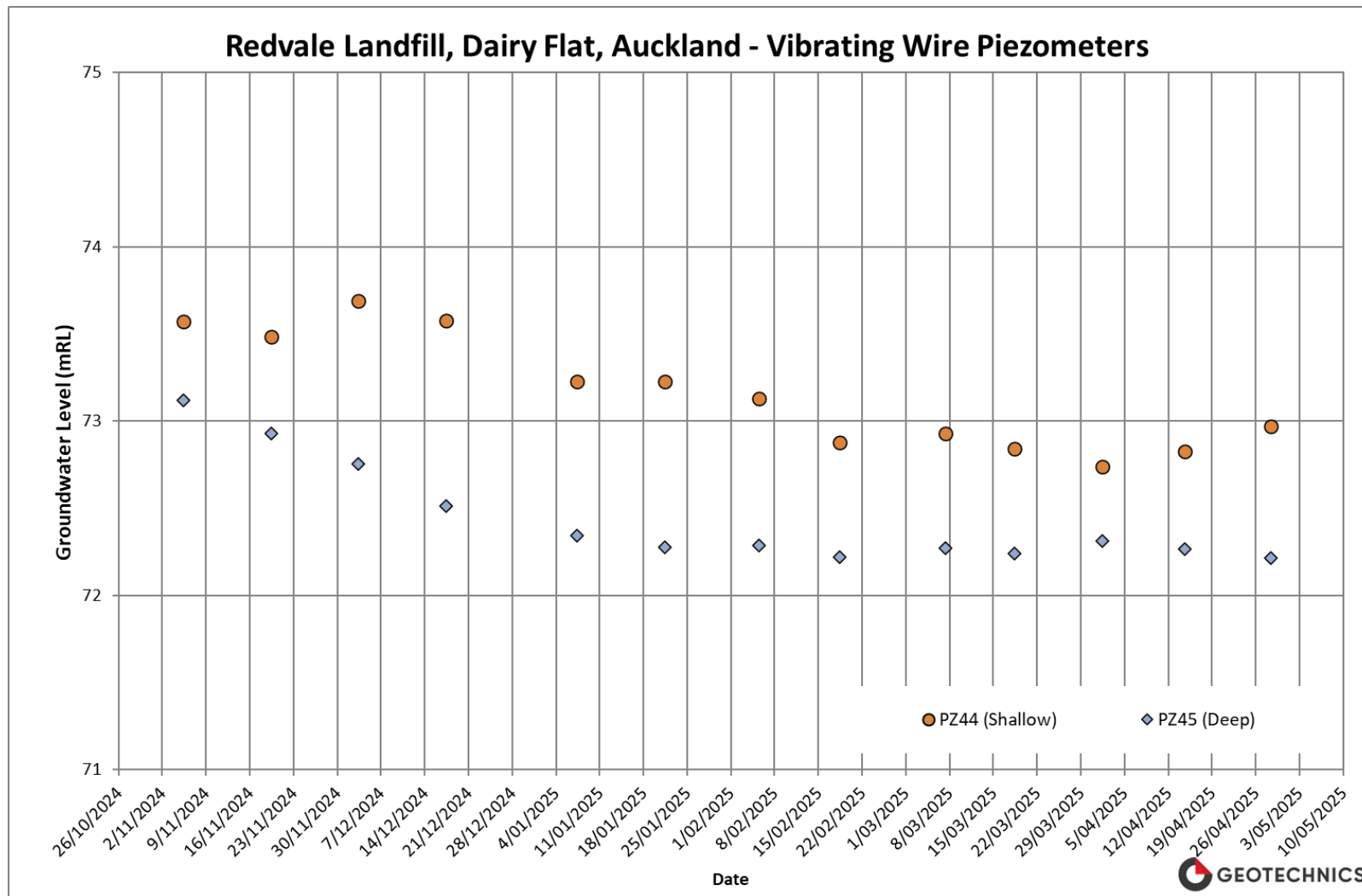


Figure Appendix C.5: Fortnightly groundwater levels taken from the continuous data in well W138 (PZ44 and PZ45). Groundwater levels are reported as m RL.

C2.3 Groundwater level contours

Groundwater contours were generated from recent time periods where the available data have the most complete groundwater level monitoring record. We have used June 2021 (45 wells) and March 2022 (57 wells) as representative time periods for winter and summer groundwater levels, respectively, to develop 'present-day' seasonal groundwater contours for the wider site. We have also generated a November 2024 groundwater surface to represent the most recent measured groundwater levels, although only 14 monitoring wells had recorded groundwater levels.

The groundwater surfaces (and contours) were generated in Surfer 27⁴⁵, using the default ordinary Kriging option to linearly interpolate between the measured manual groundwater levels in m RL. This simple interpolation method is considered appropriate because of the sparse number of data points (the manual groundwater levels). In addition, we did not allow the interpolation to generate contours outside of the area containing the groundwater monitoring wells.

Where groundwater monitoring wells are within 15 m of each other, the average groundwater level between the two wells has been used to create the contour plots.

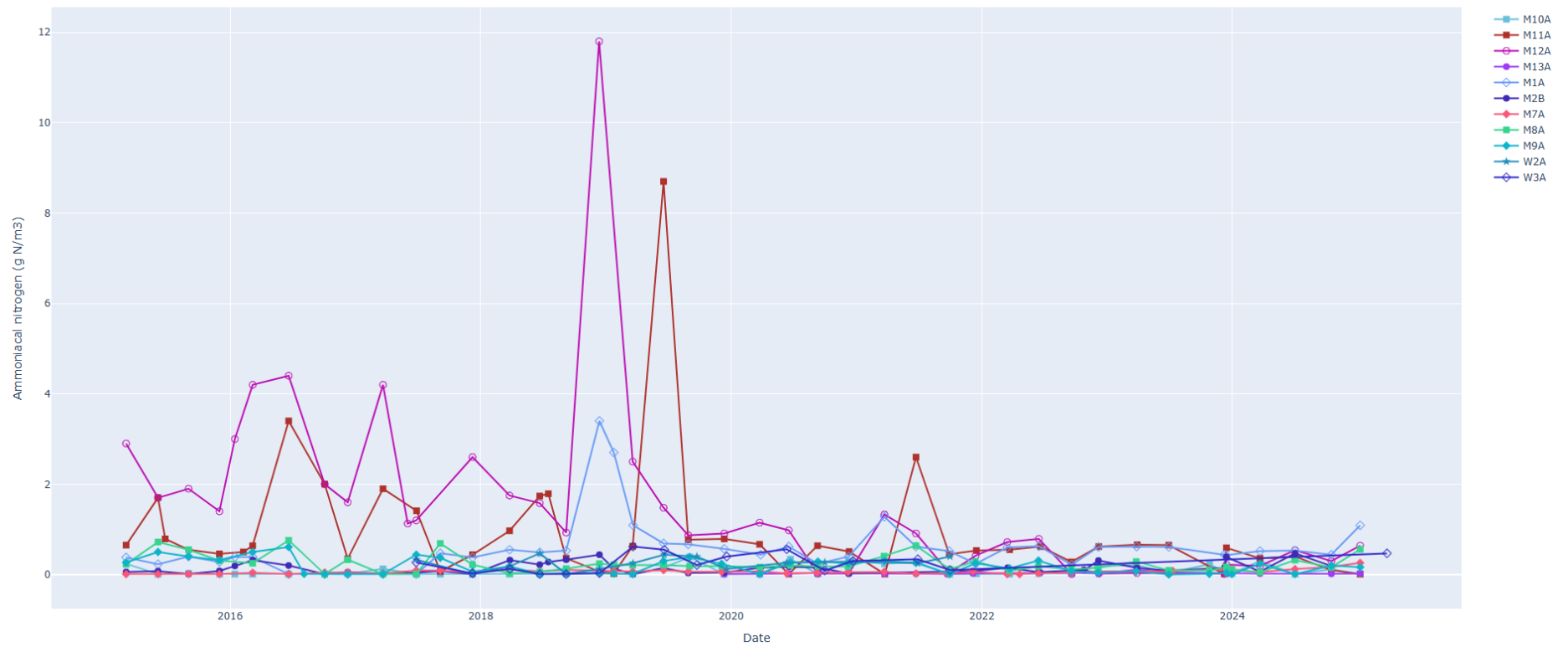
Given the limited number of data points, there is some uncertainty in the groundwater surfaces (and contours), especially in areas where data is sparse.

⁴⁵ Golden Software, LLC. Surfer 27.1.229, Feb 3 2024. Golden, Colorado, USA.

