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Defining your legacy:

Practical and cost-effective methods to characterise a legacy landfill site

Welcome

What is a legacy landfill?

A legacy landfill (site) is…

‘A historical facility for the disposal of waste to land that is now closed, is unlikely to have environmental control and monitoring systems in accordance with today’s standards, and is not regulated via a specific licensing/authorisation process’

A



B



C



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Ongoing challenges

- Not constructed/operated/closed to a current standard
- Lack of documented information about the sites
- Lack of funding and/or ability to obtain funding (too late to consider in gate fees!)
- Lack of management/support/expertise



Why now? What's changed?

① Increased regulatory oversight

② Development pressures

③ Community awareness

④ Unanticipated hazards



Available guidelines

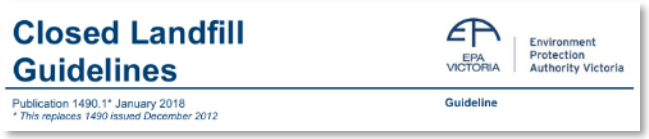
None specifically for legacy landfills in Australia – although something drafted by NSW EPA

NSW



Managing Environmental Risks from Legacy Landfills

Victoria



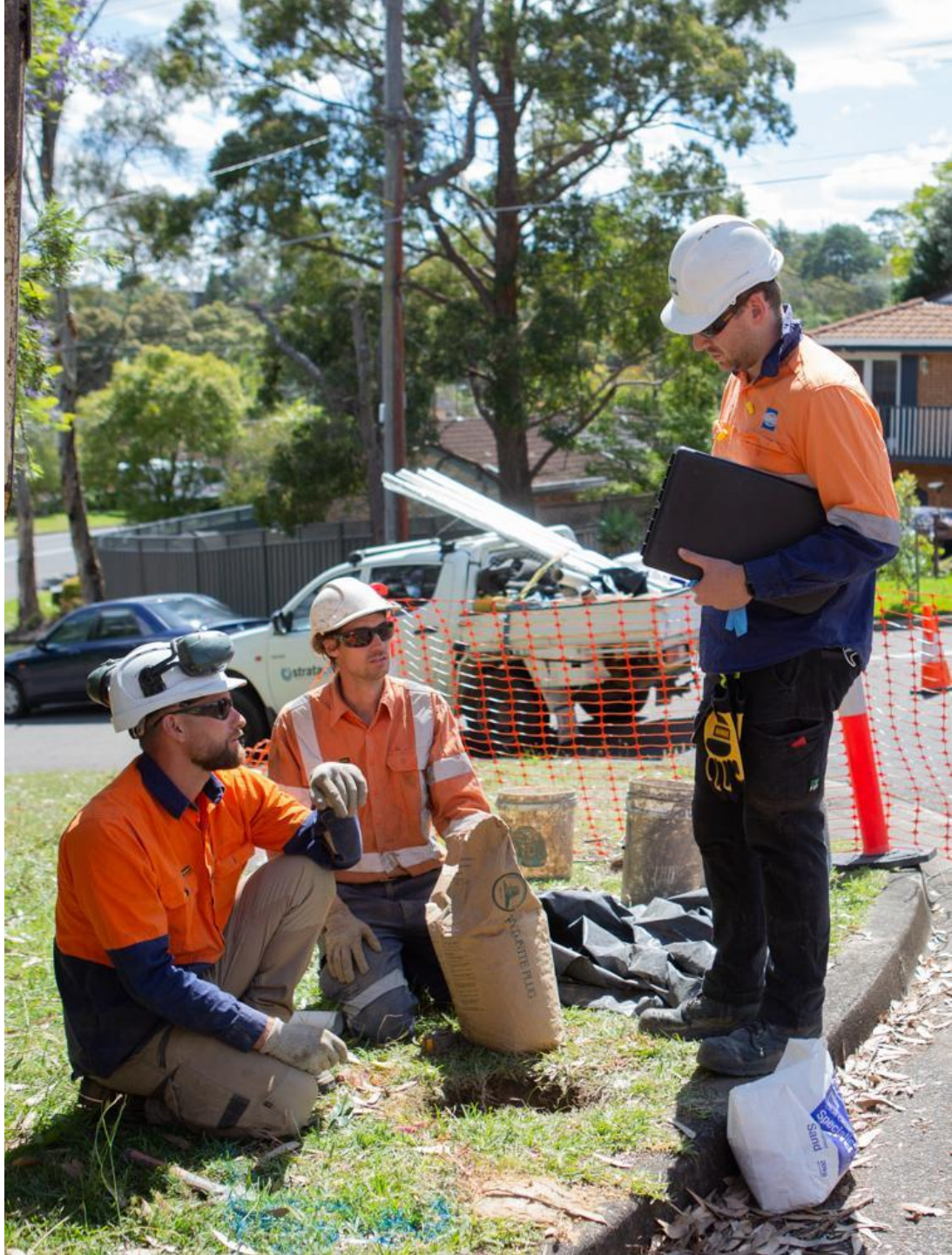
UK



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Why characterisation is important

- Risk is the driver, and risk cannot be adequately assessed without characterisation – same for liabilities
- You need to understand the problem (if there is one?!) before coming up with a solution
- Data gaps need to be understood and quantified – it's no use collecting the wrong data / collecting data for the sake of it
- It's not all about risk and liabilities – this process can help identify opportunities to beneficially reuse the site as well



Conceptual site models – a reliable framework

- Conceptual site models are a common tool that provide a unified characterisation of a site based on the available data

