National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Assessment Resource

Mathematics and Statistics Level 2

Resource title: Getting around the neighbourhood

This exemplar supports assessment against:

Achievement Standard 91260

Apply network methods in solving problems

Student and grade boundary specific exemplar

The material has been gathered from student material specific to an A or B assessment resource.

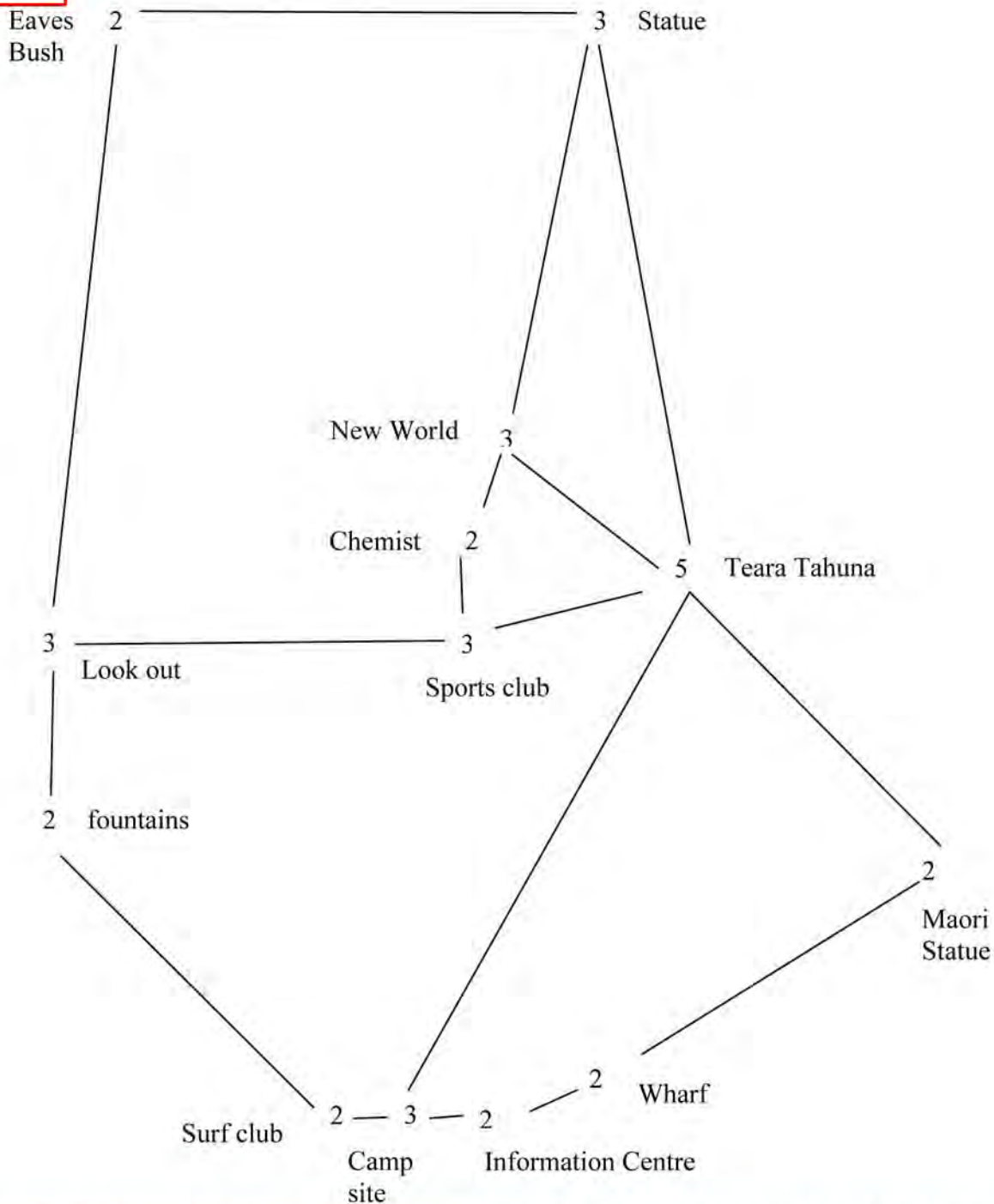Date version published by   December 2011
Ministry of Education   To support internal assessment from 2012

This task involves students using networks to design tourist maps for the local area.