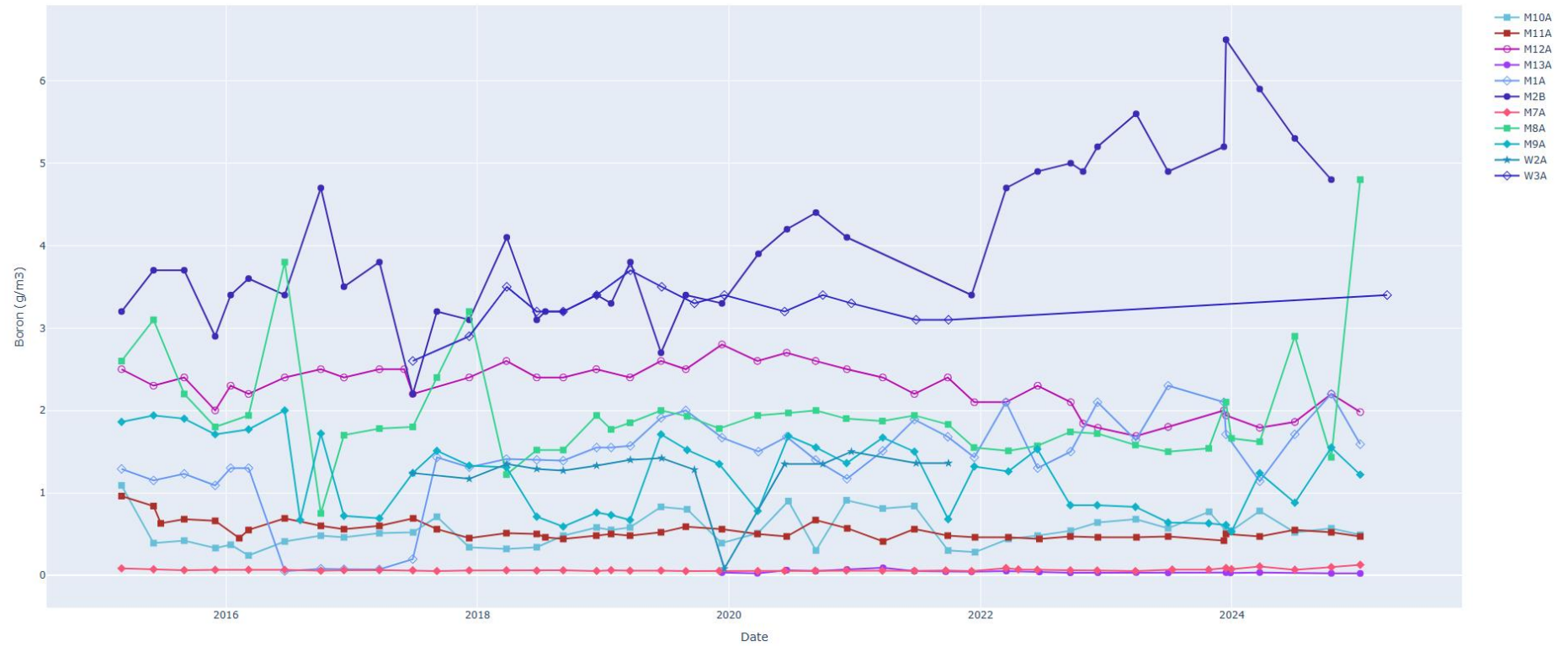
C3 Groundwater and leachate quality

C3.1 Groundwater quality

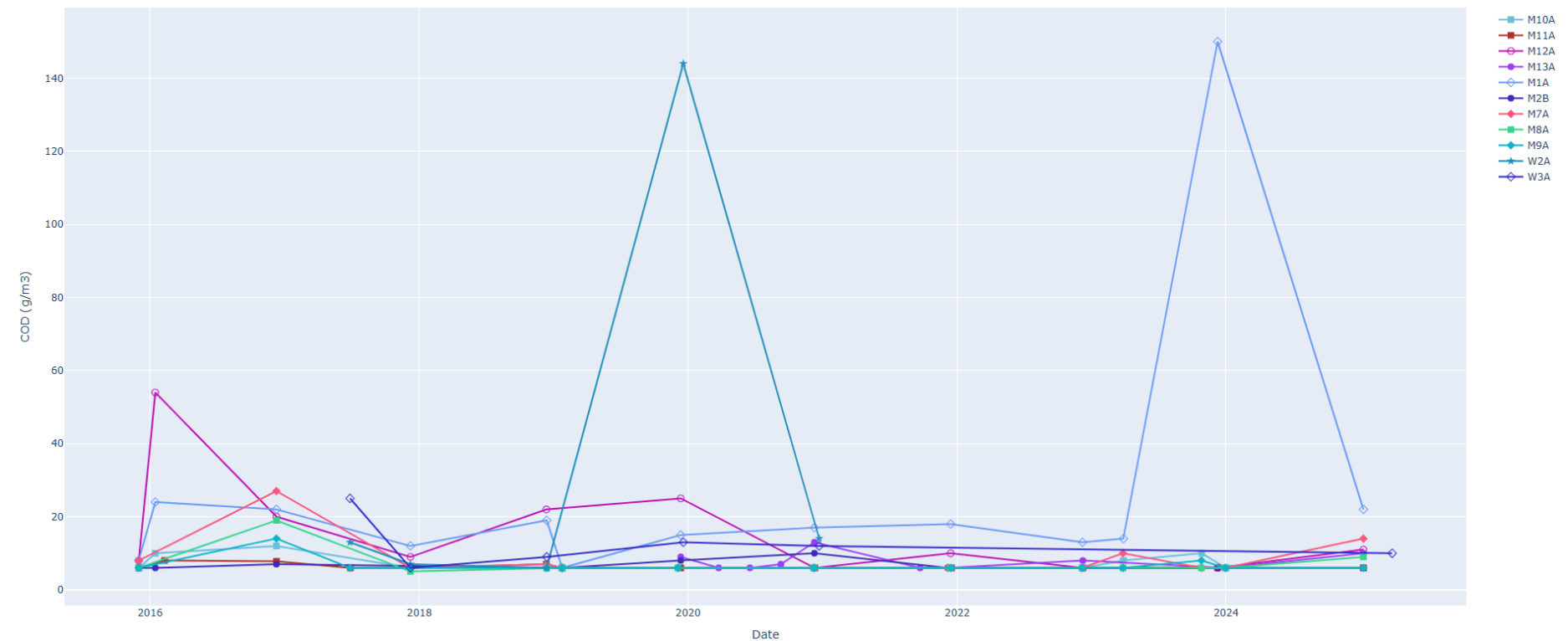
Ammoniacal Nitrogen in Groundwater



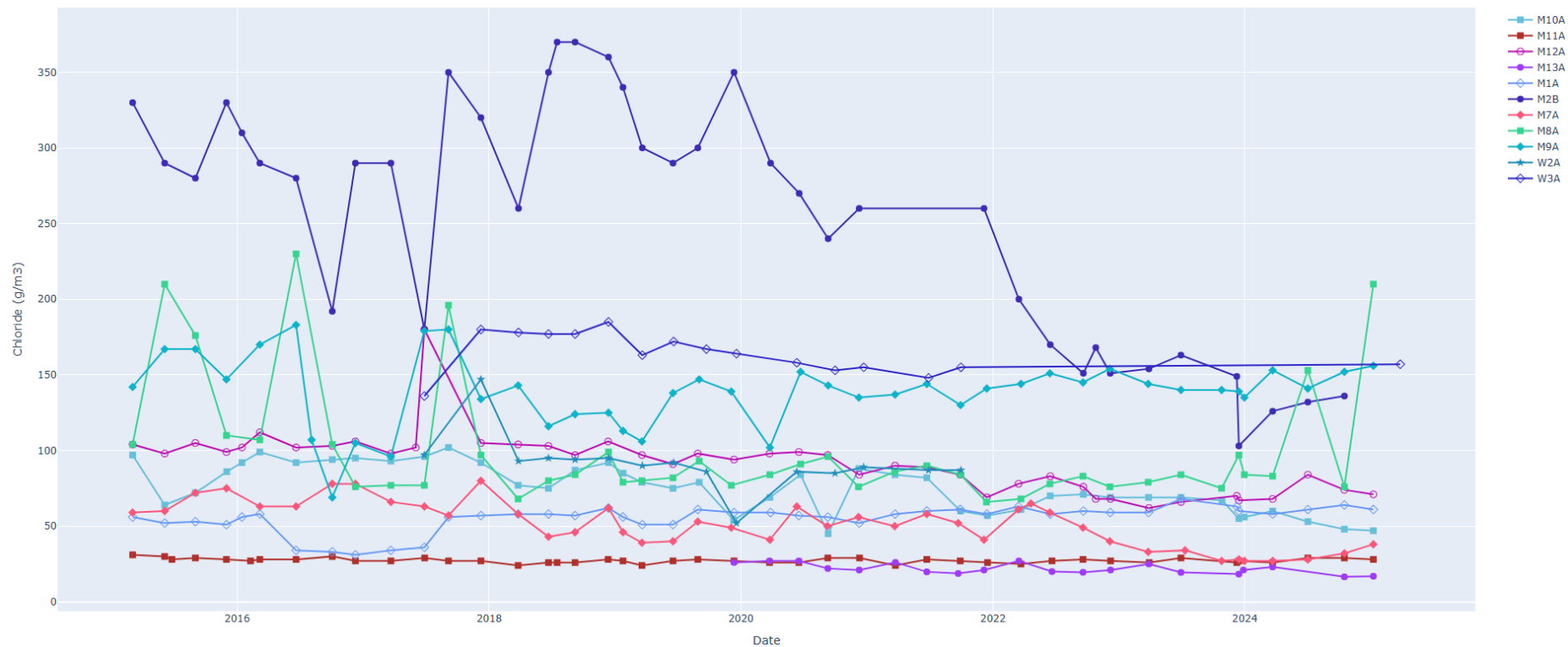
Boron in Groundwater



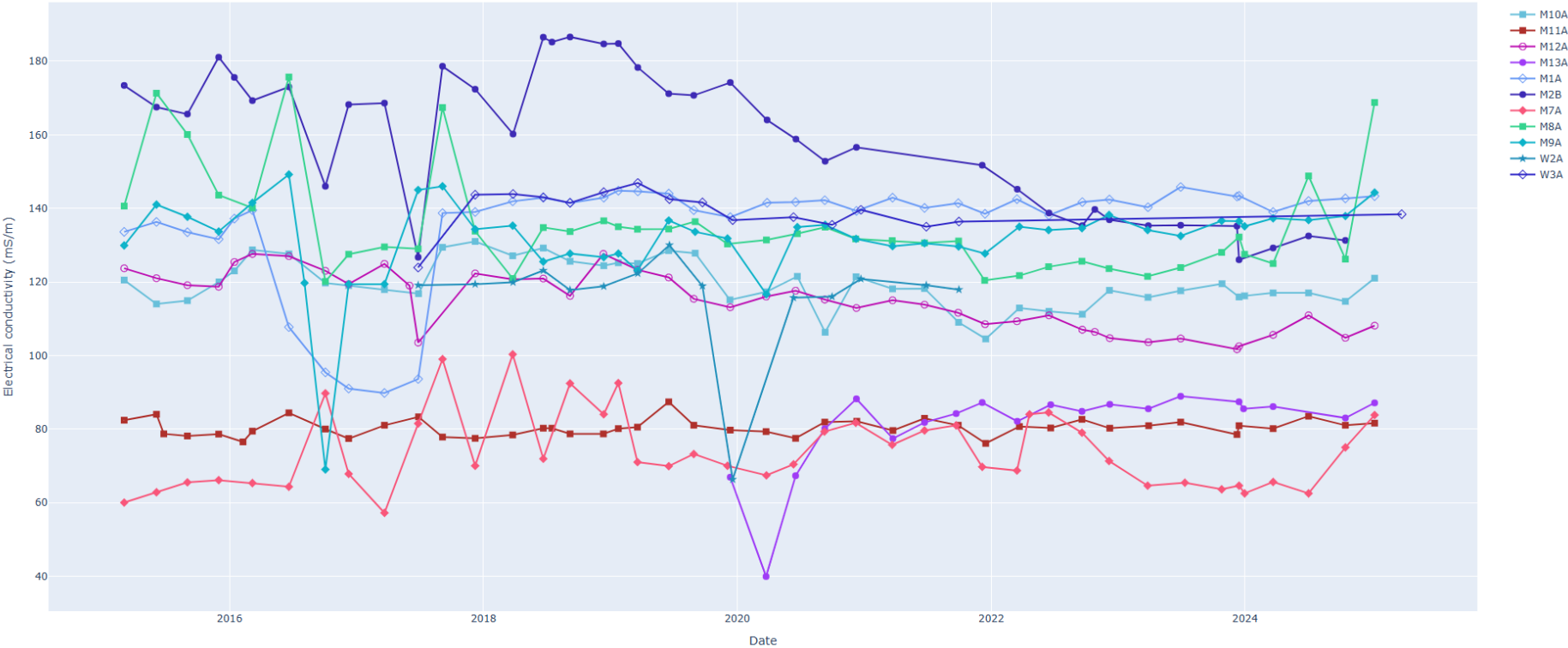
Chemical Oxygen Demand in Groundwater



Chloride in Groundwater



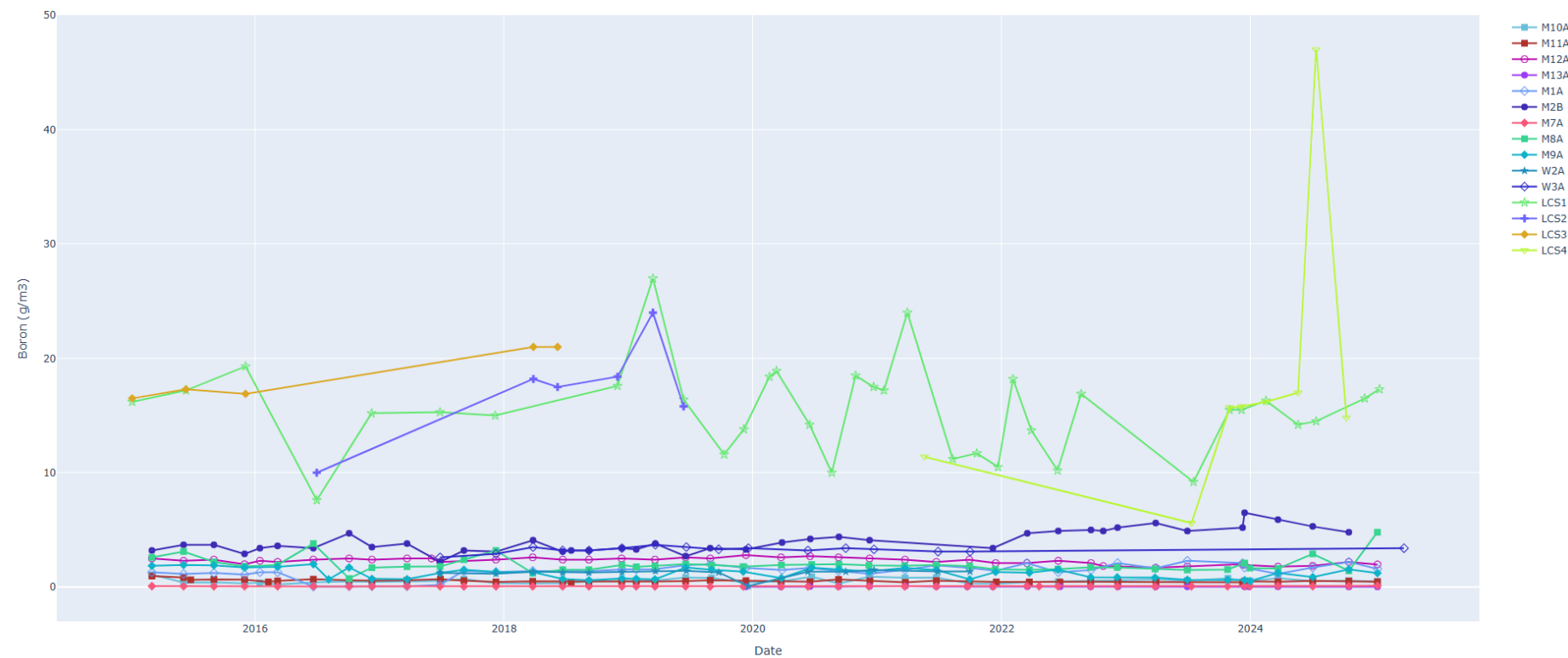
Electrical Conductivity in Groundwater



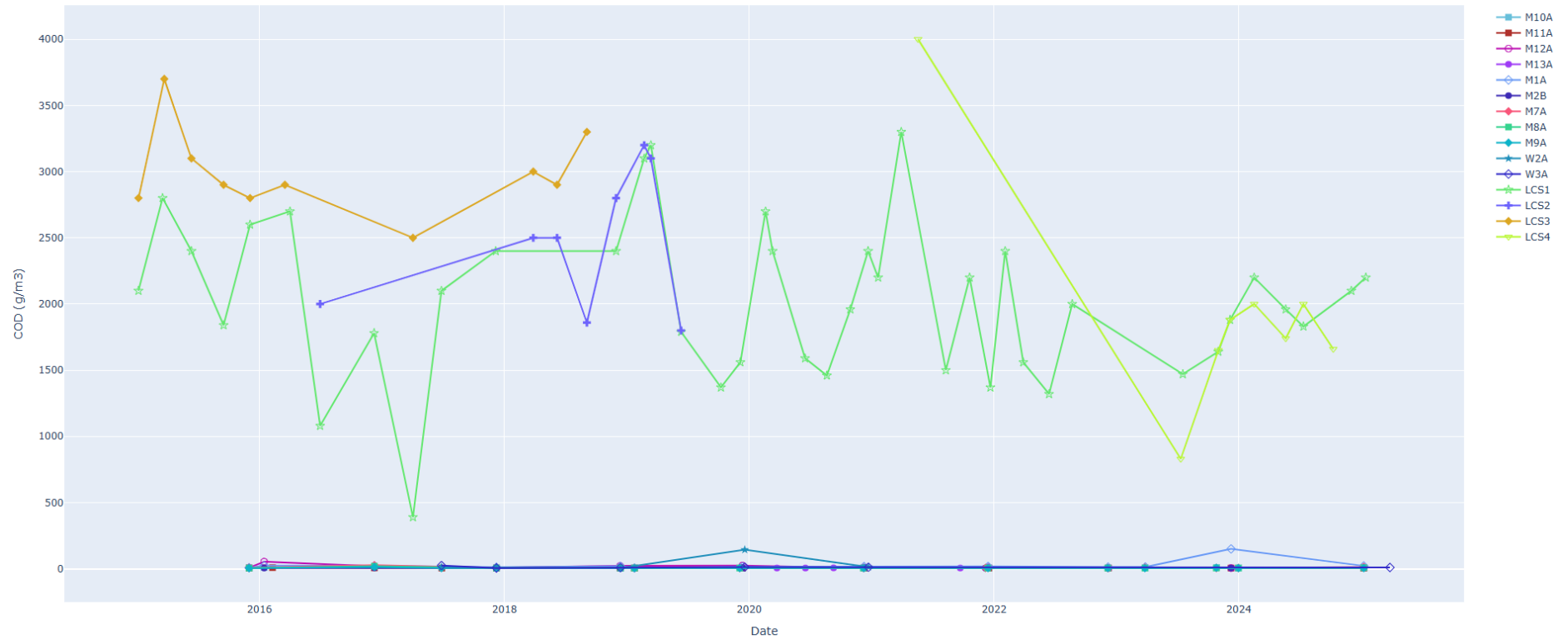
C3.2 Leachate quality



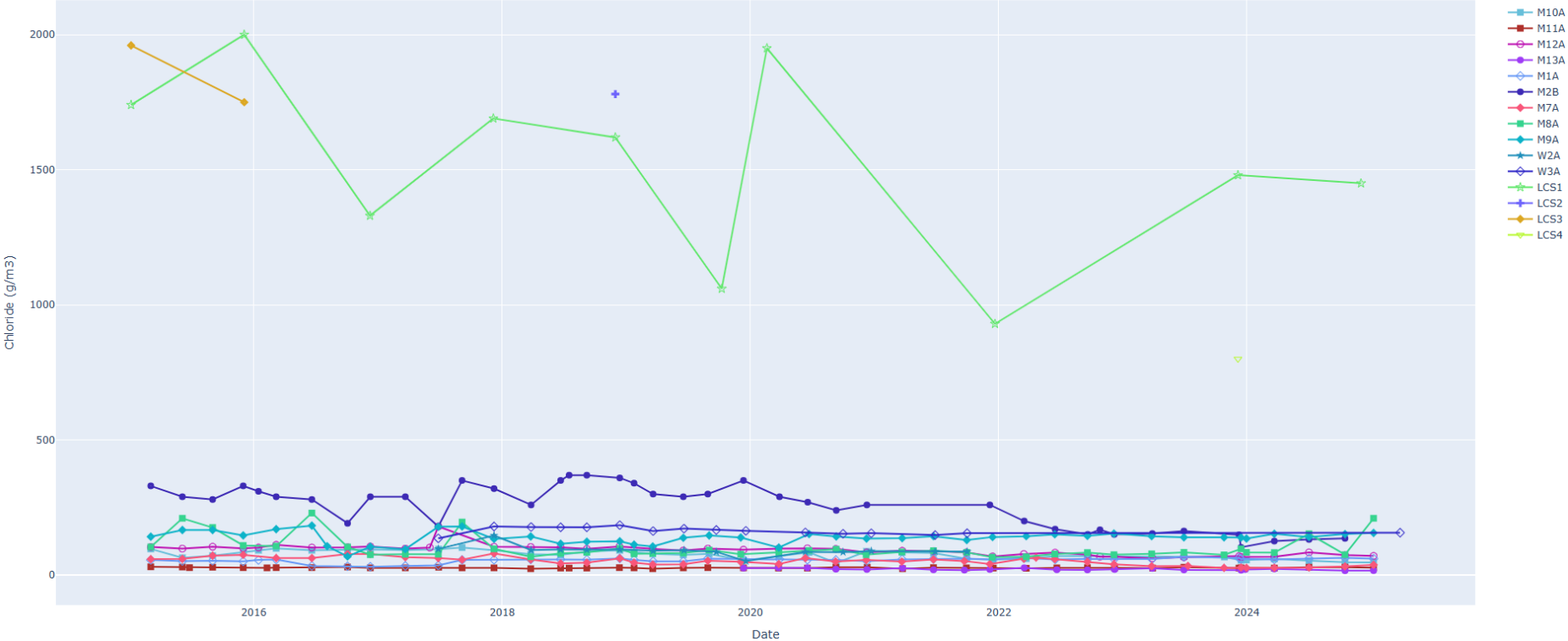
Boron in Groundwater and Leachate



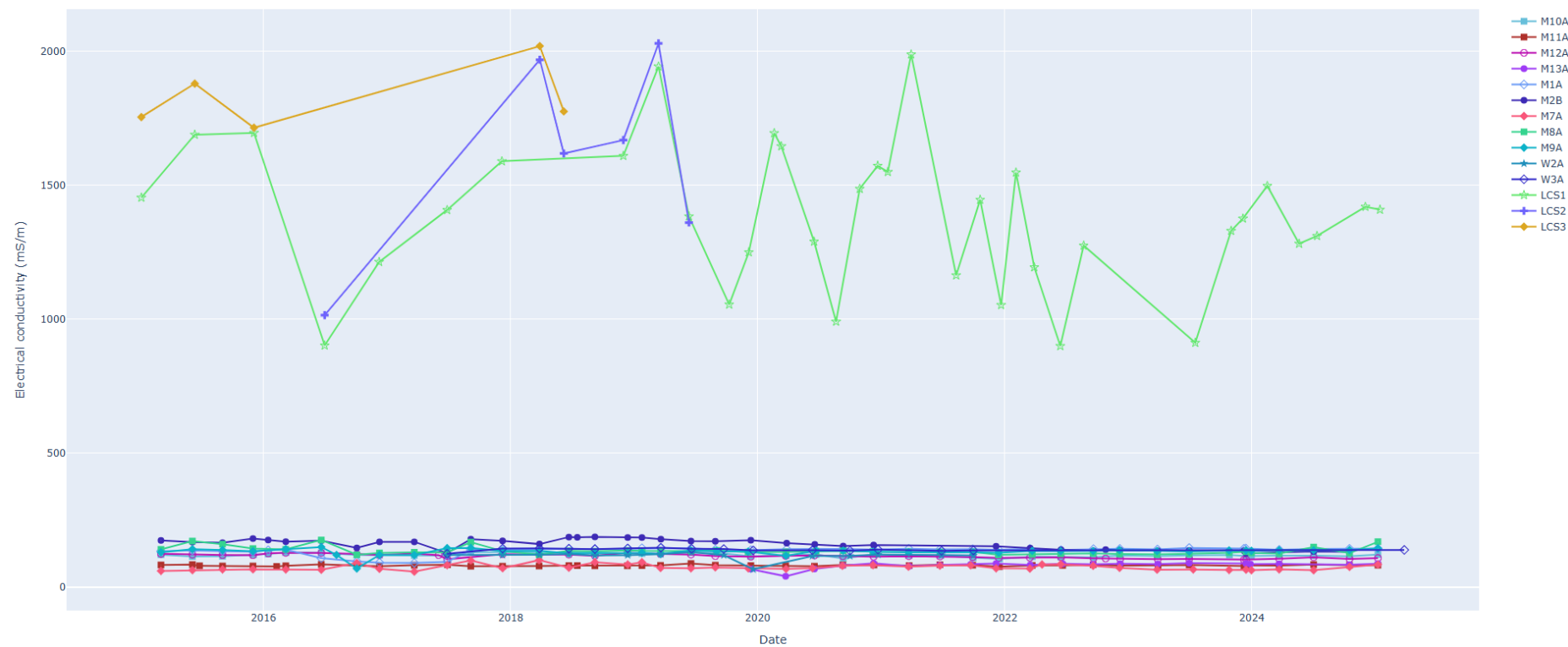
Chemical Oxygen Demand in Groundwater and Leachate



Chloride in Groundwater and Leachate



Electrical Conductivity in Groundwater and Leachate



Appendix D Existing Landfill Fate and Transport Modelling

D1 Fate and transport modelling

D1.1 Source concentrations

The RBCA software package used to assess contaminant fate and transport uses the maximum leachate concentrations from the Redvale leachate collection system at LCS1. The maximum leachate concentrations are summarised in Table Appendix D.1.

Table Appendix D.1: Contaminant source concentrations

Contaminant type	Contaminant	Leachate source concentration [mg/L]	Source of leachate data
Metals	Aluminium	9.30E-01	Redvale leachate LCS1 95% UCL
	Antimony	7.36E-03	Redvale leachate LCS1 95% UCL
	Arsenic	1.37E-01	Redvale leachate LCS1 95% UCL
	Barium	3.89E+00	Redvale leachate LCS1 95% UCL
	Beryllium	1.00E-02	WMI Leachate Report Volume 1 Maximum
	Boron	1.94E+01	Redvale leachate LCS1 95% UCL
	Cadmium	9.40E-04	Redvale leachate LCS1 95% UCL
	Chromium	2.87E-01	Redvale leachate LCS1 95% UCL
	Copper	1.22E-01	Redvale leachate LCS1 95% UCL
	Fluoride	6.44E-01	Redvale leachate LCS1 95% UCL
	Lead	2.31E-02	Redvale leachate LCS1 95% UCL
	Lithium	6.89E-01	Redvale leachate LCS1 95% UCL
	Mercury	4.47E-04	Redvale leachate LCS1 95% UCL
	Molybdenum	3.90E-03	Redvale leachate LCS1 95% UCL
	Nickel	1.52E-01	Redvale leachate LCS1 95% UCL
	Selenium	1.95E-02	Redvale leachate LCS1 95% UCL
	Silver	1.42E-03	Redvale leachate LCS1 95% UCL
	Tin	1.31E-02	Redvale leachate LCS1 95% UCL
	Vanadium	7.71E-02	Redvale leachate LCS1 95% UCL
	Zinc	4.00E-01	Redvale leachate LCS1 95% UCL 10 years
Inorganics	Cyanide	5.00E-02	Redvale leachate LCS1 95% UCL
	Sulphides	1.38E+01	Redvale leachate LCS1 95% UCL
Organics	Aniline	7.22E+00	Redvale leachate LCS1 95% UCL
	Benzene	7.38E-03	Redvale leachate LCS1 95% UCL
	Bromodichloromethane	1.05E+00	Redvale leachate LCS1 95% UCL
	Bromoform	1.05E+00	Redvale leachate LCS1 95% UCL
	Carbon disulphide	5.00E+00	Redvale leachate LCS1 95% UCL
	Carbon tetrachloride	1.63E-03	Redvale leachate LCS1 95% UCL

Contaminant type	Contaminant	Leachate source concentration [mg/L]	Source of leachate data
	Chlordane, alpha	3.00E-02	Class 1 WAC
	Chlordane, gamma	3.00E-02	Class 1 WAC
	Chlorobenzene	1.03E+00	Redvale leachate LCS1 95% UCL
	Chloroform	1.47E-03	Redvale leachate LCS1 95% UCL
	Dibromochloromethane	1.06E+00	Redvale leachate LCS1 95% UCL
	Dichloromethane	7.71E+01	Redvale leachate LCS1 95% UCL
	Diethylphthalate	5.26E+00	Redvale leachate LCS1 95% UCL
	Dimethylphthalate	3.22E+00	Redvale leachate LCS1 95% UCL
	Endrin	1.72E+00	Redvale leachate LCS1 95% UCL
	Ethylbenzene	4.46E+01	Redvale leachate LCS1 95% UCL
	Heptachlor	1.69E+00	Redvale leachate LCS1 95% UCL
	Hexachloro-1,3-butadiene	1.05E+00	Redvale leachate LCS1 95% UCL
	Hexachlorobenzene	1.81E+00	Redvale leachate LCS1 95% UCL
	Hexachloroethane	1.77E+00	Redvale leachate LCS1 95% UCL
	Lindane	1.79E+00	Redvale leachate LCS1 95% UCL
	m-cresol	2.30E-02	Redvale leachate LCS1 95% UCL
	Methoxychlor	1.00E+01	Redvale leachate LCS1 95% UCL
	Methyl ethyl ketone	3.21E+03	Redvale leachate LCS1 95% UCL
	Naphthalene	1.00E+01	Redvale leachate LCS1 95% UCL
	Nitrobenzene	1.93E+00	Redvale leachate LCS1 95% UCL
	o-cresol	3.50E+01	Redvale leachate LCS1 95% UCL
	p-cresol	9.39E+02	Redvale leachate LCS1 95% UCL
	Pentachlorophenol	8.53E-01	Redvale leachate LCS1 95% UCL
	Phenol	1.99E+02	Redvale leachate LCS1 95% UCL
	Polychlorinated biphenyls	3.60E-02	Redvale leachate LCS1 95% UCL
	Pyridine	5.00E+00	Class 1 WAC
	Tetrachloroethene	1.76E-03	Redvale leachate LCS1 95% UCL
	Toluene	2.77E-02	Redvale leachate LCS1 95% UCL
	Total cresol	1.78E+03	Redvale leachate LCS1 95% UCL
	Toxaphene	5.00E-01	Class 1 WAC
	Tributyltin oxide	9.21E-04	Redvale leachate LCS1 95% UCL
	Trichloroethene	1.84E+00	Redvale leachate LCS1 95% UCL
	Vinyl chloride	8.27E+00	Redvale leachate LCS1 95% UCL
	m-xylene	8.98E+01	Redvale leachate LCS1 95% UCL
	o-xylene	3.02E+01	Redvale leachate LCS1 95% UCL
	p-xylene	8.98E+01	Redvale leachate LCS1 95% UCL
	1,1,2 Trichloroethane	9.70E-01	Redvale leachate LCS1 95% UCL
	1,1,2,2 Tetrachloroethane	1.05E+00	Redvale leachate LCS1 95% UCL

Contaminant type	Contaminant	Leachate source concentration [mg/L]	Source of leachate data
	1,1-dichloroethene	1.03E+00	Redvale leachate LCS1 95% UCL
	1,2 Dibromo-3-chloropropane	1.04E+00	Redvale leachate LCS1 95% UCL
	1,2 Dichlorobenzene	1.05E+00	Redvale leachate LCS1 95% UCL
	Dichloroethene, cis-1,2	2.11E+00	Redvale leachate LCS1 95% UCL
	Dichloroethene, trans-1,2	1.05E+00	Redvale leachate LCS1 95% UCL
	1,2 Dichloropropane	1.05E+00	Redvale leachate LCS1 95% UCL
	1,2-dichloroethane	1.65E-03	Redvale leachate LCS1 95% UCL
	1,3 Dichloropropene	1.48E+00	Redvale leachate LCS1 95% UCL
	1,4-dichlorobenzene	2.90E+00	Redvale leachate LCS1 95% UCL
	2 Chlorophenol	2.43E+00	Redvale leachate LCS1 95% UCL
	2,4 Dichlorophenol	6.40E-01	Redvale leachate LCS1 95% UCL
	2,4,5-trichlorophenol	6.29E-01	Redvale leachate LCS1 95% UCL
	2,4,6-trichlorophenol	6.84E-01	Redvale leachate LCS1 95% UCL
	2,4-dichlorophenoxyacetic acid	1.00E+01	Class 1 WAC
	2,4-dinitrotoluene	1.80E+00	Redvale leachate LCS1 95% UCL
Perfluorinated alkylated substances (PFAS)	Perfluorohexanesulfonate (PFHxS)	8.00E-04	Redvale leachate LCS1 maximum
	Perfluorooctane sulfonic acid (PFOS)	4.30E-04	Redvale leachate LCS1 maximum
	Perfluorooctanoic acid (PFOA)	6.70E-04	Redvale leachate LCS1 maximum
	Perfluoroheptanoic acid (PFHpA)	3.30E-04	Redvale leachate LCS1 maximum

Note:

Blue shaded cells indicate source concentrations adopted as half of the level of laboratory detection.

Light brown shaded cells indicate source concentrations adopted from the Class 1 WAC.

Modelling parameters

The information provided in this appendix relates to the assessment of potential effects on surface water, the Rangitopuni Stream. The following equation is used to calculate the total concentrations C in surface water for each of the receptors:

$$C = \frac{C_{sw}Q_{sw} + C_{gw}Q_{gw}}{Q_{sw} + Q_{gw}}$$

with the upstream contaminant concentration in surface water C_{sw} , the stream flow at the point of exposure (derived from NIWA Rivermaps), the contaminant concentration in groundwater at the point of exposure C_{gw} and the groundwater discharge into the point of exposure stream reach Q_{gw} . The upstream contaminant concentration in surface water is assumed to be zero.

The groundwater discharge is calculated using the following equation:

$$Q_{gw} = K * i * l_{gws} + \delta_{gws}$$

with hydraulic conductivity K , hydraulic gradient i , length of groundwater/surface water interface l_{gws} and depth of groundwater/surface water interface δ_{gws} (assumed to be the stream depth).

The tables in Section 5.2.8 summarise the model input parameters adopted for assessing fate and transport characteristics in relation to the surface water receptors.\

D1.2 Point of exposure guideline values

Guideline values discussed in Section 5.2.6 are provided in Table Appendix D.2.

Table Appendix D.2: Point of exposure guideline values

Contaminant	ANZG (2018) Freshwater 95% toxicant DGVs [mg/L]	ANZG (2023) Irrigation Guidelines [mg/L]	Other guideline values [mg/L]
Aluminium	5.50E-02	5.00E+00	-
Antimony	9.00E-03	-	-
Arsenic	2.40E-02	1.00E-01	-
Barium	-	-	1.00E+00 (ANZECC 2000)
Beryllium	1.00E-02	1.00E-01	-
Boron	9.40E-01	5.00E-01	-
Cadmium	2.00E-04	1.00E-02	-
Chromium	3.30E-03	1.00E-01	-
Copper	1.40E-03	2.00E-01	-
Fluoride	1.70E+00	1.00E+00	-
Lead	3.40E-03	2.00E-01	-
Lithium	-	7.50E-02	-
Mercury	6.00E-04	2.00E-03	-
Molybdenum	3.40E-02	1.00E-02	-
Nickel	1.10E-02	2.00E-01	-
Selenium	1.10E-02	2.00E-02	-
Silver	5.00E-05	-	-
Tin	3.00E-03	-	-
Vanadium	6.00E-03	1.00E-01	-
Zinc	8.00E-03	2.00E+00	-
Cyanide	7.00E-03	-	-
Aniline	2.50E-01	-	-
Benzene	9.50E-01	-	-
Bromodichloromethane	-	-	6.00E-02 (DWSNZ)
Bromoform	-	-	1.00E-01 (DWSNZ)
Carbon disulphide	2.00E-02	-	-
Carbon tetrachloride	2.40E-01	-	-
Chlordane, gamma	8.00E-05	-	-

Contaminant	ANZG (2018) Freshwater 95% toxicant DGVs [mg/L]	ANZG (2023) Irrigation Guidelines [mg/L]	Other guideline values [mg/L]
Chlorobenzene (monochlorobenzene)	5.50E-02	-	-
Chloroform	7.70E-01	-	-
Dibromochloromethane	-	-	1.50E-01 (DWSNZ)
Dichloromethane	4.00E+00	-	-
Dimethylphthalate	3.70E+00	-	-
Endrin	2.00E-05	-	-
Ethylbenzene	8.00E-02	-	-
Heptachlor	9.00E-05	-	-
Hexachloro-1,3-butadiene	4.00E-05	-	-
Hexachlorobenzene	1.00E-04	-	-
Hexachloroethane	3.60E-01	-	-
m-cresol	-	-	2.0E-01 (ANZECC 2000)
Methoxychlor	5.00E-06	-	-
Methyl ethyl ketone	-	-	-
Naphthalene	1.60E-02	-	-
Nitrobenzene	5.50E-01	-	-
o-cresol	-	-	4.0E-01 (ANZECC 2000)
p-cresol	-	-	1.0E-01 (ANZECC 2000)
Pentachlorophenol	1.00E-02	-	-
Phenol	3.20E-01	-	-
Polychlorinated biphenyls	3.00E-05	-	-
Pyridine	-	-	5.0E+00 (ANZECC 2000)
Tetrachloroethene	7.00E-02	-	-
Toluene	1.80E-01	-	-
Toxaphene	2.00E-04	-	-
Tributyltin oxide	4.00E-06	-	-
Trichloroethene	-	-	3.00E-02 (ANZECC 2000)
Vinyl chloride	-	-	3.00E-04 (DWSNZ)
m xylene	7.50E-02	-	-
o xylene	3.50E-01	-	-
p xylene	2.00E-01	-	-
1,1,2 Trichloroethane	6.50E+00	-	-
1,1,2,2-tetrachloroethane	7.00E-02	-	-
1,1-dichloroethene	7.00E-01	-	-
1,2 Dibromo-3- chloropropane	-	-	1.00E-03 (DWSNZ)
1,2 Dichlorobenzene	1.60E-01	-	-
1,2 Dichloroethene	-	-	6.00E-02 (DWSNZ)

Contaminant	ANZG (2018) Freshwater 95% toxicant DGVs [mg/L]	ANZG (2023) Irrigation Guidelines [mg/L]	Other guideline values [mg/L]
1,2-dichloropropane	9.00E-01	-	-
1,2-dichloroethane	1.90E+00	-	-
1,3 Dichloropropene	1.00E-04	-	-
1,4-dichlorobenzene	2.60E-01	-	-
2 Chlorophenol	4.90E-01	-	-
2,4 Dichlorophenol	1.60E-01	-	-
2,4,5-trichlorophenol	2.00E-02	-	-
2,4,6-trichlorophenol	2.00E-02	-	-
2,4-dichlorophenoxyacetic acid	2.80E-01	-	-
2,4-dinitrotoluene	6.50E-02	-	-
Perfluorohexanesulfonate (PFHxS)	-	-	7.00E-05 ^{AU}
Perfluorooctane sulfonic acid (PFOS)	-	-	7.00E-05 ^{AU}
Perfluorooctanoic acid (PFOA)	-	-	5.60E-04 ^{AU}
Perfluoroheptanoic acid (PFHpA)	-	-	5.60E-04 ^{AU}

Note:

Cells with a hyphen indicate guideline values not available.

^{AU} indicates Australian Drinking Water Guidelines.

D2 RBCA fate and transport model results

The following tables present the results of the groundwater and surface water receptor concentrations predicted by the RBCA model, as described in Section 5.2.

D2.1 Rangitopuni Stream receptor

Predicted steady-state concentrations in groundwater at the Rangitopuni Stream have been estimated using RBCA. Table Appendix D.3 details the predicted steady state concentrations in groundwater at the point of exposure and the predicted concentrations in surface water of the Rangitopuni Stream.