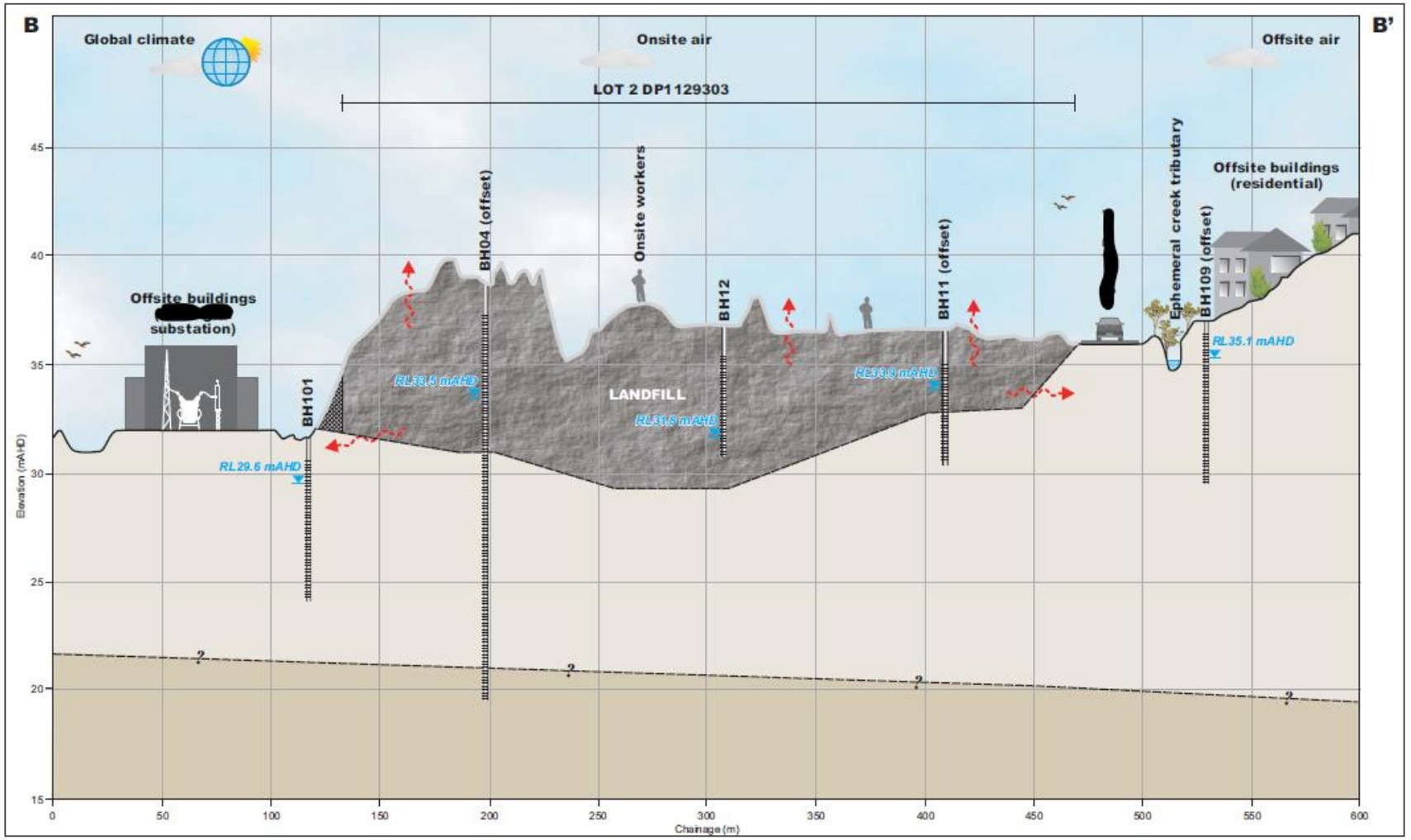
- Use a simplified model (source pathway receptor) to characterise the landfill and its risks – they can explain in one diagram what hundreds of pages of investigations are trying to say

- Can be progressively updated as more data is obtained / as the site and surround evolve

- A good conceptual site model tells the story of the site, in a way that is understandable for all relevant stakeholders and audiences

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Building a robust model



Sources → Migration Pathways → Exposure Pathways → Receptors

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Cost-effective activities

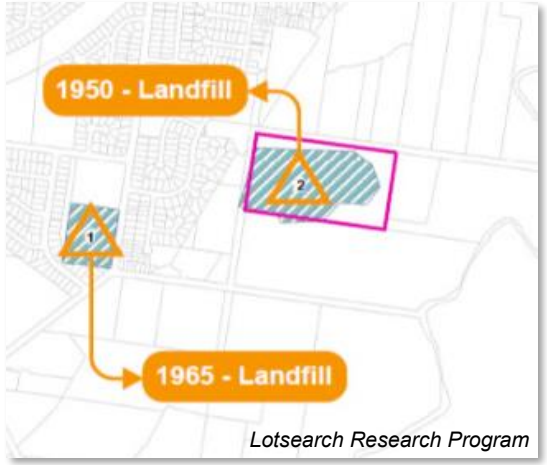
① Look at and consolidate relevant site records (file for each site)



② Interview current and previous staff and document



③ Proprietary Environmental Search report: legacy landfill component



④ Stakeholder engagement, community consultation, and use of historical societies



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Cost-effective tools

Spatial/GIS Services (e.g. QLD Globe, NSW SIX Maps, ACTmapi, etc.)

Aerial Photography Registers – Google Earth, Nearmaps, etc.

Before You Dig Australia

Australian Groundwater Explorer

National Greenhouse and Energy Reporting (NGER) Solid Waste Calculator

Simplified risk assessment packages (e.g. NSW EPA's E-RAMP, EPA VIC's self-assessment tool for closed landfill environmental risk)

Joint Waste Groups (for example Hunter Joint Organisation)

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Data gaps and risk screening

- The conceptual site model can be used to identify potential complete contamination source-pathway-receptor linkages. The data gap is what is preventing you from determining if it is actual or potential.

- The conceptual site model helps you to visualise the risk and screen out the high-risk linkages. In turn, this helps you rank your data gaps and assess the cost/benefit of filling those gaps

- Practicality is important – we'd all love to know the exact extent of a legacy landfill, but is that ever going to be practically achievable?

