Panama Reserve/

Josef Langer Charitable Trust

Public Access Improvement

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Abstract

- The Panama Reserve, located in the Eastern Bays of Banks Peninsula, is a 200-hectareblock of regenerative native bush which is owned and managed by the Josef Langar Charitable Trust. Within the Reserve is a unique trachyte lava dome connected to an exposed feeder dyke. The reserve has a series of rough walking tracks and rock climbs, but accessibility to the area is limited to bikes and walkers via four entry sites.
- These access points require improvements to encourage and attract future visitation and usage of the reserve. The project provides recommendations and methods and costs, for access developments at the Panama Reserve, and directional signs for increasing recognition and visitation.
- Access improvements for Panama Reserve are focused on car parking. Due to the remote nature of the reserve vehicle and possibly bike access is the main way visitors will reach the reserve; therefore, infrastructure is required to support and enable their visitation.
- Current and potential car parking site locations were reviewed and investigated. Within these areas, geotechnical evaluation of the ground was completed through Hand Auger and Scala Penetrometer Testing as well as general site evaluation and surveying. Field data series were then analyzed, informing the ground bearing capacity of the site and site suitability.
- For each site estimated costs were derived, and investigations into potential restrictions and compliance issues i.e., Outstanding Natural Landscape, Cultural Significant Sites, property boundaries, and how these might affect the proposed development.

Findings

On-ground investigations found that of the three proposed car parking sites, sites labeled Upper and Lower Carpark meet the ground bearing capacity requirements to support a car park. These areas were also accessible and of suitable size. While the Middle Carpark was not tested for ground bearing capacity due to noticeably boggy ground and its inaccessibility to visitors in 2WD's.

Site Recommendations

Based on the findings it is recommended that the Upper and Lower car parks are developed further to allow access at both the top and bottom of the reserve to cater to different visitor needs and that informal corflute signs are placed along the two main entry routes to the reserve. At the Upper Carpark this is recommended as a gravel sealed 7 stall area, with bike rack and picnicking area. While the Lower Carpark is recommended as a grassed 13 stall area, also with bike parking.

Signage Recommendations

Access improvements and signage will not only make the area more suitable for public use, but also increase the reserve's appeal for visitors, support the Josef Langer Charitable Trust objective of providing education on the site's significance. One of the Josef Langer Charitable Trust's main objectives is to source and allocate funds for projects which support their charitable objects such as raising awareness for sustainable management of land and increasing monitoring on the quality of the environment, specifically on Banks Peninsular. By increasing the numbers of visitors there is an opportunity to increase their donation numbers, further helping other projects within the area.

Further research could be done to look at expanding car parking locations as visitor numbers increase.

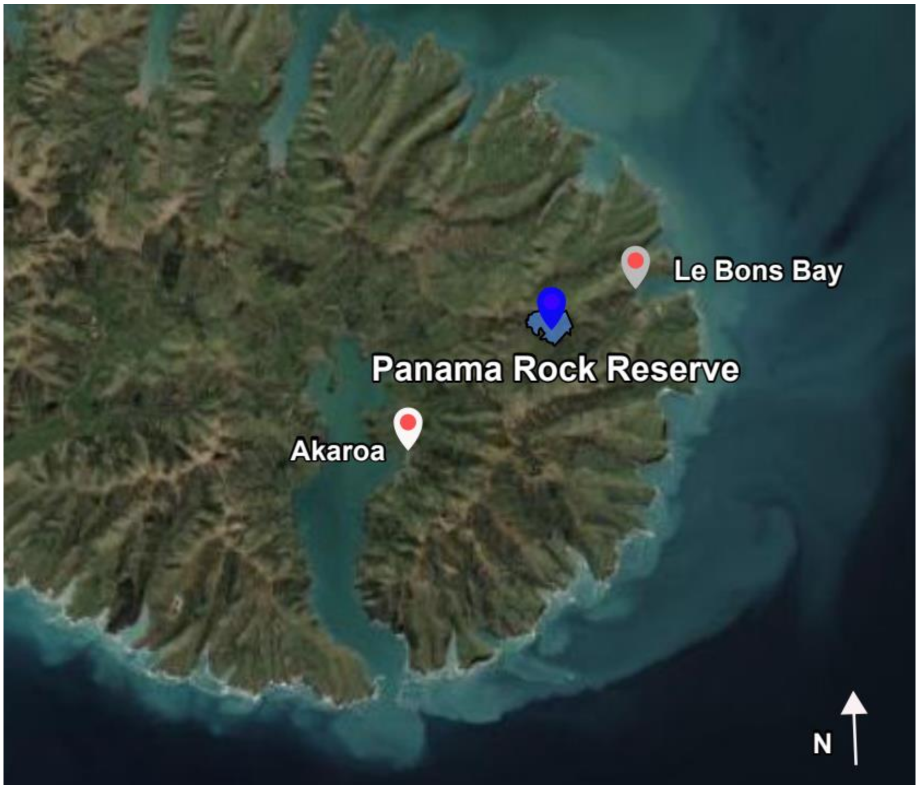


Figure 1: Location of Panama Reserve in reference to Le Bons Bay, Akaroa and the wider Banks Peninsular region

Figure 2: Location of Panama Reserve (Blue area) with reference to Le Bons Bay and the surrounding roads (Red)

1. Introduction

Location and Site Overview

Panama Reserve is located within the Eastern Bays of Banks Peninsular in the South Island of New Zealand. The reserve sits within the valley above Le Bons Bays, is a 90-minute drive from Central Christchurch and 30-minute drive from Akaora (the nearest town). Panama Reserve covers a 200-hectare block of land that was used for logging and farming in the 1800's.

In 2005 the Josef Langer Charitable Trust (JLCT) was established and has secured this land in order to reinstate regenerative bush within the area, which has been greatly achieved. While the trust continues Kaitiakitanga over this land and hopes to improve recognition of the area, they also seek to help other projects and communities within the Banks Peninsular area. Most notably within areas of conservation, sustainable management and enhancement of land, raising awareness for lands and researching quality of the environment which they do through funds raised from the Campsite and Lodge on site.

Aims

The aim of this research project is to understand areas in which access can be improved to Panama Reserve in order to increase accessibility and hopefully increase visitor rates.

Scope

The scope of this project encompasses both potential signage to direct visitors to the reserve as well as potential car parking solutions on site at the reserve.

Signage to the reserve has been investigated in the manner of where is most suitable to place signs for ease of visitor use, as well as what style of sign is most effective while also being cost effective.

Three potential/existing car park locations were identified to be tested through Hand Aguer, Scala Penetrometer testing and surveying to identify their suitability as a car park location. A site overview, observations, testing (if applicable), and recommendations and design has been completed for each of these sites outlining the results at each site. Lastly this report covers the quoted costs that each car park design will incur if carried out.

2.Signage to Reserve

Intro

To increase greater visitation to the reserve, greater recognition of the site is needed. A key approach to this is by placing signs on the connecting roadways to direct visitors to Panama Reserve. Current signage is restricted to the site itself and therefore improvements are required. This section provides recommendations and processes for implementing greater signage to Panama Reserve.

Two stage process 1) sign network, and 2) Types of signs. A sign network looks at the existing roading network and defines key intersections where signs are required to direct visitors to the reserve. There are various directional signs that can be implemented, from formal to informal. From sign network analysis. Identified sites were analyzed with several signage options presented. An overview recommendation for signage is included based on different criteria and costs.

2.1 Current Limitations

Lower Carpark

A limitation to development at this site is the difficulty of finding and driving Panama Road. The road is obscured by a blind turn when travelling from Akaroa via Summit and Le Bons Bay Road, that is easy to surpass unknowingly. Implemented signage will help in avoiding this limitation. Furthermore, visitors travelling from Okains Bay may also consider the journey to the Lower Carpark site to be too difficult or too far as well.

Upper Carpark

The main limitation to this car park design would be the road up to the car park. If someone wanted to come up from Big Hill Road or Camerons Track the drive can be very difficult in a 2WD car, especially for visitors that may not be used to driving on tight unpaved roads.
Okains Bay campground is a popular place for tourists to stay and is very close to Panama Rock, the shortest road to get to the Panama rock car park would be big hill road which is step and unpaved. Big hill road also has little to no signage for it and would be nearly impossible to find for someone that does not have knowledge of the area.
If this proposed car park on Lavericks Road was to go ahead there would need to be signage added to the bottom of big hill road displaying that it was an entry way to Panama Reserve. As well as sign postage around the area of Panama Reserve showing the way there and explaining that road may not be suitable for all car type and or not confident drivers.

2.2 Sign Network

Locating the intersections which are linked with the reserve. Identifying the locations by using Google Earth and Arc Online to find those intersections that can be used as the suitable place to set up a sign. The methods include road screening, comparing route distance, 3D visualization, and site assessment. Using Christchurch City Council (CCC) district plan and regulations from the New Zealand transport agency (NZTA), we can find out what sign is suitable to put on the site. Analysing the results and giving recommendations to the reserve.

Road Screening

A good guiding system decides high visitation rates for a rural tourist spot, (Dornbusch & Kawczynska, 1992). Due to the unique topography of the Bank peninsula, the road in the region is complex and zigzags. Road screening helps find these roads which can link to the reserve in this area and settle signs.

The road screening starts with those close to or who pass by the reserve, like Lavericks Ridge Rd, Panama Rd, and Camerons Track. The next stage is to choose the roads which are in decent condition, eg. wide, and have a good connection with other roads. Roads that fit these criteria are Summit Rd, Le Bones Bay Rd, and Okains Bay Rd. Those are the main rural roads used by locals and linked with state highways.

Using Arc Online and Google earth to visualize the routes helps to identify whether those routes pass through any private land which is prohibited. Two routes have been chosen for this project, which are shown in Table 3. Due to the time limit and harsh weather, the site assessment was only half completed in the field. As shown in Fig.1, There are 9 key intersections to direct visitors to Panama Reserve.

Based on these critical route points, signage has been classified as highly recommended and suggested (Fig 2).

Table 1. Critical route points to visit Panama Reserve.

Number	Start	Passing	Passing	Passing	Passing	End
Route 1	Christchurch Rd	Okains Bay Rd	Summit Rd	Camerons Track	Lavericks Ridge Road	Panama Rd
Route 2	Christchurch Rd	Long Bay Rd	Summit Rd	Le Bons Bay Rd		Panama Rd

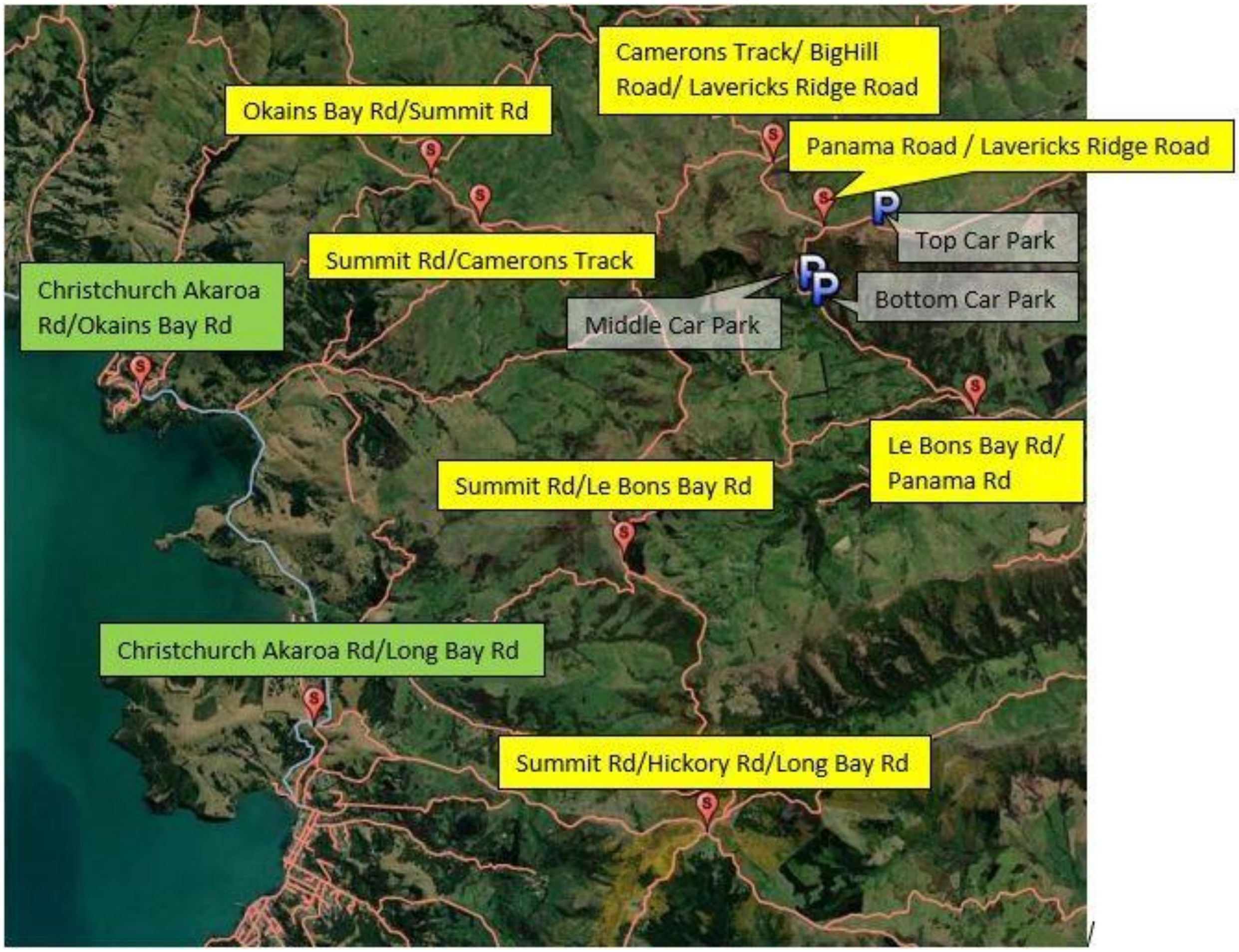


Figure 3. Screenshot of intersections for Panama Reserve to put a sign with the name of each site. (Yellow color: Highly Recommended site; Green color: Suggested site)

2.3 Types of signs

Sign Regulations

During site assessment, many similar signs beside the road came into our view which matched the ideal sign we desired. Those signs are identified as formal signs and informal signs.

Formal Sign:

- Is required to go through CCC formal processes.
- Based on NZTA's regulations, the formal signs that can be used in this project are general interest signs and tourist signs.
- The process to apply for a formal sign is shown in Table 1.

Informal Sign:

- Does not have to go through the formal council processes.
- The informal sign will only need to fit the CCC District Plan, then can be put on the road.
- No formal process for an informal sign, but the requirements for design are shown in Table 2.