Table Appendix D.3: Predicted concentrations at the Rangitopuni Stream

Contaminant	Predicted steady state concentration in groundwater [mg/L]	Predicted steady state concentration in surface water [mg/L]	Ecological receptor guideline values [mg/L]	Irrigation receptor guideline values [mg/L]	Other guideline values [mg/L]
Aluminium	7.06E-03	1.32E-07	5.50E-02	5.00E+00	-
Antimony	5.59E-05	1.04E-09	9.00E-03	-	-
Arsenic	1.04E-03	1.95E-08	2.40E-02	1.00E-01	-
Barium	2.95E-02	5.51E-07	-	-	1.00E+00

Contaminant	Predicted steady state concentration in groundwater [mg/L]	Predicted steady state concentration in surface water [mg/L]	Ecological receptor guideline values [mg/L]	Irrigation receptor guideline values [mg/L]	Other guideline values [mg/L]
Beryllium	7.60E-05	1.42E-09	-	1.00E-01	-
Boron	1.47E-01	2.74E-06	9.40E-01	5.00E-01	-
Cadmium	7.14E-06	1.33E-10	2.00E-04	1.00E-02	-
Chromium	2.18E-03	4.06E-08	3.30E-03	1.00E-01	-
Copper	9.24E-04	1.72E-08	1.40E-03	2.00E-01	-
Fluoride	4.89E-03	9.12E-08	1.70E+00	1.00E+00	-
Lead	1.76E-04	3.27E-09	3.40E-03	2.00E-01	-
Lithium	5.24E-03	9.76E-08	-	7.50E-02	-
Mercury	3.40E-06	6.33E-11	6.00E-04	2.00E-03	-
Molybdenum	2.97E-05	5.53E-10	3.40E-02	1.00E-02	-
Nickel	1.15E-03	2.15E-08	1.10E-02	2.00E-01	-
Selenium	1.48E-04	2.76E-09	1.10E-02	2.00E-02	-
Silver	1.08E-05	2.02E-10	5.00E-05	-	-
Tin	9.90E-05	1.85E-09	3.00E-03	-	-
Vanadium	5.86E-04	1.09E-08	6.00E-03	1.00E-01	-
Zinc	3.04E-03	5.66E-08	8.00E-03	2.00E+00	-
Cyanide	3.80E-04	7.08E-09	7.00E-03	-	-
Aniline	5.48E-02	1.02E-06	2.50E-01	-	-
Benzene	6.63E-51	1.24E-55	9.50E-01	-	-
Bromodichloromethane	7.96E-03	1.48E-07	-	-	6.00E-02
Bromoform	4.05E-80	7.56E-85	-	-	1.00E-01
Carbon disulphide	7.07E-62	1.32E-66	2.00E-02	-	-
Carbon tetrachloride	1.63E-103	3.05E-108	2.40E-01	-	-
Chlordane, gamma	3.00E-102	5.60E-107	8.00E-05	-	-
Chlorobenzene	1.03E-100	1.92E-105	5.50E-02	-	-
Chloroform	1.31E-31	2.44E-36	7.70E-01	-	-
Dibromochloromethane	1.42E-99	2.65E-104	-	-	1.50E-01
Dimethylphthalate	7.25E-31	1.35E-35	3.70E+00	-	-
Endrin	1.72E-100	3.21E-105	2.00E-05	-	-
Ethyl benzene	4.46E-99	8.32E-104	8.00E-02	-	-
Heptachlor	1.69E-100	3.15E-105	9.00E-05	-	-
Hexachloro-1,3-butadiene	1.10E-100	2.05E-105	4.00E-05	-	-
Hexachlorobenzene	1.81E-100	3.37E-105	1.00E-04	-	-
Hexachloroethane	1.78E-100	3.31E-105	3.60E-01	-	-
m-cresol	2.30E-102	4.29E-107	-	-	2.0E-01
Methoxychlor	1.00E-99	1.87E-104	5.00E-06	-	-

Contaminant	Predicted steady state concentration in groundwater [mg/L]	Predicted steady state concentration in surface water [mg/L]	Ecological receptor guideline values [mg/L]	Irrigation receptor guideline values [mg/L]	Other guideline values [mg/L]
Methyl ethyl ketone	3.21E-97	5.99E-102	-	-	-
Naphthalene	1.00E-99	1.87E-104	1.60E-02	-	-
Nitrobenzene	2.47E-91	4.61E-96	5.50E-01	-	-
o-cresol	3.51E-99	6.54E-104	-	-	4.0E-01
p-cresol	9.40E-98	1.75E-102	-	-	1.0E-01
Pentachlorophenol	7.40E-79	1.38E-83	1.00E-02	-	-
Phenol	1.99E-98	3.71E-103	3.20E-01	-	-
Polychlorinated biphenyls	3.60E-102	6.71E-107	3.00E-05	-	-
Pyridine	5.01E-100	9.33E-105	-	-	5.0E+00
Tetrachloroethene	2.60E-75	4.84E-80	7.00E-02	-	-
Toluene	2.77E-102	5.16E-107	1.80E-01	-	-
Toxaphene	5.01E-101	9.33E-106	2.00E-04	-	-
Tributyltin oxide	9.20E-104	1.72E-108	4.00E-06	-	-
Trichloroethene	1.31E-38	2.44E-43	-	-	3.00E-02
Vinyl chloride	3.38E-15	6.30E-20	-	-	3.00E-04
m xylene	8.98E-99	1.68E-103	7.50E-02	-	-
o xylene	6.59E-93	1.23E-97	3.50E-01	-	-
p xylene	8.98E-99	1.68E-103	2.00E-01	-	-
1,1,2 Trichloroethane	7.83E-46	1.46E-50	6.50E+00	-	-
1,1,2,2 Tetrachloroethane	1.05E-100	1.96E-105	7.00E-02	-	-
1,1-dichloroethene	1.03E-100	1.92E-105	7.00E-01	-	-
1,2 Dibromo-3-chloropropane	1.04E-100	1.94E-105	-	-	1.00E-03
1,2 Dichlorobenzene	1.05E-100	1.96E-105	1.60E-01	-	-
Dichloroethene, cis-1,2	1.91E-19	3.56E-24	-	-	6.00E-02
Dichloroethene, trans-1,2	1.76E-23	3.29E-28			6.00E-02
1,2 Dichloropropane	3.32E-26	6.18E-31	9.00E-01	-	-
1,2-dichloroethane	2.84E-50	5.29E-55	1.90E+00	-	-
1,3 Dichloropropene	1.49E-100	2.77E-105	1.00E-04	-	-
1,4-dichlorobenzene	2.91E-100	5.42E-105	2.60E-01	-	-
2 Chlorophenol	1.85E-02	3.45E-07	4.90E-01	-	-
2,4 Dichlorophenol	6.40E-101	1.19E-105	1.60E-01	-	-
2,4,5-trichlorophenol	7.26E-62	1.35E-66	2.00E-02	-	-
2,4,6-trichlorophenol	9.93E-43	1.85E-47	2.00E-02	-	-
2,4-dichlorophenoxyacetic acid	1.00E-99	1.87E-104	2.80E-01	-	-

Contaminant	Predicted steady state concentration in groundwater [mg/L]	Predicted steady state concentration in surface water [mg/L]	Ecological receptor guideline values [mg/L]	Irrigation receptor guideline values [mg/L]	Other guideline values [mg/L]
2,4-dinitrotoluene	3.33E-65	6.21E-70	6.50E-02	-	-
Perfluorohexanesulfonate (PFHxS)	6.08E-06	1.13E-10	-	-	7.00E-05
Perfluorooctane sulfonic acid (PFOS)	3.27E-06	6.09E-11	-	-	7.00E-05
Perfluorooctanoic acid (PFOA)	5.09E-06	9.49E-11	-	-	5.60E-04
Perfluoroheptanoic acid (PFHpA)	2.51E-06	4.67E-11	-	-	5.60E-04

Appendix E RBCA Model Input/Output Reports

E1 RBCA Model base case Rangitopuni Stream

Main Screen

RBCA Tool Kit for Chemical Releases
Version 2.6 ©2011 GSI Environmental Inc.

1. Project Information

Site Name:	ARL-TP: CLASS1_BASE_RANGITOPUNI STREAM_95UCL_ECOLOGIC		
Location:	RODNEY, AUCKLAND		
Completed By:	LP		
Date:	25-Jun-25	Job ID:	1092369.6

2. Which Type of RBCA Analysis?

Tier 1

Risk-Based
Screening
Levels

Tier 2/3

Site-Specific
Target Levels

3. Calculation Options

Affects which input data are required

☒ **Baseline Risks (Forward mode)**
☒ **RBCA Cleanup Levels (Backward mode)**

☐ Individual Constituent Risk Goals Only
☐ Individual and Cumulative Risk Goals

☒ Apply Source Depletion Algorithm

Time to Future Exposure
 (yr)

4. RBCA Evaluation Process

Prepare Input Data

Data Complete? (■ yes, ■ no)

☒ Exposure Pathways

↓

☒ Constituents of Concern (COCs)

↓

☒ Transport Models

↓

Soil Parameters

↓

☒ GW Parameters

↓

Air Parameters

Review Output

Exposure Flowchart

 COC Chem. Parameters

 Input Data Summary

 User-Spec. COC Data...

 Transient Domenico Analysis...

5. Commands and Options

New Site

Load Data...

Save Data As...

User Chemical Database

Set Units

Print Sheet

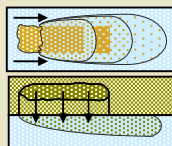
Print Report

Quit

Help

Exposure Pathway Identification

1. Groundwater Exposure



Groundwater Ingestion/ Surface Water Impact

Receptor: None ▼ None ▼ S.W. ▼
 Distance: On-site Off-site1 Off-site2
 0 0 480 (m)

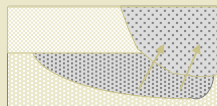
Source Media:

- ☒ Affected Groundwater
☐ Affected Soils Leaching to Groundwater

Option:

- ☐ Apply MCL value as ingestion RBEL (backward mode only)

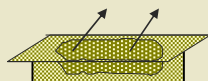
GW Discharge to Surface Water Exposure



- ☐ Swimming
☐ Fish Consumption
☒ Specified Water Quality Criteria

Enter Criteria

2. Surface Soil Exposure



Combined Exposure

Source Media:

- Receptor: None ▼
 On-site
 Construction Worker ☐
☐ Direct Ingestion
☐ Dermal Contact
☐ Inhalation (vol+part)
☐ Vegetable Ingestion

Option:

- ☐ Apply UK (CLEA) SGV as soil concentration limit

Veg Options

Site Name: ARL TP: CLASS1_BASE_RANGITOPUNI_STREAM_95UCL_ECOLOGICAL

Location: RODNEY, AUCKLAND

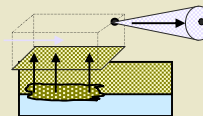
Compl. By: LP

Job ID: 1092369.6

Date: 25-Jun-25

3. Air Exposure

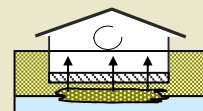
Volatilization and Particulates to Outdoor Air Inhalation



Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- Construction worker ☐
☐ Affected Soils--Volatilization to Ambient Outdoor Air
☐ Affected Groundwater--Volatilization to Ambient Outdoor Air
☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



Volatilization to Indoor Air Inhalation

Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- ☐ Affected Soils--Volatilization to Enclosed Space
☐ Affected Soils Leaching to GW--Volatilization to Enclosed Space
☐ Affected Groundwater--Volatilization to Enclosed Space

Bldg Options

4. Commands and Options

Main Screen

Print Sheet

Set Units

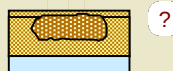
Help

Exposure Factors & Target Risks

Exposure Flowchart

Transport Modeling Options

1. Vertical Transport, Surface Soil Column



Outdoor Air Volatilization Factors

- ☐ Surface soil volatilization model only ASTM Model
- ☐ Combination surface soil/Johnson & Ettinger models
 Thickness of surface soil zone 1.00 (m)
- ☐ User-specified VF from other model Enter VF Values

Indoor Air Volatilization Factors More Info: BioVapor model

- ☐ Johnson & Ettinger model for soil and groundwater volatilization
- ☐ Johnson & Ettinger for soil, Mass Flux model for groundwater
- ☐ User-specified VF from other model Enter VF Values

Soil-to-Groundwater Leaching Factor

- ☐ ASTM Model
- ☐ Apply Soil Attenuation Model (SAM) Enter Decay Rates
- ☐ Allow first-order biodecay Enter LF Values
- ☐ User-specified LF from other model Enter LF Values

Modeling Options

- ☐ Disable Mass Balance Limit
- ☐ Apply Dual Equilibrium Desorption Model

2. Lateral Air Dispersion Factor

- ☐ 3-D Gaussian dispersion model Off-site 1 Off-site 2
- ☐ User-Specified ADF 1.00E+0 1.00E+0 (-)

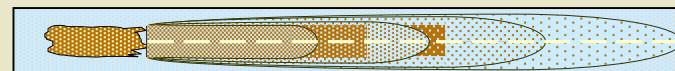
Site Name: ARL-TP: CLASS1_BASE_RANGITOPUNI STREAM105 ID: 1092369.6

Location: RODNEY, AUCKLAND

Date: 25-Jun-25

Compl. By: LP

3. Groundwater Dilution Attenuation Factor



Calculate DAF using Domenico Model

- ☐ Domenico equation with dispersion only (no biodegradation) Enter Decay Rates
- ☒ Domenico equation first-order decay Enter Site Data
- ☐ Modified Domenico equation using electron acceptor superposition Enter Site Data

Biodegradation Capacity NG (mg/L)

— or —

User-Specified DAF Values

- ☐ DAF values from other model or site data Enter DAF Values

4. Chemical Decay and Source Depletion



Enter Decay Rates

Enter Source Mass

5. Commands and Options

Main Screen

Print Sheet

Help

Site-Specific Groundwater Parameters

1. Water-Bearing Unit ?

Hydrogeology

Groundwater Darcy velocity (cm/s)

Groundwater seepage velocity (cm/s)

or or

Hydraulic conductivity (cm/s)

Hydraulic gradient (-)

Effective porosity (-)

Sorption

Fraction organic carbon--saturated zone (-)

Groundwater pH (-)

2. Groundwater Source Zone ?

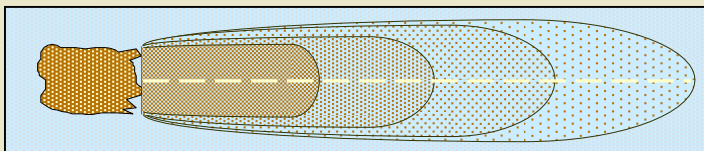
Groundwater plume width at source (m)

Plume (mixing zone) thickness at source (m)

or

Saturated thickness (m)

Length of source zone (m)



Site Name: ARL TP: CLASS1_BASE_RANGITOPUNI STREAM_95UCL_ECOLOG1002369.6
 Location: RODNEY, AUCKLAND Date: 25-Jun-25
 Compl. By: LP

3. Groundwater Dispersion ?

Model: ASTM Default ▼

GW Ingestion

GW to Indoor Air

	Off-site 1	Off-site 2	Off-site 1	Off-site 2
Distance to GW receptors	0	490	0	0 (m)
Calculate ▼	↓	↓	↓	↓
Longitudinal dispersivity	0	1	0	0 (m)
Transverse dispersivity	0	1	0	0 (m)
Vertical dispersivity	0	1	0	0 (m)

4. Groundwater Discharge to Surface Water ?

	Off-site 2
Distance to GW/SW discharge point	490 (m)
Plume width at GW/SW discharge	150 (m)
Plume thickness at GW/SW discharge	1 (m)
Surface water flowrate at GW/SW discharge	0.014 (m ³ /s)

5. Commands and Options

Main Screen

Use/Set Default
Values

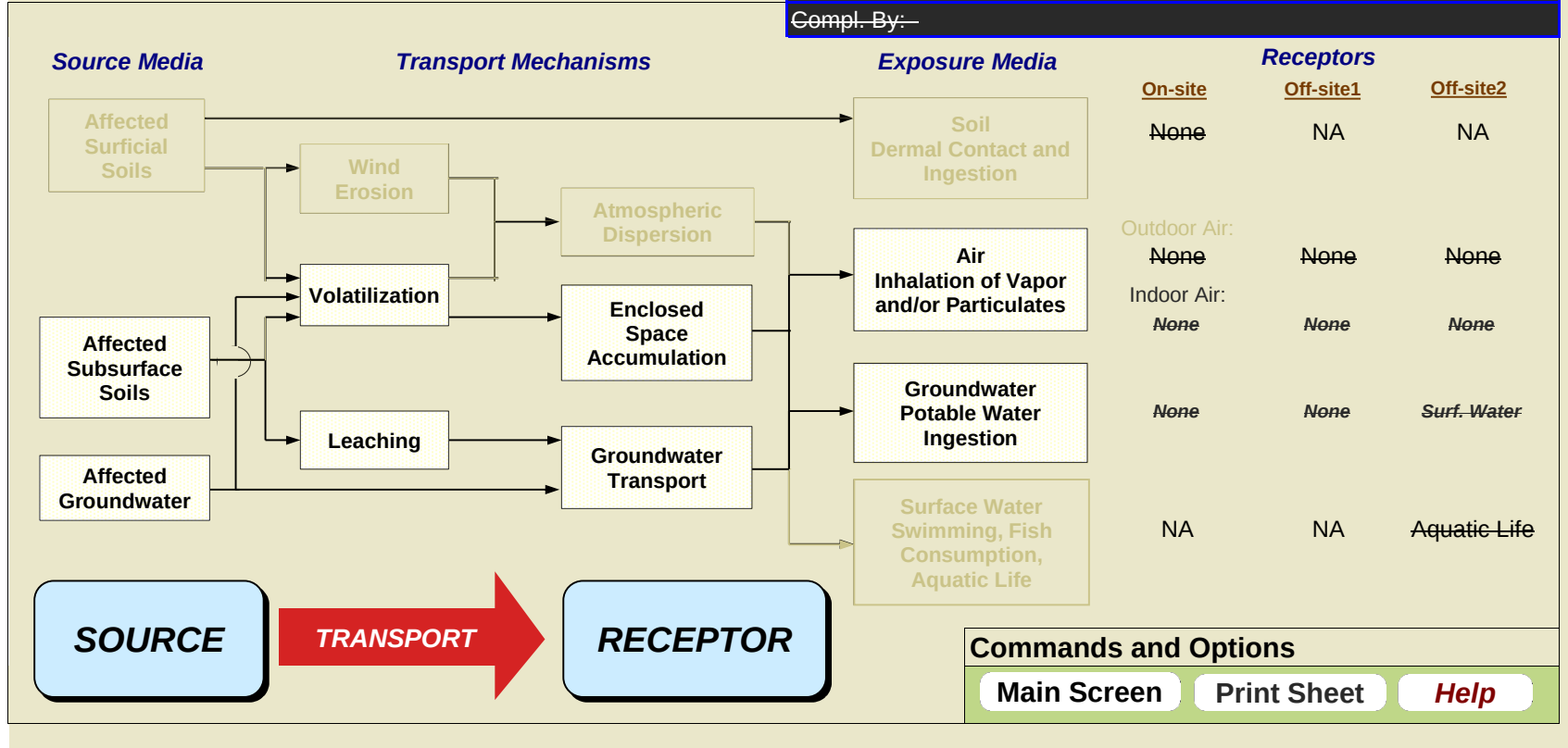
Print Sheet

Set Units

Help

Exposure Pathway Flowchart

Site Name:— Job ID:—
 Location:— Date: 0-Jan-00
 Compl. By:—



RBCA SITE ASSESSMENT	User-Specified COC Data
----------------------	-------------------------

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (1–30 m)	
	value (mg/L)	note	value (mg/kg)	note
Aluminum	0.3E-1	Redvale-leachate-LCS1-95UC		
Antimony	7.4E-3	Redvale-leachate-LCS1-95UC		
Arsenic	1.4E-1	Redvale-leachate-LCS1-95UC		
Barium	3.9E+0	Redvale-leachate-LCS1-95UC		
Beryllium	1.0E-2	WMI-Leachate-Report-Max		
Boron	1.9E+1	Redvale-leachate-LCS1-95UC		
Cadmium	9.4E-4	Redvale-leachate-LCS1-95UC		
Chromium (III) (total chromium)	2.9E-1	Redvale-leachate-LCS1-95UC		
Copper	1.2E-1	Redvale-leachate-LCS1-95UC		
Fluorine (soluble fluoride)	6.4E-1	Redvale-leachate-LCS1-95UC		
Lead (inorganic)	2.3E-2	Redvale-leachate-LCS1-95UC		
Lithium	6.9E-1	Redvale-leachate-LCS1-95UC		
Mercury	4.5E-4	Redvale-leachate-LCS1-95UC		
Molybdenum	3.9E-3	Redvale-leachate-LCS1-95UC		
Nickel	1.5E-1	Redvale-leachate-LCS1-95UC		
Selenium	2.0E-2	Redvale-leachate-LCS1-95UC		
Silver	1.4E-3	Redvale-leachate-LCS1-95UC		
Tin	1.3E-2	Redvale-leachate-LCS1-95UC		
Vanadium	7.7E-2	Redvale-leachate-LCS1-95UC		
Zinc	4.0E-1	leachate-LCS1-95UCL-10-YR		
Cyanide	5.0E-2	Redvale-leachate-LCS1-95UC		
Aniline	7.2E+0	Redvale-leachate-LCS1-95UC		
Benzene	7.4E-3	Redvale-leachate-LCS1-95UC		
Bromodichloromethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Bromoform	1.0E+0	Redvale-leachate-LCS1-95UC		
Carbon disulfide	5.0E+0	Redvale-leachate-LCS1-95UC		
Carbon tetrachloride	1.6E-3	Redvale-leachate-LCS1-95UC		
Chlordane, gamma	3.0E-2	WAC-Class-1		
Chlorobenzene	1.0E+0	Redvale-leachate-LCS1-95UC		
Chloroform	1.5E-3	Redvale-leachate-LCS1-95UC		
Dibromochloromethane	1.1E+0	Redvale-leachate-LCS1-95UC		
Dimethylphthalate	3.2E+0	Redvale-leachate-LCS1-95UC		
Endrin	1.7E+0	Redvale-leachate-LCS1-95UC		
Ethyl benzene	4.5E+1	Redvale-leachate-LCS1-95UC		
Heptachlor	1.7E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobutadiene	1.1E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobenzene	1.3E+0	Redvale-leachate-LCS1-95UC		
Hexachloroethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Cresol, m-	2.2E-2	Redvale-leachate-LCS1-95UC		
Methoxychlor	1.0E+1	Redvale-leachate-LCS1-95UC		
Methyl ethyl ketone	3.2E+3	Redvale-leachate-LCS1-95UC		
Naphthalene	1.0E+1	Redvale-leachate-LCS1-95UC		
Nitrobenzene	1.9E+0	Redvale-leachate-LCS1-95UC		
Cresol, o-	3.5E+1	Redvale-leachate-LCS1-95UC		
Cresol, p-	0.4E+2	Redvale-leachate-LCS1-95UC		
Pentachlorophenol	8.5E-1	Redvale-leachate-LCS1-95UC		
Phenol	2.0E+2	Redvale-leachate-LCS1-95UC		
Polychlorinated biphenyls (liquid)	3.6E-2	Redvale-leachate-LCS1-95UC		
Pyridine	5.9E+0	WAC-Class-1		
Tetrachloroethylene	1.8E-3	Redvale-leachate-LCS1-95UC		
Toluene	2.8E-2	Redvale-leachate-LCS1-95UC		
Toxaphene	5.0E-1	WAC-Class-1		
Tributyltin oxide ^a	9.2E-4	Redvale-leachate-LCS1-95UC		
Trichloroethylene	1.9E+0	Redvale-leachate-LCS1-95UC		
Vinyl chloride	9.3E+0	Redvale-leachate-LCS1-95UC		
Xylene, m-	9.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, o-	3.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, p-	9.0E+1	Redvale-leachate-LCS1-95UC		
Trichloroethane, 1,1,2-	9.7E-1	Redvale-leachate-LCS1-95UC		
Tetrachloroethane, 1,1,2,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, 1,1-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dibromo-3-chloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, cis-1,2-	2.1E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, trans-1,2	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethane, 1,2-	1.7E-3	Redvale-leachate-LCS1-95UC		
Dichloropropene, 1,3-	1.5E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,4-	2.9E+0	Redvale-leachate-LCS1-95UC		
Chlorophenol, 2-	2.4E+0	Redvale-leachate-LCS1-95UC		
Dichlorophenol, 2,4-	6.4E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,5-	6.3E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,6-	6.8E-1	Redvale-leachate-LCS1-95UC		
Dichlorophenoxyacetic acid, 2,4-	1.0E+1	WAC-Class-1		
Dinitrotoluene, 2,4-	1.8E+0	Redvale-leachate-LCS1-95UC		
PFHxS	8.0E-4	Redvale-leachate-LCS1-MAX		
PFOS	4.3E-4	Redvale-leachate-LCS1-MAX		
PFDA	6.7E-4	Redvale-leachate-LCS1-MAX		
PFHpA	3.3E-4	Redvale-leachate-LCS1-MAX		

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
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Site Name:-	Site Location:-	Completed By:-	Date Completed: 0-Jan-00
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1 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS	☐ (CHECKED IF PATHWAY IS ACTIVE)
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SOILS LEACHING TO GROUNDWATER

Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc. limit reached? ("■" if yes) ; Time (yr)	
	Soil Conc. (mg/kg)	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None
Aluminum						NA	NA
Antimony						NA	NA
Arsenic						NA	NA
Barium						NA	NA
Beryllium						NA	NA
Boron						NA	NA
Cadmium						NA	NA
Chromium (III) (total chromium)						NA	NA
Copper						NA	NA
Fluorine (soluble fluoride)						NA	NA
Lead (inorganic)						NA	NA
Lithium						NA	NA
Mercury						NA	NA
Molybdenum						NA	NA
Nickel						NA	NA
Selenium						NA	NA
Silver						NA	NA
Tin						NA	NA
Vanadium						NA	NA
Zinc						NA	NA
Cyanide						NA	NA
Aniline						NA	NA
Benzene						NA	NA
Bromodichloromethane						NA	NA
Bromoform						NA	NA
Carbon disulfide						NA	NA
Carbon tetrachloride						NA	NA

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Chlordane, gamma						NA	NA
Chlorobenzene						NA	NA
Chloroform						NA	NA
Dibromochloromethane						NA	NA
Dimethylphthalate						NA	NA
Endrin						NA	NA
Ethyl benzene						NA	NA
Heptachlor						NA	NA
Hexachlorobutadiene						NA	NA
Hexachlorobenzene						NA	NA
Hexachloroethane						NA	NA
Cresol, m-						NA	NA
Methoxychlor						NA	NA
Methyl ethyl ketone						NA	NA
Naphthalene						NA	NA
Nitrobenzene						NA	NA
Cresol, o-						NA	NA
Cresol, p-						NA	NA
Pentachlorophenol						NA	NA
Phenol						NA	NA
Polychlorinated biphenyls (liquid)						NA	NA
Pyridine						NA	NA
Tetrachloroethylene						NA	NA
Toluene						NA	NA
Toxaphene						NA	NA
Tributyltin oxide *						NA	NA
Trichloroethylene						NA	NA
Vinyl chloride						NA	NA
Xylene, m-						NA	NA
Xylene, o-						NA	NA
Xylene, p-						NA	NA
Trichloroethane, 1,1,2-						NA	NA
Tetrachloroethane, 1,1,2,2-						NA	NA
Dichloroethylene, 1,1-						NA	NA
Dibromo-3-chloropropane, 1,2-						NA	NA
Dichlorobenzene, 1,2-						NA	NA
Dichloroethylene, cis-1,2-						NA	NA
Dichloroethylene, trans-1,2						NA	NA
Dichloropropane, 1,2-						NA	NA