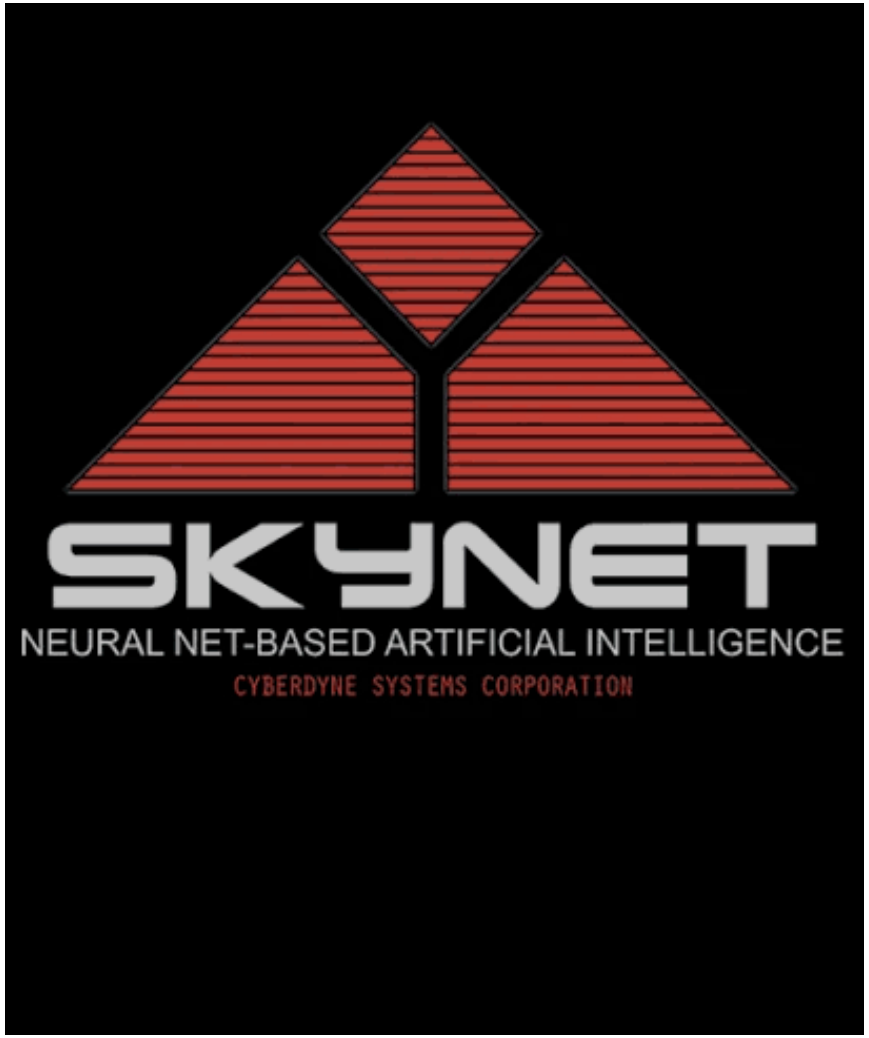


Generative AI – how can it help/hinder?

– Let’s have a go and find out!



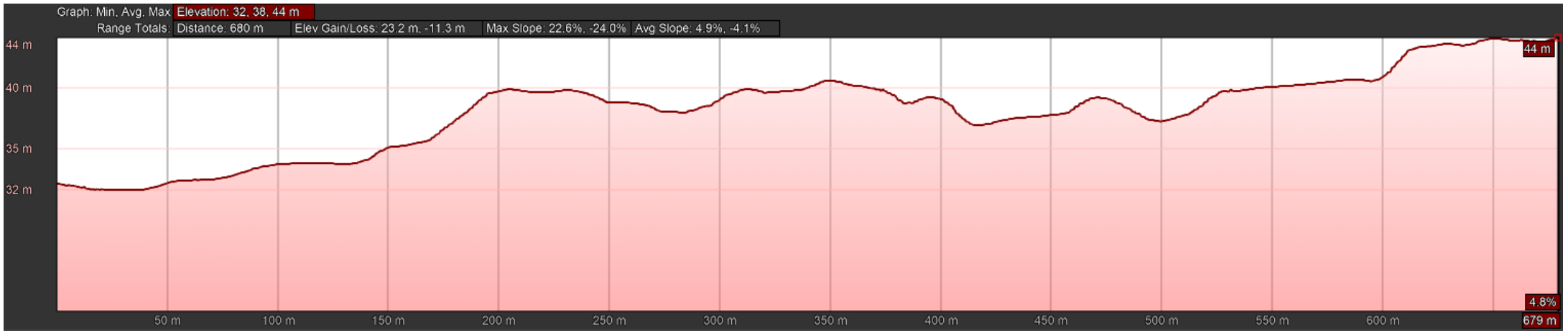




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Start with Googling, never fails.

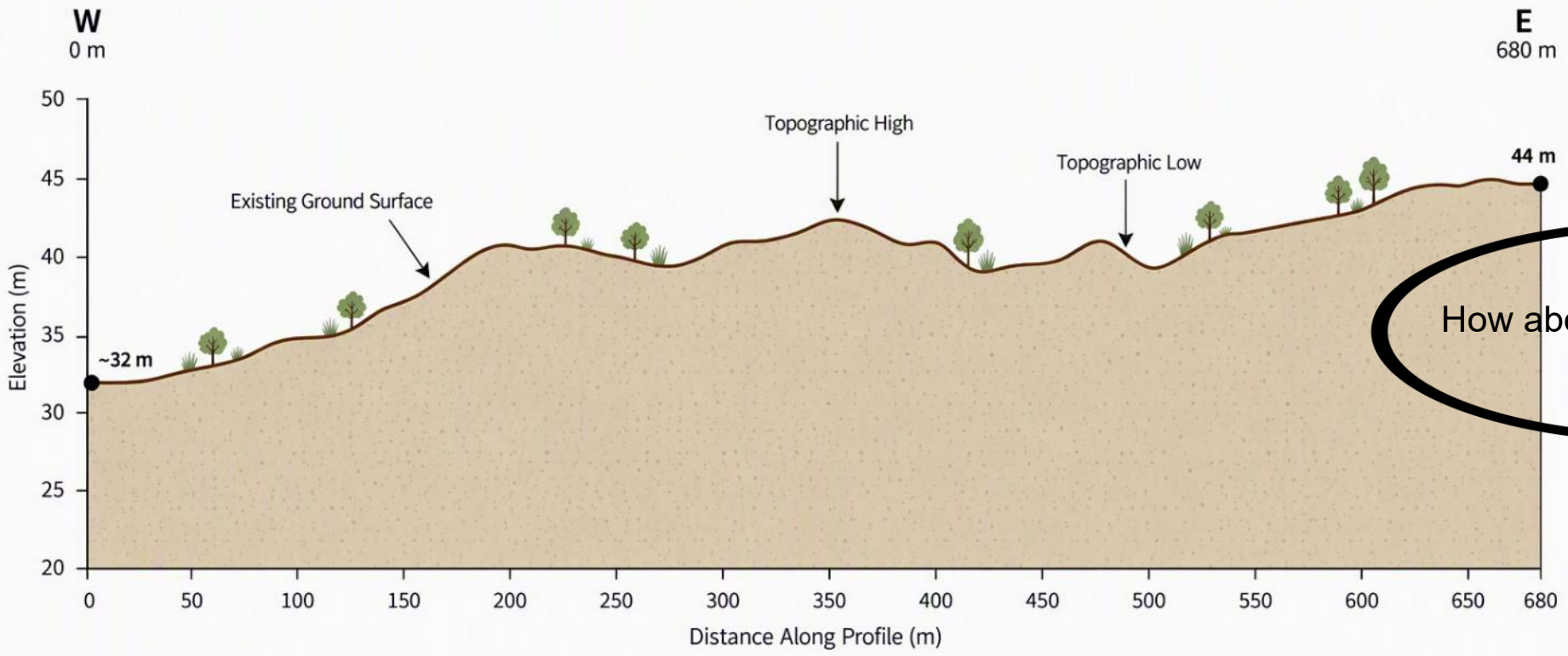




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Figure 1. Conceptual Site Model (2D Cross-Section)

West–East Profile (Length: 680 m)



How about some receptors?