Table 2. The process of applying formal signs (Tourist signs & General interest signs)

<table>
<tr><th>Sign Types</th><th>Steps to apply a sign</th><th colspan="2">Relevant Text/ Link</th></tr>
<tr><td rowspan="7">Tourist sign</td><td>1.Decide the form of a tourist sign</td><td colspan="2">Checking 'Traffic control devices manual' in Part 2: Direction, service, and general guide signs Page 6-3.</td></tr>
<tr><td>2.Choose the sign specifications via the website</td><td colspan="2">www.nzta.govt.nz/resources/traffic-control-devices-manual/sign-specifications/</td></tr>
<tr><td>3.Sign design and layout</td><td colspan="2">Checking 'Traffic control devices manual' in Part 2: Direction, service, and general guide signs Page 6-3 to Page 6-4.</td></tr>
<tr><td>4.Meet the sign criteria</td><td colspan="2">Checking 'Traffic control devices manual' in Part 2: Direction, service and general guide signs Page 6-5 to Page 6-6</td></tr>
<tr><td>5.Sign for tourist facilities (could be used for directing the car park)</td><td colspan="2">Checking 'Traffic control devices manual' in Part 2: Direction, service and general guide signs Page 6-7 to Page 6-12</td></tr>
<tr><td>6.Applications/contact with NZTA</td><td colspan="2">Tourist signs on state highways - information and application form | Waka Kotahi NZ Transport Agency (nzta.govt.nz)</td></tr>
<tr><td>7.Applications with CCC</td><td>1). Building and planning permission for signs: Christchurch City Council (ccc.govt.nz)</td><td>2.Looking for planning permission for signs and discussing the details for specific requirements need contact with dutyplanner/dutyplanner@ccc.govt.nz</td></tr>
<tr><td rowspan="4">General interest sign</td><td>1.Decide the form of General interest sign</td><td colspan="2">Checking 'Traffic control devices manual' in Part 2: Direction, service and general guide signs Page 8-2</td></tr>
<tr><td>2.Choose the sign specifications via the website</td><td colspan="2">www.nzta.govt.nz/resources/traffic-control-devices-manual/sign-specifications/</td></tr>
<tr><td>3.Sign design and layout</td><td colspan="2">Checking 'Traffic control devices manual' in Part 2: Direction, service and general guide signs Page 8-2 to Page 8-3</td></tr>
<tr><td>4.Applications/contact with NZTA</td><td colspan="2">tcd@nzta.govt.nz</td></tr>
</table>

	5.Applications with CCC	1).Building and planning permission for signs: Christchurch City Council (ccc.govt.nz)	2.Looking for planning permission for signs and discussing the details for specific requirements need contact with dutyplanner/dutyplanner@ccc.govt.nz

Table 3. The requirements for informal sign (Free-standing/ Corflute Sign)

Sign Type	CCC district plan criteria	
Free-standing/Corflute Sign	6.8 Signs/6.8.4 Rules/6.8.4.1 Activity status tables/6.8.4.1.1 Permitted activities/P11	6.8 Signs/6.8.4 Rules/6.8.4.2 Built from standards/6.8.4.2.6 Free-standing sign/ Open Space Natural Zone (except Orton Bradley Park)

2.4 Signage Options

Plan A: Formal Signs

Use Formal signs for all sites (highly recommended sign & suggested sign). The recommended NZTA sign needed in this project is the tourist sign and the general interest sign.

Plan B: Informal Signs

Use informal signs only for highly recommended sites. The recommended informal sign in this project is the free-standing Corflute sign.

Plan C: Informal and Formal – Recommended

Use informal signs for the highly recommended site (stage 1) and apply formal signs for the suggested site (stage 2).

2.5 Recommended Signage

This study recommends the Trust apply Plan C and implement this through a 2-stage process (Table 4).

Stage 1: Involves 5mm Corflute signs positioned at each highly recommended site. The Corflute signs are recommended as they are inexpensive, waterproof, easy to maintain or replace, and convenient to attach onto fences or waratahs.

Following the CCC District Plan guidelines, the sign for the reserve is the small off-site sign and the size of the sign will not exceed 1.4 m^2. It is recommended that the reserve signs be 800 mm × 500 mm, which is visible for the road and fits for the CCC regulation for the small off-site sign (Fig 3).

3.3mm Corflute signs for the 7 intersections, including two steel Waratah posts, and four zip ties to attach the sign, has a total cost of $434.59. Which can be seen in *Appendix 5. Costing.* This has been calculated at an 800x400 sign size for printing efficiency, "as at preferred size of 800x500 you'd only get 6 PRINTS PER SHEET" of corflute according to Gareth from The Print Company, see *Appendix 5. Costing.* An alternative costing for 5mm thick signs has also been provided in *Appendix 5. Costing.*

Stage 2: Applying tourist signs from NZTA. The sign will direct visitors from the state highway to the reserve and link to the informal Corflute signs for better guidance. Due to the price for the tourist sign being unknown on the NZTA website, all relevant fees will be found out when the application is approved by NZTA.

Table 4. The intersection site with types of formal signs & informal signs and recommendations.

<table>
<tr><th>Intersection Site</th><th>Formal sign</th><th>Informal sign</th><th colspan="2">Recommendations</th></tr>
<tr><td>Summit Rd/ Le Bons Bay Rd</td><td rowspan="7">General Interest Sign</td><td rowspan="7">Free-standing Corflute Sign</td><td rowspan="7">Free-standing Corflute Sign</td><td rowspan="7">Stage 1</td></tr>
<tr><td>Le Bons Bay Rd/ Panama Rd</td></tr>
<tr><td>Summit Rd/ Camerons Track</td></tr>
<tr><td>Camerons Track/ Big Hill Road/ Lavericks Ridge Road</td></tr>
<tr><td>Okains Bay Road / Summit Road</td></tr>
<tr><td>Panama Road / Lavericks Ridge Road</td></tr>
<tr><td>Summit Rd/ Hickory Rd/ Long Bay Rd</td></tr>
<tr><td>Christchurch Akaroa Rd/ Okains Bay Rd</td><td rowspan="2">Tourist Sign</td><td rowspan="2"></td><td rowspan="2">Tourist Sign</td><td rowspan="2">Stage 2</td></tr>
<tr><td>Christchurch Akaroa Rd/ Long Bay Rd</td></tr>
</table>

Figure 4: Example of directional sign design for informal corflute signs (800x500mm)

3. Car parking Background Information

A detailed review of car park design has been undertaken in order to fulfil the requirements of the project objectives. Reviewed literature is presented within Appendix 2.

This literature informed car park designs, most notably through understanding of how car parks can affect the surrounding environment, blend into the surrounding environment and the requirements of the environment at the site. Of note is that much of the literature focuses on urban areas, large-scale sites, and 'rule of thumb' ideas. While these ideas are still relevant to Panama Rock Reserve adaption to the smaller scale rural setting is required.

Key findings relevant to Panama Reserve are:

- Vegetated Margins/Boxes – in the management of space, direction of vehicles, visual amenity
- Separated Bike racks from Car Stalls – site safety
- Earth Bund for Minimal Visual Impact – reduce site impacts
- Permeable Surface Material for Runoff and Visual Impact – reduce ecological impacts
- Investigative techniques and procedures - Hand Augers and Scala or Cone Penetrometer testing for site investigation. These were performed at both the Lower and Upper Carparks on the 26/8/2022, and results/analysis from this testing can be found in *Appendix 3. Lower Carpark* and *Appendix 4. Upper Carpark.*

3.1 Panama Reserve Carparks

Investigated carpark sites at Panama Reserve are labeled as Upper Lower and Middle in Figure 5.

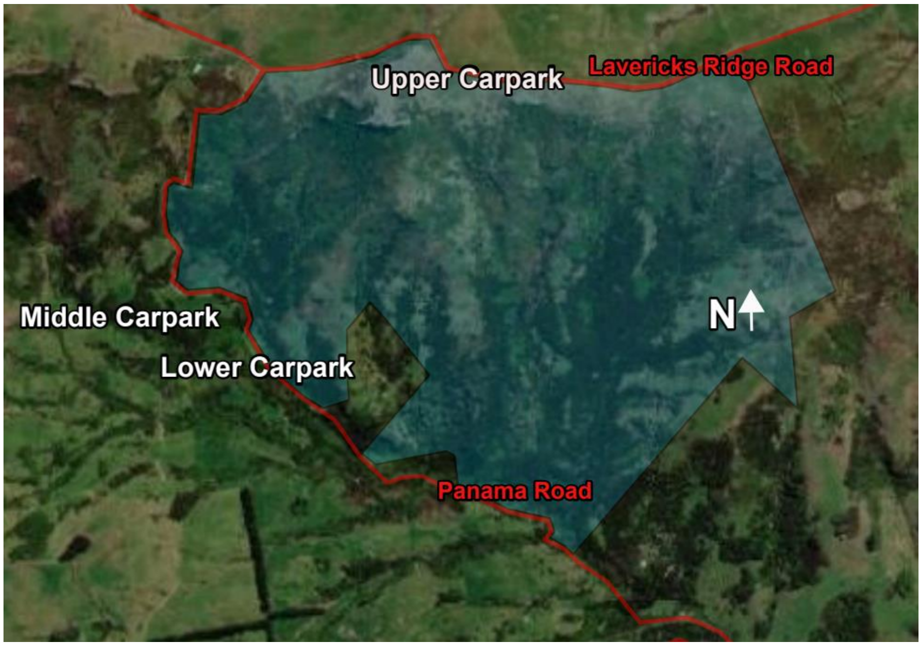


Figure 5: Panama Reserve boundary, with locations of Upper Middle and Lower Carpark shown, as well as reference to the surrounding roads

The following presents investigations and findings for the Middle Carpark, Lower Carpark and Upper Carpark respectively.

4. Middle Carpark

Figure 6: Aerial view of Middle Carpark location showing open flat land to the North of the road and open areas along the sides of the road.

4.1 Site Overview

This area is being investigated for car parking due to its proximity to existing tracks that lead directly from the proposed site to the rest of the reserve and allow visitors a very good view of the geological dike and lava dome features. Making it a desirable car park location for the Josef Langer Charitable Trust. The proposed site (Middle Carpark) is located at the top end of Panama Road as seen in Figure 5 and 6.

4.2 Observations

Upon driving to this proposed site location, the road was found to be in poor shape with potholing and ruts from recent heavy rains. Exposing large rocks within the road surface which in combination with the already relatively steep incline and tight blind corner made the road difficult to navigate. These road conditions can be seen in Figures 7 and 8. This road surface was manageable in a 4WD car but would not be suitable for a 2WD, the most common car type visitors may bring.

The proposed area soil was soft while standing on them and waterlogged. It was deemed unlikely there would be good ground for quite some depth, and it was decided CPT and Hand Auger tests were not necessary to confirm this. It was observed that there was a small gulley system directing water runoff from the hills into this area.

The roadside area was investigated further as the soil was much firmer and was holding up with the 4WD parked there at the current time. It was found that on the northern side of the road there was around 5m of depth and 25m length of viable parking space as well as expansive space on the southern side.



Figure 7: Evidence of rutting within the road surface.

A) *B)* *C)*


Figure 8:

A) Shows blind corner

B) Shows steepness of the blind corner

Limitations of the proposed area are:

- Difficult access road
- Potential inability to excavate area due to difficult access road
- Waterlogged soils/Marshy
- Ecological ramifications of drainage systems
- Hazard of blind corner and turning cars

Limitations of the roadside parking area are:

- Difficult access road
- Large tree a dropping hazard
- Regenerating natives
- Hazard of blind corner and turning cars

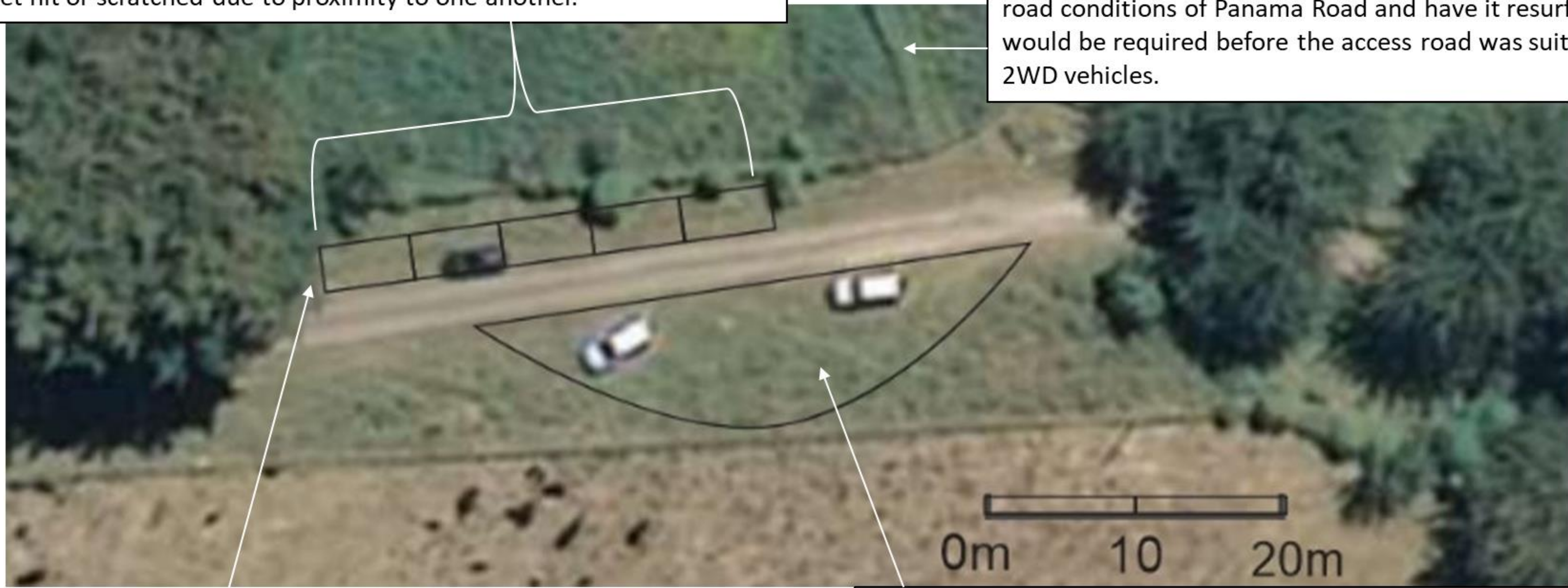
4.3 Recommendations and Design

Based on the above investigation and restrictions within the area, a formal car parking development is not recommended. Instead, informal parking on the northern roadside is recommended (Figure 9), with maintenance of the turnaround area opposite the entry gates.

This recommended parking area will still take advantage of the current tracks, but it would limit the number of people able to park and enter the reserve from this location, which for environmental degradation reasons may be preferred to having more parking available. Due to the current road condition this solution would not be suitable for 2WD vehicles. It is recommended that contact with the council be made to address the road conditions of Panama Road and have it resurfaced would be required before the access road was suitable for 2WD vehicles.

Area is 25 meters long.
This means the area can fit 4 cars very comfortably in a parallel position, as the minimum requirement is 5.5m in length on a parking stall.
Allowing 3 meters of extra length which due to the nature of 4WD's being larger this extra length should be added to each stall to allow for people to move freely around cars and give a sense of safely for car owners that they are unlikely to get hit or scratched due to proximity to one another.

This recommended parking area would still take advantage of the current tracks, but it would limit the number of people able to park and enter the reserve, which for environmental degradation reasons may be preferred to having more parking available. This solution would not be suitable for 2WD vehicles and contact with the council to address the road conditions of Panama Road and have it resurfaced would be required before the access road was suitable for 2WD vehicles.



Area is between 5-6 meters wide from roadside to the fence line allowing the minimum required width of a carpark (2m). As well as allowing extra room on either side for doors to open and people to stand which should reduce the risk of car-pedestrian accidents due to the blind corner as people have room to stay well away from the roadside.

Here is solid ground that we recommend using as a turning bay.
A turning bay would be helpful for this area as visitors must leave via Panama Road which requires turning around from the recommended parking zone.
In order to make this turning process as safe as possible with the blind corner nearby this turning zone would allow drivers to manoeuvre off of the road and away from this traffic hazard caused by the blind corner.