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Dichloroethane, 1,2-						NA	NA
Dichloropropene, 1,3-						NA	NA
Dichlorobenzene, 1,4-						NA	NA
Chlorophenol, 2-						NA	NA
Dichlorophenol, 2,4-						NA	NA
Trichlorophenol, 2,4,5-						NA	NA
Trichlorophenol, 2,4,6-						NA	NA
Dichlorophenoxyacetic acid, 2,4-						NA	NA
Dinitrotoluene, 2,4-						NA	NA
PFHxS						NA	NA
PFOS						NA	NA
PFOA						NA	NA
PFHpA						NA	NA

NOTE: POE = Point of exposure

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
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Site Name:- Site Location:- Completed By:- Date Completed: 0-Jan-00 2 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY							
OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)							
GROUNDWATER:-							
Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc reaches limit? ("■" If yes) ; Time (yr)	
	Groundwater Conc. (mg/L)	Off-site 1 (0 m)	Off-site 2 (480 m)	Off-site 1 (0 m)	Off-site 2 (480 m)	Off-site 1 (0 m)	Off-site 2 (480 m)
		None	Surf. Water	None	Surf. Water	None	Surf. Water
Aluminum	9.3E-1		7.1E-3		3.0E+3	NA	☐ NA
Antimony	7.4E-3		5.6E-5		4.8E+2	NA	☐ NA
Arsenic	1.4E-1		1.0E-3		1.3E+3	NA	☐ NA
Barium	3.9E+0		3.0E-2		5.4E+4	NA	☐ NA
Beryllium	1.0E-2		7.6E-5		7.0E+0	NA	☐ NA
Boron	1.9E+1		1.5E-1		5.0E+4	NA	☐ NA
Cadmium	9.4E-4		7.1E-6		1.1E+1	NA	☐ NA
Chromium (III) (total chromium)	2.9E-1		2.2E-3		1.8E+2	NA	☐ NA
Copper	1.2E-1		9.2E-4		7.5E+1	NA	☐ NA
Fluorine (soluble fluoride)	6.4E-1		4.9E-3		9.1E+4	NA	☐ NA
Lead (inorganic)	2.3E-2		1.8E-4		1.8E+2	NA	☐ NA
Lithium	6.9E-1		5.2E-3		4.0E+3	NA	☐ NA
Mercury	4.5E-4		3.4E-6		3.2E+1	NA	☐ NA
Molybdenum	3.9E-3		3.0E-5		1.8E+3	NA	☐ NA
Nickel	1.5E-1		1.2E-3		5.9E+2	NA	☐ NA
Selenium	2.0E-2		1.5E-4		5.9E+2	NA	☐ NA
Silver	1.4E-3		1.1E-5		2.7E+0	NA	☐ NA
Tin	1.3E-2		9.9E-5		1.6E+2	NA	☐ NA
Vanadium	7.7E-2		5.9E-4		3.2E+2	NA	☐ NA
Zinc	4.0E-1		3.0E-3		4.3E+2	NA	☐ NA
Cyanide	5.0E-2		3.8E-4		3.8E+2	NA	☐ NA
Aniline	7.2E+0		5.5E-2		1.3E+4	NA	☐ NA
Benzene	7.4E-3		6.6E-5		5.1E+4	NA	☐ NA
Bromodichloromethane	1.0E+0		8.0E-3		3.2E+3	NA	☐ NA
Bromoform	1.0E+0		4.1E-8		5.4E+3	NA	☐ NA
Carbon disulfide	5.0E+0		7.1E-6		1.1E+3	NA	☐ NA
Carbon tetrachloride	1.6E-3		1.6E-10		1.3E+4	NA	☐ NA

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Chlordane, gamma	3.0E-2		3.0E-102		4.3E+0	NA	☒	NA
Chlorobenzene	1.0E+0		1.0E-100		3.0E+3	NA	☒	NA
Chloroform	1.5E-3		1.3E-31		4.1E+4	NA	☒	NA
Dibromochloromethane	1.1E+0		1.4E-99		8.0E+3	NA	☒	NA
Dimethylphthalate	3.2E+0		7.3E-31		2.0E+5	NA	☒	NA
Endrin	1.7E+0		1.7E-100		1.1E+0	NA	☒	NA
Ethyl benzene	4.5E+1		4.5E-99		4.3E+3	NA	☒	NA
Heptachlor	1.7E+0		1.7E-100		4.8E+0	NA	☒	NA
Hexachlorobutadiene	1.1E+0		1.1E-100		2.1E+0	NA	☒	NA
Hexachlorobenzene	1.8E+0		1.8E-100		5.4E+0	NA	☒	NA
Hexachloroethane	1.8E+0		1.8E-100		1.9E+4	NA	☒	NA
Cresol, m-	2.3E-2		2.3E-102		1.1E+4	NA	☒	NA
Methoxychlor	1.0E+1		1.0E-99		2.7E-1	NA	☒	NA
Methyl ethyl ketone	3.2E+3		3.2E-97		5.4E+3	NA	☒	NA
Naphthalene	1.0E+1		1.0E-99		8.6E+2	NA	☒	NA
Nitrobenzene	1.9E+0		2.5E-91		3.0E+4	NA	☒	NA
Cresol, o-	3.5E+1		3.5E-99		2.1E+4	NA	☒	NA
Cresol, p-	9.4E+2		9.4E-98		5.4E+3	NA	☒	NA
Pentachlorophenol	8.5E-1		7.4E-79		5.4E+2	NA	☒	NA
Phenol	2.0E+2		2.0E-98		1.7E+4	NA	☒	NA
Polychlorinated biphenyls (liquid)	3.6E-2		3.6E-102		1.6E+0	NA	☒	NA
Pyridine	5.0E+0		5.0E-100		2.7E+5	NA	☒	NA
Tetrachloroethylene	1.8E-3		2.6E-75		3.8E+3	NA	☒	NA
Toluene	2.8E-2		2.8E-102		9.7E+3	NA	☒	NA
Toxaphene	5.0E-1		5.0E-101		1.1E+1	NA	☒	NA
Tributyltin oxide *	9.2E-4		9.2E-104		2.1E-1	NA	☒	NA
Trichloroethylene	1.8E+0		1.3E-38		1.6E+3	NA	☒	NA
Vinyl chloride	8.3E+0		3.4E-15		1.6E+1	NA	☒	NA
Xylene, m-	9.0E+1		9.0E-99		4.0E+3	NA	☒	NA
Xylene, o-	3.0E+1		6.6E-93		1.9E+4	NA	☒	NA
Xylene, p-	9.0E+1		9.0E-99		1.1E+4	NA	☒	NA
Trichloroethane, 1,1,2-	9.7E-1		7.8E-46		3.5E+5	NA	☒	NA
Tetrachloroethane, 1,1,2,2-	1.0E+0		1.0E-100		3.8E+3	NA	☒	NA
Dichloroethylene, 1,1-	1.0E+0		1.0E-100		3.8E+4	NA	☒	NA
Dibromo-3-chloropropane, 1,2-	1.0E+0		1.0E-100		5.4E+1	NA	☒	NA
Dichlorobenzene, 1,2-	1.0E+0		1.0E-100		8.6E+3	NA	☒	NA
Dichloroethylene, cis-1,2-	2.1E+0		1.9E-19		3.2E+3	NA	☒	NA
Dichloroethylene, trans-1,2	1.0E+0		1.8E-23		3.2E+3	NA	☒	NA
Dichloropropane, 1,2-	1.0E+0		3.3E-26		4.8E+4	NA	☒	NA

RBCA Tool Kit for Chemical Releases, Version 2.6

Dichloroethane, 1,2-	1.7E-3		2.8E-50		1.0E+5	NA	☐	NA
Dichloropropene, 1,3-	1.5E+0		1.5E-100		1.1E+3	NA	☐	NA
Dichlorobenzene, 1,4-	2.9E+0		2.9E-100		1.4E+4	NA	☐	NA
Chlorophenol, 2-	2.4E+0		1.8E-2		2.6E+4	NA	☐	NA
Dichlorophenol, 2,4-	6.4E-1		6.4E-101		8.6E+3	NA	☐	NA
Trichlorophenol, 2,4,5-	6.3E-1		7.3E-62		1.1E+3	NA	☐	NA
Trichlorophenol, 2,4,6-	6.8E-1		9.9E-43		1.1E+3	NA	☐	NA
Dichlorophenoxyacetic acid, 2,4-	1.0E+1		1.0E-99		1.5E+4	NA	☐	NA
Dinitrotoluene, 2,4-	1.8E+0		3.3E-65		3.5E+3	NA	☐	NA
PFHxS	8.0E-4		6.1E-6		3.8E+0	NA	☐	NA
PFOS	4.3E-4		3.3E-6		3.8E+0	NA	☐	NA
PFOA	6.7E-4		5.1E-6		3.0E+1	NA	☐	NA
PFHpA	3.3E-4		2.5E-6		3.0E+1	NA	☐	NA

NOTE: POE = Point of exposure

E2 RBCA Model sensitivity results

RANGITOPUNI STREAM SENSITIVITY

	BASE CASE	HIGH K	LOW K	SW LOW	SW LOW	
Contaminant	GW conc at POE	GW conc at POE	GW conc at POE	GW conc at POE	SW conc at POE after dilution	ANZG 95% or other
Aluminum	7.1E-3	7.1E-3	7.1E-3	7.1E-3	1.32E-06	5.50E-02
Antimony	5.6E-5	5.6E-5	5.6E-5	5.6E-5	1.04E-08	9.00E-03
Arsenic	1.0E-3	1.0E-3	1.0E-3	1.0E-3	1.95E-07	2.40E-02
Barium	3.0E-2	3.0E-2	3.0E-2	3.0E-2	5.51E-06	1.00E+00
Beryllium	7.6E-5	7.6E-5	7.6E-5	7.6E-5	1.42E-08	1.00E-01
Boron	1.5E-1	1.5E-1	1.5E-1	1.5E-1	2.74E-05	9.40E-01
Cadmium	7.1E-6	7.1E-6	7.1E-6	7.1E-6	1.33E-09	2.00E-04
Chromium (III) (total chromium)	2.2E-3	2.2E-3	2.2E-3	2.2E-3	4.06E-07	3.30E-03
Copper	9.2E-4	9.2E-4	9.2E-4	9.2E-4	1.72E-07	1.40E-03
Fluorine (soluble fluoride)	4.9E-3	4.9E-3	4.9E-3	4.9E-3	9.12E-07	1.70E+00
Lead (inorganic)	1.8E-4	1.8E-4	1.8E-4	1.8E-4	3.27E-08	3.40E-03
Lithium	5.2E-3	5.2E-3	5.2E-3	5.2E-3	9.76E-07	7.50E-02
Mercury	3.4E-6	3.4E-6	3.4E-6	3.4E-6	6.33E-10	6.00E-04
Molybdenum	3.0E-5	3.0E-5	3.0E-5	3.0E-5	5.53E-09	3.40E-02
Nickel	1.2E-3	1.2E-3	1.2E-3	1.2E-3	2.15E-07	1.10E-02
Selenium	1.5E-4	1.5E-4	1.5E-4	1.5E-4	2.76E-08	1.10E-02
Silver	1.1E-5	1.1E-5	1.1E-5	1.1E-5	2.02E-09	5.00E-05
Tin	9.9E-5	9.9E-5	9.9E-5	9.9E-5	1.84E-08	3.00E-03
Vanadium	5.9E-4	5.9E-4	5.9E-4	5.9E-4	1.09E-07	6.00E-03
Zinc	3.0E-3	3.0E-3	3.0E-3	3.0E-3	5.66E-07	8.00E-03
Cyanide	3.8E-4	3.8E-4	3.8E-4	3.8E-4	7.08E-08	7.00E-03
Aniline	5.5E-2	5.5E-2	5.5E-2	5.5E-2	1.02E-05	2.50E-01
Benzene	6.6E-51	3.7E-18	7.4E-103	6.6E-51	1.24E-54	9.50E-01
Bromodichloromethane	8.0E-3	8.0E-3	8.0E-3	8.0E-3	1.48E-06	6.00E-02
Bromoform	4.1E-80	7.2E-26	1.0E-100	4.1E-80	7.56E-84	1.00E-01
Carbon disulfide	7.1E-62	1.2E-19	5.0E-100	7.1E-62	1.32E-65	2.00E-02
Carbon tetrachloride	1.6E-103	2.0E-38	1.6E-103	1.6E-103	3.05E-107	2.40E-01
Chlordane, gamma	3.0E-102	3.0E-102	3.0E-102	3.0E-102	5.60E-106	8.00E-05
Chlorobenzene	1.0E-100	2.0E-41	1.0E-100	1.0E-100	1.92E-104	5.50E-02
Chloroform	1.3E-31	1.2E-12	3.9E-92	1.3E-31	2.44E-35	7.70E-01
Dibromochloromethane	1.4E-99	5.3E-32	1.1E-100	1.4E-99	2.65E-103	1.50E-01
Dimethylphthalate	7.3E-31	4.3E-10	5.0E-97	7.3E-31	1.35E-34	3.70E+00
Endrin	1.7E-100	6.8E-63	1.7E-100	1.7E-100	3.21E-104	2.00E-05
Ethyl benzene	4.5E-99	9.1E-45	4.5E-99	4.5E-99	8.32E-103	8.00E-02
Heptachlor	1.7E-100	1.7E-100	1.7E-100	1.7E-100	3.15E-104	9.00E-05
Hexachlorobutadiene	9.3E-101	1.1E-100	1.1E-100	1.1E-100	1.96E-104	7.00E-04
Hexachlorobenzene	1.8E-100	1.8E-100	1.8E-100	1.8E-100	3.37E-104	1.00E-04
Hexachloroethane	1.8E-100	1.8E-100	1.8E-100	1.8E-100	3.31E-104	3.60E-01
Cresol, m-	2.30E-102	1.96E-70	2.3E-102	2.3E-102	4.29E-106	2.00E-01
Methoxychlor	1.00E-99	1.00E-99	1.0E-99	1.0E-99	1.87E-103	5.00E-06
Methyl ethyl ketone	3.21E-97	2.13E-54	3.2E-97	3.2E-97	5.99E-101	-
Naphthalene	1.00E-99	1.00E-99	1.0E-99	1.0E-99	1.87E-103	1.60E-02
Nitrobenzene	2.47E-91	3.19E-29	1.9E-100	2.5E-91	4.61E-95	5.50E-01
Cresol, o-	3.51E-99	3.51E-99	3.5E-99	3.5E-99	6.54E-103	4.00E-01
Cresol, p-	9.40E-98	2.60E-85	9.4E-98	9.4E-98	1.75E-101	1.00E-01
Pentachlorophenol	7.40E-79	1.57E-25	8.5E-101	7.4E-79	1.38E-82	1.00E-02
Phenol	1.99E-98	3.89E-87	2.0E-98	2.0E-98	3.71E-102	3.20E-01
Polychlorinated biphenyls (liquid)	3.60E-102	3.61E-102	3.6E-102	3.6E-102	6.72E-106	3.00E-05
Pyridine	5.01E-100	1.96E-60	5.0E-100	5.0E-100	9.33E-104	5.00E+00
Tetrachloroethylene	2.60E-75	2.98E-26	1.8E-103	2.6E-75	4.84E-79	1.00E-02
Toluene	2.77E-102	2.77E-102	2.8E-102	2.8E-102	5.16E-106	1.80E-01
Toxaphene	5.0E-101	5.01E-101	5.0E-101	5.0E-101	9.33E-105	2.00E-04
Tributyltin oxide	9.20E-104	9.22E-104	9.2E-104	9.2E-104	1.72E-107	4.00E-06
Trichloroethylene	1.3E-38	1.15E-12	1.8E-100	1.3E-38	2.44E-42	3.00E-02
Vinyl chloride	3.4E-15	4.68E-05	3.8E-48	3.4E-15	6.30E-19	3.00E-04
Xylene, m-	9.0E-99	1.71E-34	9.0E-99	9.0E-99	1.68E-102	7.50E-02
Xylene, o-	6.6E-93	6.70E-29	3.0E-99	6.6E-93	1.23E-96	3.50E-01
Xylene, p-	9.0E-99	7.38E-43	9.0E-99	9.0E-99	1.68E-102	2.00E-01
Trichloroethane, 1,1,2-	7.8E-46	4.12E-15	9.7E-101	7.8E-46	1.46E-49	6.50E+00
Tetrachloroethane, 1,1,2,2-	1.0E-100	1.64E-68	1.0E-100	1.0E-100	1.96E-104	7.00E-02
Dichloroethylene, 1,1-	1.0E-100	1.43E-37	1.0E-100	1.0E-100	1.92E-104	7.00E-01
Dibromo-3-chloropropane, 1,2-	1.0E-100	3.39E-34	1.0E-100	1.0E-100	1.94E-104	1.00E-03
Dichlorobenzene, 1,2-	1.0E-100	1.49E-65	1.0E-100	1.0E-100	1.96E-104	1.60E-01
Dichloroethylene, cis-1,2-	1.9E-19	9.92E-07	2.2E-60	1.9E-19	3.56E-23	6.00E-02
Dichloroethylene, trans-1,2	1.8E-23	3.68E-08	1.5E-72	1.8E-23	3.29E-27	6.00E-02
Dichloropropane, 1,2-	3.3E-26	5.42E-09	3.4E-81	3.3E-26	6.18E-30	9.00E-01
Dichloroethane, 1,2-	2.8E-50	2.10E-18	1.7E-103	2.8E-50	5.29E-54	1.90E+00
Dichloropropene, 1,3-	1.5E-100	1.49E-100	1.5E-100	1.5E-100	2.77E-104	1.00E-04
Dichlorobenzene, 1,4-	2.9E-100	5.70E-63	2.9E-100	2.9E-100	5.42E-104	2.60E-01
Chlorophenol, 2-	1.8E-2	1.85E-02	1.8E-2	1.8E-2	3.45E-06	4.90E-01
Dichlorophenol, 2,4-	6.4E-101	3.01E-68	6.4E-101	6.4E-101	1.19E-104	1.60E-01
Trichlorophenol, 2,4,5-	7.3E-62	2.85E-20	6.3E-101	7.3E-62	1.35E-65	2.00E-02
Trichlorophenol, 2,4,6-	9.9E-43	3.03E-14	6.9E-101	9.9E-43	1.85E-46	2.00E-02
Dichlorophenoxyacetic acid, 2,4-	1.0E-99	1.00E-99	1.0E-99	1.0E-99	1.87E-103	2.80E-01
Dinitrotoluene, 2,4-	3.3E-65	5.21E-21	1.8E-100	3.3E-65	6.21E-69	6.50E-02
PFHxS	6.1E-6	6.08E-06	6.1E-6	6.1E-6	1.13E-09	7.00E-05
PFOS	3.3E-6	3.27E-06	3.3E-6	3.3E-6	6.09E-10	7.00E-05
PFOA	5.1E-6	5.09E-06	5.1E-6	5.1E-6	9.49E-10	5.60E-04
PFFHpA	2.5E-6	2.51E-06	2.5E-6	2.5E-6	4.67E-10	5.60E-04

Main Screen

RBCA Tool Kit for Chemical Releases
Version 2.6 ©2011 GSI Environmental Inc.

1. Project Information

Site Name:

Location:

Completed By:

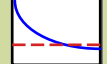
Date: Job ID:

2. Which Type of RBCA Analysis?



Tier 1

Risk-Based
Screening
Levels



Tier 2/3

Site-Specific
Target Levels

3. Calculation Options

Affects which input data are required

☒ **Baseline Risks (Forward mode)**

☒ **RBCA Cleanup Levels (Backward mode)**

☐ Individual Constituent Risk Goals Only

☐ Individual and Cumulative Risk Goals

☒ Apply Source Depletion Algorithm

Time to Future Exposure (yr)

4. RBCA Evaluation Process

Prepare Input Data

Data Complete? (■ yes, ■ no)

☒ Exposure Pathways

↓

☒ Constituents of Concern (COCs)

↓

☒ Transport Models

↓

☐ Soil Parameters

↓

☒ GW Parameters

↓

☐ Air Parameters

Review Output

Exposure Flowchart

COC Chem. Parameters

Input Data Summary

User-Spec. COC Data...

Transient Domenico Analysis...

Baseline Risks...

Cleanup Levels...

5. Commands and Options

New Site

Load Data...

Save Data As...

User Chemical Database

Set Units

Print Sheet

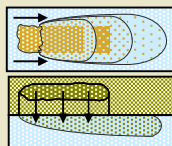
Print Report

Quit

Help

Exposure Pathway Identification

1. Groundwater Exposure



Groundwater Ingestion/ Surface Water Impact

Receptor: None ▼ None ▼ S.W. ▼
 Distance: On-site Off-site1 Off-site2
 0 0 480 (m)

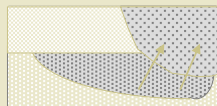
Source Media:

- ☒ Affected Groundwater
☐ Affected Soils Leaching to Groundwater

Option:

- ☐ Apply MCL value as ingestion RBEL (backward mode only)

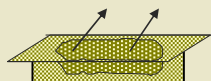
GW Discharge to Surface Water Exposure



- ☐ Swimming
☐ Fish Consumption
☒ Specified Water Quality Criteria

Enter Criteria

2. Surface Soil Exposure



Combined Exposure

Source Media:

- Receptor: None ▼
 On-site
 Construction Worker ☐
☐ Direct Ingestion
☐ Dermal Contact
☐ Inhalation (vol+part)
☐ Vegetable Ingestion

Option:

- ☐ Apply UK (CLEA) SGV as soil concentration limit

Veg Options

Site Name: ARL TP: RANGITOPUNI_95UCL_SENSITIVITY_HIGH K

Location: RODNEY, AUCKLAND

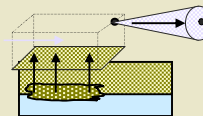
Compl. By: LP

Job ID: 1092369.6

Date: 1-Jul-25

3. Air Exposure

Volatilization and Particulates to Outdoor Air Inhalation

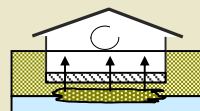


Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

Construction worker ☐

- ☐ Affected Soils--Volatilization to Ambient Outdoor Air
☐ Affected Groundwater--Volatilization to Ambient Outdoor Air
☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



Volatilization to Indoor Air Inhalation

Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- ☐ Affected Soils--Volatilization to Enclosed Space
☐ Affected Soils Leaching to GW--Volatilization to Enclosed Space
☐ Affected Groundwater--Volatilization to Enclosed Space

Bldg Options

4. Commands and Options

Main Screen

Print Sheet

Set Units

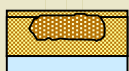
Help

Exposure Factors & Target Risks

Exposure Flowchart

Transport Modeling Options

1. Vertical Transport, Surface Soil Column



Outdoor Air Volatilization Factors

- ☐ Surface soil volatilization model only ASTM Model
☐ Combination surface soil/Johnson & Ettinger models
 Thickness of surface soil zone 1.00 (m)
☐ User-specified VF from other model Enter VF Values

Indoor Air Volatilization Factors More Info: *BioVapor* model

- ☐ Johnson & Ettinger model for soil and groundwater volatilization
 - ☐ Johnson & Ettinger for soil, Mass Flux model for groundwater
 - ☐ User-specified VF from other model
- Enter VF Values

Soil-to-Groundwater Leaching Factor

- ☐ ASTM Model
 - ☐ Apply Soil Attenuation Model (SAM)
 - ☐ Allow first-order biodecay
 - ☐ User-specified LF from other model

Modeling Options

- ☐ Disable Mass Balance Limit
- ☐ Apply Dual Equilibrium Desorption Model

2. Lateral Air Dispersion Factor

- | | Off-site 1 | Off-site 2 | |
|---|------------|------------|-----|
| ☐ 3-D Gaussian dispersion model | | | |
| ☐ User-Specified ADF | 1.00E+0 | 1.00E+0 | (-) |

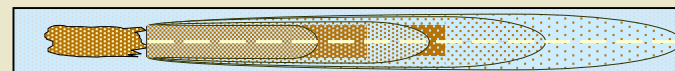
~~Site Name: ARL TP: RANGITOPUNI_95UCL SENSITIVITY HIGH~~
~~JobID: 1092369.6~~

~~Location: RODNEY, AUCKLAND~~

~~Date: 1-Jul-25~~

~~Compl. By: LP~~

3. Groundwater Dilution Attenuation Factor



Calculate DAF using Domenico Model

- ☐ Domenico equation with dispersion only (no biodegradation)
 - ☒ Domenico equation first-order decay

Enter Decay Rates
 - ☐ Modified Domenico equation using electron acceptor superposition

Enter Site Data

▼ Biodegradation Capacity ~~NG~~ (mg/L)
 — or —

User-Specified DAF Values

- DAF values from other model or site data

4. Chemical Decay and Source Depletion



Enter Decay Rates

Enter Source Mass

5. Commands and Options

Main Screen

Print Sheet

Help

Site-Specific Groundwater Parameters

1. Water-Bearing Unit ?

Hydrogeology

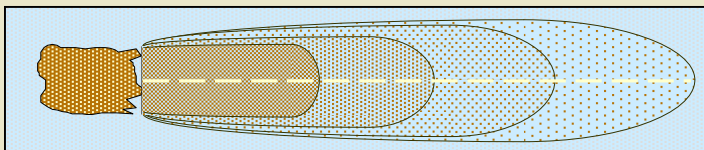
Groundwater Darcy velocity (cm/s)
 Groundwater seepage velocity (cm/s)
 or or
 Hydraulic conductivity (cm/s)
 Hydraulic gradient (-)
 Effective porosity (-)

Sorption

Fraction organic carbon--saturated zone (-)
 Groundwater pH (-)

2. Groundwater Source Zone ?

Groundwater plume width at source (m)
 Plume (mixing zone) thickness at source (m)
 Calculate or
 Saturated thickness (m)
 Length of source zone (m)