Legend

- Existing Ground Surface (from provided profile)
- Surficial Soil (sand/silt, typical)

0 100 200 300

Scale (m)
(Profile Length = 680 m)

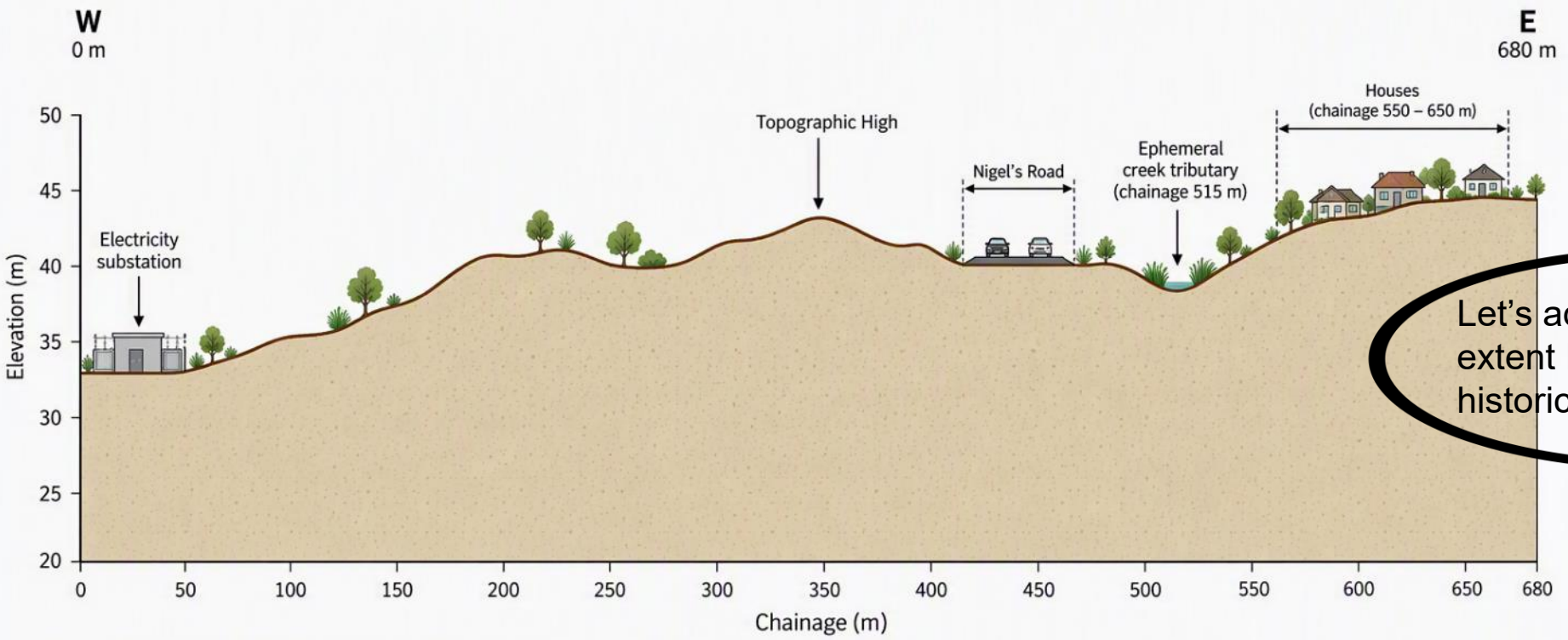
Note: This is a conceptual representation based on the provided elevation profile. Subsurface conditions, groundwater levels, and geological units are not shown at this stage.

For illustrative purposes only.

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Figure 1. Conceptual Site Model (2D Cross-Section)

West–East Profile (Length: 680 m)



Legend

- Existing ground surface (from provided profile)
- Surficial soil (sand/silt, typical)
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)

0 100 200 300

Horizontal Scale (m)
(Profile Length = 680 m)

Notes:

1. Existing ground surface based on provided elevation profile.
2. Site features (substation, road, creek tributary and houses) are indicative and shown for conceptual purposes only.
3. Subsurface conditions, groundwater levels and geological units are not shown at this stage.

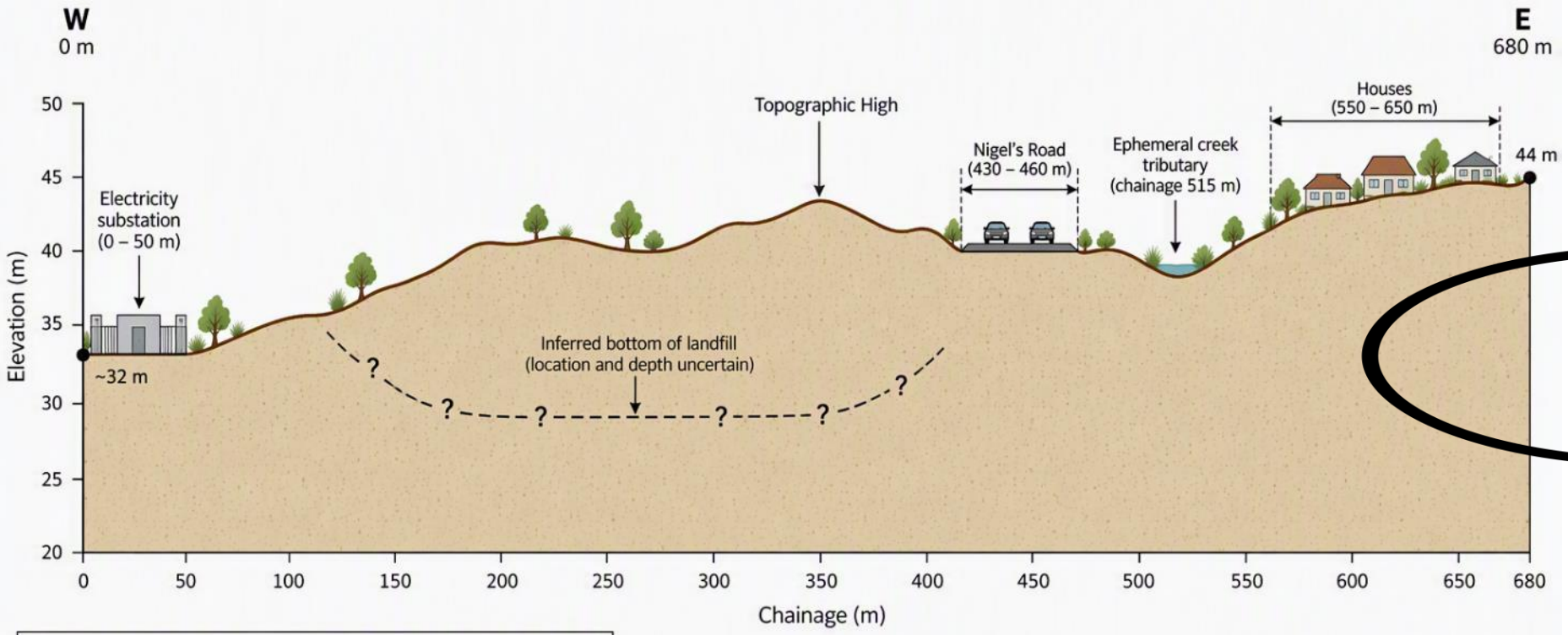
Let's add the inferred waste extent based on quarrying historical records