	Grade Boundary: Low Excellence
1.	For Excellence, a student is required to apply networks, using extended abstract thinking in solving problems. This involves devising a strategy to investigate a situation, identifying relevant concepts in context and using correct mathematical statements or communicating mathematical insight. The student has devised a strategy to investigate the three routes and has identified relevant concepts in context (1), (2), (3). For the first route, the student has applied the condition for traversability to the network but has not explained how the network with two odd nodes could be traversable or developed a traversable network from the information centre (3). For a more secure Excellence the discussion on traversability needs to be extended.

1 Route 1

Eaves Bush 2 ——————————— 3 Statue

New World 3

Chemist 2

5 Teara Tahuna

3 ——————————— 3
Look out   Sports club

2 fountains

2
Maori Statue

2 — 3 — 2   2 Wharf
Surf club Camp Information Centre
           site

You can't start and finish a tour at the information office. The map of the town has 6 odd nodes which are the nodes with a 3 or 5 on the map. For the map to be traversable there needs to be 0 or 2 odd **3** nodes. If there are 2 odd nodes you have to start at the odd node and if there are 0 odd nodes you can start anywhere.

Removing the chemist shop and New World and the paths to these points leaves 2 odd nodes at the camp site and the look out so the network is traversable because it has only 2 odd nodes.

2 Route 2

Looking for the shortest path from the information centre to the statue.
Possible paths are
0 to 1 to 10 to 6 = 184 + 1880 + 1560 = 3624 m
0 to 1 to 2 to 3 to 4 to 5 to 6 = 184 + 128 + 1352 + 440 + 1910 + 960 = 4974 m
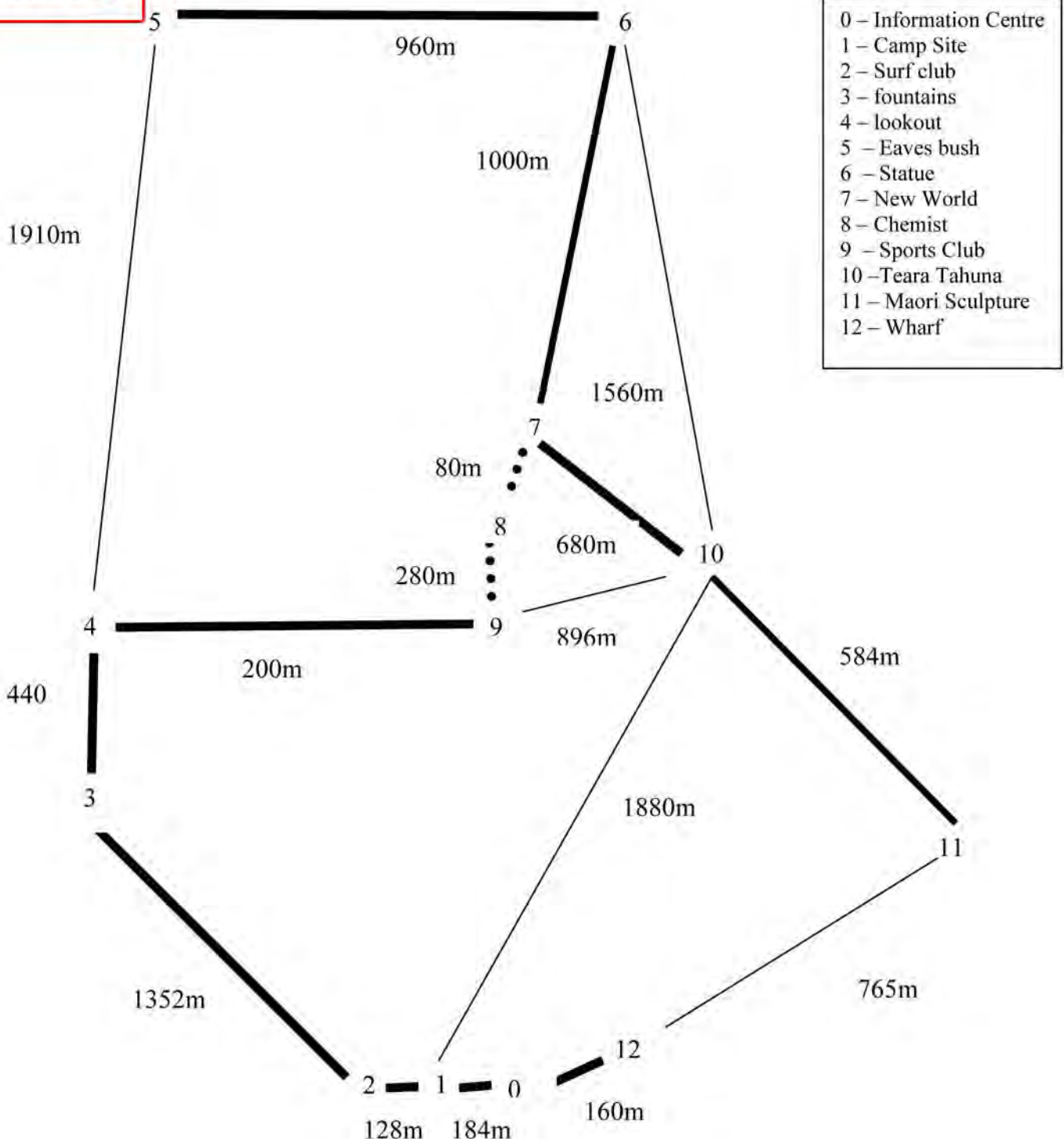
0 to 12 to 11 to 10 to 6 = 160 + 765 + 584 + 1560 = 3069 m
0 to 12 to 11 to 10 to 7 to 6 = 160 + 765 + 584 + 680 + 1000 = 3189 m
Other paths that start with 0 to 12 to 11 to 10 are all going to be longer because the other paths needed to get to 6 are more than 1560 m. From 0 to 10 it is shorter to go 0 to 12 to 11 to 10 than use the 1880 m section from 1 to 10. Going the other way past the lookout uses the 1910 m section so is also too long.
The shortest possible route is 3069 m which is information centre to wharf to Maori sculpture to Teara to the Statue