Site Name: ARL TP: RANGITOPUNI_95UCL_SENSITIVITY_HIGH-K Job ID: 1092369.6
 Location: RODNEY, AUCKLAND Date: 1-Jul-25
 Compl. By: LP

3. Groundwater Dispersion ?

Model: ASTM Default
 GW Ingestion GW to Indoor Air
 Off-site 1 Off-site 2 Off-site 1 Off-site 2
 Distance to GW receptors (m)
 Calculate
 Longitudinal dispersivity (m)
 Transverse dispersivity (m)
 Vertical dispersivity (m)

4. Groundwater Discharge to Surface Water ?

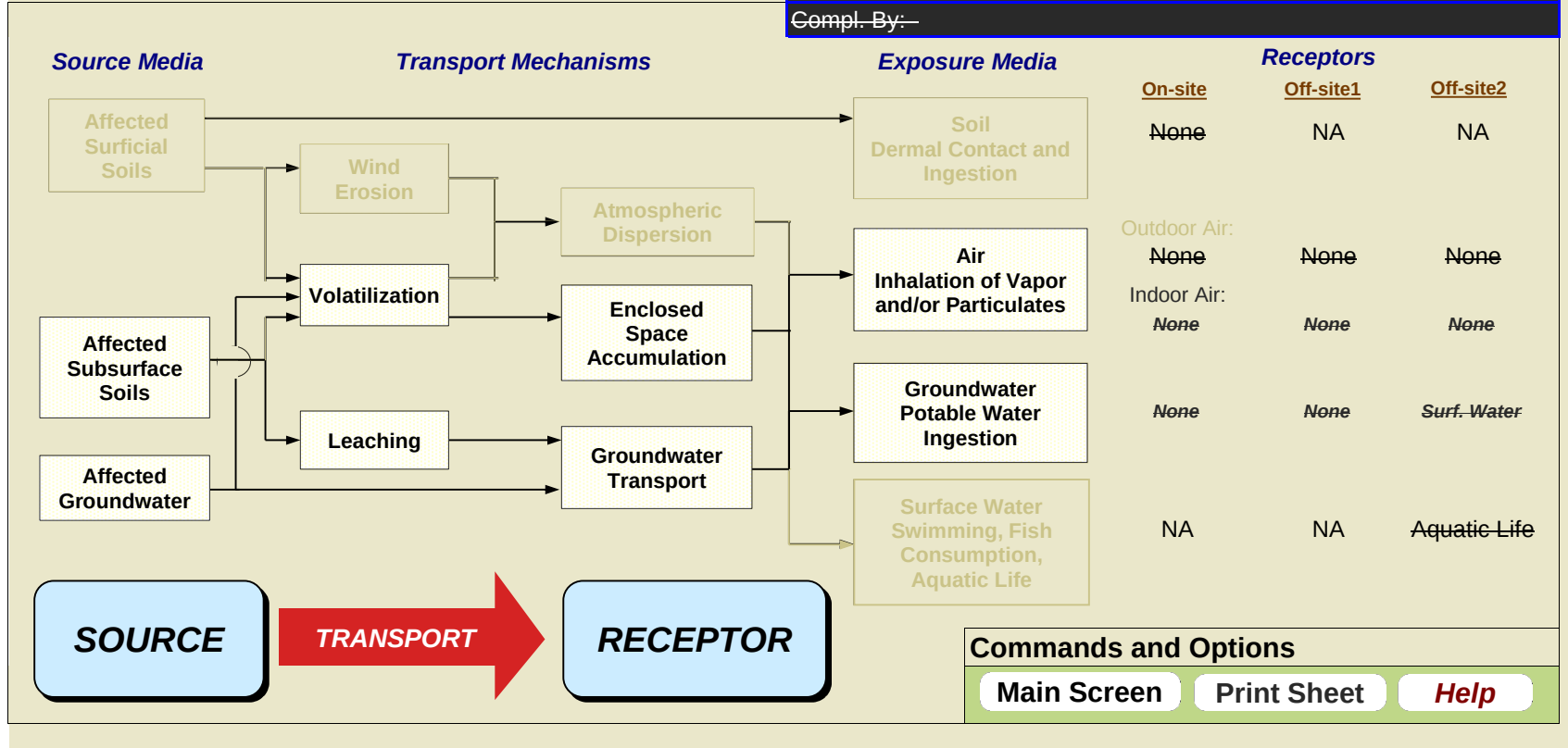
Distance to GW/SW discharge point (m)
 Plume width at GW/SW discharge (m)
 Plume thickness at GW/SW discharge (m)
 Surface water flowrate at GW/SW discharge (m³/s)

5. Commands and Options

[Main Screen](#)
[Use/Set Default
Values](#)
[Print Sheet](#)
[Set Units](#)
[Help](#)

Exposure Pathway Flowchart

Site Name:— Job ID:—
 Location:— Date: 0-Jan-00
 Compl. By:—



RBCA SITE ASSESSMENT	User-Specified COC Data
----------------------	-------------------------

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (1–30 m)	
	value (mg/L)	note	value (mg/kg)	note
Aluminum	0.3E-1	Redvale-leachate-LCS1-95UC		
Antimony	7.4E-3	Redvale-leachate-LCS1-95UC		
Arsenic	1.4E-1	Redvale-leachate-LCS1-95UC		
Barium	3.9E+0	Redvale-leachate-LCS1-95UC		
Beryllium	1.0E-2	WMI-Leachate-Report-Max		
Boron	1.9E+1	Redvale-leachate-LCS1-95UC		
Cadmium	9.4E-4	Redvale-leachate-LCS1-95UC		
Chromium (III) (total chromium)	2.9E-1	Redvale-leachate-LCS1-95UC		
Copper	1.2E-1	Redvale-leachate-LCS1-95UC		
Fluorine (soluble fluoride)	6.4E-1	Redvale-leachate-LCS1-95UC		
Lead (inorganic)	2.3E-2	Redvale-leachate-LCS1-95UC		
Lithium	6.9E-1	Redvale-leachate-LCS1-95UC		
Mercury	4.5E-4	Redvale-leachate-LCS1-95UC		
Molybdenum	3.9E-3	Redvale-leachate-LCS1-95UC		
Nickel	1.5E-1	Redvale-leachate-LCS1-95UC		
Selenium	2.0E-2	Redvale-leachate-LCS1-95UC		
Silver	1.4E-3	Redvale-leachate-LCS1-95UC		
Tin	1.3E-2	Redvale-leachate-LCS1-95UC		
Vanadium	7.7E-2	Redvale-leachate-LCS1-95UC		
Zinc	4.0E-1	leachate-LCS1-95UCL-10-YR		
Cyanide	5.0E-2	Redvale-leachate-LCS1-95UC		
Aniline	7.2E+0	Redvale-leachate-LCS1-95UC		
Benzene	7.4E-3	Redvale-leachate-LCS1-95UC		
Bromodichloromethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Bromoform	1.0E+0	Redvale-leachate-LCS1-95UC		
Carbon disulfide	5.0E+0	Redvale-leachate-LCS1-95UC		
Carbon tetrachloride	1.6E-3	Redvale-leachate-LCS1-95UC		
Chlordane, gamma	3.0E-2	WAC-Class-1		
Chlorobenzene	1.0E+0	Redvale-leachate-LCS1-95UC		
Chloroform	1.5E-3	Redvale-leachate-LCS1-95UC		
Dibromochloromethane	1.1E+0	Redvale-leachate-LCS1-95UC		
Dimethylphthalate	3.2E+0	Redvale-leachate-LCS1-95UC		
Endrin	1.7E+0	Redvale-leachate-LCS1-95UC		
Ethyl benzene	4.5E+1	Redvale-leachate-LCS1-95UC		
Heptachlor	1.7E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobutadiene	1.1E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobenzene	1.3E+0	Redvale-leachate-LCS1-95UC		
Hexachloroethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Cresol, m-	2.2E-2	Redvale-leachate-LCS1-95UC		
Methoxychlor	1.0E+1	Redvale-leachate-LCS1-95UC		
Methyl ethyl ketone	3.2E+3	Redvale-leachate-LCS1-95UC		
Naphthalene	1.0E+1	Redvale-leachate-LCS1-95UC		
Nitrobenzene	1.9E+0	Redvale-leachate-LCS1-95UC		
Cresol, o-	3.5E+1	Redvale-leachate-LCS1-95UC		
Cresol, p-	0.4E+2	Redvale-leachate-LCS1-95UC		
Pentachlorophenol	8.5E-1	Redvale-leachate-LCS1-95UC		
Phenol	2.0E+2	Redvale-leachate-LCS1-95UC		
Polychlorinated biphenyls (liquid)	3.6E-2	Redvale-leachate-LCS1-95UC		
Pyridine	5.9E+0	WAC-Class-1		
Tetrachloroethylene	1.8E-3	Redvale-leachate-LCS1-95UC		
Toluene	2.8E-2	Redvale-leachate-LCS1-95UC		
Toxaphene	5.0E-1	WAC-Class-1		
Tributyltin oxide ^a	9.2E-4	Redvale-leachate-LCS1-95UC		
Trichloroethylene	1.9E+0	Redvale-leachate-LCS1-95UC		
Vinyl chloride	9.3E+0	Redvale-leachate-LCS1-95UC		
Xylene, m-	9.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, o-	3.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, p-	9.0E+1	Redvale-leachate-LCS1-95UC		
Trichloroethane, 1,1,2-	9.7E-1	Redvale-leachate-LCS1-95UC		
Tetrachloroethane, 1,1,2,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, 1,1-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dibromo-3-chloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, cis-1,2-	2.1E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, trans-1,2	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethane, 1,2-	1.7E-3	Redvale-leachate-LCS1-95UC		
Dichloropropene, 1,3-	1.5E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,4-	2.9E+0	Redvale-leachate-LCS1-95UC		
Chlorophenol, 2-	2.4E+0	Redvale-leachate-LCS1-95UC		
Dichlorophenol, 2,4-	6.4E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,5-	6.3E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,6-	6.8E-1	Redvale-leachate-LCS1-95UC		
Dichlorophenoxyacetic acid, 2,4-	1.0E+1	WAC-Class-1		
Dinitrotoluene, 2,4-	1.8E+0	Redvale-leachate-LCS1-95UC		
PFHxS	8.0E-4	Redvale-leachate-LCS1-MAX		
PFOS	4.3E-4	Redvale-leachate-LCS1-MAX		
PFDA	6.7E-4	Redvale-leachate-LCS1-MAX		
PFHpA	3.3E-4	Redvale-leachate-LCS1-MAX		

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
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Site Name:-	Site Location:-	Completed By:-	Date Completed: 0-Jan-00
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1 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS	☐ (CHECKED IF PATHWAY IS ACTIVE)
---	---

SOILS LEACHING TO GROUNDWATER

Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc. limit reached? ("■" if yes) ; Time (yr)	
	Soil Conc. (mg/kg)	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None
Aluminum						NA	NA
Antimony						NA	NA
Arsenic						NA	NA
Barium						NA	NA
Beryllium						NA	NA
Boron						NA	NA
Cadmium						NA	NA
Chromium (III) (total chromium)						NA	NA
Copper						NA	NA
Fluorine (soluble fluoride)						NA	NA
Lead (inorganic)						NA	NA
Lithium						NA	NA
Mercury						NA	NA
Molybdenum						NA	NA
Nickel						NA	NA
Selenium						NA	NA
Silver						NA	NA
Tin						NA	NA
Vanadium						NA	NA
Zinc						NA	NA
Cyanide						NA	NA
Aniline						NA	NA
Benzene						NA	NA
Bromodichloromethane						NA	NA
Bromoform						NA	NA
Carbon disulfide						NA	NA
Carbon tetrachloride						NA	NA

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Chlordane, gamma						NA	NA
Chlorobenzene						NA	NA
Chloroform						NA	NA
Dibromochloromethane						NA	NA
Dimethylphthalate						NA	NA
Endrin						NA	NA
Ethyl benzene						NA	NA
Heptachlor						NA	NA
Hexachlorobutadiene						NA	NA
Hexachlorobenzene						NA	NA
Hexachloroethane						NA	NA
Cresol, m-						NA	NA
Methoxychlor						NA	NA
Methyl ethyl ketone						NA	NA
Naphthalene						NA	NA
Nitrobenzene						NA	NA
Cresol, o-						NA	NA
Cresol, p-						NA	NA
Pentachlorophenol						NA	NA
Phenol						NA	NA
Polychlorinated biphenyls (liquid)						NA	NA
Pyridine						NA	NA
Tetrachloroethylene						NA	NA
Toluene						NA	NA
Toxaphene						NA	NA
Tributyltin oxide *						NA	NA
Trichloroethylene						NA	NA
Vinyl chloride						NA	NA
Xylene, m-						NA	NA
Xylene, o-						NA	NA
Xylene, p-						NA	NA
Trichloroethane, 1,1,2-						NA	NA
Tetrachloroethane, 1,1,2,2-						NA	NA
Dichloroethylene, 1,1-						NA	NA
Dibromo-3-chloropropane, 1,2-						NA	NA
Dichlorobenzene, 1,2-						NA	NA
Dichloroethylene, cis-1,2-						NA	NA
Dichloroethylene, trans-1,2						NA	NA
Dichloropropane, 1,2-						NA	NA

RBCA Tool Kit for Chemical Releases, Version 2.6

Dichloroethane, 1,2-						NA	NA
Dichloropropene, 1,3-						NA	NA
Dichlorobenzene, 1,4-						NA	NA
Chlorophenol, 2-						NA	NA
Dichlorophenol, 2,4-						NA	NA
Trichlorophenol, 2,4,5-						NA	NA
Trichlorophenol, 2,4,6-						NA	NA
Dichlorophenoxyacetic acid, 2,4-						NA	NA
Dinitrotoluene, 2,4-						NA	NA
PFHxS						NA	NA
PFOS						NA	NA
PFOA						NA	NA
PFHpA						NA	NA

NOTE: POE = Point of exposure

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
-----------------------------	---

Site Name:- Site Location:- Completed By:- Date Completed: 0-Jan-00 2 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

GROUNDWATER:-

Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc reaches limit? ("■" If yes) ; Time (yr)	
	Groundwater Conc. (mg/L)	Off-site 1 (0 m)	Off-site 2 (480 m)	Off-site 1 (0 m)	Off-site 2 (480 m)	Off-site 1 (0 m)	Off-site 2 (480 m)
		None	Surf. Water	None	Surf. Water	None	Surf. Water
Aluminum	9.3E-1		7.1E-3		3.0E+2	NA	■ NA
Antimony	7.4E-3		5.6E-5		4.8E+1	NA	■ NA
Arsenic	1.4E-1		1.0E-3		1.3E+2	NA	■ NA
Barium	3.9E+0		3.0E-2		5.4E+3	NA	■ NA
Beryllium	1.0E-2		7.6E-5		7.0E-1	NA	■ NA
Boron	1.9E+1		1.5E-1		5.0E+3	NA	■ NA
Cadmium	9.4E-4		7.1E-6		1.1E+0	NA	■ NA
Chromium (III) (total chromium)	2.9E-1		2.2E-3		1.8E+1	NA	■ NA
Copper	1.2E-1		9.2E-4		7.5E+0	NA	■ NA
Fluorine (soluble fluoride)	6.4E-1		4.9E-3		9.1E+3	NA	■ NA
Lead (inorganic)	2.3E-2		1.8E-4		1.8E+1	NA	■ NA
Lithium	6.9E-1		5.2E-3		4.0E+2	NA	■ NA
Mercury	4.5E-4		3.4E-6		3.2E+0	NA	■ NA
Molybdenum	3.9E-3		3.0E-5		1.8E+2	NA	■ NA
Nickel	1.5E-1		1.2E-3		5.9E+1	NA	■ NA
Selenium	2.0E-2		1.5E-4		5.9E+1	NA	■ NA
Silver	1.4E-3		1.1E-5		2.7E-1	NA	■ NA
Tin	1.3E-2		9.9E-5		1.6E+1	NA	■ NA
Vanadium	7.7E-2		5.9E-4		3.2E+1	NA	■ NA
Zinc	4.0E-1		3.0E-3		4.3E+1	NA	■ NA
Cyanide	5.0E-2		3.8E-4		3.8E+1	NA	■ NA
Aniline	7.2E+0		5.5E-2		1.3E+3	NA	■ NA
Benzene	7.4E-3		3.7E-18		5.1E+3	NA	■ NA
Bromodichloromethane	1.0E+0		8.0E-3		3.2E+2	NA	■ NA
Bromoform	1.0E+0		7.2E-26		5.4E+2	NA	■ NA
Carbon disulfide	5.0E+0		1.2E-19		1.1E+2	NA	■ NA
Carbon tetrachloride	1.6E-3		2.0E-38		1.3E+3	NA	■ NA

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Chlordane, gamma	3.0E-2		3.0E-102		4.3E-1	NA	☒	NA
Chlorobenzene	1.0E+0		2.0E-41		3.0E+2	NA	☒	NA
Chloroform	1.5E-3		1.2E-12		4.1E+3	NA	☒	NA
Dibromochloromethane	1.1E+0		5.3E-32		8.0E+2	NA	☒	NA
Dimethylphthalate	3.2E+0		4.3E-10		2.0E+4	NA	☒	NA
Endrin	1.7E+0		6.8E-63		1.1E-1	NA	☒	NA
Ethyl benzene	4.5E+1		9.1E-45		4.3E+2	NA	☒	NA
Heptachlor	1.7E+0		1.7E-100		4.8E-1	NA	☒	NA
Hexachlorobutadiene	1.1E+0		1.1E-100		2.1E-1	NA	☒	NA
Hexachlorobenzene	1.8E+0		1.8E-100		5.4E-1	NA	☒	NA
Hexachloroethane	1.8E+0		1.8E-100		1.9E+3	NA	☒	NA
Cresol, m-	2.3E-2		2.0E-70		1.1E+3	NA	☒	NA
Methoxychlor	1.0E+1		1.0E-99		2.7E-2	NA	☒	NA
Methyl ethyl ketone	3.2E+3		2.1E-54		5.4E+2	NA	☒	NA
Naphthalene	1.0E+1		1.0E-99		8.6E+1	NA	☒	NA
Nitrobenzene	1.9E+0		3.2E-29		3.0E+3	NA	☒	NA
Cresol, o-	3.5E+1		3.5E-99		2.1E+3	NA	☒	NA
Cresol, p-	9.4E+2		2.6E-85		5.4E+2	NA	☒	NA
Pentachlorophenol	8.5E-1		1.6E-25		5.4E+1	NA	☒	NA
Phenol	2.0E+2		3.9E-87		1.7E+3	NA	☒	NA
Polychlorinated biphenyls (liquid)	3.6E-2		3.6E-102		1.6E-1	NA	☒	NA
Pyridine	5.0E+0		2.0E-60		2.7E+4	NA	☒	NA
Tetrachloroethylene	1.8E-3		3.0E-26		3.8E+2	NA	☒	NA
Toluene	2.8E-2		2.8E-102		9.7E+2	NA	☒	NA
Toxaphene	5.0E-1		5.0E-101		1.1E+0	NA	☒	NA
Tributyltin oxide *	9.2E-4		9.2E-104		2.1E-2	NA	☒	NA
Trichloroethylene	1.8E+0		1.2E-12		1.6E+2	NA	☒	NA
Vinyl chloride	8.3E+0		4.7E-5		1.6E+0	NA	☒	NA
Xylene, m-	9.0E+1		1.7E-34		4.0E+2	NA	☒	NA
Xylene, o-	3.0E+1		6.7E-29		1.9E+3	NA	☒	NA
Xylene, p-	9.0E+1		7.4E-43		1.1E+3	NA	☒	NA
Trichloroethane, 1,1,2-	9.7E-1		4.1E-15		3.5E+4	NA	☒	NA
Tetrachloroethane, 1,1,2,2-	1.0E+0		1.6E-68		3.8E+2	NA	☒	NA
Dichloroethylene, 1,1-	1.0E+0		1.4E-37		3.8E+3	NA	☒	NA
Dibromo-3-chloropropane, 1,2-	1.0E+0		3.4E-34		5.4E+0	NA	☒	NA
Dichlorobenzene, 1,2-	1.0E+0		1.5E-65		8.6E+2	NA	☒	NA
Dichloroethylene, cis-1,2-	2.1E+0		9.9E-7		3.2E+2	NA	☒	NA
Dichloroethylene, trans-1,2	1.0E+0		3.7E-8		3.2E+2	NA	☒	NA
Dichloropropane, 1,2-	1.0E+0		5.4E-9		4.8E+3	NA	☒	NA

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Dichloroethane, 1,2-	1.7E-3		2.1E-18		1.0E+4	NA	☒	NA
Dichloropropene, 1,3-	1.5E+0		1.5E-100		1.1E+2	NA	☒	NA
Dichlorobenzene, 1,4-	2.9E+0		5.7E-63		1.4E+3	NA	☒	NA
Chlorophenol, 2-	2.4E+0		1.8E-2		2.6E+3	NA	☒	NA
Dichlorophenol, 2,4-	6.4E-1		3.0E-68		8.6E+2	NA	☒	NA
Trichlorophenol, 2,4,5-	6.3E-1		2.8E-20		1.1E+2	NA	☒	NA
Trichlorophenol, 2,4,6-	6.8E-1		3.0E-14		1.1E+2	NA	☒	NA
Dichlorophenoxyacetic acid, 2,4-	1.0E+1		1.0E-99		1.5E+3	NA	☒	NA
Dinitrotoluene, 2,4-	1.8E+0		5.2E-21		3.5E+2	NA	☒	NA
PFHxS	8.0E-4		6.1E-6		3.8E-1	NA	☒	NA
PFOS	4.3E-4		3.3E-6		3.8E-1	NA	☒	NA
PFOA	6.7E-4		5.1E-6		3.0E+0	NA	☒	NA
PFHpA	3.3E-4		2.5E-6		3.0E+0	NA	☒	NA

NOTE: POE = Point of exposure

Main Screen

RBCA Tool Kit for Chemical Releases
Version 2.6 ©2011 GSI Environmental Inc.

1. Project Information

Site Name:

Location:

Completed By:

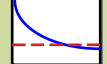
Date: Job ID:

2. Which Type of RBCA Analysis?



Tier 1

Risk-Based
Screening
Levels



Tier 2/3

Site-Specific
Target Levels

3. Calculation Options

Affects which input data are required

☒ **Baseline Risks (Forward mode)**

☒ **RBCA Cleanup Levels (Backward mode)**

☐ Individual Constituent Risk Goals Only
 ☐ Individual and Cumulative Risk Goals

☒ Apply Source Depletion Algorithm
Time to Future Exposure
 (yr)

4. RBCA Evaluation Process

Prepare Input Data

Data Complete? (■ yes, ■ no)

☒ Exposure Pathways

↓

☒ Constituents of Concern (COCs)

↓

☒ Transport Models

↓

☐ Soil Parameters

↓

☒ GW Parameters

↓

☐ Air Parameters

Review Output

Exposure Flowchart

COC Chem. Parameters

Input Data Summary

User-Spec. COC Data...

Transient Domenico Analysis...

Baseline Risks...

Cleanup Levels...

5. Commands and Options

New Site

Load Data...

Save Data As...