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Figure 1. Conceptual Site Model (2D Cross-Section)

West–East Profile (Length: 680 m)



Legend

- Existing ground surface (from provided profile)
- Surficial soil (sand/silt, typical)
- Inferred bottom of landfill (location and depth uncertain)
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)

0 100 200 300

Horizontal Scale (m)
(Profile Length = 680 m)

Notes:

1. Existing ground surface based on provided elevation profile.
2. Inferred bottom of landfill is conceptual only, based on available information.
3. Subsurface conditions, groundwater levels and geological units are not shown at this stage.
4. Site features (substation, road, creek tributary and houses) are indicative and shown for conceptual purposes only.

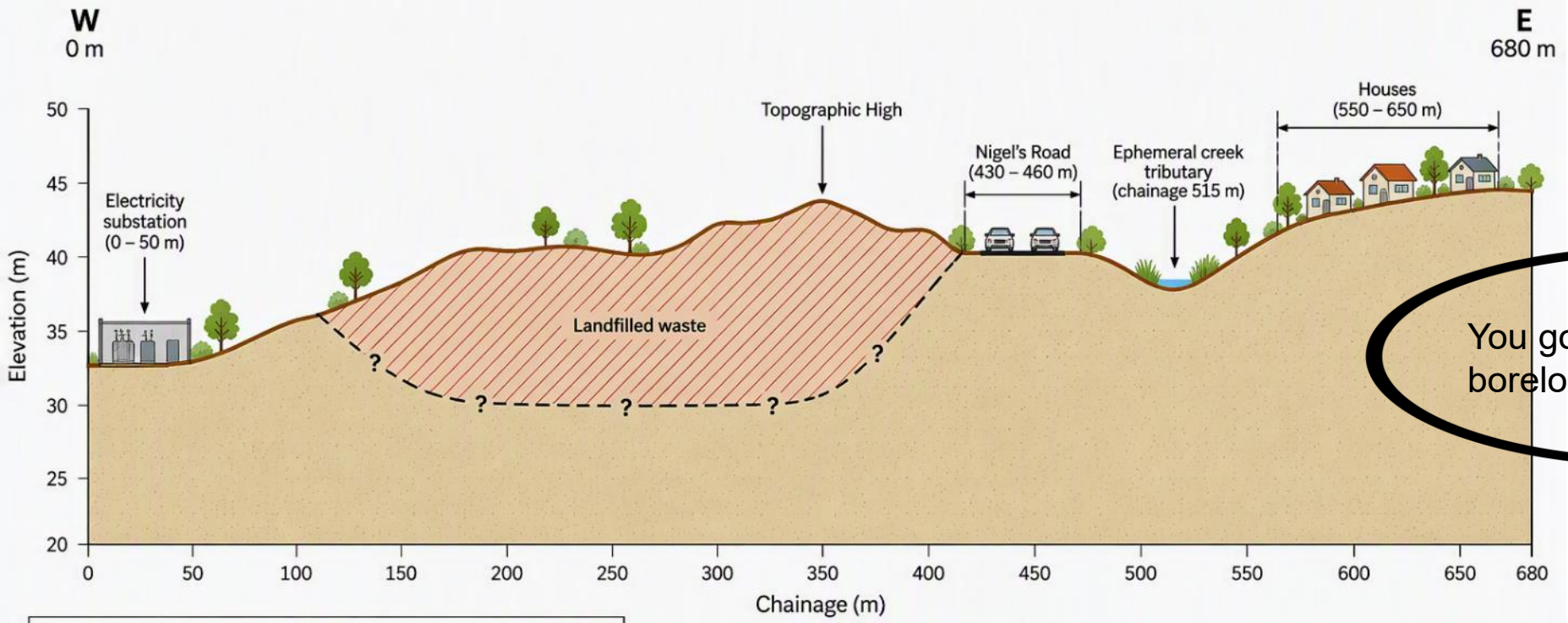
Not quite…



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Figure 1. Conceptual Site Model (2D Cross-Section)

West–East Profile (Length: 680 m)



Legend

- Existing ground surface (from provided profile)
- Surficial soil (sand/silt, typical)
- Landfilled waste
- Inferred bottom of landfill (location and depth uncertain)
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)

0 100 200 300

Horizontal Scale (m)
(Profile Length = 680 m)

Notes:

1. Existing ground surface based on provided elevation profile.
2. Extent and depth of landfilled waste are conceptual and subject to confirmation by further investigation.
3. Subsurface conditions, groundwater levels and geological units are not shown at this stage.
4. Site features (substation, road, creek tributary and houses) are indicative and shown for conceptual purposes only.

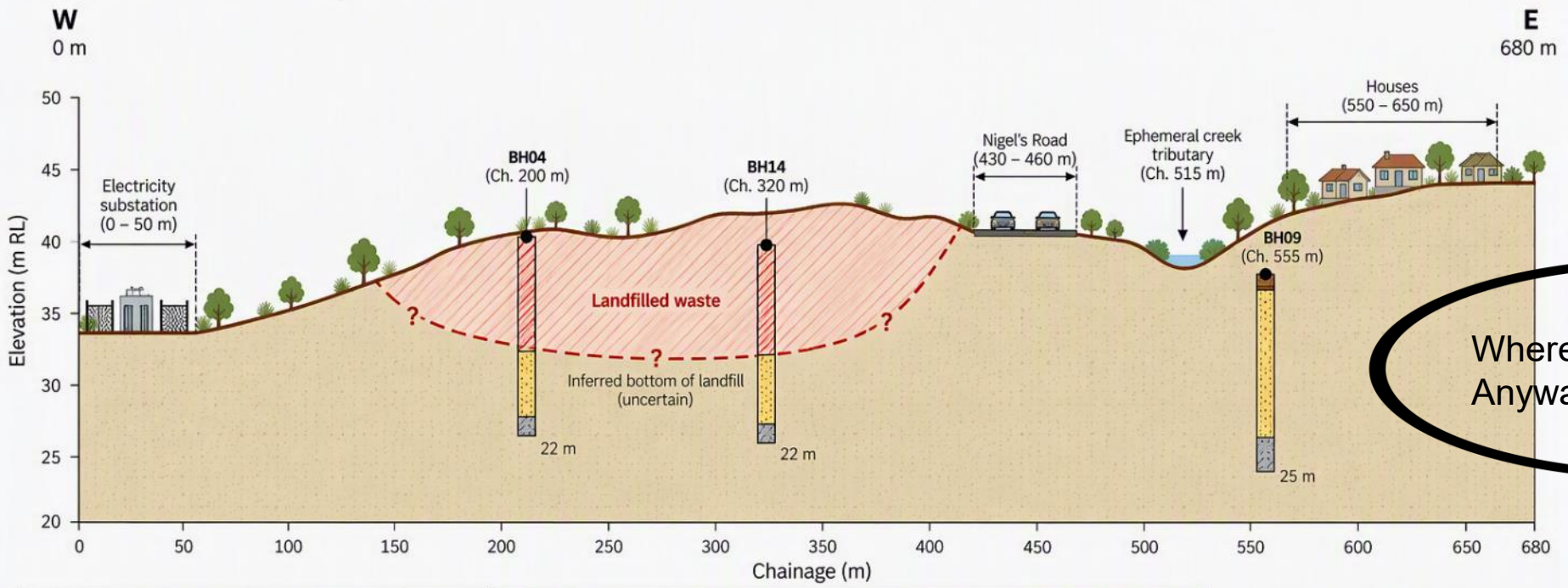
You got it, now how about borelogs?