Figure 9: Recommendations for parking solution at Middle Carpark Site

5. Lower Carpark

5.1 Overview

As an alternative to the Middle Carpark, an area lower down Panama Road was investigated as a Lower Carpark option where the road surface was still accessible via 2WD unlike further up Panama Road.

Figure 10: Aerial perspective of the lower car park site, providing a perspective of a flat, low vegetated area running adjacent to Panama Rd.

5.2 Observations

Located on Panama Road before the informal Middle Carpark the site consists of a long, flat and reasonably low vegetated area. Figure 10 shows the proposed parking location, further indicated by the design and recommendations in figure 12. The site area currently has minimal use, besides access to a farm gate that enters the reserve which is suspected to be used for lower track maintenance. Presently, there is a lack of safe roadside parking at this location.

5.3 Testing - Geotechnical Evaluation

Table 5: Lower car park ground pressure results from Hand Auger and Scala Penetrometer testing, for sites A and C.

Site	Average CPT (Blows Per 100mm)	Average (mm) per blow	Average allowable Bearing Pressure (kPa)	Average ultimate Bearing Pressure (kPa)
Site A	3.888888889	36.83333333	112	336
Site C	10.23529412	14.20476582	200	600

Within *Appendix 3 Geotechnical Evalution: Lower Carpark* are tables of all Hand Auger and Scala Penetrometer Test results for sites A, B, and C with reference to where these are located within the proposed car park area. As well as the ultimate bearing pressure that was calculated from these results.

Ground investigations find that the area designated for the lower car park as good ground, and suitable for car park development.

5.4 Site Issues

5.4a Ground water and drainage

At location both the loess and loess colluvium exceed the required ultimate ground bearing capacity of 300 kPa (*appendix 3d).* Ground bearing capacity calculations at location A indicate loess did exceed the ultimate capacity of 300 kPa, whereas the underlying loess colluvium exceeded the required 300 kPa (*appendix 3b).* It was at the contact between these two units the water table was found at 1.1m depth (*appendix 3b).* Reduction of water saturation in the loess unit at location A will increase the loess units ultimate bearing capacity to an acceptable level, supported by (Savvateev et al., 1987), stating "in the water saturated condition loess soils are of a lower bearing capacity". To reduce groundwork to a minimum, to desaturate the ground at Location A, a flax margin will satisfy the need shown in *figure ten.*

5.4b Property Boundaries and Reserve

Historical land ownership boundaries do not correlate with the existence of Panam Rd and are skewed roughly ten meters to the northeast (figure 11). The site is therefore considered to be located on council owned public land.

Figure 11: Council and PRR reserve boundary from historical land surveys. The council road boundary is offset from its actual position, highlighting the lower car park is predominantly on Council Land.

5.5 Recommendations and Design

It is proposed that the lower car park be developed with the above design in Figure 12.

5.5a Carpark Surface

Keeping the surface type of the lower car park as mowed and maintained grass requires minimal groundwork needed in car park development. Service history of reserve tracks and maintenance of a current turning bay located further along Panama Road at the 'middle car park' indicate; mowing and cutting services are available to Panama Road, and maintenance of the lower car park is probable for future use. For these reasons it is recommended that mowed grass in the surface layer. This recommendation aligns with ideologies of the Josef Langer, and the Josef Langer Trust, who desire to protect natural wildlife, whilst keeping initial development costs and practices to a minimum.

It is recommended that a site scrap occur to the area of proposed carpark with blackberry bushes. This would not only remove blackberries but also smooth the parking surface in this zone, enabling easier parking and easier maintenance.

5.5b Planting

Flax margin species selection (figure 12):

- *Phormium Tenax*
- *Phormium Cookianum*

Kanuka margin species selection (figure 12):

- *Kanuka tree*
- *Manuka tree*

Central vegetative box species selection (figure 12)

- Trees
  - *Mahoe (Te Mara Reo)*
  - *Lemonwood (Terata)*
  - *Kaikomako*
  - *Kanuka*
  - *Kowhai*
  - *Fuchsia (Kotukutuku)*
- Shrubbery
  - *Koromiko (Heliohebe Lavaudiana)*
  - *Koromiko (Hebe Strictissima)*
  - *Celmisia Mackaui*
- Flax
  - *Phormium Tenax*
  - *Phormium Cookianum*

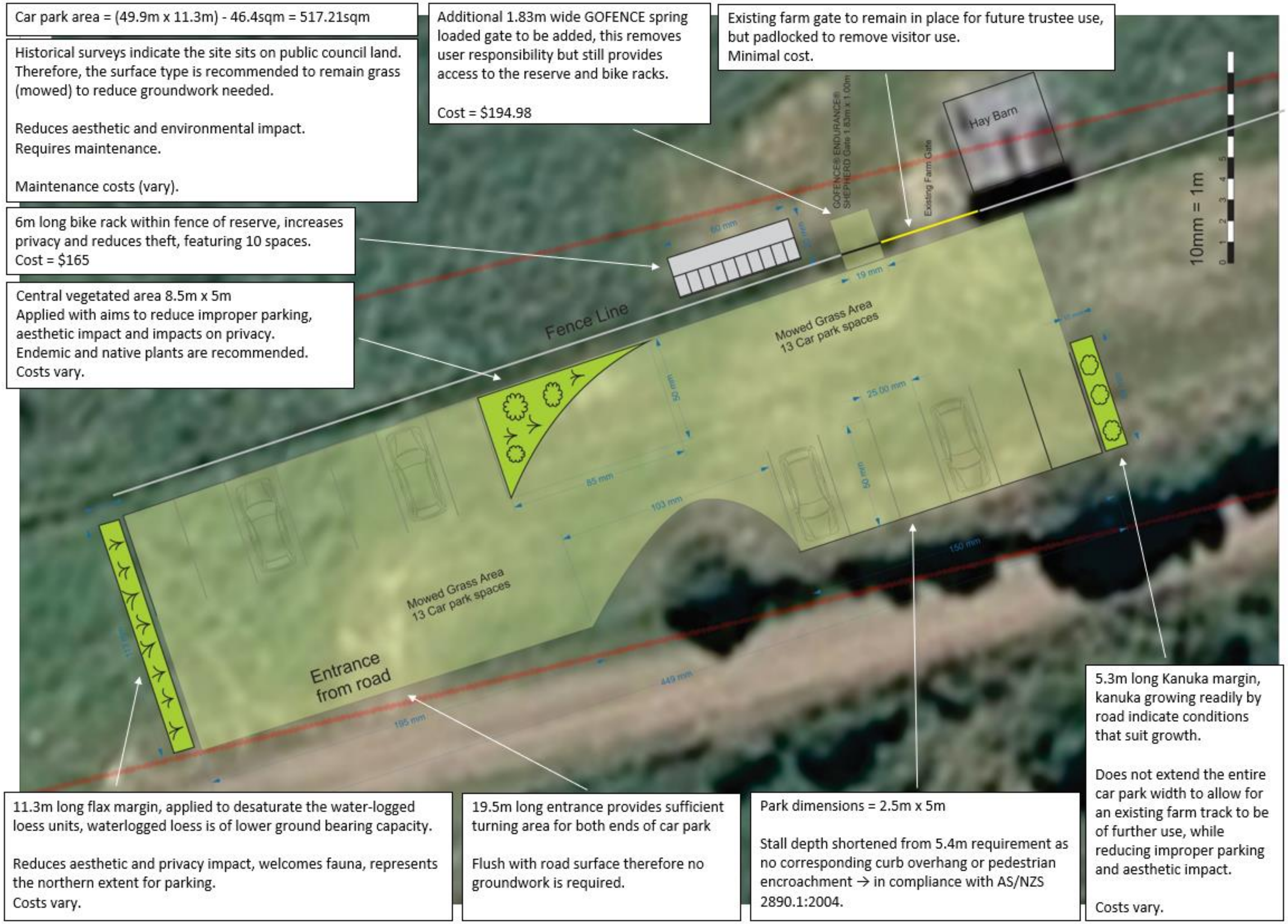


Figure 12: Recommended formal parking solution for the Lower Carpark Site.

5.6 Implications

Currently, the reserve's walking tracks from the proposed lower car park location are in poor condition. Figure 13 shows the condition of the reserve track heading uphill, taking the user toward the ‘middle car park’ where the current main entrance to the reserve is considered. Figure 14 shows the condition of the reserve track heading down hill, taking the user to the lower section of the reserve where currently maintained and in use walking tracks are located. If the lower car park is to be used, both tracks will need adequate maintenance to make visitor use easier.

Figure 13: Current state of the walking track heading up hill, toward middle car park, from the lower car park.

Figure 14: Current state of the walking track heading down hill, to connect with lower reserve tracks, from the lower car park.

6. Upper Carpark

The proposed 'upper carpark' site is located off Lavericks Ridge Road near Panama Rock (approximately a 12-minute drive from the Summit Road turnoff via Cameron's Track). Shown in earlier Figure 5 and below in Figure 15. It can also be accessed from Le Bons Bay via Lavericks Ridge Rd.

Figure 15: Aerial perspective of proposed Upper Carpark location, showing flat grassed area to the south of the road. Panama Rock can be seen as reference point.

6.1 Overview

Located on an exposed ridgeline, the site consists of a large, relatively flat, grass dominated area with small bracken and minimal Matagouri shrubs. Figure 15 shows the proposed parking area with bracken and grass looking down towards Lavericks Bay. Some boulders are scattered throughout, and aged Totara stumps are present but easily avoidable with the proposed carpark design. The area is fenced off parallel to the road with an access gate to the reserve which is currently only accessible by raised vehicles due to a roadside ditch. Presently, there is a lack of safe roadside parking due to uneven surfaces and inadequate space.

6.2 Observations

For the site investigation we looked at the conditions of the site; size, shape, and orientation of the field. The soil types and vegetation that are present as well as the overall environment of the site. The accessibility into the site as well as the proximity to Panama rock. Finally, we noted what features would be required to make a functioning car park in the location.

6.3 Testing - Geotechnical

The results found from the CPTs show that bed rock is encountered at relatively shallow depths throughout the investigation area. Soils overlying the bedrock consist of loess with basaltic clasts and 0.2m thick topsoil layer. Figure 16 shows bearing capacity calculations derived from penetrometer tests and core log data. It compares this to physical samples found in the field as well as a log of blows per mm. According to NZS 3604:2011, 'good ground' is defined by having an ultimate bearing capacity of 300 kPa. Therefore, the loess underlying the topsoil on site is suitable to experience large loads from vehicles without failure. The topsoil is relatively soft and may become muddy with frequent use in winter months.

Sample

Soil Type	Depth (m)	CPT Blows/100mm	mm per blow	Average mm/blow/unit	Allowable bearing pressure (kPa)	Ultimate bearing pressure (kPa)
Topsoil	0.1	1	100	100	37	111
	0.2	1	100			
Loess	0.3	3	33.33333333	27.77777778	140	420
	0.4	4	25			
	0.5	4	25			
Loess Col	0.6	6	16.66666667	28.33333333	100	300
	0.7	4	25			
	0.8	4	25			
	0.9	2	50			
Weathered L	1	4	25	12.48055956	210	630
	1.1	4	25			
	1.2	5	20			
	1.3	12	8.333333333			
	1.4	14	7.142857143			
	1.5	16	6.25			
	1.6	11	9.090909091			
	1.7	9	11.11111111			
	1.8	9	11.11111111			
	1.9	7	14.28571429			

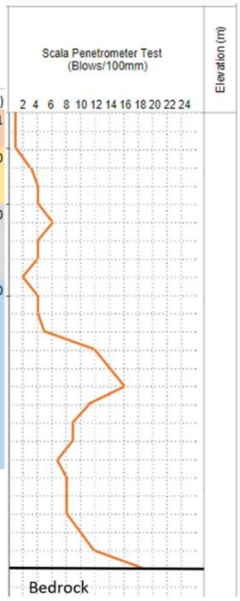


Figure 16: Geotechnical findings from site B - Upper Carpark, comparing physical samples with penetrometer test findings.

6.4 Recommendations and Design

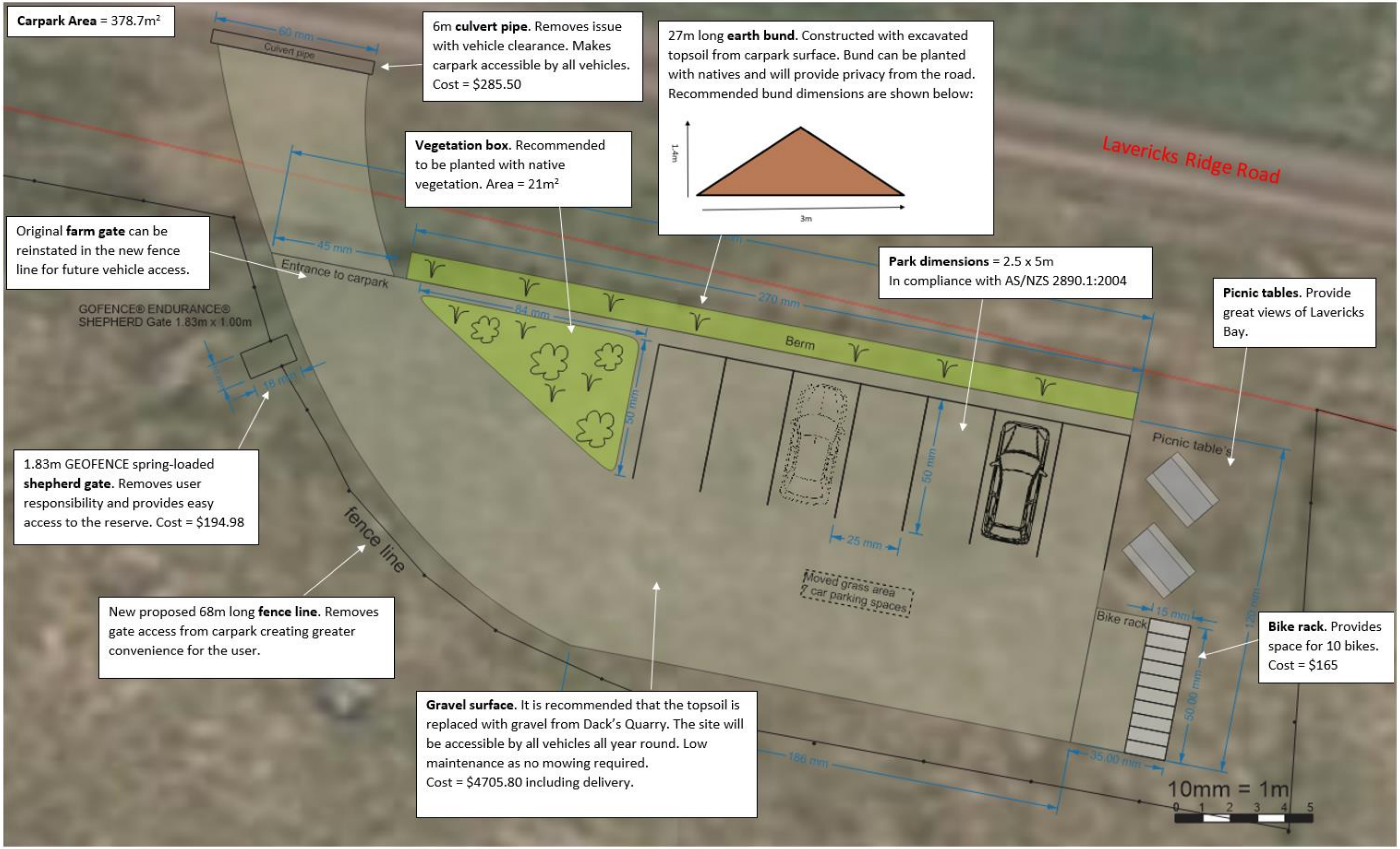


Figure 17: Recommended formal parking solution for the Upper Carpark Site.