User Chemical Database

Set Units

Print Sheet

Print Report

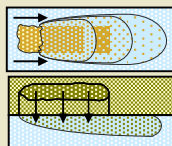
Quit

Help

Exposure Pathway Identification

1. Groundwater Exposure

Groundwater Ingestion/ Surface Water Impact



Receptor: None ▼ None ▼ S.W. ▼
 Distance: On-site Off-site1 Off-site2
 0 0 480 (m)

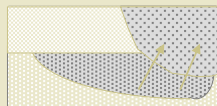
Source Media:

- ☒ Affected Groundwater
☐ Affected Soils Leaching to Groundwater

Option:

- ☐ Apply MCL value as ingestion RBEL (backward mode only)

GW Discharge to Surface Water Exposure

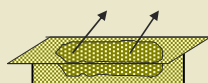


- ☐ Swimming
☐ Fish Consumption
☒ Specified Water Quality Criteria

Enter Criteria

2. Surface Soil Exposure

Combined Exposure



Receptor: None ▼
 On-site
 Construction Worker ☐
 Source Media:
☐ Direct Ingestion
☐ Dermal Contact
☐ Inhalation (vol+part)
☐ Vegetable Ingestion

Option:

- ☐ Apply UK (CLEA) SGV as soil concentration limit

Veg Options

Site Name: ARL TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW K

Location: RODNEY, AUCKLAND

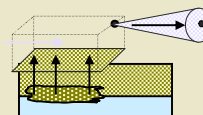
Compl. By: LP

Job ID: 1092369.6

Date: 1-Jul-25

3. Air Exposure

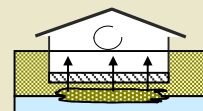
Volatilization and Particulates to Outdoor Air Inhalation



Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- Construction worker ☐
☐ Affected Soils--Volatilization to Ambient Outdoor Air
☐ Affected Groundwater--Volatilization to Ambient Outdoor Air
☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



Volatilization to Indoor Air Inhalation

Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- ☐ Affected Soils--Volatilization to Enclosed Space
☐ Affected Soils Leaching to GW--Volatilization to Enclosed Space
☐ Affected Groundwater--Volatilization to Enclosed Space

Bldg Options

4. Commands and Options

Main Screen

Print Sheet

Set Units

Help

Exposure Factors & Target Risks

Exposure Flowchart

Transport Modeling Options

1. Vertical Transport, Surface Soil Column

Outdoor Air Volatilization Factors

- ☐ Surface soil volatilization model only ASTM Model
- ☐ Combination surface soil/Johnson & Ettinger models
 Thickness of surface soil zone 1.00 (m)
- ☐ User-specified VF from other model Enter VF Values

Indoor Air Volatilization Factors More Info: BioVapor model

- ☐ Johnson & Ettinger model for soil and groundwater volatilization
- ☐ Johnson & Ettinger for soil, Mass Flux model for groundwater
- ☐ User-specified VF from other model Enter VF Values

Soil-to-Groundwater Leaching Factor

- ☐ ASTM Model
- ☐ Apply Soil Attenuation Model (SAM) Enter Decay Rates
- ☐ Allow first-order biodecay Enter LF Values
- ☐ User-specified LF from other model Enter LF Values

Modeling Options

- ☐ Disable Mass Balance Limit
- ☐ Apply Dual Equilibrium Desorption Model

2. Lateral Air Dispersion Factor

- ☐ 3-D Gaussian dispersion model Off-site 1 Off-site 2
- ☐ User-Specified ADF 1.00E+0 1.00E+0 (-)

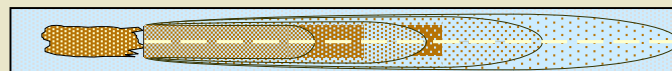
Site Name: ARL-TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW ID: 1092369.6

Location: RODNEY, AUCKLAND

Date: 1-Jul-25

Compl. By: LP

3. Groundwater Dilution Attenuation Factor



Calculate DAF using Domenico Model

- ☐ Domenico equation with dispersion only (no biodegradation)
- ☒ Domenico equation first-order decay Enter Decay Rates
- ☐ Modified Domenico equation using electron acceptor superposition Enter Site Data

Biodegradation Capacity NG (mg/L)

— or —

User-Specified DAF Values

- ☐ DAF values from other model or site data Enter DAF Values

4. Chemical Decay and Source Depletion



Enter Decay Rates

Enter Source Mass

5. Commands and Options

Main Screen

Print Sheet

Help

Site-Specific Groundwater Parameters

1. Water-Bearing Unit ?

Hydrogeology

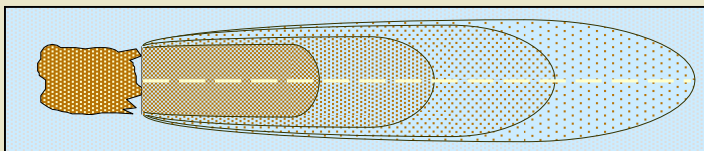
Groundwater Darcy velocity (cm/s)
 Groundwater seepage velocity (cm/s)
 or or
 Hydraulic conductivity (cm/s)
 Hydraulic gradient (-)
 Effective porosity (-)

Sorption

Fraction organic carbon--saturated zone (-)
 Groundwater pH (-)

2. Groundwater Source Zone ?

Groundwater plume width at source (m)
 Plume (mixing zone) thickness at source (m)
 or
 Saturated thickness (m)
 Length of source zone (m)



Site Name: ARL TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW-K Job ID: 1092369.6
 Location: RODNEY, AUCKLAND Date: 1-Jul-25
 Compl. By: LP

3. Groundwater Dispersion ?

Model: ASTM Default ▼

GW Ingestion

GW to Indoor Air

	Off-site 1	Off-site 2	Off-site 1	Off-site 2
Distance to GW receptors	0	490	0	0 (m)
Calculate ▼	↓	↓	↓	↓
Longitudinal dispersivity	0	1	0	0 (m)
Transverse dispersivity	0	1	0	0 (m)
Vertical dispersivity	0	1	0	0 (m)

4. Groundwater Discharge to Surface Water ?

	Off-site 2
Distance to GW/SW discharge point	490 (m)
Plume width at GW/SW discharge	150 (m)
Plume thickness at GW/SW discharge	1 (m)
Surface water flowrate at GW/SW discharge	0.014 (m ³ /s)

5. Commands and Options

Main Screen

Use/Set Default
Values

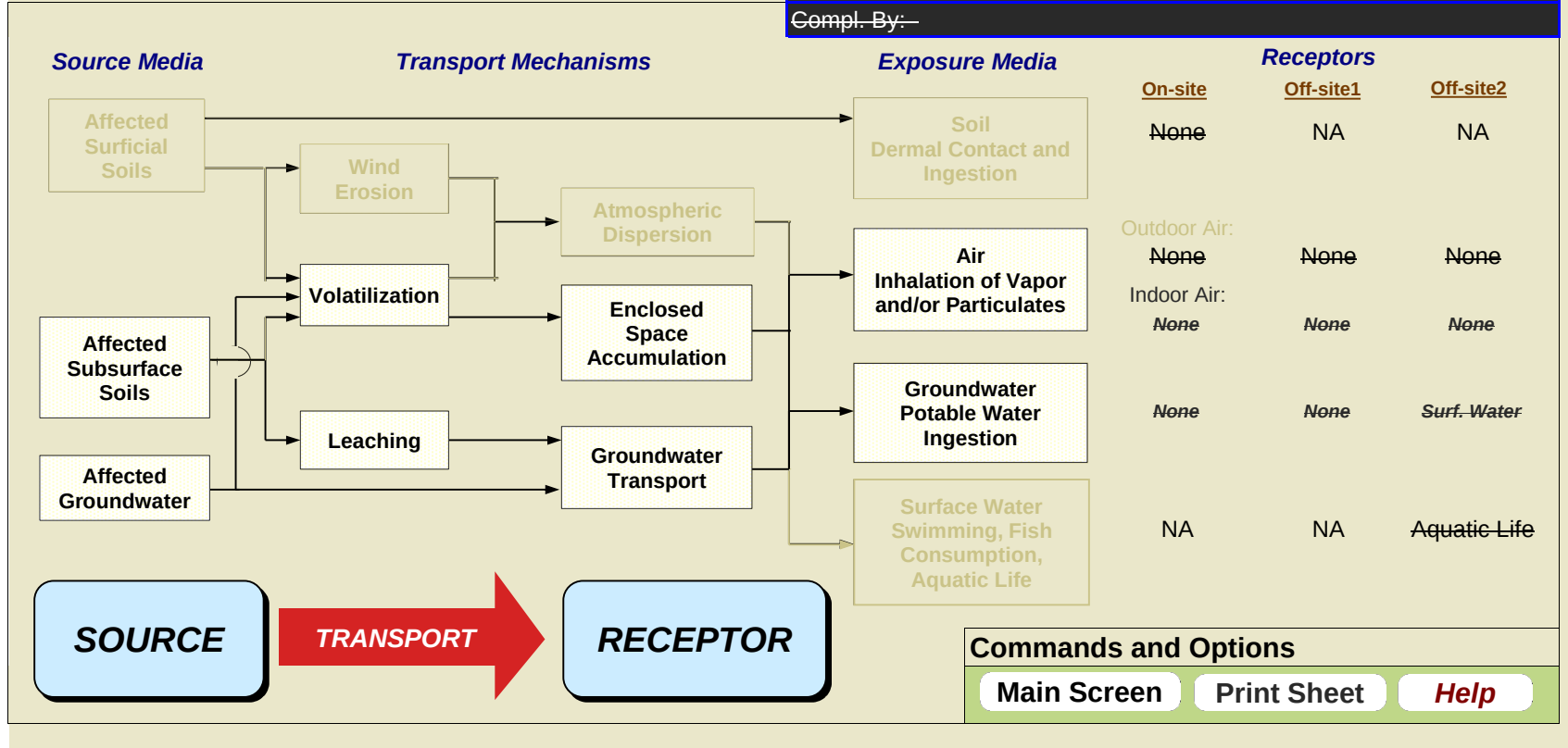
Print Sheet

Set Units

Help

Exposure Pathway Flowchart

Site Name:— Job ID:—
 Location:— Date: 0-Jan-00
 Compl. By:—



RBCA SITE ASSESSMENT	User-Specified COC Data
----------------------	-------------------------

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (1–30 m)	
	value (mg/L)	note	value (mg/kg)	note
Aluminum	0.3E-1	Redvale-leachate-LCS1-95UC		
Antimony	7.4E-3	Redvale-leachate-LCS1-95UC		
Arsenic	1.4E-1	Redvale-leachate-LCS1-95UC		
Barium	3.9E+0	Redvale-leachate-LCS1-95UC		
Beryllium	1.0E-2	WMI-Leachate-Report-Max		
Boron	1.9E+1	Redvale-leachate-LCS1-95UC		
Cadmium	9.4E-4	Redvale-leachate-LCS1-95UC		
Chromium (III) (total chromium)	2.9E-1	Redvale-leachate-LCS1-95UC		
Copper	1.2E-1	Redvale-leachate-LCS1-95UC		
Fluoride (soluble fluoride)	6.4E-1	Redvale-leachate-LCS1-95UC		
Lead (inorganic)	2.3E-2	Redvale-leachate-LCS1-95UC		
Lithium	6.9E-1	Redvale-leachate-LCS1-95UC		
Mercury	4.5E-4	Redvale-leachate-LCS1-95UC		
Molybdenum	3.9E-3	Redvale-leachate-LCS1-95UC		
Nickel	1.5E-1	Redvale-leachate-LCS1-95UC		
Selenium	2.0E-2	Redvale-leachate-LCS1-95UC		
Silver	1.4E-3	Redvale-leachate-LCS1-95UC		
Tin	1.3E-2	Redvale-leachate-LCS1-95UC		
Vanadium	7.7E-2	Redvale-leachate-LCS1-95UC		
Zinc	4.0E-1	leachate-LCS1-95UCL-10-YR		
Cyanide	5.0E-2	Redvale-leachate-LCS1-95UC		
Aniline	7.2E+0	Redvale-leachate-LCS1-95UC		
Benzene	7.4E-3	Redvale-leachate-LCS1-95UC		
Bromodichloromethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Bromoform	1.0E+0	Redvale-leachate-LCS1-95UC		
Carbon disulfide	5.0E+0	Redvale-leachate-LCS1-95UC		
Carbon tetrachloride	1.6E-3	Redvale-leachate-LCS1-95UC		
Chlordane, gamma	3.0E-2	WAC-Class-1		
Chlorobenzene	1.0E+0	Redvale-leachate-LCS1-95UC		
Chloroform	1.5E-3	Redvale-leachate-LCS1-95UC		
Dibromochloromethane	1.1E+0	Redvale-leachate-LCS1-95UC		
Dimethylphthalate	3.2E+0	Redvale-leachate-LCS1-95UC		
Endrin	1.7E+0	Redvale-leachate-LCS1-95UC		
Ethyl benzene	4.5E+1	Redvale-leachate-LCS1-95UC		
Heptachlor	1.7E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobutadiene	1.1E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobenzene	1.3E+0	Redvale-leachate-LCS1-95UC		
Hexachloroethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Cresol, m-	2.2E-2	Redvale-leachate-LCS1-95UC		
Methoxychlor	1.0E+1	Redvale-leachate-LCS1-95UC		
Methyl ethyl ketone	3.2E+3	Redvale-leachate-LCS1-95UC		
Naphthalene	1.0E+1	Redvale-leachate-LCS1-95UC		
Nitrobenzene	1.9E+0	Redvale-leachate-LCS1-95UC		
Cresol, o-	3.5E+1	Redvale-leachate-LCS1-95UC		
Cresol, p-	0.4E+2	Redvale-leachate-LCS1-95UC		
Pentachlorophenol	8.5E-1	Redvale-leachate-LCS1-95UC		
Phenol	2.0E+2	Redvale-leachate-LCS1-95UC		
Polychlorinated biphenyls (liquid)	3.6E-2	Redvale-leachate-LCS1-95UC		
Pyridine	5.9E+0	WAC-Class-1		
Tetrachloroethylene	1.8E-3	Redvale-leachate-LCS1-95UC		
Toluene	2.8E-2	Redvale-leachate-LCS1-95UC		
Toxaphene	5.0E-1	WAC-Class-1		
Tributyltin oxide ^a	9.2E-4	Redvale-leachate-LCS1-95UC		
Trichloroethylene	1.9E+0	Redvale-leachate-LCS1-95UC		
Vinyl chloride	9.3E+0	Redvale-leachate-LCS1-95UC		
Xylene, m-	9.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, o-	3.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, p-	9.0E+1	Redvale-leachate-LCS1-95UC		
Trichloroethane, 1,1,2-	9.7E-1	Redvale-leachate-LCS1-95UC		
Tetrachloroethane, 1,1,2,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, 1,1-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dibromo-3-chloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, cis-1,2-	2.1E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, trans-1,2	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethane, 1,2-	1.7E-3	Redvale-leachate-LCS1-95UC		
Dichloropropene, 1,3-	1.5E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,4-	2.9E+0	Redvale-leachate-LCS1-95UC		
Chlorophenol, 2-	2.4E+0	Redvale-leachate-LCS1-95UC		
Dichlorophenol, 2,4-	6.4E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,5-	6.3E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,6-	6.8E-1	Redvale-leachate-LCS1-95UC		
Dichlorophenoxyacetic acid, 2,4-	1.0E+1	WAC-Class-1		
Dinitrotoluene, 2,4-	1.8E+0	Redvale-leachate-LCS1-95UC		
PFHxS	8.0E-4	Redvale-leachate-LCS1-MAX		
PFOS	4.3E-4	Redvale-leachate-LCS1-MAX		
PFDA	6.7E-4	Redvale-leachate-LCS1-MAX		
PFHpA	3.3E-4	Redvale-leachate-LCS1-MAX		

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
-----------------------------	---

Site Name:- Site Location:- Completed By:- Date Completed: 0-Jan-00 1 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)

SOILS LEACHING TO GROUNDWATER

Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc. limit reached? ("■" if yes) ; Time (yr)	
	Soil Conc. (mg/kg)	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None
Aluminum						NA	NA
Antimony						NA	NA
Arsenic						NA	NA
Barium						NA	NA
Beryllium						NA	NA
Boron						NA	NA
Cadmium						NA	NA
Chromium (III) (total chromium)						NA	NA
Copper						NA	NA
Fluorine (soluble fluoride)						NA	NA
Lead (inorganic)						NA	NA
Lithium						NA	NA
Mercury						NA	NA
Molybdenum						NA	NA
Nickel						NA	NA
Selenium						NA	NA
Silver						NA	NA
Tin						NA	NA
Vanadium						NA	NA
Zinc						NA	NA
Cyanide						NA	NA
Aniline						NA	NA
Benzene						NA	NA
Bromodichloromethane						NA	NA
Bromoform						NA	NA
Carbon disulfide						NA	NA
Carbon tetrachloride						NA	NA

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Chlordane, gamma						NA	NA
Chlorobenzene						NA	NA
Chloroform						NA	NA
Dibromochloromethane						NA	NA
Dimethylphthalate						NA	NA
Endrin						NA	NA
Ethyl benzene						NA	NA
Heptachlor						NA	NA
Hexachlorobutadiene						NA	NA
Hexachlorobenzene						NA	NA
Hexachloroethane						NA	NA
Cresol, m-						NA	NA
Methoxychlor						NA	NA
Methyl ethyl ketone						NA	NA
Naphthalene						NA	NA
Nitrobenzene						NA	NA
Cresol, o-						NA	NA
Cresol, p-						NA	NA
Pentachlorophenol						NA	NA
Phenol						NA	NA
Polychlorinated biphenyls (liquid)						NA	NA
Pyridine						NA	NA
Tetrachloroethylene						NA	NA
Toluene						NA	NA
Toxaphene						NA	NA
Tributyltin oxide *						NA	NA
Trichloroethylene						NA	NA
Vinyl chloride						NA	NA
Xylene, m-						NA	NA
Xylene, o-						NA	NA
Xylene, p-						NA	NA
Trichloroethane, 1,1,2-						NA	NA
Tetrachloroethane, 1,1,2,2-						NA	NA
Dichloroethylene, 1,1-						NA	NA
Dibromo-3-chloropropane, 1,2-						NA	NA
Dichlorobenzene, 1,2-						NA	NA
Dichloroethylene, cis-1,2-						NA	NA
Dichloroethylene, trans-1,2						NA	NA
Dichloropropane, 1,2-						NA	NA

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Dichloroethane, 1,2-						NA	NA
Dichloropropene, 1,3-						NA	NA
Dichlorobenzene, 1,4-						NA	NA
Chlorophenol, 2-						NA	NA
Dichlorophenol, 2,4-						NA	NA
Trichlorophenol, 2,4,5-						NA	NA
Trichlorophenol, 2,4,6-						NA	NA
Dichlorophenoxyacetic acid, 2,4-						NA	NA
Dinitrotoluene, 2,4-						NA	NA
PFHxS						NA	NA
PFOS						NA	NA
PFOA						NA	NA
PFHpA						NA	NA

NOTE: POE = Point of exposure

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
-----------------------------	---

Site Name:- Site Location:- Completed By:- Date Completed: 0-Jan-00 2 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY							
OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)							
GROUNDWATER:-							
Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc reaches limit? ("■" If yes) ; Time (yr)	
	Groundwater Conc. (mg/L)	Off-site 1 (0 m)	Off-site 2 (480 m)	Off-site 1 (0 m)	Off-site 2 (480 m)	Off-site 1 (0 m)	Off-site 2 (480 m)
		None	Surf. Water	None	Surf. Water	None	Surf. Water
Aluminum	9.3E-1		7.1E-3		3.0E+4	NA	☐ NA
Antimony	7.4E-3		5.6E-5		4.8E+3	NA	☐ NA
Arsenic	1.4E-1		1.0E-3		1.3E+4	NA	☐ NA
Barium	3.9E+0		3.0E-2		5.4E+5	NA	☐ NA
Beryllium	1.0E-2		7.6E-5		7.0E+1	NA	☐ NA
Boron	1.9E+1		1.5E-1		5.0E+5	NA	☐ NA
Cadmium	9.4E-4		7.1E-6		1.1E+2	NA	☐ NA
Chromium (III) (total chromium)	2.9E-1		2.2E-3		1.8E+3	NA	☐ NA
Copper	1.2E-1		9.2E-4		7.5E+2	NA	☐ NA
Fluorine (soluble fluoride)	6.4E-1		4.9E-3		9.1E+5	NA	☐ NA
Lead (inorganic)	2.3E-2		1.8E-4		1.8E+3	NA	☐ NA
Lithium	6.9E-1		5.2E-3		4.0E+4	NA	☐ NA
Mercury	4.5E-4		3.4E-6		3.2E+2	NA	☐ NA
Molybdenum	3.9E-3		3.0E-5		1.8E+4	NA	☐ NA
Nickel	1.5E-1		1.2E-3		5.9E+3	NA	☐ NA
Selenium	2.0E-2		1.5E-4		5.9E+3	NA	☐ NA
Silver	1.4E-3		1.1E-5		2.7E+1	NA	☐ NA
Tin	1.3E-2		9.9E-5		1.6E+3	NA	☐ NA
Vanadium	7.7E-2		5.9E-4		3.2E+3	NA	☐ NA
Zinc	4.0E-1		3.0E-3		4.3E+3	NA	☐ NA
Cyanide	5.0E-2		3.8E-4		3.8E+3	NA	☐ NA
Aniline	7.2E+0		5.5E-2		1.3E+5	NA	☐ NA
Benzene	7.4E-3		7.4E-103		5.1E+5	NA	☐ NA
Bromodichloromethane	1.0E+0		8.0E-3		3.2E+4	NA	☐ NA
Bromoform	1.0E+0		1.0E-100		5.4E+4	NA	☐ NA
Carbon disulfide	5.0E+0		5.0E-100		1.1E+4	NA	☐ NA
Carbon tetrachloride	1.6E-3		1.6E-103		1.3E+5	NA	☐ NA

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Chlordane, gamma	3.0E-2		3.0E-102		4.3E+1	NA	☒	NA
Chlorobenzene	1.0E+0		1.0E-100		3.0E+4	NA	☒	NA
Chloroform	1.5E-3		3.9E-92		4.1E+5	NA	☒	NA
Dibromochloromethane	1.1E+0		1.1E-100		8.0E+4	NA	☒	NA
Dimethylphthalate	3.2E+0		5.0E-97		2.0E+6	NA	☒	NA
Endrin	1.7E+0		1.7E-100		1.1E+1	NA	☒	NA
Ethyl benzene	4.5E+1		4.5E-99		4.3E+4	NA	☒	NA
Heptachlor	1.7E+0		1.7E-100		4.8E+1	NA	☒	NA
Hexachlorobutadiene	1.1E+0		1.1E-100		2.1E+1	NA	☒	NA
Hexachlorobenzene	1.8E+0		1.8E-100		5.4E+1	NA	☒	NA
Hexachloroethane	1.8E+0		1.8E-100		1.9E+5	NA	☒	NA
Cresol, m-	2.3E-2		2.3E-102		1.1E+5	NA	☒	NA
Methoxychlor	1.0E+1		1.0E-99		2.7E+0	NA	☒	NA
Methyl ethyl ketone	3.2E+3		3.2E-97		5.4E+4	NA	☒	NA
Naphthalene	1.0E+1		1.0E-99		8.6E+3	NA	☒	NA
Nitrobenzene	1.9E+0		1.9E-100		3.0E+5	NA	☒	NA
Cresol, o-	3.5E+1		3.5E-99		2.1E+5	NA	☒	NA
Cresol, p-	9.4E+2		9.4E-98		5.4E+4	NA	☒	NA
Pentachlorophenol	8.5E-1		8.5E-101		5.4E+3	NA	☒	NA
Phenol	2.0E+2		2.0E-98		1.7E+5	NA	☒	NA
Polychlorinated biphenyls (liquid)	3.6E-2		3.6E-102		1.6E+1	NA	☒	NA
Pyridine	5.0E+0		5.0E-100		2.7E+6	NA	☒	NA
Tetrachloroethylene	1.8E-3		1.8E-103		3.8E+4	NA	☒	NA
Toluene	2.8E-2		2.8E-102		9.7E+4	NA	☒	NA
Toxaphene	5.0E-1		5.0E-101		1.1E+2	NA	☒	NA
Tributyltin oxide *	9.2E-4		9.2E-104		2.1E+0	NA	☒	NA
Trichloroethylene	1.8E+0		1.8E-100		1.6E+4	NA	☒	NA
Vinyl chloride	8.3E+0		3.8E-48		1.6E+2	NA	☒	NA
Xylene, m-	9.0E+1		9.0E-99		4.0E+4	NA	☒	NA
Xylene, o-	3.0E+1		3.0E-99		1.9E+5	NA	☒	NA
Xylene, p-	9.0E+1		9.0E-99		1.1E+5	NA	☒	NA
Trichloroethane, 1,1,2-	9.7E-1		9.7E-101		3.5E+6	NA	☒	NA
Tetrachloroethane, 1,1,2,2-	1.0E+0		1.0E-100		3.8E+4	NA	☒	NA
Dichloroethylene, 1,1-	1.0E+0		1.0E-100		3.8E+5	NA	☒	NA
Dibromo-3-chloropropane, 1,2-	1.0E+0		1.0E-100		5.4E+2	NA	☒	NA
Dichlorobenzene, 1,2-	1.0E+0		1.0E-100		8.6E+4	NA	☒	NA
Dichloroethylene, cis-1,2-	2.1E+0		2.2E-60		3.2E+4	NA	☒	NA
Dichloroethylene, trans-1,2	1.0E+0		1.5E-72		3.2E+4	NA	☒	NA
Dichloropropane, 1,2-	1.0E+0		3.4E-81		4.8E+5	NA	☒	NA

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Dichloroethane, 1,2-	1.7E-3		1.7E-103		1.0E+6	NA	☒	NA
Dichloropropene, 1,3-	1.5E+0		1.5E-100		1.1E+4	NA	☒	NA
Dichlorobenzene, 1,4-	2.9E+0		2.9E-100		1.4E+5	NA	☒	NA
Chlorophenol, 2-	2.4E+0		1.8E-2		2.6E+5	NA	☒	NA
Dichlorophenol, 2,4-	6.4E-1		6.4E-101		8.6E+4	NA	☒	NA
Trichlorophenol, 2,4,5-	6.3E-1		6.3E-101		1.1E+4	NA	☒	NA
Trichlorophenol, 2,4,6-	6.8E-1		6.9E-101		1.1E+4	NA	☒	NA
Dichlorophenoxyacetic acid, 2,4-	1.0E+1		1.0E-99		1.5E+5	NA	☒	NA
Dinitrotoluene, 2,4-	1.8E+0		1.8E-100		3.5E+4	NA	☒	NA
PFHxS	8.0E-4		6.1E-6		3.8E+1	NA	☒	NA
PFOS	4.3E-4		3.3E-6		3.8E+1	NA	☒	NA
PFOA	6.7E-4		5.1E-6		3.0E+2	NA	☒	NA
PFHpA	3.3E-4		2.5E-6		3.0E+2	NA	☒	NA

NOTE: POE = Point of exposure

Main Screen

RBCA Tool Kit for Chemical Releases
Version 2.6 ©2011 GSI Environmental Inc.

1. Project Information

Site Name:	ARL-TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW SW		
Location:	RODNEY, AUCKLAND		
Completed By:	LP		
Date:	1-Jul-25	Job ID:	1092369.6

2. Which Type of RBCA Analysis?

Tier 1

Risk-Based
Screening
Levels

Tier 2/3

Site-Specific
Target Levels

3. Calculation Options

Affects which input data are required

☒
Baseline Risks (Forward mode)

☒
RBCA Cleanup Levels (Backward mode)

☐
Individual Constituent Risk Goals Only

☐
Individual and Cumulative Risk Goals

☒
Apply Source Depletion Algorithm

Time to Future Exposure

0

(yr)

4. RBCA Evaluation Process

Prepare Input Data

Data Complete? (■ yes, ■ no)

☒ Exposure Pathways

↓

☒ Constituents of Concern (COCs)

↓

☒ Transport Models

↓

Soil Parameters

↓

☒ GW Parameters

↓

Air Parameters

Review Output

Exposure Flowchart

 COC Chem. Parameters

 Input Data Summary

 User-Spec. COC Data...

 Transient Domenico Analysis...

 Baseline Risks...

5. Commands and Options

New Site

Load Data...