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Figure 1. Conceptual Site Model (2D Cross-Section with Borelogs)

West–East Profile (Length: 680 m)





Legend

- Existing ground surface (from provided profile)
- Landfilled waste (interpreted from borelogs)
- Inferred bottom of landfill (uncertain)
- Surficial soil (sand/silt, typical)
- Topsoil
- Clay / silt
- Weathered rock / shale
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)
- Borehole (with lithology)

Borelog summaries (from import table)

BH04 (Ch. 200 m)
RL (collar): 40.0 m
Total depth: 22.0 m
- 0 – 10.0 m **Landfilled waste** (mixed waste – soil, rubble)
- 10.0 – 20.0 m **Clay** (silty clay)
- 20.0 – 22.0 m Weathered shale

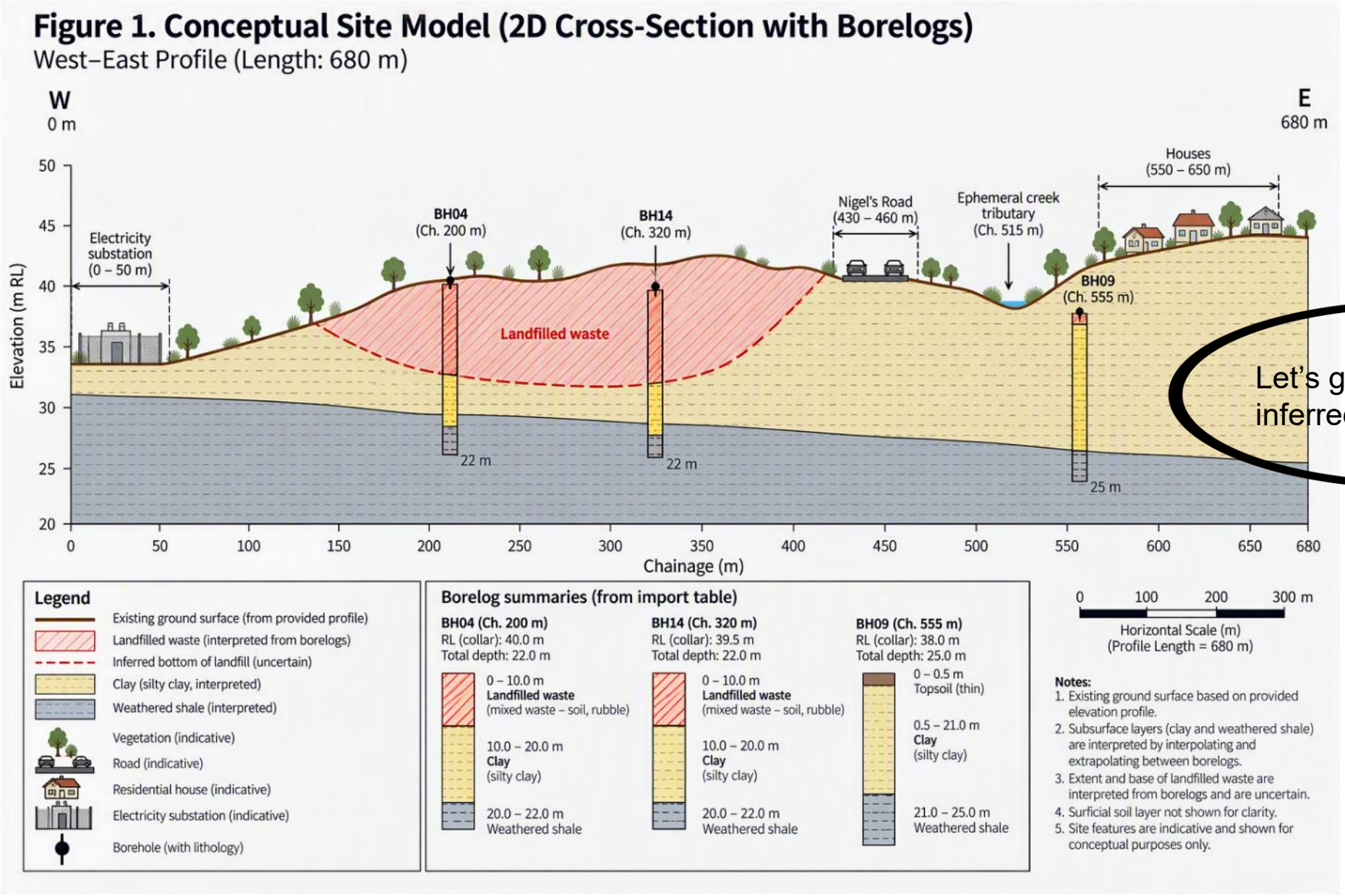
BH14 (Ch. 320 m)
RL (collar): 39.5 m
Total depth: 22.0 m
- 0 – 10.0 m **Landfilled waste** (mixed waste – soil, rubble)
- 10.0 – 20.0 m **Clay** (silty clay)
- 20.0 – 22.0 m Weathered shale

BH09 (Ch. 555 m)
RL (collar): 38.0 m
Total depth: 25.0 m
- 0 – 0.5 m **Topsoil**
- 0.5 – 21.0 m **Clay** (silty clay)
- 21.0 – 25.0 m Shale

0 100 200 300 m
Horizontal Scale (m)
(Profile Length = 680 m)

Notes:
1. Existing ground surface based on provided elevation profile.
2. Borelog information from imported table (CSM_Borelog_Import_NDDS).
3. Extent and base of landfilled waste are interpreted from borelogs and are uncertain.
4. Subsurface conditions between boreholes are inferred.
5. Site features are indicative and shown for conceptual purposes only.