Excavation and Hard Landscaping

6.4a Excavation

It is recommended that the topsoil in the area is excavated to a 0.2m depth to form an earth bund that will reduce the visual impact of the carpark. This is due to the topsoil having a ground bearing capacity of less than 300kPa, therefore may fail under pressure applied from vehicles. The surface area of the carpark is 378.7m^2, therefore the topsoil would equate to a volume of 75m^3.

6.4b Earth bund

The 27m long earth bund can be constructed from excavated topsoil which will provide privacy and lessen the visual impact of the car park. See figure 17 for recommended bund dimensions

6.4c Surface aggregate

Local aggregate source Dacks Quarry, has recommended that the topsoil be replaced with two layers of gravel to ensure a stable parking platform with adequate drainage. Firstly, a sublease of AP65 is to be used for the first 150mm depth. AP65 is a strong basecourse for foundations. For the remaining 50mm, AP20 is recommended due to its high strength and density. This would come to a cost of $4,705.80 including delivery and GST. Figure 18 shows a cross section comparing the two aggregate types.

Figure 18: Cross section of AP65 and AP30 aggregate for proposed upper car park

6.4d Road Entrance

A $285.50 250mm x 6m Iplex Nexus culvert pipe will be needed for the design as the car parking area sits on higher ground than the road. The natural drainage will remain on the side of the road, with the ditch flowing through the pipe.

6.4e Access to the reserve

The current entrance to the reserve is a 4m wide farm gate (figure 17). The old farm gate can be reinstated to where the new fence line is to maintain vehicle access into the reserve. Figure 17 shows the old fence line in red and the proposed fence line in black behind the car park.
We recommend installing a 1.8m wide Gofence endurance shepherd gate at the cost of $194.98. This is a spring-loaded gate that shuts on its own and does not require users to shut the gate themselves. 1.8m would be wide enough for a bike to get through comfortably. If cost is an issue here than the old farm gate would still work, the only issue is when people do not close animals could come in and out of the reserve and past people’s cars.

Figure 19: The current farm gate at Panama Reserve that is will be reinstated to the new fence line.

6.4f Planting

Vegetation to be planted in the central box and earth bund to reduce the aesthetic impacts of the parking area and to help the car parking spaces and entrance to be more clearly defined. We recommend native Akaroa species of bush, tussock, and flax to be added to not introduce exotic plants to the area.

- Bush species:
  - Kanuka
  - Akaeke (Olearia avicenniaefolia)
  - Kowhai
- Tussocks/ flax species:
  - Poa cita wī, (silver tussock)
  - Poa colensoi (blue tussock)
  - Acaena caesiiglauca
  - Phormium tenax

7. Overall Recommendations

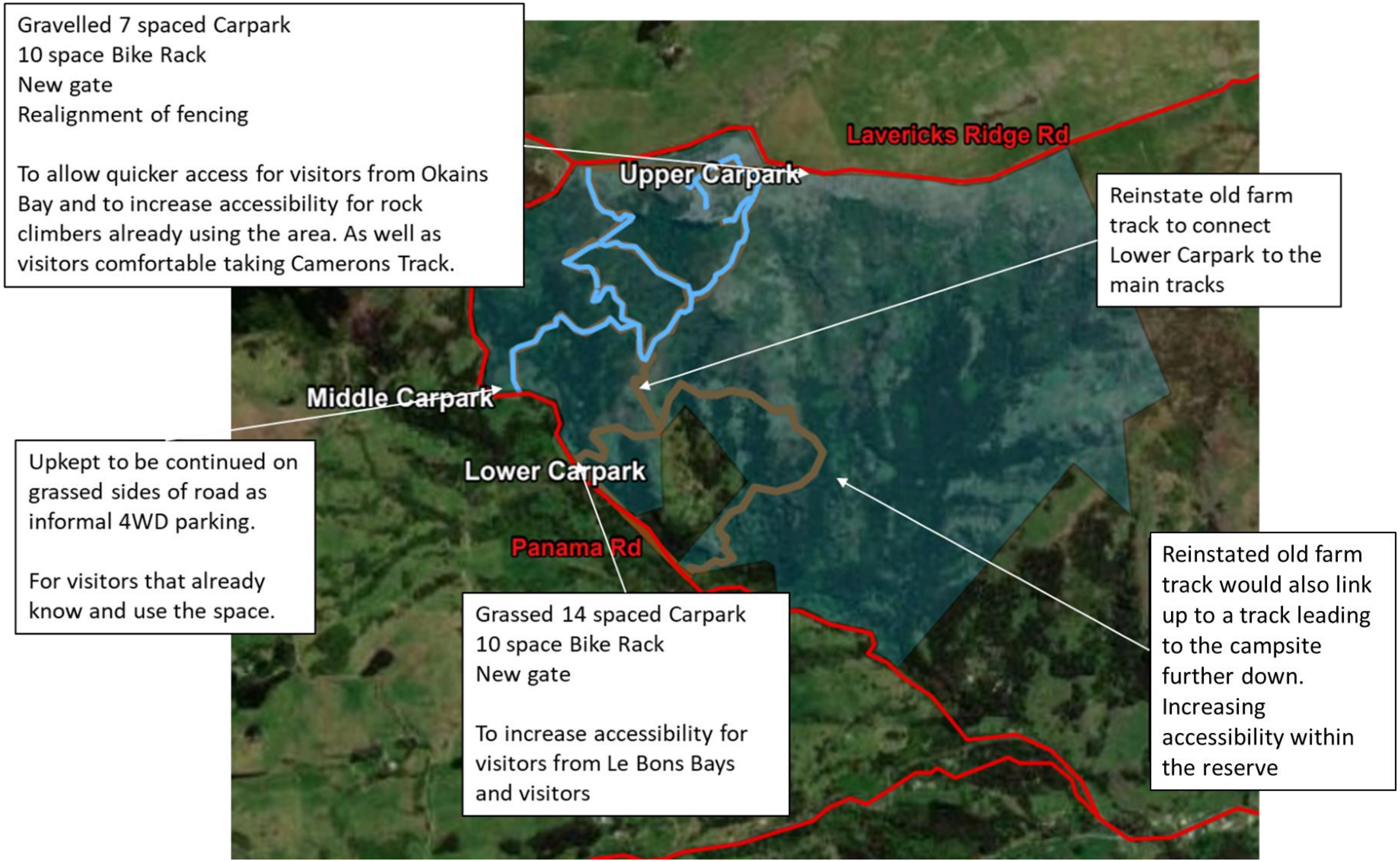


Figure 20: Map of final recommendation for car parking solutions and associated implications

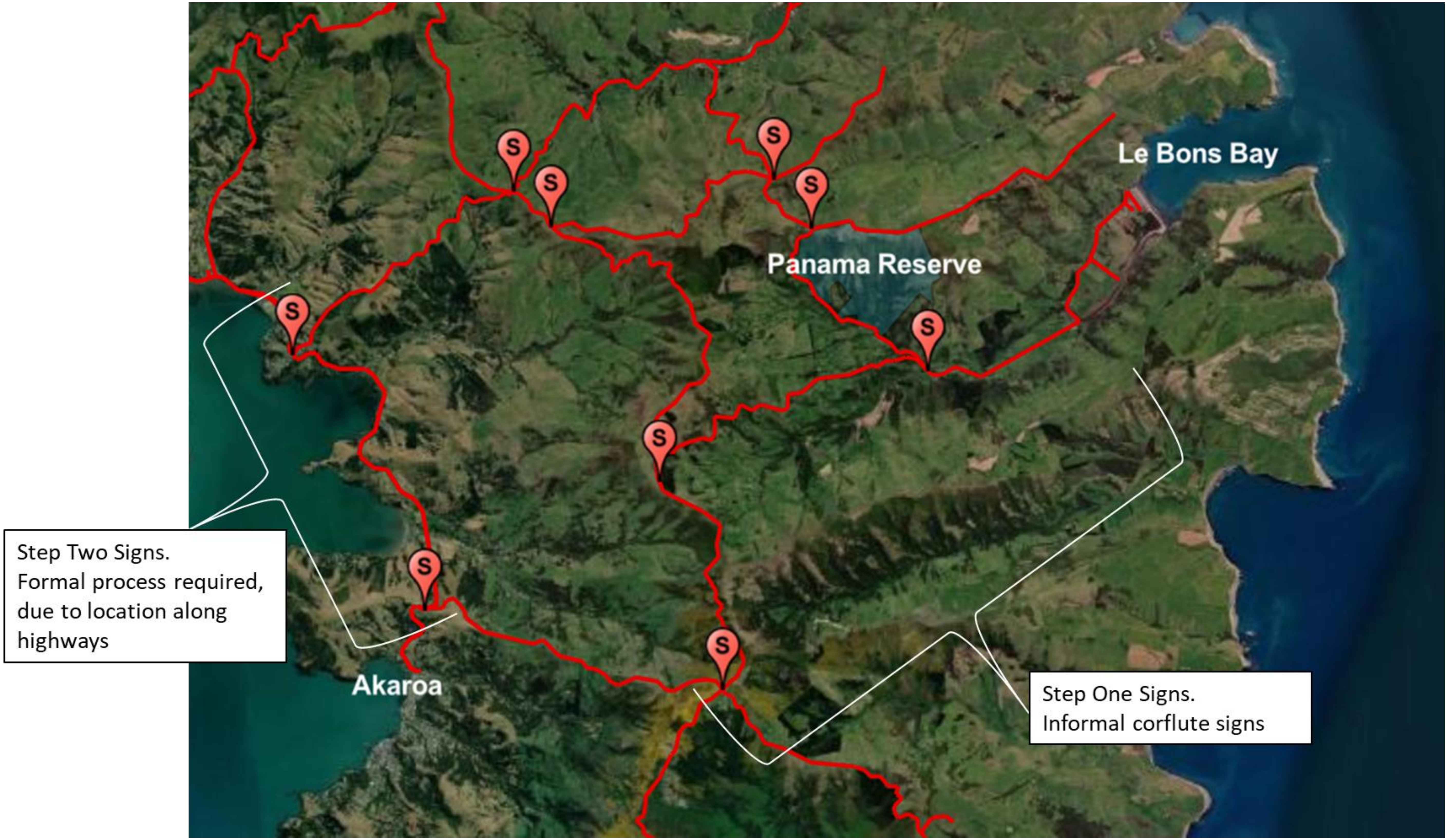


Figure 21: Map of final recommendations for signage. Including Step One and Step Two Signs

8. Costing

Including all recommended developments, the cost of these projects would come to $5,667.82 (based on the most expensive options, if applicable). Although this does not include any labor required to execute the projects or machinery to excavate the Upper Carpark. A full breakdown of these costs by project is available in ***Appendix – Costing.***

9. Considerations

9.1 Māori Significance

Within the Mahaanui Iwi Management Plan (2013) there is no mention of The Panama Reserve site or the La Bons Bay area (Katawa) holding significance within Te Rūnanga o Koukourarata's history nor is there any significant places for Māori shown on the Kā Huru Manu (Ngai Tahu, 2022) map within Panama Reserve. But forming a relationship with the local Mana Whenua of Te Rūnanga o Koukourarata to understand the site's significance or if there are any taonga present in the area for them, should be prioritized.

9.2 Outstanding Natural Landscape

It has been found that part of the many outstanding natural landscapes identified by CCC on Banks Peninsular runs right through Panama Reserve. While the boundary for this outstanding landscape runs just short of the Middle and Lower Carpark locations the Upper Carpark is encompassed within it, as can be seen in Figure 22 B). This means due to the recommended earthworks at the Upper Carpark location a permit may be required as these activities would change the landscape.

To date an email regarding the situation and proposed car park design has been sent to Mark Stevenson (Manager Planning) at the CCC and this has been forwarded to Paul Lowe (Manger of Resource Consents). It is our hope that the minimal earthworks and earth bund obstructing view of the car park from the road will mean changes to the outstanding natural landscape are minimal enough to not require a permit or consents process.

A) Outstanding Landscapes of Banks Peninsular shown in blue with Panama Reserve in red

B) Location of Upper Carpark in reference to the boundary of the Outstanding Natural Lanscape boundary shown in blue.

Figure 22: Location of Outstanding Natural Landscape and Upper Carpark within this.

10. Conclusion

The aim of this report was to understand and investigate ways in which access could be improved at Panama Reserve, for the Josef Langer Charitable Trust, to increase visitor rates.

This report has found that in order to improve access to Panama Reserve it is necessary to improve the signage to direct visitors to the area and avoid any confusion on which route to take. Not only will this help visitors planning on going to Panama Reserve but also peak curiosity for travelers within the area that see the signs. This was recommended to be done through a two-step process. Step one, being informal corflute signs attached to waratahs alongside the road. With potential for JLCT to further investigate formal signage alongside the main highway as a step two.

To improve car parking access within the reserve it was found that the Upper Carpark and Lower Carpark are the best sites for development. With the Upper Carpark being recommended for rock climbers and Okains Bay visitor access and this would ideally be graveled to reduce maintenance on JLCT. The Lower Carpark site is recommended to instead be kept grassed to reduce environmental impacts and to be maintained by JLCT. This car park would be for general visitors.

It is expected that if these recommended changes are carried out, then visitors already visiting the area will have a better experience through accessing the area by using the signage but also a better experience when entering the reserve due to the formal parking solutions, giving visitors peace of mind around their vehicle's safety. A better overall experience leading to a high return rate of visitors.

It is also expected that through having signage and formal parking this will encourage travelers not planning on visiting the reserve to stop by.

It should be noted that the number of car stalls within each recommended car park design is based off the easily accessible flat areas within these sites. While the small number of spaces may be ideal for keeping environmental degradation from visitors low, if the trust wishes to expand the number of parking spaces, alternative areas will likely have to be investigated further.

11. Acknowledgements

We want to take a moment to acknowledge the people who helped us create this report.

First and foremost, we would like to thank Sam Hampton for his continual guidance and patience throughout. This report would not be here without him.

Thank you to The Josef Langer Charitable Trust for providing us with an exciting and interesting research project. Also, Ollie Rutland-Sims and Jamie Dalglish for supporting our group at the conference.

We would also like to thank Simon Kingham and Sarah McSweeney for their teaching in Geog309, as well as the rest of the supporting team for Geog309.

Finally, thank you to all the businesses that helped aid our research and provided quotes for their resources; Nigel at Dacks Quarry, Cass and Lily at CCC and Gareth at The Print Company.