Save Data As...

User Chemical Database

Set Units

Print Sheet

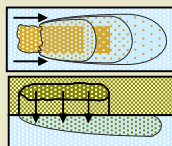
Print Report

Quit

Help

Exposure Pathway Identification

1. Groundwater Exposure



Groundwater Ingestion/ Surface Water Impact

Receptor: None ▼ None ▼ S.W. ▼
 Distance: On-site Off-site1 Off-site2
 0 0 480 (m)

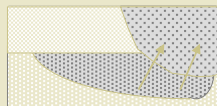
Source Media:

- ☒ Affected Groundwater
☐ Affected Soils Leaching to Groundwater

Option:

- ☐ Apply MCL value as ingestion RBEL (backward mode only)

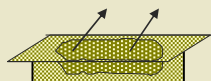
GW Discharge to Surface Water Exposure



- ☐ Swimming
☐ Fish Consumption
☒ Specified Water Quality Criteria

Enter Criteria

2. Surface Soil Exposure



Combined Exposure

Source Media:

- Receptor: None ▼
 On-site
 Construction Worker ☐
☐ Direct Ingestion
☐ Dermal Contact
☐ Inhalation (vol+part)
☐ Vegetable Ingestion

Option:

- ☐ Apply UK (CLEA) SGV as soil concentration limit

Veg Options

Site Name: ARL TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW SW

Location: RODNEY, AUCKLAND

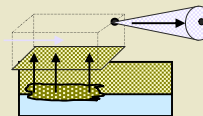
Compl. By: LP

Job ID: 1092369.6

Date: 1-Jul-25

3. Air Exposure

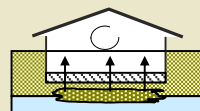
Volatilization and Particulates to Outdoor Air Inhalation



Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- Construction worker ☐
☐ Affected Soils--Volatilization to Ambient Outdoor Air
☐ Affected Groundwater--Volatilization to Ambient Outdoor Air
☐ Affected Surface Soils--Particulates to Ambient Outdoor Air



Volatilization to Indoor Air Inhalation

Receptor: None ▼ None ▼ None ▼
 Distance: On-site Off-site1 Off-site2
 0 0 0 (m)

Source Media:

- ☐ Affected Soils--Volatilization to Enclosed Space
☐ Affected Soils Leaching to GW--Volatilization to Enclosed Space
☐ Affected Groundwater--Volatilization to Enclosed Space

Bldg Options

4. Commands and Options

Main Screen

Print Sheet

Set Units

Help

Exposure Factors & Target Risks

Exposure Flowchart

Transport Modeling Options

1. Vertical Transport, Surface Soil Column

Outdoor Air Volatilization Factors

- ☐ Surface soil volatilization model only ASTM Model  ?
☐ Combination surface soil/Johnson & Ettinger models
 Thickness of surface soil zone 1.00 (m)
☐ User-specified VF from other model Enter VF Values

Indoor Air Volatilization Factors More Info: BioVapor model ?

- ☐ Johnson & Ettinger model for soil and groundwater volatilization
☐ Johnson & Ettinger for soil, Mass Flux model for groundwater
☐ User-specified VF from other model Enter VF Values

Soil-to-Groundwater Leaching Factor

- ☐ ASTM Model
☐ Apply Soil Attenuation Model (SAM) Enter Decay Rates
☐ Allow first-order biodecay
☐ User-specified LF from other model Enter LF Values

Modeling Options

- ☐ Disable Mass Balance Limit
☐ Apply Dual Equilibrium Desorption Model

2. Lateral Air Dispersion Factor

- ☐ 3-D Gaussian dispersion model
☐ User-Specified ADF Off-site 1 Off-site 2
 1.00E+0 1.00E+0 (-)

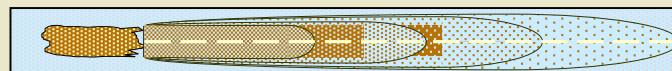
Site Name: ARL-TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW SID: 1092369.6

Location: RODNEY, AUCKLAND

Date: 1-Jul-25

Compl. By: LP

3. Groundwater Dilution Attenuation Factor



Calculate DAF using Domenico Model

- ☐ Domenico equation with dispersion only (no biodegradation)
☒ Domenico equation first-order decay Enter Decay Rates
☐ Modified Domenico equation using electron acceptor superposition Enter Site Data

Biodegradation Capacity NG (mg/L)
 — or —

User-Specified DAF Values

- ☐ DAF values from other model or site data Enter DAF Values

4. Chemical Decay and Source Depletion



Enter Decay Rates

Enter Source Mass

5. Commands and Options

Main Screen

Print Sheet

Help

Site-Specific Groundwater Parameters

1. Water-Bearing Unit ?

Hydrogeology

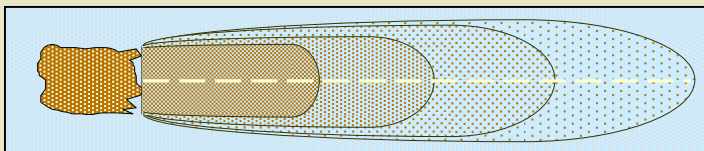
Groundwater Darcy velocity (cm/s)
 Groundwater seepage velocity (cm/s)
 or or
 Hydraulic conductivity (cm/s)
 Hydraulic gradient (-)
 Effective porosity (-)

Sorption

Fraction organic carbon--saturated zone (-)
 Groundwater pH (-)

2. Groundwater Source Zone ?

Groundwater plume width at source (m)
 Plume (mixing zone) thickness at source (m)
 Calculate or
 Saturated thickness (m)
 Length of source zone (m)



Site Name: ARL TP: RANGITOPUNI_95UCL_SENSITIVITY_LOW SW Job ID: 1092369.6
 Location: RODNEY, AUCKLAND Date: 1-Jul-25
 Compl. By: LP

3. Groundwater Dispersion ?

Model: ASTM Default ▼

GW Ingestion

GW to Indoor Air

	Off-site 1	Off-site 2	Off-site 1	Off-site 2
Distance to GW receptors	0	490	0	0 (m)
Calculate ↓	↓	↓	↓	↓
Longitudinal dispersivity	0	1	0	0 (m)
Transverse dispersivity	0	1	0	0 (m)
Vertical dispersivity	0	1	0	0 (m)

4. Groundwater Discharge to Surface Water ?

Distance to GW/SW discharge point (m) Off-site 2
 Plume width at GW/SW discharge (m)
 Plume thickness at GW/SW discharge (m)
 Surface water flowrate at GW/SW discharge (m³/s)

5. Commands and Options

Main Screen

Use/Set Default
Values

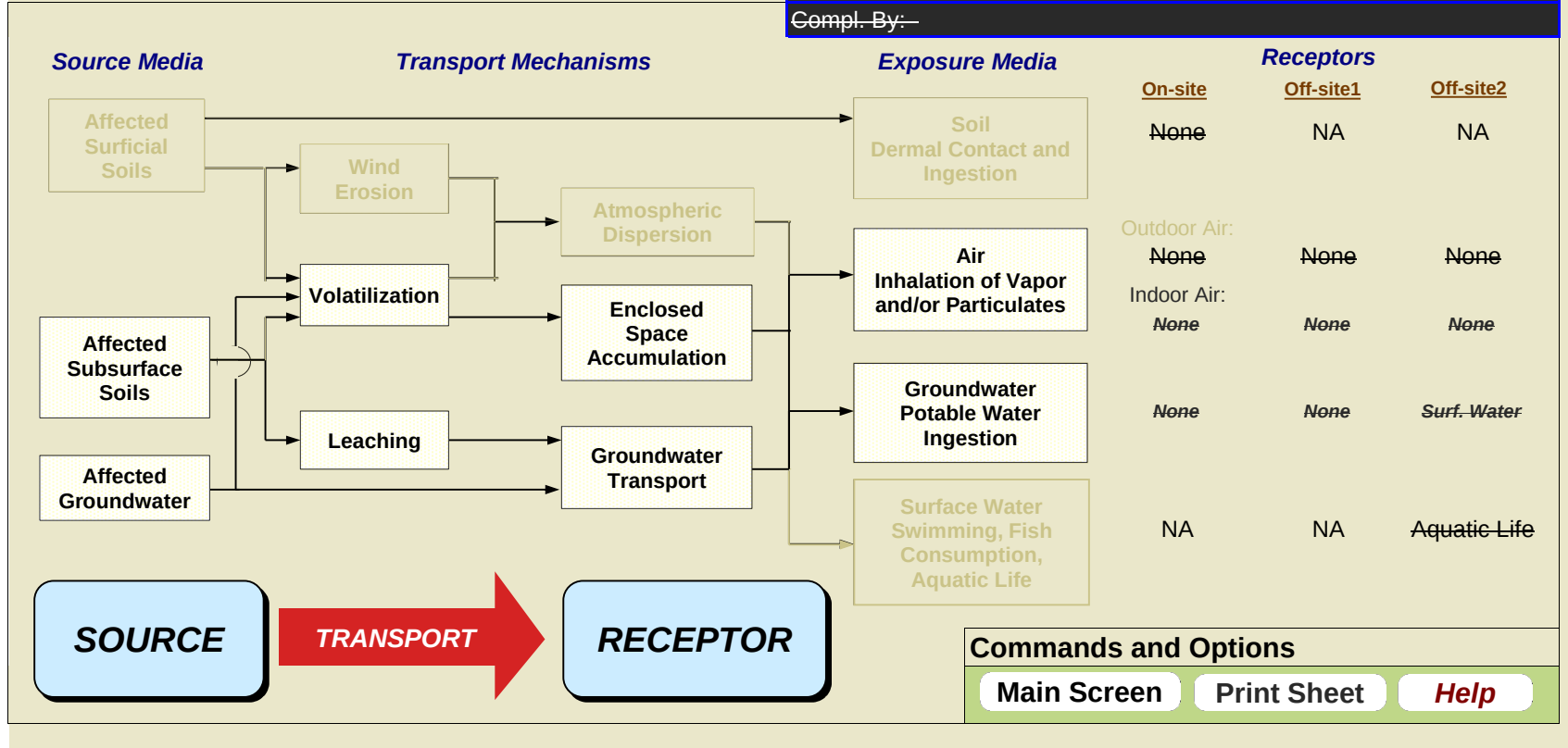
Print Sheet

Set Units

Help

Exposure Pathway Flowchart

Site Name:— Job ID:—
 Location:— Date: 0-Jan-00
 Compl. By:—



RBCA SITE ASSESSMENT	User-Specified COC Data
----------------------	-------------------------

REPRESENTATIVE COC CONCENTRATIONS IN SOURCE MEDIA

CONSTITUENT	Representative COC Concentration			
	Groundwater		Soils (1–30 m)	
	value (mg/L)	note	value (mg/kg)	note
Aluminum	0.3E-1	Redvale-leachate-LCS1-95UC		
Antimony	7.4E-3	Redvale-leachate-LCS1-95UC		
Arsenic	1.4E-1	Redvale-leachate-LCS1-95UC		
Barium	3.9E+0	Redvale-leachate-LCS1-95UC		
Beryllium	1.0E-2	WMI-Leachate-Report-Max		
Boron	1.9E+1	Redvale-leachate-LCS1-95UC		
Cadmium	9.4E-4	Redvale-leachate-LCS1-95UC		
Chromium (III) (total chromium)	2.9E-1	Redvale-leachate-LCS1-95UC		
Copper	1.2E-1	Redvale-leachate-LCS1-95UC		
Fluoride (soluble fluoride)	6.4E-1	Redvale-leachate-LCS1-95UC		
Lead (inorganic)	2.3E-2	Redvale-leachate-LCS1-95UC		
Lithium	6.9E-1	Redvale-leachate-LCS1-95UC		
Mercury	4.5E-4	Redvale-leachate-LCS1-95UC		
Molybdenum	3.9E-3	Redvale-leachate-LCS1-95UC		
Nickel	1.5E-1	Redvale-leachate-LCS1-95UC		
Selenium	2.0E-2	Redvale-leachate-LCS1-95UC		
Silver	1.4E-3	Redvale-leachate-LCS1-95UC		
Tin	1.3E-2	Redvale-leachate-LCS1-95UC		
Vanadium	7.7E-2	Redvale-leachate-LCS1-95UC		
Zinc	4.0E-1	leachate-LCS1-95UCL-10-YR		
Cyanide	5.0E-2	Redvale-leachate-LCS1-95UC		
Aniline	7.2E+0	Redvale-leachate-LCS1-95UC		
Benzene	7.4E-3	Redvale-leachate-LCS1-95UC		
Bromodichloromethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Bromoform	1.0E+0	Redvale-leachate-LCS1-95UC		
Carbon disulfide	5.0E+0	Redvale-leachate-LCS1-95UC		
Carbon tetrachloride	1.6E-3	Redvale-leachate-LCS1-95UC		
Chlordane, gamma	3.0E-2	WAC-Class-1		
Chlorobenzene	1.0E+0	Redvale-leachate-LCS1-95UC		
Chloroform	1.5E-3	Redvale-leachate-LCS1-95UC		
Dibromochloromethane	1.1E+0	Redvale-leachate-LCS1-95UC		
Dimethylphthalate	3.2E+0	Redvale-leachate-LCS1-95UC		
Endrin	1.7E+0	Redvale-leachate-LCS1-95UC		
Ethyl benzene	4.5E+1	Redvale-leachate-LCS1-95UC		
Heptachlor	1.7E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobutadiene	1.1E+0	Redvale-leachate-LCS1-95UC		
Hexachlorobenzene	1.3E+0	Redvale-leachate-LCS1-95UC		
Hexachloroethane	1.3E+0	Redvale-leachate-LCS1-95UC		
Cresol, m-	2.2E-2	Redvale-leachate-LCS1-95UC		
Methoxychlor	1.0E+1	Redvale-leachate-LCS1-95UC		
Methyl ethyl ketone	3.2E+3	Redvale-leachate-LCS1-95UC		
Naphthalene	1.0E+1	Redvale-leachate-LCS1-95UC		
Nitrobenzene	1.9E+0	Redvale-leachate-LCS1-95UC		
Cresol, o-	3.5E+1	Redvale-leachate-LCS1-95UC		
Cresol, p-	0.4E+2	Redvale-leachate-LCS1-95UC		
Pentachlorophenol	8.5E-1	Redvale-leachate-LCS1-95UC		
Phenol	2.0E+2	Redvale-leachate-LCS1-95UC		
Polychlorinated biphenyls (liquid)	3.6E-2	Redvale-leachate-LCS1-95UC		
Pyridine	5.9E+0	WAC-Class-1		
Tetrachloroethylene	1.8E-3	Redvale-leachate-LCS1-95UC		
Toluene	2.8E-2	Redvale-leachate-LCS1-95UC		
Toxaphene	5.0E-1	WAC-Class-1		
Tributyltin oxide ^a	9.2E-4	Redvale-leachate-LCS1-95UC		
Trichloroethylene	1.9E+0	Redvale-leachate-LCS1-95UC		
Vinyl chloride	9.3E+0	Redvale-leachate-LCS1-95UC		
Xylene, m-	9.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, o-	3.0E+1	Redvale-leachate-LCS1-95UC		
Xylene, p-	9.0E+1	Redvale-leachate-LCS1-95UC		
Trichloroethane, 1,1,2-	9.7E-1	Redvale-leachate-LCS1-95UC		
Tetrachloroethane, 1,1,2,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, 1,1-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dibromo-3-chloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, cis-1,2-	2.1E+0	Redvale-leachate-LCS1-95UC		
Dichloroethylene, trans-1,2	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloropropane, 1,2-	1.0E+0	Redvale-leachate-LCS1-95UC		
Dichloroethane, 1,2-	1.7E-3	Redvale-leachate-LCS1-95UC		
Dichloropropene, 1,3-	1.5E+0	Redvale-leachate-LCS1-95UC		
Dichlorobenzene, 1,4-	2.9E+0	Redvale-leachate-LCS1-95UC		
Chlorophenol, 2-	2.4E+0	Redvale-leachate-LCS1-95UC		
Dichlorophenol, 2,4-	6.4E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,5-	6.3E-1	Redvale-leachate-LCS1-95UC		
Trichlorophenol, 2,4,6-	6.8E-1	Redvale-leachate-LCS1-95UC		
Dichlorophenoxyacetic acid, 2,4-	1.0E+1	WAC-Class-1		
Dinitrotoluene, 2,4-	1.8E+0	Redvale-leachate-LCS1-95UC		
PFHxS	8.0E-4	Redvale-leachate-LCS1-MAX		
PFOS	4.3E-4	Redvale-leachate-LCS1-MAX		
PFDA	6.7E-4	Redvale-leachate-LCS1-MAX		
PFHpA	3.3E-4	Redvale-leachate-LCS1-MAX		

RBGA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
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Site Name:-	Site Location:-	Completed By:-	Date Completed: 0-Jan-00
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1 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY

OFF-SITE GROUNDWATER EXPOSURE PATHWAYS	☐ (CHECKED IF PATHWAY IS ACTIVE)
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SOILS LEACHING TO GROUNDWATER

Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc. limit reached? ("■" if yes) ; Time (yr)	
	Soil Conc. (mg/kg)	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None	Off-site 1 (0-m) None	Off-site 2 (480-m) None
Aluminum						NA	NA
Antimony						NA	NA
Arsenic						NA	NA
Barium						NA	NA
Beryllium						NA	NA
Boron						NA	NA
Cadmium						NA	NA
Chromium (III) (total chromium)						NA	NA
Copper						NA	NA
Fluorine (soluble fluoride)						NA	NA
Lead (inorganic)						NA	NA
Lithium						NA	NA
Mercury						NA	NA
Molybdenum						NA	NA
Nickel						NA	NA
Selenium						NA	NA
Silver						NA	NA
Tin						NA	NA
Vanadium						NA	NA
Zinc						NA	NA
Cyanide						NA	NA
Aniline						NA	NA
Benzene						NA	NA
Bromodichloromethane						NA	NA
Bromoform						NA	NA
Carbon disulfide						NA	NA
Carbon tetrachloride						NA	NA

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Chlordane, gamma						NA	NA
Chlorobenzene						NA	NA
Chloroform						NA	NA
Dibromochloromethane						NA	NA
Dimethylphthalate						NA	NA
Endrin						NA	NA
Ethyl benzene						NA	NA
Heptachlor						NA	NA
Hexachlorobutadiene						NA	NA
Hexachlorobenzene						NA	NA
Hexachloroethane						NA	NA
Cresol, m-						NA	NA
Methoxychlor						NA	NA
Methyl ethyl ketone						NA	NA
Naphthalene						NA	NA
Nitrobenzene						NA	NA
Cresol, o-						NA	NA
Cresol, p-						NA	NA
Pentachlorophenol						NA	NA
Phenol						NA	NA
Polychlorinated biphenyls (liquid)						NA	NA
Pyridine						NA	NA
Tetrachloroethylene						NA	NA
Toluene						NA	NA
Toxaphene						NA	NA
Tributyltin oxide *						NA	NA
Trichloroethylene						NA	NA
Vinyl chloride						NA	NA
Xylene, m-						NA	NA
Xylene, o-						NA	NA
Xylene, p-						NA	NA
Trichloroethane, 1,1,2-						NA	NA
Tetrachloroethane, 1,1,2,2-						NA	NA
Dichloroethylene, 1,1-						NA	NA
Dibromo-3-chloropropane, 1,2-						NA	NA
Dichlorobenzene, 1,2-						NA	NA
Dichloroethylene, cis-1,2-						NA	NA
Dichloroethylene, trans-1,2						NA	NA
Dichloropropane, 1,2-						NA	NA

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Dichloroethane, 1,2-						NA	NA
Dichloropropene, 1,3-						NA	NA
Dichlorobenzene, 1,4-						NA	NA
Chlorophenol, 2-						NA	NA
Dichlorophenol, 2,4-						NA	NA
Trichlorophenol, 2,4,5-						NA	NA
Trichlorophenol, 2,4,6-						NA	NA
Dichlorophenoxyacetic acid, 2,4-						NA	NA
Dinitrotoluene, 2,4-						NA	NA
PFHxS						NA	NA
PFOS						NA	NA
PFOA						NA	NA
PFHpA						NA	NA

NOTE: POE = Point of exposure

RBCA SITE ASSESSMENT	Tier 2 Domenico Groundwater Modeling Summary
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Site Name:- Site Location:- Completed By:- Date Completed: 0-Jan-00 2 OF 2

DOMENICO GROUNDWATER MODELING SUMMARY							
OFF-SITE GROUNDWATER EXPOSURE PATHWAYS ☐ (CHECKED IF PATHWAY IS ACTIVE)							
GROUNDWATER:-							
Constituents of Concern	1) Source Medium	2) Steady-state Exposure Concentration Groundwater: POE Conc. (mg/L)		3) POE Concentration Limit Groundwater: POE Conc. (mg/L)		4) Time to Reach POE Conc. Limit Conc reaches limit? ("■" If yes) ; Time (yr)	
	Groundwater Conc. (mg/L)	Off-site 1 (0 m) None	Off-site 2 (480 m) Surf. Water	Off-site 1 (0 m) None	Off-site 2 (480 m) Surf. Water	Off-site 1 (0 m) None	Off-site 2 (480 m) Surf. Water
Aluminum	9.3E-1		7.1E-3		3.0E+2	NA	☐ NA
Antimony	7.4E-3		5.6E-5		4.8E+1	NA	☐ NA
Arsenic	1.4E-1		1.0E-3		1.3E+2	NA	☐ NA
Barium	3.9E+0		3.0E-2		5.4E+3	NA	☐ NA
Beryllium	1.0E-2		7.6E-5		7.0E-1	NA	☐ NA
Boron	1.9E+1		1.5E-1		5.0E+3	NA	☐ NA
Cadmium	9.4E-4		7.1E-6		1.1E+0	NA	☐ NA
Chromium (III) (total chromium)	2.9E-1		2.2E-3		1.8E+1	NA	☐ NA
Copper	1.2E-1		9.2E-4		7.5E+0	NA	☐ NA
Fluorine (soluble fluoride)	6.4E-1		4.9E-3		9.1E+3	NA	☐ NA
Lead (inorganic)	2.3E-2		1.8E-4		1.8E+1	NA	☐ NA
Lithium	6.9E-1		5.2E-3		4.0E+2	NA	☐ NA
Mercury	4.5E-4		3.4E-6		3.2E+0	NA	☐ NA
Molybdenum	3.9E-3		3.0E-5		1.8E+2	NA	☐ NA
Nickel	1.5E-1		1.2E-3		5.9E+1	NA	☐ NA
Selenium	2.0E-2		1.5E-4		5.9E+1	NA	☐ NA
Silver	1.4E-3		1.1E-5		2.7E-1	NA	☐ NA
Tin	1.3E-2		9.9E-5		1.6E+1	NA	☐ NA
Vanadium	7.7E-2		5.9E-4		3.2E+1	NA	☐ NA
Zinc	4.0E-1		3.0E-3		4.3E+1	NA	☐ NA
Cyanide	5.0E-2		3.8E-4		3.8E+1	NA	☐ NA
Aniline	7.2E+0		5.5E-2		1.3E+3	NA	☐ NA
Benzene	7.4E-3		6.6E-5		5.1E+3	NA	☐ NA
Bromodichloromethane	1.0E+0		8.0E-3		3.2E+2	NA	☐ NA
Bromoform	1.0E+0		4.1E-8		5.4E+2	NA	☐ NA
Carbon disulfide	5.0E+0		7.1E-6		1.1E+2	NA	☐ NA
Carbon tetrachloride	1.6E-3		1.6E-10		1.3E+3	NA	☐ NA

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Chlordane, gamma	3.0E-2		3.0E-102		4.3E-1	NA	☒	NA
Chlorobenzene	1.0E+0		1.0E-100		3.0E+2	NA	☒	NA
Chloroform	1.5E-3		1.3E-31		4.1E+3	NA	☒	NA
Dibromochloromethane	1.1E+0		1.4E-99		8.0E+2	NA	☒	NA
Dimethylphthalate	3.2E+0		7.3E-31		2.0E+4	NA	☒	NA
Endrin	1.7E+0		1.7E-100		1.1E-1	NA	☒	NA
Ethyl benzene	4.5E+1		4.5E-99		4.3E+2	NA	☒	NA
Heptachlor	1.7E+0		1.7E-100		4.8E-1	NA	☒	NA
Hexachlorobutadiene	1.1E+0		1.1E-100		2.1E-1	NA	☒	NA
Hexachlorobenzene	1.8E+0		1.8E-100		5.4E-1	NA	☒	NA
Hexachloroethane	1.8E+0		1.8E-100		1.9E+3	NA	☒	NA
Cresol, m-	2.3E-2		2.3E-102		1.1E+3	NA	☒	NA
Methoxychlor	1.0E+1		1.0E-99		2.7E-2	NA	☒	NA
Methyl ethyl ketone	3.2E+3		3.2E-97		5.4E+2	NA	☒	NA
Naphthalene	1.0E+1		1.0E-99		8.6E+1	NA	☒	NA
Nitrobenzene	1.9E+0		2.5E-91		3.0E+3	NA	☒	NA
Cresol, o-	3.5E+1		3.5E-99		2.1E+3	NA	☒	NA
Cresol, p-	9.4E+2		9.4E-98		5.4E+2	NA	☒	NA
Pentachlorophenol	8.5E-1		7.4E-79		5.4E+1	NA	☒	NA
Phenol	2.0E+2		2.0E-98		1.7E+3	NA	☒	NA
Polychlorinated biphenyls (liquid)	3.6E-2		3.6E-102		1.6E-1	NA	☒	NA
Pyridine	5.0E+0		5.0E-100		2.7E+4	NA	☒	NA
Tetrachloroethylene	1.8E-3		2.6E-75		3.8E+2	NA	☒	NA
Toluene	2.8E-2		2.8E-102		9.7E+2	NA	☒	NA
Toxaphene	5.0E-1		5.0E-101		1.1E+0	NA	☒	NA
Tributyltin oxide *	9.2E-4		9.2E-104		2.1E-2	NA	☒	NA
Trichloroethylene	1.8E+0		1.3E-38		1.6E+2	NA	☒	NA
Vinyl chloride	8.3E+0		3.4E-15		1.6E+0	NA	☒	NA
Xylene, m-	9.0E+1		9.0E-99		4.0E+2	NA	☒	NA
Xylene, o-	3.0E+1		6.6E-93		1.9E+3	NA	☒	NA
Xylene, p-	9.0E+1		9.0E-99		1.1E+3	NA	☒	NA
Trichloroethane, 1,1,2-	9.7E-1		7.8E-46		3.5E+4	NA	☒	NA
Tetrachloroethane, 1,1,2,2-	1.0E+0		1.0E-100		3.8E+2	NA	☒	NA
Dichloroethylene, 1,1-	1.0E+0		1.0E-100		3.8E+3	NA	☒	NA
Dibromo-3-chloropropane, 1,2-	1.0E+0		1.0E-100		5.4E+0	NA	☒	NA
Dichlorobenzene, 1,2-	1.0E+0		1.0E-100		8.6E+2	NA	☒	NA
Dichloroethylene, cis-1,2-	2.1E+0		1.9E-19		3.2E+2	NA	☒	NA
Dichloroethylene, trans-1,2	1.0E+0		1.8E-23		3.2E+2	NA	☒	NA
Dichloropropane, 1,2-	1.0E+0		3.3E-26		4.8E+3	NA	☒	NA

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Dichloroethane, 1,2-	1.7E-3		2.8E-50		1.0E+4	NA	☒	NA
Dichloropropene, 1,3-	1.5E+0		1.5E-100		1.1E+2	NA	☒	NA
Dichlorobenzene, 1,4-	2.9E+0		2.9E-100		1.4E+3	NA	☒	NA
Chlorophenol, 2-	2.4E+0		1.8E-2		2.6E+3	NA	☒	NA
Dichlorophenol, 2,4-	6.4E-1		6.4E-101		8.6E+2	NA	☒	NA
Trichlorophenol, 2,4,5-	6.3E-1		7.3E-62		1.1E+2	NA	☒	NA
Trichlorophenol, 2,4,6-	6.8E-1		9.9E-43		1.1E+2	NA	☒	NA
Dichlorophenoxyacetic acid, 2,4-	1.0E+1		1.0E-99		1.5E+3	NA	☒	NA
Dinitrotoluene, 2,4-	1.8E+0		3.3E-65		3.5E+2	NA	☒	NA
PFHxS	8.0E-4		6.1E-6		3.8E-1	NA	☒	NA
PFOS	4.3E-4		3.3E-6		3.8E-1	NA	☒	NA
PFOA	6.7E-4		5.1E-6		3.0E+0	NA	☒	NA
PFHpA	3.3E-4		2.5E-6		3.0E+0	NA	☒	NA

NOTE: POE = Point of exposure

Appendix F Take and Divert Modelling

Technical Memorandum

F1 Take and Divert numerical modelling

Note: This technical memorandum should be read in conjunction with the Hydrogeological Assessment described in the main body of this report, which provides a detailed description of the environmental setting and outlines the excavation requirements for the Class 2 footprint extension.