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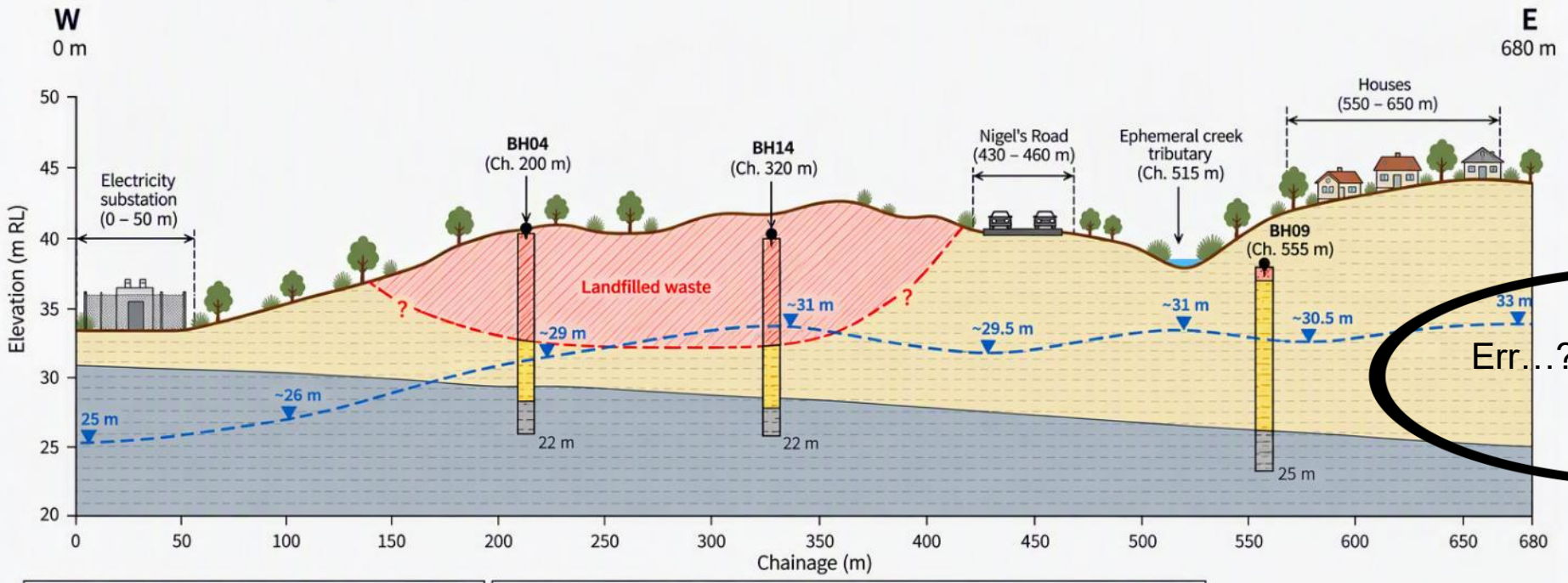
Let's get fancy, how about inferred groundwater levels?



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Figure 1. Conceptual Site Model (2D Cross-Section with Borelogs and Groundwater)

West–East Profile (Length: 680 m)



Err...? Interesting approach.



Legend

- Existing ground surface (from provided profile)
- Landfilled waste (interpreted from borelogs)
- Inferred bottom of landfill (uncertain)
- Clay (silty clay, interpreted)
- Weathered shale (interpreted)
- Interpreted Groundwater Surface
- Groundwater level (approximate RL)
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)
- Borehole (with lithology)

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BH09 (Ch. 555 m)
RL (collar): 38.0 m
Total depth: 25.0 m
- 0 – 0.5 m Topsoil (thin)
- 0.5 – 21.0 m **Clay** (silty clay)
- 21.0 – 25.0 m Weathered shale

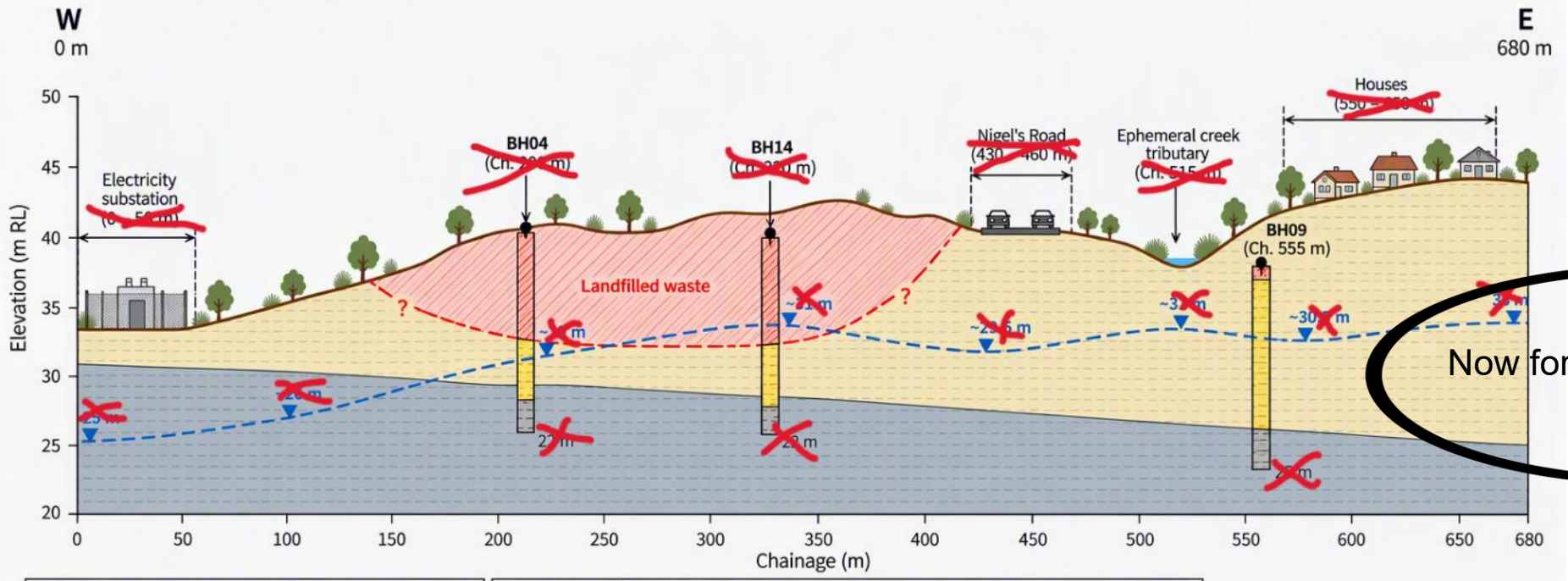
0 100 200 300 m
Horizontal Scale (m)
(Profile Length = 680 m)

Notes:
1. Existing ground surface based on provided elevation profile.
2. Groundwater surface is interpreted from conceptual hydrogeological assessment (RL 25 m at chainage 0 m to RL 33 m at chainage 680 m), with intermediate highs and lows.
3. Subsurface layers (clay and weathered shale) are interpreted by interpolating and extrapolating between borelogs.
4. Extent and base of landfilled waste are interpreted from borelogs and are uncertain.
5. Site features are indicative and shown for conceptual purposes only.