Appendix

1. Signage

Appendix 1a (table): Shows geographical (Latitude and Longitude) location of each recommended sign

Intersection Site	Latitude	Longitude
Summit Rd/ Le Bons Bay Rd	43°46'34.21"S	173° 0'39.66"E
Le Bons Bay Rd/ Panama Rd	43°45'43.95"S	173° 3'27.49"E
Summit Rd/ Camerons Track	43°44'38.43"S	172°59'31.15"E
Camerons Track/ Big Hill Road/ Lavericks Ridge Road	43°44'17.70"S	173° 1'52.30"E
Okains Bay Road / Summit Road	43°44'22.66"S	172°59'7.66"E
Panama Road / Lavericks Ridge Road	43°44'39.46"S	173° 2'15.15"E
Summit Rd/ Hickory Rd/ Long Bay Rd	43°48'7.85"S	173° 1'19.18"E
Christchurch Akaroa Rd/ Okains Bay Rd	43°45'36.17"S	172°56'48.77"E
Christchurch Akaroa Rd/ Long Bay Rd	43°47'31.48"S	172°58'12.39"E

Re: Ask a question form

IC Info CCC <info@ccc.govt.nz>
To Zhendong Shao

Reply | Reply All | Forward | ...
Mon 9/26/2022 2:57 AM

If there are problems with how this message is displayed, click here to view it in a web browser.
Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

你通常不会收到来自 info@ccc.govt.nz 的电子邮件。了解这一点为什么很重要

Good Evening Zhendong,

Thank you for your signage request for the Panama Reserve in Bank Peninsula.

I can see that this is not a council reserve. This reserve is located on private property, therefore this is not a request that we would send through to our parks team. More information about putting signage on private property can be found on the link below. You may need to get in touch with a duty planner for further advice.

https://ccc.govt.nz/consents-and-licences/business-licences-and-consents/signage

Please feel free to reply to this email, or contact us on 03 941 8999, should you have further enquiries. We are available 24 hours a day, seven days a week.

Ngā mihi

Cass

Customer Services Representative
Citizen & Customer Services
Phone: 03 941 8999
Email: info@ccc.govt.nz

Appendix 1b. E-mail response from one of the staff from Christchurch city council.

RE: Planning Approval

DutyPlanner <DutyPlanner@ccc.govt.nz>
To Zhendong Shao

Reply | Reply All | Forward

Wed 9/28/2022 10:16 AM

You replied to this message on 9/28/2022 1:18 PM.

你通常不会收到来自 dutyplanner@ccc.govt.nz 的电子邮件。了解这一点为什么很重要

Hi Zhendong,

Thank you for your query to Council regarding road signage in the Banks Peninsula. I have forwarded your query to Council's Traffic Engineer, Andrew. He may respond to you, if he is not too busy.

Ngā Mihi,

Lily Lamble
Duty Planner

Te Hononga Civic Offices, 53 Hereford Street, Christchurch
PO Box 73013, Christchurch 8154
ccc.govt.nz

Christchurch City Council

Appendix 1c. E-mail response from one of the Duty Planner in Christchurch city council.

2. Literature Review

What are the Key Elements of Carpark Design?

Introduction

This project is aimed at improving the access to Panama Reserve. Currently there is no parking area for visitors, other than on the side of the road, nor is there visitor facilities that may improve the visitor experience and ability to access the reserve. What has been decided as the best way to improve access is a carparking area with a section suitable for bike biking as well. This has been decided due to the remote location and rough terrain to reach the reserve, meaning transport options other than cars and potentially bikes are unlikely.

Because of the nature of the reserve and wanting to protect the land within it, any improvement to access of the site must stay in line with these values. This means materials such as concrete and practices such as deep excavation of the site are not options that this group will be investigating.

Within this area of access improvement/carparking our group has identified five main areas of literature review to be investigating.

1. The Key Elements of Carpark Design.
2. What Site Conditions are Required for Carpark Development?
3. What is the Current Visitor Type and How can Enhancements Improve Their Access?
4. What are the Environmental Impacts of Carpark Development?
5. How can GIS be used to Support Site Analysis?

In this literature review I will be looking at the key elements of carpark design, most specifically the amount of space needed per carpark and how angled carpark differ from straight carparks, along with requirements for bike parking/lock up and how to incorporate environmental aspects into the design.

Carpark Size, Angling and Manoeuvring

When it comes to carpark sizes the average size of a carpark can vary across regions and countries due to the change in car sizes in different countries specifically. In New Zealand the Wellington City Council requires car parks to be "2.4 metres wide and 5.4 metres long, with a minimum of 300mm clearance on both sides for a car door to open.". Across multiple other articles including, Mikusova, M., & Abdunazarov, J. (2019) and Mikusova & Abdunazarov (2019) it seems to be a consensus that the width requirements either side of a parked car is 300mm-500mm, this variation is often due to the angling of the car. If a car is parked at an angle there is less room required between cars, and if cars are parked at 90 degrees a wider gap between cars is required (Mikusova & Abdunazarov. 2019).

Not only does there need to be enough room for the car to park but enough room for the car to drive into said park. While all cars having different turning circles on average (Dimensions, 2021) passenger town cars require at least 5.8m and 3.5m outer and inner turning radius to allow for exiting a straight 90degree car park and this decreases with more angled carparks.

While these generalisations accommodate the average town car the more likely vehicles visiting Panama Reserve will be 4WD and vans, meaning a slight increase on these dimensions may be necessary as well as staying at the higher end of the gap allowance range.

Not only does the size of the car park matter to ensure cars can safely enter and exit the site, but Simon Bell (2008) also argues that increased park size and manoeuvring space allows for visitors to feel more relaxed that crashes or scrapes are unlikely to happen in the carpark. This allows them to feel more comfortable spending longer at the site and straying further from the located carpark in order to fully experience the site. This is especially important at Panama Reserve as all walking trails or lookouts are located a decent walking distance from the proposed carpark sites. This concept reinforces that idea that all recommended dimensions or gap allowance should likely be kept on the larger side for Panama Reserve. While Simon Bell discusses this concept in relation to car parking it also has relevance to bike parking as well.

Bike Parking

With the increase in biking in recent years a key element in most carpark designs is an area for bike lock up. While Panama Reserve is remote within Banks Peninsula, a bike ride from Akaroa would only take around 2 hours (according to google maps) and this would be much shorter for people staying in places such as Okains, or La Bons Bay.

Larsen (2017) suggests that bike users feel most comfortable when bike lock up areas are separate from car parking due to tensions between cyclists and vehicle users on the roads. In order to keep them separate cyclists need a dedicated area with secure upright stands to lock the bikes to. Larsen (2017) also suggests that steel U-shaped stands are the most secure as it allows cyclists to lock both wheels and the bike frame to the stand rather than just one wheel like other bike stand designs. Although in the case of Panama Reserve a different more natural material may be used to keep with the surrounding environment a small number of these bike stand would hopefully encourage more cyclists to the area. As making sure there is quality bike parking at Panama Reserve ultimately helps strive for more bike transportation than motor vehicles in the area in order to relieve stress on the local environment.

Visual Enhancement

Because this project has a focus on the environment and preserving it, this environment must also be displayed throughout the carpark, rather than having a ‘concrete jungle’ look. Maria Ignatieva et, al (2008) shows a variety of ways to enhance a carparking space by bringing more nature in through swales vegetated in natives rather than concrete drainage systems. These vegetated swales allow for decreased erosion due to fallen foliage acting as a sponge to decrease the erosive energy. She also suggests permeable surfaces rather than concrete where possible which also help mitigate water pooling in the areas as well is being more visually and environmentally pleasing.

The Auckland Council (2022) also recommends mitigating negative visual impacts of a carpark by having plants every 6-10 car park spaces. This is a rule of thumb mostly used within cityscapes so for a more rural carpark such as one for Panama Reserve this may be increased to planting every 3-5 parking spaces that match the surrounding flora.

To combine both of these visual enhancement approaches Waitakere Ranges (Waitakere Ranges Local Board, 2018) has incorporated swales in between rows of carparking to both break up the hardstone areas as well as capture stormwater runoff. While this is a great way of implementing visual enhancements that are purpose driven the Panama Site will likely not require enough carparking to section off areas in this way, although it is a possibility to still consider.

The Waitakere Ranges has also incorporated natural material wheel stops to still make the carpark safe and secure while in keeping with the natural environment in which places such as the Waitakere Ranges and Panama Reserve are located.

Conclusions

After investigating the literature on carpark design, I found that the majority of the literature is based on multistorey carpark buildings or curb side parking within cities. While this makes sense with increasing city size and car usage, it is only useful to the Panama Reserve Access project to a certain degree.

Within the literature most carparks follow the same 'rule of thumb's' or guidelines around carpark size and spacing for traditional 'town cars' which for our project is still very useful although dimensions will likely need enlarging for the expected visitor transportation types. Bike parking and car parking is also rarely mentioned in conjunction within the literature further backing up the idea Larsen (2017) had, that they may be best keep apart within parking designs as well. There are many different options suggested for incorporating visual/environmental aspects into parking design but once again many of them are made on the basis of being in urban areas rather than rural designs.

Overall, not much literature is based on rural small carparks such as the proposed ones for Panama Reserve, although many aspects of a more standard carpark design can still be helpful in considering overall layout and functionality.

What Site Conditions are Required for Access Improvements to the Panama Reserve?

Introduction:

The Panama Reserve, located towards the Eastern Bays of Banks Peninsula, is a 200-hectareblock of regenerative native bush which is owned and managed by the Josef Langar Charitable Trust. Situated on the block of land is a unique trachyte lava dome connected to an exposed feeder dyke. The reserve has a series of rough walking tracks and rock climbs, but accessibility to the area is limited to bikes and 4WD vehicles via four entry sites. These access points require improvements to encourage and attract future visitation and usage of the reserve. The aim of the project is to investigate sufficient information regarding costs, recommendations and methods for access developments at the Panama Reserve and provide this data to the Josef Langar Charitable Trust. Access improvements will not only make the area more suitable for public use, but also drive the reserve's appeal to members of the public/tourists, while providing education on the site's significance. Overall, the project is split into five different sub-topics:

1.What are the key elements of carpark design?
2.What site conditions are required for carparking and access developments?
3.Ground/access approaches to understand visitor type and provide enhancement that supports their visitation.
4.What are the environmental impacts of carpark development?
5.How can GIS best be used to support site analysis?

Focus:

This literature review will focus on the site conditions that are required for carparking and access developments on the Panama Reserve. From a geotechnical point of view, there are many different aspects that need to be covered in order to ensure the site conditions are suitable for access and carpark developments. Geotechnical considerations include, soil creep, soil type, erosion, soil compression, bearing capacity, seismic hazards and rockfall. Issues with these may prevent an entrance and car park to be developed safely. A series of cone penetration tests and core logs will be sampled from each existing access point to determine the most suitable location for entrance development. Similar investigations have been conducted locally/internationally and have used corresponding methods to complete these assessments. The main focus of this sub-theme review is to gather methods and perspectives from existing literature in order to gain an understanding of how to geotechnically analyse ground properties. Furthermore, this will provide information on the suitable geological conditions for safe and long-lasting access improvements to the Josef Langar Trust, Panama Reserve.

Methods:

According to (Bell & Pettinga, 1985), the first step to developing land for public use is to identify any potential hazards such as landslips or flooding. Secondly is to assess any geomorphic, geotechnical or geologic constraints in the area. A common method to understand geotechnical site conditions is the cone penetration test (CPT). This is a test carried out by geotechnical engineers to investigate the mechanical and physical properties of subsurface strata, groundwater conditions and the geologic regime of surface material, (Robertson & Cabal, 2014). This can also be used to calculate bearing capacity. This specifies the amount of pressure that can be applied to the ground by a structure without settlement occurring, (Canterbury, 2015). Drilling auger holes is an effective way of analysing the soil profile and determining the different soil properties while causing little disturbance to the soil when done properly, (Tomlison, 2001). These also aid and provide context to the data gathered from CPT's. Samples from the auger holes can then be taken to a laboratory for evaluation to understand chemical and physical characteristics. The hand auger method was used by (Glassey, 1986), while investigating the geotechnical properties of lime stabilised loess on a proposed subdivision on the Port Hills, Canterbury. Seismic refraction applications were also used to determine the bedrock nature in the area. ACPT could work as an alternative to this method as it would give an accurate reading of bed rock depth and also include the water table level. Hazards/Potential

Issues: Simplistically, Banks Peninsula is mainly made up of volcanic bedrock produced from the Lyttleton/Akaroa calderas. Overlain is a glacial aged loess that varies in thickness, approximately 0.5m -20m+ in some areas, (Glassey, 1986). According to (Dorsey, 1988), the Banks Peninsula loess can become susceptible to erosion when wet. Adequate drainage measures will need to be taken into consideration to determine the longevity of the access improvements. Soil creep is the gradual movement of a slope on a weathered surface, (Jowett, 1995), and mainly occurs where there is highwater content above a layer of low permeability, (Glassey, 1986). Shady areas of loess on Banks Peninsula with slope angles between 20 and 38 degrees are usually the most vulnerable to surface soil creep, (Glassey, 1986). Major landslides are less likely to occur in loess as the soils are relatively consolidated but may be subject to failure in major rainfall events. Exceeding bearing capacity by overloading the surface with gravels for the carparking/access areas may lead to failure and an inconsistent surface for water runoff.

Critical Evaluation:

The reviewed literature includes many relevant and useful methods that are applicable to the main theme and sub-themes of the overall project scope. The majority of the literature was sourced from local case studies on Banks Peninsula. This is extremely helpful as it provides valuable information of the geological conditions and geotechnical factors to take into consideration before physical data is collected as a group. For example, (Glassey, 1986), (Dorsey, 1988) and (Bell & Pettinga, 1985) provide in depth evaluations of geological conditions on Banks Peninsula and the issues the project may face. While (Robertson & Cabal, 2014) and (Tomlison, 2001) include relevant techniques to obtain data from the field. However, majority of the literature is published over 30years ago. Between the present and then, many factors would have most likely changed such as ground condition sand technology. GIS could now be used to identify geomorphology and measure accurate slope angles. Equipment such as cone penetrometers are common and used in practice more often. While seismic refraction tests using a hammer and plate have become less practised.

The 2010 and 2011 Canterbury earthquakes also need to be taken into consideration as the information from the literature was gathered well before these events took place. In conclusion, the literature is extremely relevant to the overall project and provides valuable information regarding the geotechnical, geomorphological and geological elements of the main topic. However, it may be viewed as outdated due to technological and physical changes

What are the Environmental Impacts of Car Park Development?

Introduction

Existing access to Panama Reserve is (PR) considered unsatisfactory. This project aims to improve access to PRR. The importance lies in understanding and promoting the land and history of PRR. PRR is a feeder dyke to an ancient, presently eroded, volcanic dome complex, unusually exposed above the surface. The unusual surface exposure promotes favourable conditions for tourism and education, reinforcing the importance of improving site access. The subthemes of the project are: What are the key elements of carpark design? What site conditions are required for carpark development? What are the approaches to understand visitor type and provide enhancements that support their visitation? How can GIS best be used to support site analysis? What are the environmental impacts of carpark development? This review will focus on the last subtheme by discussing and comparing known methodologies, critical information, relationships and impacts the project brings.

Sub-theme

Improving site access to PRR introduces challenges on environmental effects. Earthworks produce temporary air pollution and potentially persisting water pollution. Existing research highlights potentially detrimental effects of impermeable surface runoff, run-off pollutants from vehicles and increased anthropogenic activity on ecological systems. The literature discussed in this report draws attention to these effects, taking slightly different approaches to research design, methodology and data collection to produce findings that will inform the current problem of improving site access to PRR. I will compare and critique the literature to the consider implications and limitations to our research.