F1.1 Introduction

This technical memorandum summarises the groundwater numerical modelling undertaken to support the Hydrogeological Assessment.

The proposed excavation details for the Class 2 footprint extension assumed in this analysis are presented in Table Appendix F.1.

The geometry of the proposed Class 2 footprint extension is described in the Landfill Engineering Report. The basegrade slopes in the south-eastern direction towards the existing Pond 6 dam with a low point at approximately 66 m RL. The side slopes extend up at a grade of 3H:1V from the base. The flattest portion of the basegrade has been designed to a minimum grade of 2% grading towards the existing dam downslope of Pond 6 where the central leachate pipe is proposed. The floor of the landfill of the basegrade is generally steeper at approximately 3% forming a vee shape to enable leachate to drain towards the central leachate collection pipe. The sidewall extends towards the outer edge at a grade of 3H:1V from the edge of the floor.

Table Appendix F.1: Excavation details

Excavation level	Excavation area	Modelled dewatering duration
66 m RL	28,990 m ²	365 days <i>Representative of pseudo steady state conditions</i>

F1.2 Hydrogeological model

The model was constructed as a single-layer representation of the bulk hydraulic system, assuming averaged conditions across the excavated soil profile. The term "bulk hydraulic system" in groundwater modelling refers to an aggregated representation of the hydrogeological system, simplifying subsurface heterogeneity (e.g., multiple geological units, groundwater conditions) into a single layer.

The hydrogeological model assumed for the analysis base case is presented in Table Appendix F.2.

Table Appendix F.2: Base case model input parameters

Layer ID	Aquifer type	Initial water level* [m RL]	Initial Groundwater flow direction	Hydraulic gradient	Isotropic hydraulic conductivity [m/day]	Specific yield [-]
Layer1	Unconfined	82 m RL at approximate centre of excavation	102° east of north	0.058	3×10^{-4}	0.02

[-]: Dimensionless; *Based on the June 2021 groundwater contours.

F1.3 Groundwater modelling

F1.3.1 Method

Groundwater modelling was undertaken using the Analytical Element Method (AEM) using three-dimensional groundwater flow modelling software Analytical Aquifer Simulator (AnAqSim). This model was used to estimate time-dependent (transient) groundwater drawdown and inflow rates.

Groundwater lowering was simulated by applying a head-specified boundary condition (initial groundwater level set at 82 m RL) at the base of the excavation.

Model results are reported at three timesteps to capture the early time pumping rates at 30 days, and later time pumping rates and drawdown at 180, and 365 days, after dewatering has commenced.

A sensitivity analysis was undertaken to evaluate the influence of varying hydraulic conductivity on model outputs (refer Table Appendix F.3). This involved two additional model runs representing values half an order of magnitude above and below the base case. Run 2 corresponds to the base case and reflects the geometric mean of the upper and lower bounds.

Table Appendix F.3: Sensitivity analysis input parameters

Run	K horizontal [m/s]	K horizontal [m/day] See note
Run1	1×10^{-8}	9×10^{-4}
Run2 – base case	3×10^{-9} (Geometric mean)	3×10^{-4}
Run3	1×10^{-9}	9×10^{-5}

Note: Rounded

The groundwater modelling is based on several simplifying assumptions as outlined in Table Appendix F.4.

Table Appendix F.4: Method and model assumptions

Assumption	Implication and comment
Infiltration recharge does not occur	This assumption provides a more conservative drawdown assessment, i.e. the predicted drawdown extent is larger than if recharge is included.
Modelling undertaken assumed a timestep of 365 days to represent pseudo steady state conditions.	This approach reflects a long-term average scenario and is suitable when infiltration recharge is not included in the model.

Assumption	Implication and comment
Model assumed a single-layer representation of the “bulk hydraulic system” assuming an averaged hydraulic conductivity and specific yield across the excavated soil profile.	Analysis does not account for potential variation in the shallow geological units that have similar hydrogeological features. This assumption is suitable at a site scale when accompanied by a parameter sensitivity analysis.
External boundary conditions adopted were ‘Head Specified External Line Boundaries’, located 1 km radius from the excavation centre.	Site-specific boundary conditions at the site were not incorporated into the model. Checks were completed for each model run to ensure that the drawdown zone of influence did not reach the head-specified external boundary conditions, therefore this assumption is suitable.

F1.4 Results

The estimated time-dependent (transient) groundwater inflow rates into the excavation for the base case (Run 2) and sensitivity assessments (Runs 1 and 3) are reported in Table Appendix F.5 below. The estimated drawdowns in the groundwater table due to the excavation are shown in Figure Appendix F.2 to Figure Appendix F.7.

The estimated conservative (Run 1) radius of influence extends to approximately 100 m from the edge of the floor of the excavation after 365 days of continuous pumping (where dewatering has no influence on the groundwater table level). We note that on the western side of the excavation, the radius of influence remains within the excavation footprint (Figure Appendix F.1). After 180 days (approximately six months), the conservative radius of influence is predicted to extend to approximately 80 m from the edge of the floor of the excavation.

Table Appendix F.5: Estimated inflow rate(s) and radius of influence from the edge of the floor of the excavation

Sensitivity analysis Run	Inflow rate at 30-day timestep	Inflow rate at 180-day timestep	Approximate maximum radius of influence after 180 days	Inflow rate at 365-day timestep	Approximate maximum radius of influence after 365 days
Run1	102 m ³ /day	35 m ³ /day	80 m	19 m ³ /day	100 m
Run2 – base case	54 m ³ /day	21 m ³ /day	50 m	13 m ³ /day	60 m
Run3	26 m ³ /day	11 m ³ /day	20 m	7 m ³ /day	30 m

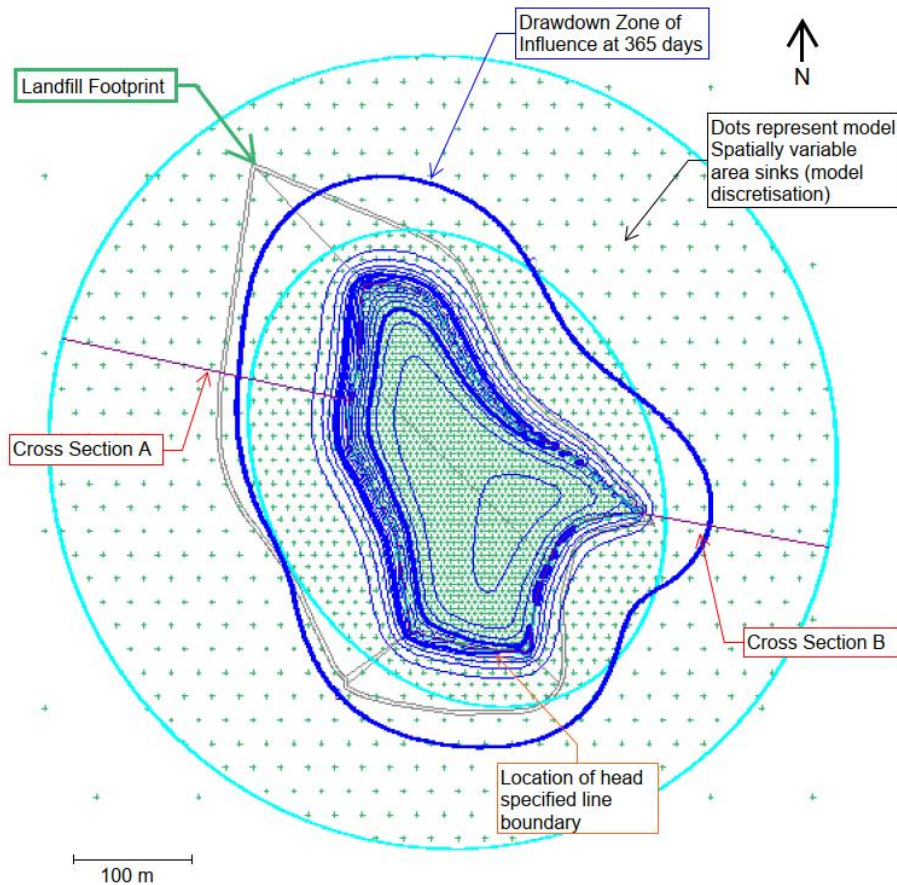


Figure Appendix F.1: Modelled zone of groundwater drawdown influence at 365 days (thick blue line) for base case (**Run 2**). Thick blue line represents location of where drawdowns in the groundwater table are estimated to be 0 m after 365 days due to modelled continuous inflows into the open excavation. The 'location of head specified line boundary' corresponds to the edge of the floor of the excavation, were the sidewalls start to steepen.

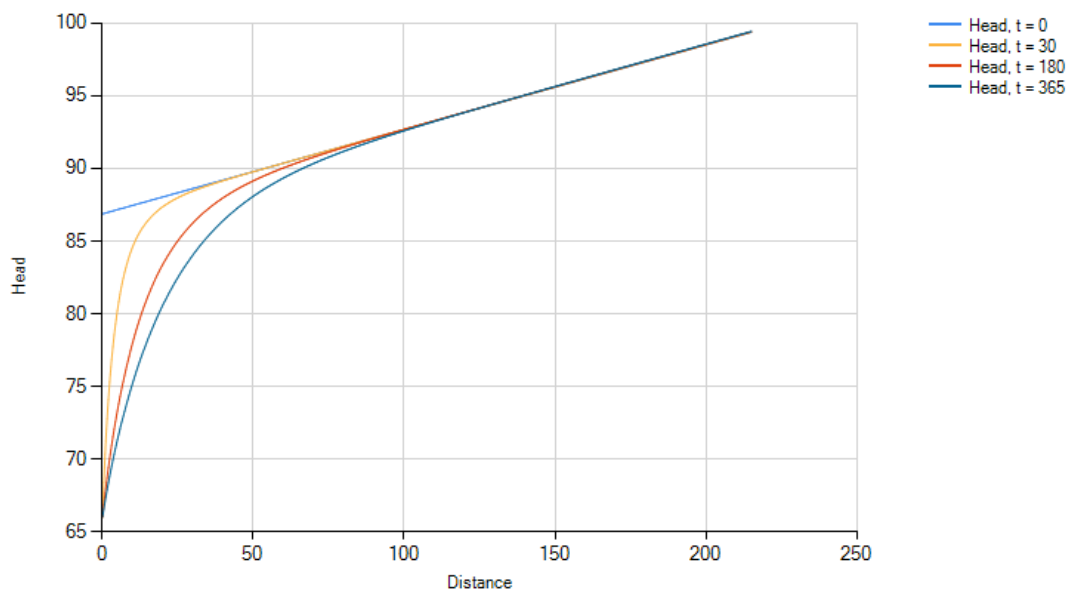


Figure Appendix F.2: **Cross section A** - groundwater drawdown (m) as function of distance from the edge of the floor of the excavation (head specified line boundary) (m). **Run 1**. Distance at 0 m corresponds to the edge of the floor of the excavation and distance increases toward the west.

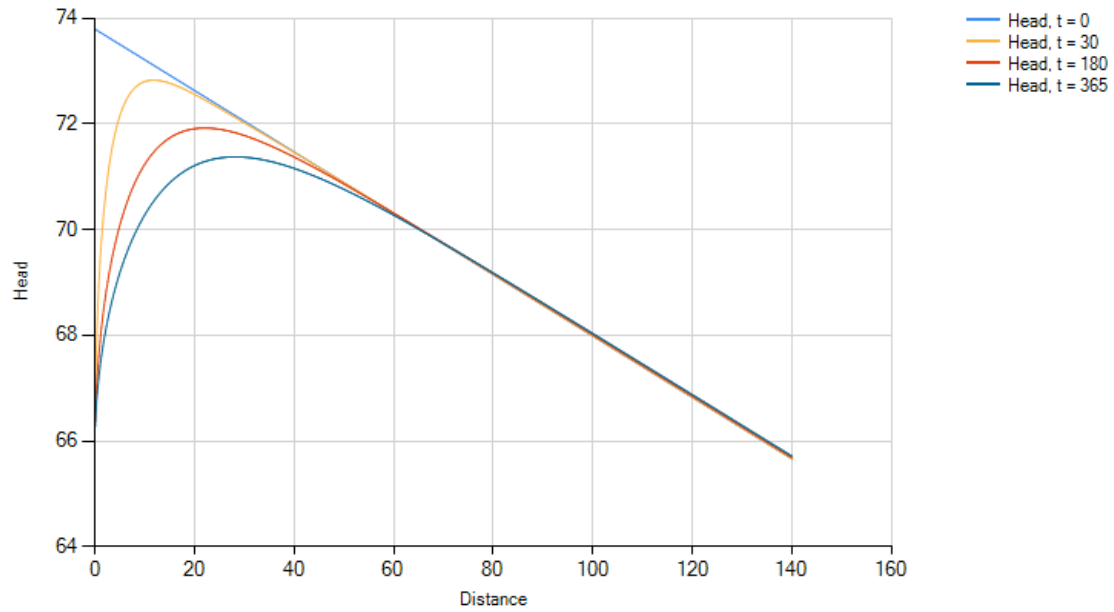


Figure Appendix F.3: **Cross section B** - groundwater drawdown (m) as function of distance from the edge of the floor of the excavation (head specified line boundary) (m). **Run 1**.

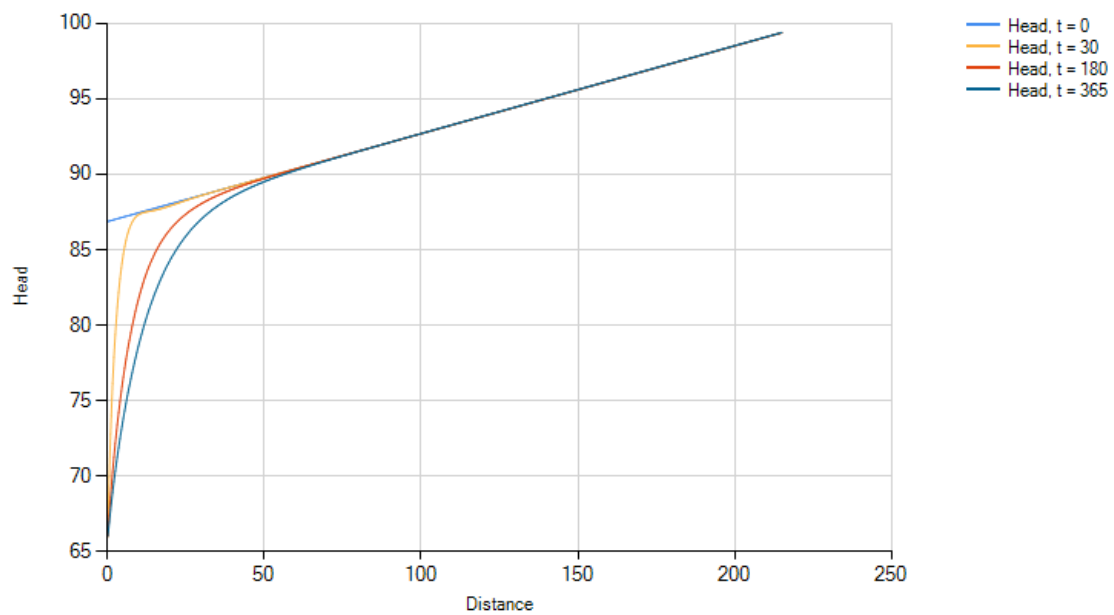


Figure Appendix F.4: **Cross section A** - groundwater drawdown (m) as function of distance from the edge of the floor of the excavation (head specified line boundary) (m). **Base case Run 2**. Distance at 0 m corresponds to the edge of the floor of the excavation and distance increases toward the west.

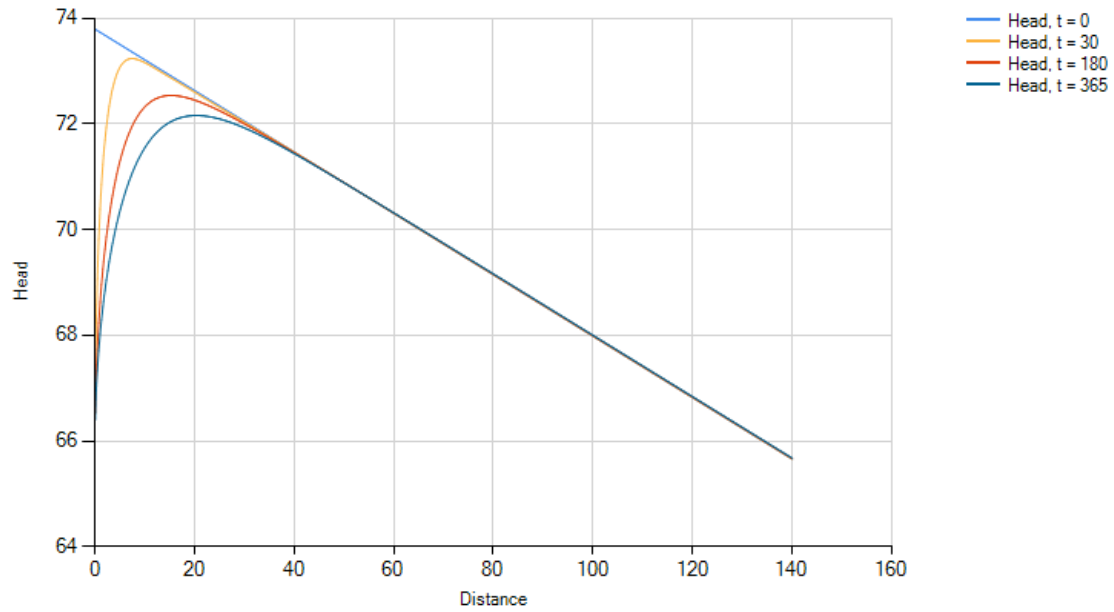


Figure Appendix F.5: **Cross section B** - groundwater drawdown (m) as function of distance from the edge of the floor of the excavation (head specified line boundary) (m). **Base case Run 2.**

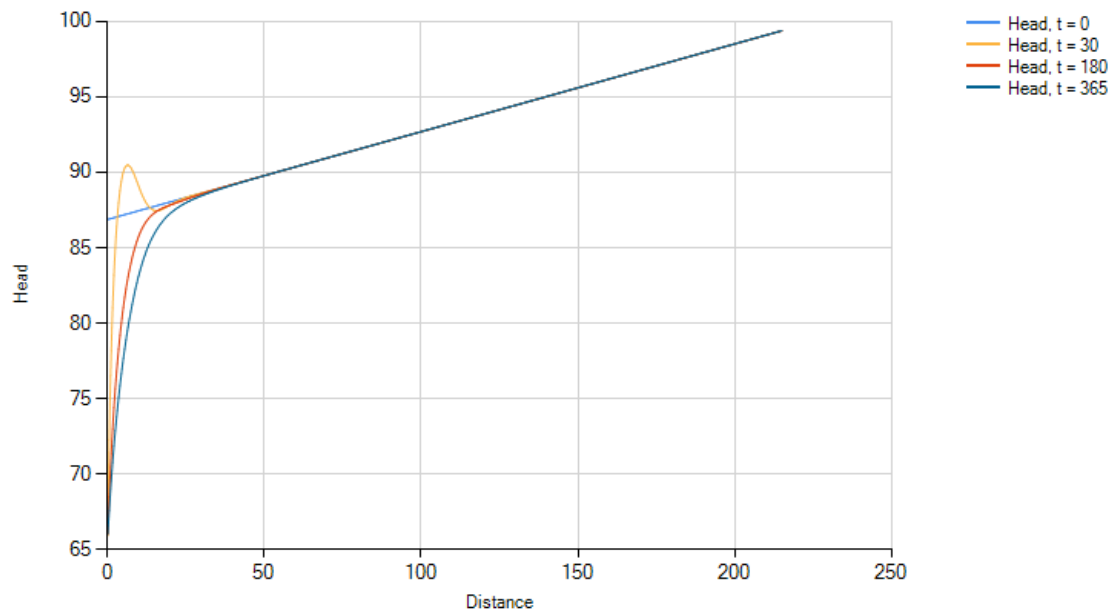


Figure Appendix F.6: **Cross section A** - groundwater drawdown (m) as function of distance from the edge of the floor of the excavation (head specified line boundary) (m). **Run 3.** Distance at 0 m corresponds to the edge of the floor of the excavation and distance increases toward the west.

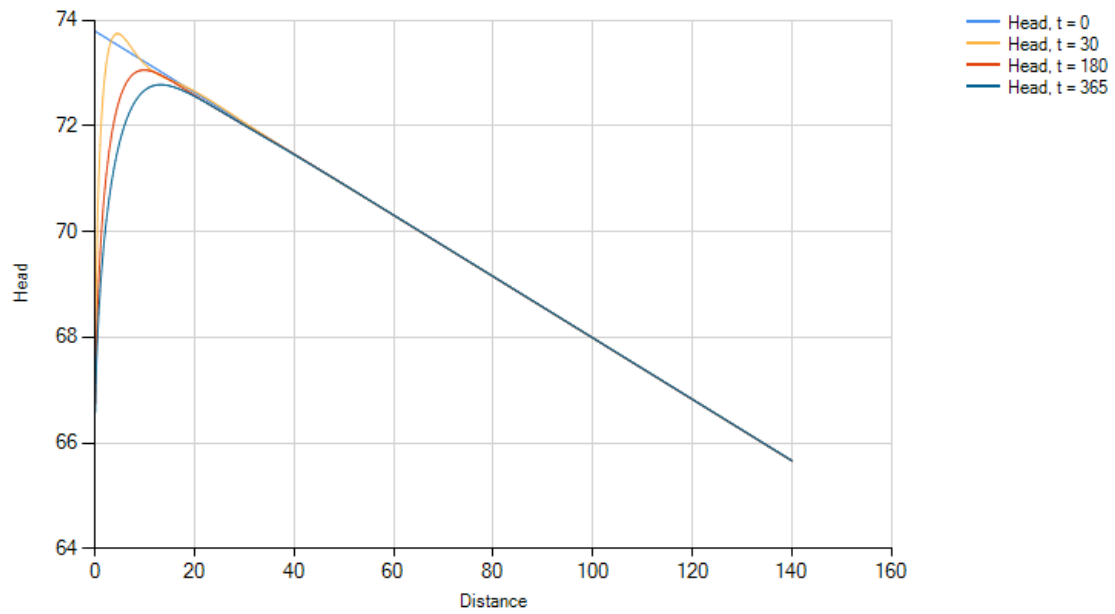


Figure Appendix F.7: **Cross section B** - groundwater drawdown (m) as function of distance from the edge of the floor of the excavation (head specified line boundary) (m). **Run 3.**



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