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Figure 1. Conceptual Site Model (2D Cross-Section with Borelogs and Groundwater)

West–East Profile (Length: 680 m)



Now for some hand markups.



Legend

- Existing ground surface (from provided profile)
- Landfilled waste (interpreted from borelogs)
- Inferred bottom of landfill (uncertain)
- Clay (silty clay, interpreted)
- Weathered shale (interpreted)
- Interpreted Groundwater Surface
- Groundwater level (approximate RL)
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)
- Borehole (with lithology)

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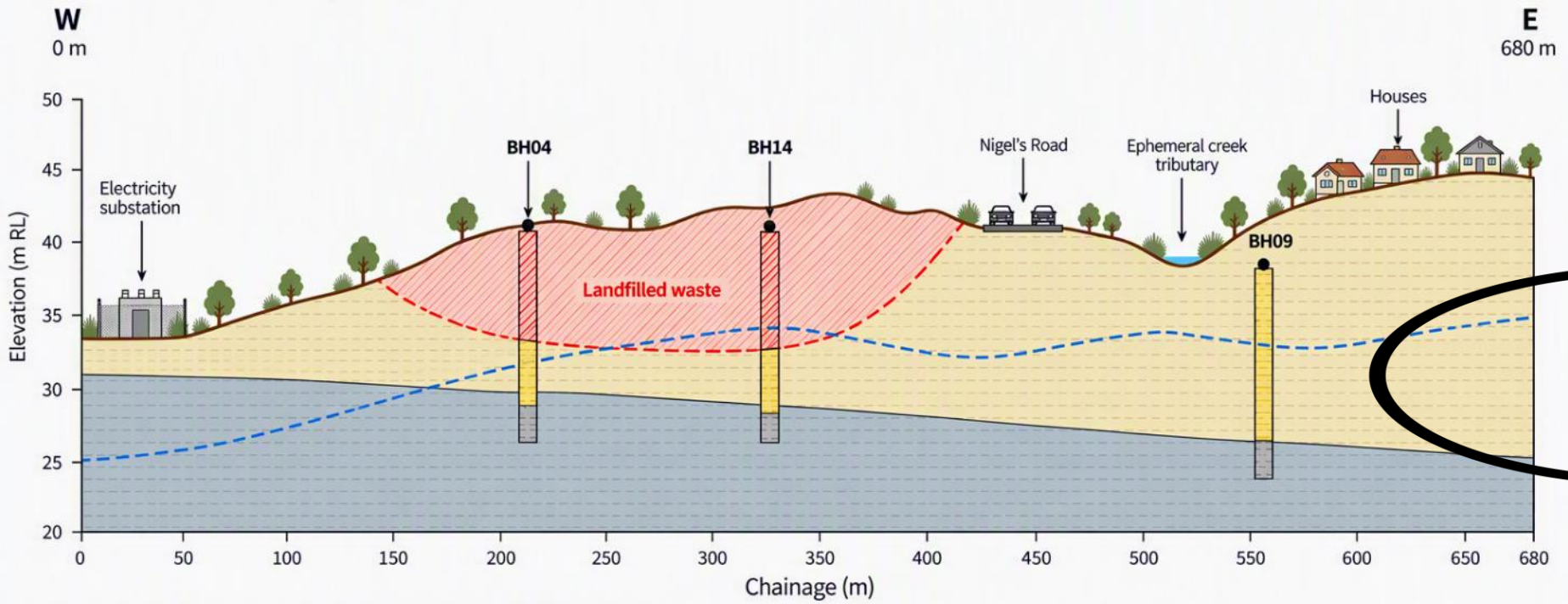
0 100 200 300 m
Horizontal Scale (m)
(Profile Length = 680 m)

Notes:
1. Existing ground surface based on provided elevation profile.
2. Groundwater surface is interpreted from conceptual hydrogeological assessment (RL 25 m at chainage 0 m to RL 33 m at chainage 680 m), with intermediate highs and lows.
3. Subsurface layers (clay and weathered shale) are interpreted by interpolating and extrapolating between borelogs.
4. Extent and base of landfilled waste are interpreted from borelogs and are uncertain.
5. Site features are indicative and shown for conceptual purposes only.

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Figure 1. Conceptual Site Model (2D Cross-Section)

West–East Profile (Length: 680 m)



Legend

- Existing ground surface (from provided profile)
- Landfilled waste (interpreted from borelogs)
- Inferred bottom of landfill (uncertain)
- Clay (silty clay, interpreted)
- Weathered shale (interpreted)
- Interpreted Groundwater Surface
- Vegetation (indicative)
- Road (indicative)
- Residential house (indicative)
- Electricity substation (indicative)
- Borehole (with lithology)

0 100 200 300 m

Horizontal Scale (m)
(Profile Length = 680 m)

Notes:

1. Existing ground surface based on provided elevation profile.
2. Groundwater surface is interpreted from conceptual hydrogeological assessment, rising from approximately RL 25 m at chainage 0 m to RL 33 m at chainage 680 m, with intermediate highs and lows.
3. Subsurface layers (clay and weathered shale) are interpreted by interpolating and extrapolating between borelogs.
4. Extent and base of landfilled waste are interpreted from borelogs and are uncertain.
5. Site features are indicative and shown for conceptual purposes only.

Not bad….



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Generative AI – how can it help/hinder? cont.

- Yes, it can do many things and offer a number of tools to support, such as helping you develop a conceptual site model.

- As with anything, the outputs need to be checked!

- It cannot overcome unverified and unsuitable data – garbage in, garbage out!

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Increasing value

Get the most out of a consultant and/or Auditor

1. The sooner the better!
2. We can be flexible
3. Navigate difficult conversations with the regulators
4. De-mystify unknowns
5. Educate and elevate
6. Achieving more together

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* Thank you

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