Research Methods

A study by Sennoune et al (2014) explores particulate emission methods of in-situ earthwork machinery. The study was conducted by attaching exhaust gas sample probes and a thermos-couple to the machinery's exhaust, and also an unburned hydrocarbons compound analyzer. The study sampled stationary or under load machinery emissions of carbon dioxide (CO_2), carbon monoxide (CO), nitrogen oxide (NO_x) and hydrocarbon gas (HC). Revitt et al (2014) aimed to quantify and discuss the source, impact, and management of carpark run-off pollution. Using set surface type and size parameters under a uniform rainfall event, the study by Revitt et al (2014) applied mathematical equations and models to theorize the run-off effects of asphalt. Taking a slightly different quantitative approach, Ament et al (2008) aimed to assess road impacts on wildlife populations in national parks. Ament et al (2008) identified 396 National Park Services (NPS), of which 196 contained publicly accessible roads and were deemed relevant. A questionnaire accumulated background information from the NPS units, including unit road length, speed limits, traffic volumes and road history. The questionnaire assessed conflicts of transportation on wildlife and mitigation practices each NPS were using. Barrett et al (1995) provided a less quantitative approach to their research, aiming to review and evaluate literature about the quantity and control of pollution from highway run off and construction. The literature focused more on existing research; however, existing data was quantitively analyzed and discussed. Buckley (2004) approached his research with a similar methodology. The research of Buckley (2004) aimed to assess the environmental impacts of motorized off-highway vehicles in ecotourism. Comparable to Barret et al (1995), Buckley (2004) articulated existing peer-reviewed research to evaluate the studies aim.

Environmental impact results

Construction phase

Studies by Sennoune et al (2014) suggest earthwork machinery, whether stationary or under load, produce excessive proportions of toxic gases. Sennoune et al (2014) highlights that the most powerful machinery produced the highest concentrations of CO_2. Highlighting a direct correlation between CO_2 and NO_x emissions. Research by Barret et al (1995) reveals road construction causes harsh changes to waters within the catchment including turbidity, suspended solids concentration, and water colour. Highlighting higher suspended solid results in reduce diversity and density of fauna in the affected area. Elaborating extent and persistence varies, concluding a rebound response to pre-construction levels can occur. Studies by Sennoune et al (2014) and Barret et al (1995) came to a consensus of negative environmental effects from road construction and earthworks.

Surface change

Studies by Rivett et al (2014) highlight impervious asphalt surface change increased suspended solids, metals, hydrocarbons, and nutrients in run-off. Rivett et al (2014) suggested that pollutants can be present in either particulate or dissolved states. Furthermore, they suggested run-off control methods such as drainage channels, gully pots, infiltration systems and riparian margins. Barret et al (1995) further highlights local peak discharge is increased by impervious road cover, discussing increased stream bank erosion and pollutants in receiving water columns. Barret et al (1995) suggests sweeping and riparian buffers as a run-off control method. Rivett et al (2014) and Barret et al (1995) reveal a consensus that run-off quantity and pollutant transport is increase with impervious surface change, however there are mitigation methods.

Anthropogenic activity

Buckley (2004) reveals in his paper offroad highway vehicles (OHV) have a direct impact on soils, vegetation, and mortality rate on fauna. Highlighting heavy soil compaction increases surface run-off, slope wash, and water born debris flows and decreases infiltration and soil microfauna. Buckley (2004) states OHV increases the spread of weeds. Buckley (2004) further highlights increased fauna deaths, especially invertebrates and lizards. This finding correlates to studies of Ament et al (2008) who highlight increased habitat fragmentation, habitat loss, and fauna mortality in American national parks due to vehicles. The researchers state only 38 out of 196 NPS use mitigation methods, most commonly wildlife signs. There is consensus between Buckley (2004) and Ament et al (2008) of the negative environmental impacts anthropogenic activity has on environments.

Limitations

There is consensus between the research that activities associated with improving site access to PRR will have adverse effects on environments. The literature remains relevant to the project, however, there are limitations on how directly applicable the research methods and findings are.

Research and findings of Ament et al (2008) thoroughly explore the environmental impacts of roads on habitats. However, the study is aimed toward interstate roads, spanning longer distances, and hosting more traffic flow than our projects concern. This finding is consistent with the research of Barret et al (1995), which highlights traffic volume as a key factor affecting highway run off quality. Revitt et al (2014) articulated their research by studying carpark run-off in an urban environment. This stimulates the idea the research was aimed for research on higher density road use as well. Barret et al (1995) states vehicles pollute roads through metals, chemical oxygen demand, oil, and grease. This finding is reinforced by Rivitt et al (2014) who further discuss vehicles pollute through hydrocarbons and nutrients. The concentrations of these pollutants are likely to be less for our project due to predicted lower traffic density. Rivett et al (2014) highlights the importance of climate change induced rainfall intensity, speculating how the characteristics of run-off may change over time. Previous studies by Buckley (2004) have focused on the impacts of OHV on dirt roads, the findings and application of this report could potentially be limited under the assumption the surface type of the existing access road is dirt. This potentially means the knowledge of OHV can only be partially applied to our project. Research by Sennoune et al (2014) may only be of partial application to our project. The machinery used in this study is limited to 11 different earthwork machines, it is unlikely this exact machinery would be used in earthworks for our projects site improvement. Therefore, limiting the application of emissions data to directly predict airborne pollutants produced during earthworks for our project.

Implications to our project

Although previous research for the literature has limitations on the direct application to our project, there remains adequate information that will inform and shape our project.

Research by Amen et al (2008) uses a large sample size, the robustness of research allows us to draw predictions from the findings. These findings allow an application of the effects of fauna habitat loss, habitat fragmentation and mortality to our project. Similarly, Buckley (2004) assesses the effects of OHV on soils, air, flora, and fauna in different environments. The broad assessment helps to inform differing environmental sensitivities, which is important to our project by deepening our understanding of how sensitive an environment may be to an increase in anthropogenic activity. Research by Barrett et al (1995) and Buckley (2004) was predominantly focused on synthesizing existing information. A broad accumulation of literature allows for multiple perspectives on relevant information to our project, eliminating perspective bias and informing and shaping our project further. Both Sennoune et al (2104) and Revitt et al (2014) took a quantitive approach to research. Information articulated by Sennoune et al (2014) quantifies the emitted pollutants from operating earthwork machinery. As mentioned in limitations the exact machinery is unlikely to be used in our project, however, the research findings are still relevant. The findings of Sennoune et al (2014) inform the most drastic airborne pollutants will be produced during machinery operation, suggesting temporary air pollution. Barrett et al (1995) informs rainfall controls how much dustfall and ionic constituents are brought to the ground to contribute to run off. Informing relevant information to our project uniform with findings of Sennoune et al (2014), highlighting temporary airborne pollutant effects during earthworks. Mathematical models suggested by Revitt et al (2014) reduce errors in estimating carpark run off due to the lack of site specificity. The design shows 4 carpark run-off models with slightly different environment and rainfall event characteristics. The importance of each characteristic on run off deepens our understanding of certain run-off effects we may see within our own project following the improvement of site access.

Conclusion

The literature provides research design, methods, and findings relevant to understanding the environmental effects of improving site access to PR. Overall, evidence suggests that there are many factors that contribute to negative environmental effects of site improvement. The literature has demonstrated a need for placement of mitigation methods to protect the quality of the environment at PR.

How can GIS best be used to support site analysis?

Project Introduction

Project abstract

Panama Reserve is located at Le Bons Bay, eastern Bank Peninsula with 200 hectares of land. The reserve is owned and run by Josef Langer Charitable Trust. With an exclusive geological setting, Panama Reserve was recognized as a geological theme park, a volcanic dome associated with a tributary dyke formed in its core. The regenerated native Flora and fauna provide a new environment for conservation, education, and recreation. The trust wishes to apply those benefits to young generations and improve the visitor experience by setting a Geosite with interpretation plates throughout the reserve. The upgraded access can help the trust run the reserve commodiously and provide highly valuable ecosystem services. With tourists increasing, economic benefits will support the trust maintains the infrastructure in the reserve. Providing a safe habitat to native flora and fauna. For the reserve to be promoted and accommodate greater visitation, these sites require upgrades for vehicles and bicycles. Current reserve access is limited to four entry sites and the project needs to analyse the sites among them. Broadly, this project is about investigating proposed Geosites/new potential Geosites and finding two appropriate sites for the reserve with ecological and national significance.

Target review

With an environmental-friendly purpose in future development, the access will be designed without original landscape destruction and include Māori elements. To get more people involved, especially young people, a local school participates in (Le Bons Bay environment school) can be a choice.

Sub-theme introduction

The project is divided into five sub-theme due to the analysed project target.

1. What is the key element of car park design?
2. What site conditions are required for car parking development?
3. Approaches to understanding visitor type and providing enhancements, that support their visitation.
4. Environmental impact of car park development-how to access?
5. How can GIS best be used to support site analysis?

The fifth sub-theme is the topic focused by this literature review. Multi-criteria analysis should be put into consideration with site selection in GIS. The element of criteria can include Spatial effects, geographical effects, geological effects, biological effects, etc. And the effects can come together in certain projects. E.g., Termite habits and effects of suitable soil for nesting on embankment environment. Biological effects mix with geological effects on embankment dam site selection. The complex and extensive criteria show GIS analysis in accurate data analysing. Even the tested evidence and map results show the ultimate best result, but the accuracy and applicability of the result have gaps between the GIS model and reality. How to make the result more precise in GIS analysis will be the same target for all articles or reports. So, this report is going to investigate questions about making GIS analysis accurate.

Methods of GIS analysis in site selection

1. Setting specific criteria by investigating the project or topic.

Investigating the background of each project will be a vital part of GIS analysing. The different project shows different requirements in site selection. In this project, to find a preferring access (car park) site of Panama Reserve (the target type is a nature area set for natural habitat protection and human recreation) should think about natural factors and human factors in influence the site selection. Like ecological impact (the impact of settling access to native flora or fauna), the slope of the access, whether tracks to access will be convenient to people, whether geological or geographical setting impacts the access by future hazards like landslides or storms, etc.

2. Using suitability map

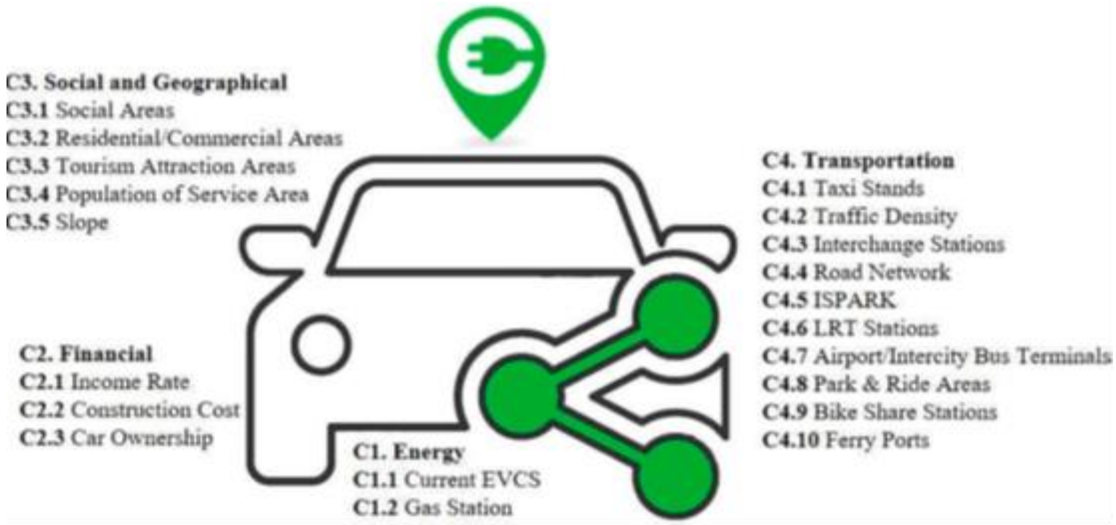
Suitable maps will match the goal of the project in GIS analysis. The category of the map can be a satellite with suitable precision. a topographical map indicates different latitudes.a land use map shows buildings, streets, and roads; a natural landscape map labels out lakes, swamps, etc.

Discussion

Globally, solid waste poses a threat to the environment, health, the social, and economic well-being of low-income countries. Landfilling is the least preferred method in the waste management hierarchy and a popular way to dispose of waste. Makonyo (2022). Landfill site selection become a vital issue in some countries. Makonyo (2022) and Wang (2022) investigated this issue by using GIS analysis in different cases. In Makonyo (2022)'s literature, an appropriate combination of 15 factors was used, including proximity to built-up areas, surface water, episodic water channels, boreholes, sensitive sites, protected areas, faults, airports, roads and railways, earthquake epicentres, LULC (Land use/land cover), geology, soil type, elevation, and slopes in Dodoma city, Tanzania. In Wang (2022)'s study, the literature collected geospatial elevation data, river water system maps, road maps, land use maps, population data, airport locations, port locations, and locations of existing Xiamen solid waste comprehensive treatment facilities in Xiamen, China. Compared with the two articles' influence factors, the main factors influencing landfill site selection are land use data, transport system data, airport locations, water systems, and elevation data. The other factors they focused on showing the different perspectives in city development on landfill site selection. The different degrees of urban development in Dodoma city and Xiamen shows the different requirements of a landfill site. Based on Makonyo (2022)'s research, Dodoma city tends to find a spot for landfill and wishes to put them in an urban construction plan. In Wang (2022)'s research, Xiamen prefers to upgrade a landfill or search for a new landfill site to replace the overloaded filled landfill site. Therefore, the urban development decides the purpose of the landfill site selection. Even though Xiamen is a super city with high urbanization in China, Wang (2022), the geological setting of the future landfill site can be a potential issue that influences the underground water and soil pollution, Chen (2014).

For eco-protection, electric cars are becoming a new tool instead of traditional fuel vehicles in urban transport. In Kaya (2022)'s article, the site selection of electric cars can make urban convenient for transport and environmental protection. Compared with landfill site selection, electric car station shows tightness of dense city development, population, and transportation. As shown in appendix 2a, Kaya (2022) indicates the influence factors are more related to human factors. But the influence factors still be limited. The station site selection should put the willingness of purchasing electric cars, the increased electric cars quantity area, and future population changing scenarios (if electric cars can reduce the financial cost for citizens, the density of the central population will decrease.)

Kumoro (2022) and Van (2011) talked about power generation by different natural energy. Kumoro output the result by analysing the geological background data and hydro condition of



Appendix 2a. Evaluation criteria for ECSSs (electric car-sharing stations) Kaya (2022).

Sungai Are District, Indonesia. Van talked about the ecological factors, wind resources, transportation factors, site slope rate, land clearing, and grid connection. The difference between those two articles is the way of power production. But in order to improve the accuracy of site selection, biological factors (native fauna and flora) can be influenced by the change in landscape and noise.

Kilicoglu (2022) talked about settlement area analysis with multifarious created maps. Kilicoglu focused on flood susceptibility maps, landslide susceptibility maps, and bio comfort suitability maps in identifying the safe areas first, considering natural disasters in the region, and then determining the appropriate areas based on bio comfort. Compared with the power plant, electric stations, and landfill sites, the settlement area needs to consider from a wider perspective. But Kilicoglu didn't put the factor of distance from other towns or villages into consideration. Convenient transport web can help to locate the settlement area, inspiring from Van (2011).

Conclusion

To make the GIS analysis more accurate should compare the peer articles and find out the advantages and disadvantages in setting criteria. The considered factor shouldn't be limited to innate factors. Different perspective considerations can bring more understanding of GIS analysis.

Introduction

How do we bring more people to a spectacular geologic site that displays a large lava dome with a beautiful feeder dyke which lays on top of the ground surface? Our group project is on how to best access improvements for the Panama Reserve /Proposed Panama Reserve Geosite. This project is in association with Josef Langer Charitable Trust and is aimed to improve tourism and accessibility in a truly breathtaking part of canterbury. This reserve within Akaroa is rural and it is rustic but this area is a real hidden gem when it comes to scenery. The issue however is not many people get the opportunity to see this corner of Canterbury due to how remote and difficult it is to access. Currently the only access points to Panama Reserve are difficult to get to and have no parking availability, making getting to the reserve a deterrent to anyone wanting to visit. We aim to improve the current options of access by designing a new car parking space close to the Panama Reserve which will make visiting the site and surrounding areas much more friendly to international tourists and local travelers alike. My group has broken this task into five sub-themes in order to find relevant literature on what designing a good car parking space entail.

Our themes include;

What are the key elements of carpark design?
What site conditions are required for car park development?
Environmental impacts of car park development and how to assess them?
How can GIS best be used to support site analysis?
Finally, the theme we will be looking at in this review is; approaches to understand visitor type and provide enhancement that supports their visitation?

This theme is key to understanding whether we will need to add anything to this parking to accommodate fora diverse range of visitors. I will attempt to understand who will be using the parking pace In Panama reserve and the habits of people who use rural parking areas in order to maximize usage and minimize waste and misuse. I will do this by finding articles about the type of people that travel to visit national parks, reserves and other rural areas.

What is an ecotourist?

I began my research by trying to find out what type of people visit national reserves and other nature areas. I came across the term 'ecotourism' which is a way to describe someone who is a nature-based tourist, I wanted to gain a deeper understanding of who ecotourists are and what their demographic is in order to be able to predict the tendencies they will have towards the Panama Reserve and the accessibility options it has. "Ecotourists are usually in the age of 20-40 year age group with a second large group of 55 years and older" (Beeton 1998) These people are usually well educated, displaying a high interest in sciences and the natural world. These people tend to be more open to new ideas and enjoy the outdoors.

What traits and tendencies do ecotourists display?

I will be looking at an article that uses personality traits as a predictor of eco-friendly behavior in tourism. The article 'The Big Five personality traits as antecedents of eco-friendly tourist Behavior gets a total of 249 random tourists from different parts of the world to complete a questionnaire measured with a seven-point likert scale. The questions consist of three categories: The big five personality traits (agreeableness, extroversion, conscientiousness, neuroticism and openness), environmental tourist behaviors and sociodemographic. SEM tests were then done to test the correlation between the big five traits and eco-positive tendencies in the tourists. I believe that extraversion and Agreeableness are the most likely to both show strong correlations towards eco-friendly behaviors. Though these findings do seem to be accurate with the hypothesis explained at the beginning of the article but due to the questionnaire being a self-report by all the participants I do question the validity of the eco-friendly claims the participants have. There may be some bias in the answering of the questions and I think that peer reports could have given a more honest answer. How will a car parking space affect the landscape appeal? The article: Landscape and the rural tourism experience: identifying key elements, addressing potential, and implications for the future, talks about the visual appeal of rural landscapes in respect to tourism. This paper aims to explore the importance of visual appeal in rural areas. It explains in the introduction that visitors to rural areas experience four types of sensorial stimulation: Aesthetic, educational, escapist and entertainment. The aesthetic stimulation is explained to be the most passive of the four stimuli. This article takes qualitative results from a survey that has participants that are visiting two villages in Portugal answer questions regarding the colours, images, sounds and smells that they associate with the villages they are visiting. The participants are aged 21-50 and are mostly Portuguese. The results of the study confirmed that the landscape is a critical element to the visitors' appeal. The results showed that Green, blue and grey are the colours most associated with the rural visitor aesthetic stimulation. I found the results of the survey somewhat underwhelming due to the lack of other perceptions such as smell, sound and feel of the environment. Though the results could have been more I do think that the understanding of the visual appeal of the rural landscape could be beneficial. Improving accessibility and tourism in rural New Zealand. The next two articles I will look at both talk about tourist accessibility in New Zealand. The first is: Global Influences on Access: The Changing Face of Access to Public Conservation Lands in New Zealand. This article describes the accessibility to the natural environment of New Zealand and cites that the first colonists of New Zealand wanted to create an environment that was accessible for recreational purposes. The second article is: Global Influences on Access: The Changing Face of Access to Public Conservation Lands in New Zealand is focused on how tourists can better access rural lands. These papers both state that free public access has taken a hit around the turn of 2000 due to more private ownership of trails and rural lands, resulting in many access ways eroding over time. Improving accessibility of tourism in New Zealand talks about tourism access in New Zealand in regards to people with disabilities. She uses semi-structured interviews in order to talk to people online and in person about their experiences and expectations with travel and tourism in New Zealand. She first breaks the ice with questions about the participants' backgrounds, in order to get them to feel more comfortable with her and be able to give a more honest assessment about accessibility for people with disabilities. Her results concluded that disabilities are a diverse experience that can be mitigated, that people are only disable when faced with structural inadequacies.

Conclusion

These articles all point towards the idea that a broad range of people visit rural landscape features such as Panama Rock, usually ageing between 19-50 with often a high level of education and a wider range of salary. These studies used mostly surveys to conduct their research which led to results that could be skewed due to bias. This can be at least partially mitigated by peer assessments and by enabling the participants to be comfortable and honest by creating a more inviting environment for questioning. Although this research has helped me to gain more of an understanding about the type of people that visit areas similar to Panama Rock, I did find difficulty in finding articles that answered the question of what could be added to a car park in order to make it more accessible to those people. I will need to conduct my own research to find the answers to this question

3. Geotechnical Evalutation: Lower Carpark

Appendix 3a: Lower Carpark testing locations for hand auger and scala cone penetrometer

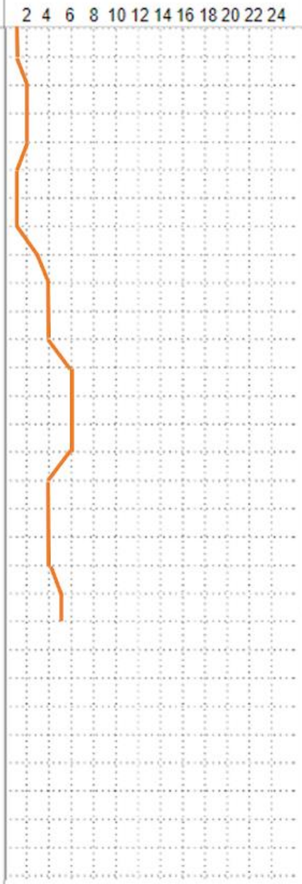
Client: Joseph Langar Trust
Project: Panama Rock Reserve Access Improvements
Location: **Site A – Lower Carpark**

Hand Auger Log and Scala Penetrometer Data

Sheet __ of __

HAND AUGER INFORMATION Drilling Method: Hand Auger Diameter Core: 50mm Excavated By:	**CO-ORDINATES: System:** Easting: Northing: Ground Level:	Date Started: Date Completed:	Logged by: Input by:

Drilling Method	Depth (m)	Sample	Shear Vane Tests	Water Level (m)	Graphic Log	**Soil Description:** grain size (fractions), colour, structure, strength, moisture, grading, bedding, plasticity, geologic formation, USCS short hand **Standard for Logging:**	Scala Penetrometer Test (Blows/100mm)	Elevation (m)
HA						Clay; topsoil; brown; massive; moisture content.		
	0.5					Loess; medium-fine grained sand; moisture content; iron oxide; moderate plasticity; light brown.		
	1.0					Loess; very high plasticity; clay.		
	1.5							
	2.0							
	2.5							
	3.0							
	3.5							



Remarks:

END OF DCP: Effective Refusal, 20+ blows per 100mm.

Appendix 3b: Soil profile hand auger and scala cone penetrometer data, location A at the lower carpark

Client: Joseph Langar Trust
Project: Panama Rock Reserve Access Improvements
Location: **Site B – Lower Carpark**

Hand Auger Log and Scala Penetrometer Data

Sheet __ of __

HAND AUGER INFORMATION	CO-ORDINATES: System:	Date Started:	Logged by:
Drilling Method: Hand Auger Diameter Core: 50mm Excavated By:	Easting: Northing: Ground Level:	Date Completed:	Input by:

Drilling Method	Depth (m)	Sample	Shear Vane Tests	Water Level (m)	Graphic Log	**Soil Description:** grain size (fractions), colour, structure, strength, moisture, grading, bedding, plasticity, geologic formation, USCS short hand **Standard for Logging:**	Scala Penetrometer Test (Blows/100mm) 2 4 6 8 10 12 14 16 18 20 22 24	Elevation (m)
HA								
	0.5							
	1.0							
	1.5							
	2.0							
	2.5							
	3.0							
	3.5							

Remarks:

END OF DCP: Effective Refusal, 20+ blows per 100mm.

Appendix 3c: Soil profile hand auger and scala cone penetrometer data, location B at the lower carpark

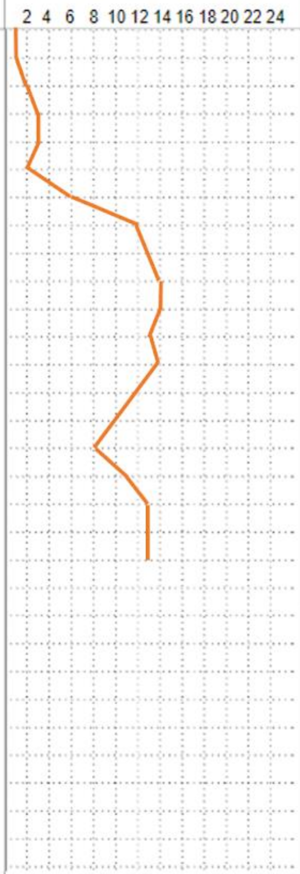
Client: Joseph Langar Trust
Project: Panama Rock Reserve Access Improvements
Location: **Site C – Lower Carpark**

Hand Auger Log and Scala Penetrometer Data

Sheet __ of __

HAND AUGER INFORMATION Drilling Method: Hand Auger Diameter Core: 50mm Excavated By:	**CO-ORDINATES: System:** Easting: Northing: Ground Level:	Date Started: Date Completed:	Logged by: Input by:

Drilling Method	Depth (m)	Sample	Shear Vane Tests	Water Level (m)	Graphic Log	**Soil Description:** grain size (fractions), colour, structure, strength, moisture, grading, bedding, plasticity, geologic formation, USCS short hand **Standard for Logging:**	Scala Penetrometer Test (Blows/100mm)	Elevation (m)
HA						Clay; dark brown; moisture content; high plasticity; topsoil; organic matter.		
						Loess; coarse sand; low plasticity; iron oxide minerals; moderately sorted; organic matter.		
	0.5							
						Loess; very fine/fine sand; well sorted.		
	1.0							
	1.5							
	2.0							
	2.5							
	3.0							
	3.5							



Remarks:

END OF DCP: Effective Refusal, 20+ blows per 100mm.

Appendix 3d: Soil profile hand auger and scala cone penetrometer data, location C at the lower car park

Location A Bearing Pressure Analysis

Soil Type	Depth (m)	CPT (Blows Per 100mm)	(mm) per blow	Average mm/blow/unit	Allowable Bearing Pressure (kPa	Ultimate Bearing Pressure (kPa)
	0.1	1	100			
	0.2	2	50			
Top Soil	0.3	2	50	66.66666667	53	159
	0.4	2	50			
	0.5	1	100			
	0.6	1	100			
	0.7	1	100			
	0.8	3	33.33333333			
	0.9	4	25			
	1	4	25			
Loess	1.1	4	25	57.29166667	59	177
	1.2	6	16.16666666			
	1.3	6	16.16666666			
	1.4	6	16.16666666			
	1.5	6	16.16666666			
	1.6	4	25			
	1.7	4	25			
	1.8	4	25			
	1.9	4	25			
	2	5	20			
Loess Colluvium	2.1	5	20	20.46666666	165	495

Appendix 3e: Location A scala cone penetrometer tests and ultimate bearing pressure calculations

The scala cone penetrometer tests at Location A experienced; soft top soils with less than 3 blows per 100mm for the first 0.3m. Furthermore, medium-fine sand grained loesse with a range of 1 to 4 blows per 100mm from 0.3m to 1.1m depth.

This represented a density increase consistent with both a plasticity increase and an increase in moisture content of the loess. At 1.1m resided the water table, consistent with a stratigraphic change to loess colluvium. The loess colluvium held a very high plasticity, experiencing 4 to 6 blows per 100mm until the scala cone penetrometer tests finished at 2.1m depth.

Appendix 3e highlights; the topsoil had an allowable and an ultimate bearing pressure of 53 kPa and 159 kPa respectively, loess had an allowable and an ultimate bearing pressure of 59 kPa and 177 kPa respectively, and loess colluvium had an allowable and an ultimate bearing pressure of 165 kPa and 495 kPa respectively. NZS 3604:2011 states 'good ground' is defined by having an ultimate bearing capacity of 300 kPa (Zealand, 2011), 'good ground' is therefore equivalent to 3 blows per 100mm. From the hand auger descriptions and scala penetrometer tests, the loess colluvium meets the requirements of 'good ground' whereas the overlying loess and topsoil do not.

Location C Bearing Pressure Analysis

Soil Type	Depth	CPT (Blows Per 100mm)	(mm) per blow	Average mm/blow/unit	Allowable Bearing Pressure (kPa)	Ultimate Bearing Pressure (kPa)
	0.1	1	100			
Top Soil	0.2	2	50	75	46	138
	0.3	3	33.33333333			
	0.4	3	33.33333333			
	0.5	2	50			
	0.6	6	16.66666667			
Loess	0.7	12	8.333333333	28.33333333	120	360
	0.8	13	7.692307692			
	0.9	14	7.142857143			
	1	14	7.142857143			
	1.1	13	7.692307692			
	1.2	14	7.142857143			
	1.3	12	8.333333333			
	1.4	10	10			
	1.5	8	12.5			
	1.6	11	9.090909091			
	1.7	13	7.692307692			
	1.8	13	7.692307692			
Loess Colluvium	1.9	13	7.692307692	8.317862693	280	840

Appendix 3f: Location C scala cone penetrometer tests and ultimate bearing pressure calculationS

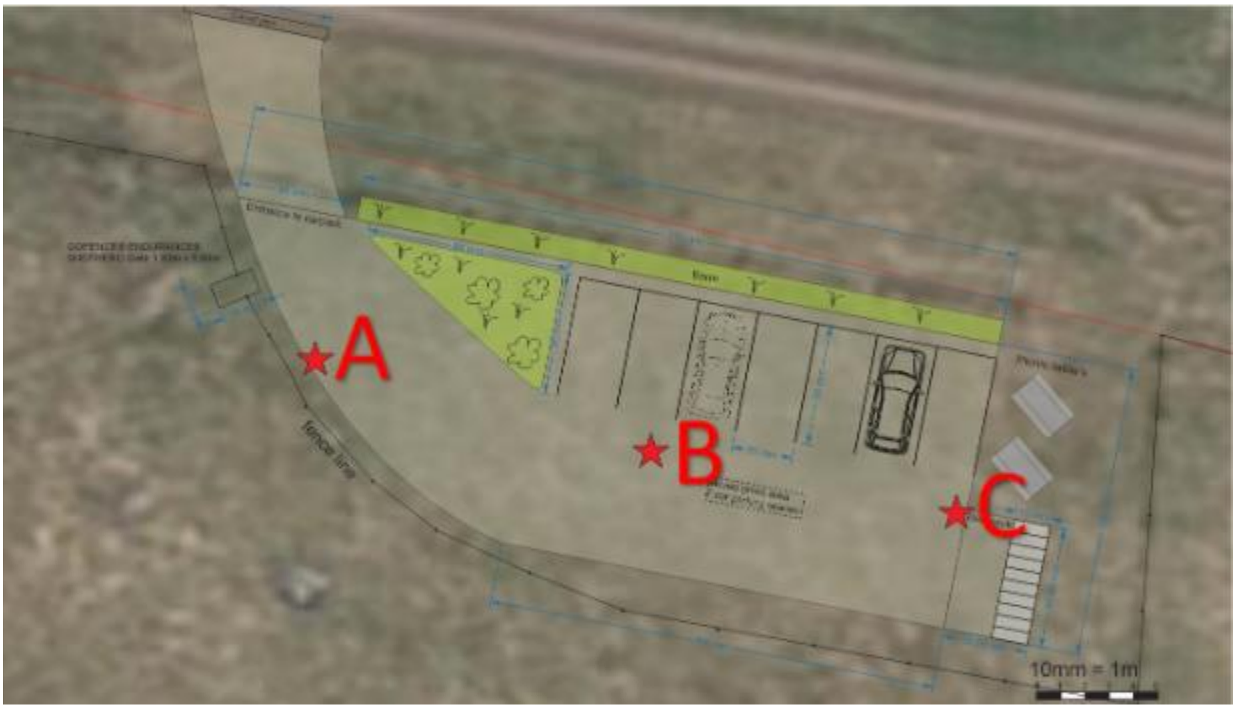
The scala cone penetrometer tests at Location A experienced; soft top soils with less than 3 blows per 100mm for the first 0.2m. Furthermore, coarse sand grained loesse with a range of 2 to 12 blows per 100mm from 0.2m to 0.7m depth. This represented a density increase consistent with both a plasticity increase and an increase in moisture content of the loess. At 0.7m was a stratigraphic change to a very fine/fine sand size grained loess colluvium. From 0.7m to 1.2m depth, the loess colluvium unit withstood blows ranging from 12 to 14 per 100mm, further decreasing to a low of 8 blows at 1.5m deep before increasing to 13 blows per 100mm by the time the scala cone penetrometer tests finished at 1.9m depth.

Appendix 3f highlights; the topsoil had an allowable and an ultimate bearing pressure of 46 kPa and 138 kPa respectively, loess had an allowable and an ultimate bearing pressure of 120 kPa and 360 kPa respectively, and loess colluvium had an allowable and an ultimate bearing pressure of 280 kPa and 840 kPa respectively. NZS 3604:2011 states 'good ground' is defined by having an ultimate bearing capacity of 300 kPa (Zealand, 2011), 'good ground' is therefore equivalent to 3 blows per 100mm. From the hand auger descriptions and scala penetrometer tests, the loess and loess colluvium meet the requirements of 'good ground' whereas the topsoil does not.

Location B Bearing Pressure Analysis

At location B a hand auger sample was not taken due to a lack of time during the site testing day and for this reason, the ultimate bearing pressure could not be determined in this area. Due to the location of this site being in between sites A and C for which there is comprehensive testing completed on, and relatively similar results from these two sites, we can assume that site B is likely to be of similar condition.

4. Geotechnical Evalution: Upper Carpark



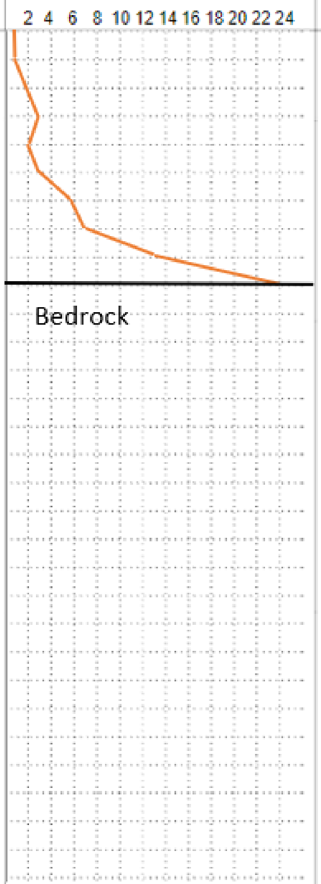
Appendix 4a: Upper Carpark testing locations for hand auger and Scala cone penetrometer

Client: Joseph Langar Trust
Project: Panama Rock Reserve Access Improvements
Location: **Site A – Upper Carpark**

Hand Auger Log and Scala Penetrometer Data

Sheet __ of __

HAND AUGER INFORMATION	CO-ORDINATES: System:	Date Started:	Logged by:
Drilling Method: Hand Auger Diameter Core: 50mm Excavated By:	Easting: Northing: Ground Level:	Date Completed:	Input by:

Drilling Method	Depth (m)	Sample	Shear Vane Tests	Water Level (m)	Graphic Log	**Soil Description:** grain size (fractions), colour, structure, strength, moisture, grading, bedding, plasticity, geologic formation, USCS short hand **Standard for Logging:**	Scala Penetrometer Test (Blows/100mm)	Elevation (m)
HA	0.5 1.0 1.5 2.0 2.5 3.0 3.5							

Remarks:

END OF DCP: Effective Refusal, 20+ blows per 100mm.

Appendix 4b: Scala cone penetrometer data, showing the number of blows taken to drop 100mm of soil at site A at the upper carpark.

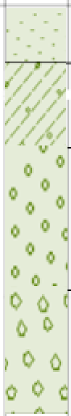
Client: Joseph Langar Trust
Project: Panama Rock Reserve Access Improvements
Location: **Site B – Upper Carpark**

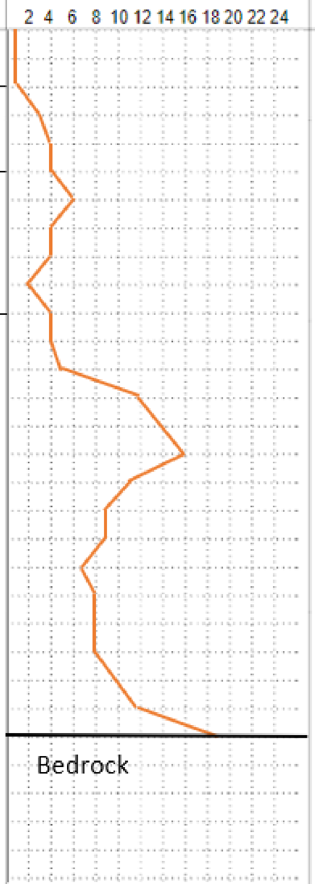
Hand Auger Log and Scala Penetrometer Data

Sheet __ of __

HAND AUGER INFORMATION	CO-ORDINATES: System:	Date Started:	Logged by:
Drilling Method: Hand Auger Diameter Core: 50mm Excavated By:	Easting: Northing: Ground Level:	Date Completed:	Input by:

Drilling Method	Depth (m)	Sample	Shear Vane Tests	Water Level (m)	Graphic Log	Soil Description: grain size (fractions), colour, structure, strength, moisture, grading, bedding, plasticity, geologic formation, USCS short hand **Standard for Logging:**	Scala Penetrometer Test (Blows/100mm)	Elevation (m)
HA						Medium-fine sand; dark brown; moderate sorting; dark brown; organic material		
						Loess; brownish orange.		
	0.5					Loess colluvium w/ basaltic clasts (~4mm); oxidized; weathered at depth; feldspar present.		
	1.0					Very weathered lava; grey; 4-64mm clasts; more cohesion than overlying unit; olivine present.		
	1.5							
	2.0							
	2.5							
	3.0							
	3.5							





Remarks:

END OF DCP: Effective Refusal, 20+ blows per 100mm.

Appendix 4c: Soil properties from hand auger testing and scala cone penetrometer test data at site B at the upper car park

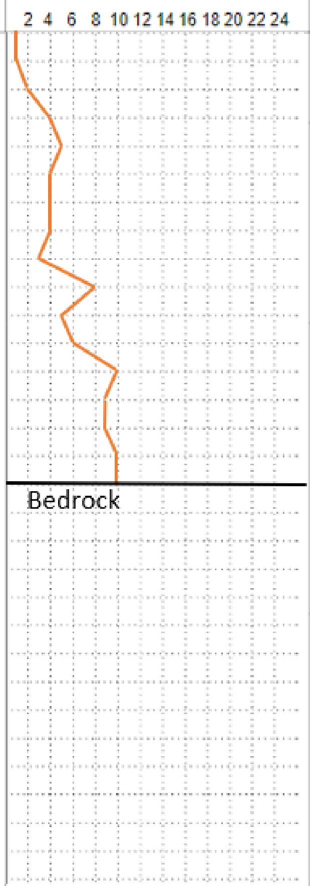
Client: Joseph Langar Trust
Project: Panama Rock Reserve Access Improvements
Location: Site C – Upper Carpark

Hand Auger Log and Scala Penetrometer Data

Sheet __ of __

HAND AUGER INFORMATION	CO-ORDINATES: System:	Date Started:	Logged by:
Drilling Method: Hand Auger Diameter Core: 50mm Excavated By:	Easting: Northing: Ground Level:	Date Completed:	Input by:

Drilling Method	Depth (m)	Sample	Shear Vane Tests	Water Level (m)	Graphic Log	**Soil Description:** grain size (fractions), colour, structure, strength, moisture, grading, bedding, plasticity, geologic formation, USCS short hand **Standard for Logging:**	Scala Penetrometer Test (Blows/100mm)	Elevation (m)
HA								
	0.5							
	1.0							
	1.5							
	2.0							
	2.5							
	3.0							
	3.5							



Remarks:

END OF DCP: Effective Refusal, 20+ blows per 100mm.

Appendix 4d: Scala cone penetrometer data, showing the number of blows taken to drop 100mm of soil at site A at the upper carpark.

Location B Bearing Pressure Analysis

Soil Type	Depth (m)	CPT Blows/100mm	mm per blow	Average mm/blow/unit	Allowable bearing pressure (kPa	Ultimate bearing pressure (kPa)
Med Sand	0.1	1	100	100	37	111
	0.2	1	100			
Loess	0.3	3	33.33333333	27.77777778	140	420
	0.4	4	25			
	0.5	4	25			
Loess Col	0.6	6	16.66666667	28.33333333	100	300
	0.7	4	25			
	0.8	4	25			
	0.9	2	50			
Weather Lava	1	4	25	12.48055956	210	630
	1.1	4	25			
	1.2	5	20			
	1.3	12	8.333333333			
	1.4	14	7.142857143			
	1.5	16	6.25			
	1.6	11	9.090909091			
	1.7	9	11.11111111			
	1.8	9	11.11111111			
	1.9	7	14.28571429			

Appendix 4e: Location B scala cone penetrometer tests and ultimate bearing pressure calculations

5. Costing

Upper Carpark

Gravel Paving - Upper Carpark	Cost per m^3	m^3 (rounded)	Total
AP20 (50mm deep)	$35.90	17	$610.30
AP65 (150mm deep)	$30.00	50	$1,500.00
Delivery	**Cost per 8m^3**	**8m^3 (rounded)**	**Total**
	$170.00	9	$1,530.00
			GST
			$546.05
			Total + GST
			$4,186.35
Spring Loaded Gate (Gofence)			$194.98
Culvert Pipe			$285.50
Fencing			TBC
Bike Rack (10 Spaces)			$165
			Upper Carpark Total Costing
			$4,831.83

Appendix 5a: Costing Breakdown of Upper Carpark. Including Gravel and gravel delivery, Gate, Culvert Pipe and Bike Rack

N

Nigel Gualter <g.consult@xtra.co.nz>

to me

Fri, 30 Sept, 10:04

Hi Mikayla

I would recommend putting down a sublease of AP65 or AP40 depending on what the current ground conditions are like and then topping of with 50mm of AP20

Pricing per cubic metre ex quarry ex GST AP65 $30, AP40 $35, AP2035.90

Delivery is $170 per hour +GST for 8 cubic metres
Please3 feel free to call me and discuss further if you need any clarification

Nigel GUALTER

DACKSQUARRY

DACKSCONCRETE

Appendix 5b: Email sent from Nigel Gualter quoting Dacks Quarry gravel prices for the Upper Carpark

Lower Carpark

Lower Carpark	
Bike Rack (10 Spaces)	$165
Spring Loaded Gate (Gofence)	$194.98
	Total Lower Carpark Costing
	$360

Appendix 5c: Costing Breakdown for Lower Carpark. Including bike rack and gate.

Signage

3.3mm

Signage - 7 signs (each containing: 2 Waratahs, 4 Zip Ties, 1 Conrflute Printed Sign)		
	Each	**Total (GST Included)**
Waratah https://www.bunnings.co.nz/summit-steel-wire-1-65m-black-y-post_p0814003	11.7	163.8
Ziptie 25 Pack https://www.bunnings.co.nz/crescent-200-x-4-8mm-black-cable-tie-25-pack_p0319560	3.72	7.44
9 x Corflute Sign (800mm x 400mm x 3.3mm)		263.35
		Total
		434.59

Appendix 5d: Costing Breakdown for Step One Signage. Including 14 Waratahs, 28 Zip Ties and 7 Corflute Signs (400x800)

Good to hear from you and thanks for your email! Please be aware that we sell our Coreflute/Foamboard by the sheet only (1200x2400) and with your preferred size of 800x500 you'd only get 6 PRINTS PER SHEET.

Alternatively if you could re-size the artwork to 800x400 you'd get 9 PRINTS PER SHEET:

Product: Coreflute Signs
Size: SEE BELOW
Stock: 3.3mm
Print: Single Sided, Colour
Finishing: Cut to size and packed
Quantity:

6 x (800x500) Price: $229 + gst + delivery/collection (please advise)
9 x (800x400) Price: $229 + gst + delivery/collection (please advise)

How does that sound? Production time for these would be around 1-2 days until ready to dispatch so let me know if you're keen to get ball rolling and I will set this up. Hope to hear from you soon 😊

Appendix 5e: Email from Gareth at The Print Company, quoting price for variable sign sizes and unit amounts with design from Figure 3 printed.

5mm

Signage - 7 signs (each containing: 2 Waratahs, 4 Zip Ties, 1 Conrflute Printed Sign)		
	Each	**Total (GST Included)**
Waratah https://www.bunnings.co.nz/summit-steel-wire-1-65m-black-y-post_p0814003	11.7	163.8
Ziptie 25 Pack https://www.bunnings.co.nz/crescent-200-x-4-8mm-black-cable-tie-25-pack_p0319560	3.72	7.44
9 x Corflute Sign (800mm x 400mm x 5mm)		304.75
		Total 475.99

Appendix 5f: Costing Breakdown for Step One Signage. Including 14 Waratahs, 28 Zip Ties and 7 Corflute Signs (400x800)

Info <info@theprintcompany.co.nz> 15:4

to me

Thanks Mikayla and if you opt for 5mm stock it will be $265 + gst + delivery/collection 😎

Kind Regards,

Gareth Jenkins

The Print Company

P. 0800 280 000 or 021 846 953

Ground floor, 109 Dominion Road, Mt Eden, Auckland 1024

Appendix 5e: Email from Gareth at The Print Company, quoting price difference for 5mm thickness rather than 3.3mm in Appendix 5d and 5e

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