Route 3 ③

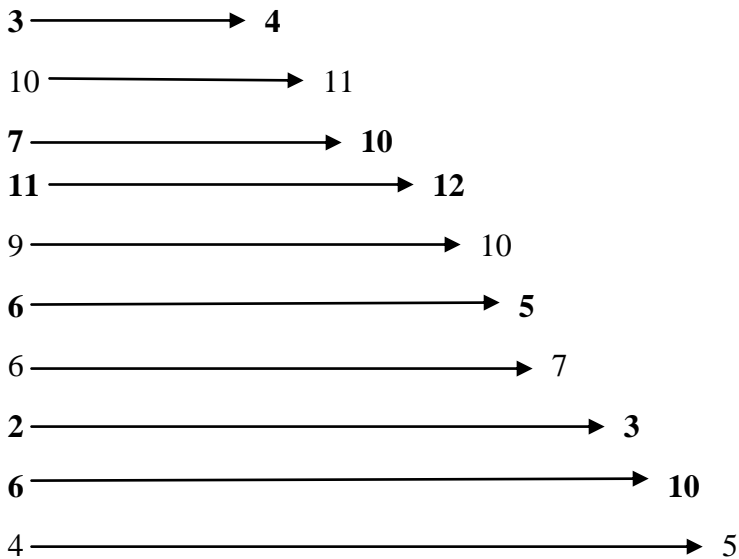| Legend |
|--------|
| 0 – Information Centre |
| 1 – Camp Site |
| 2 – Surf club |
| 3 – fountains |
| 4 – lookout |
| 5 – Eaves bush |
| 6 – Statue |
| 7 – New World |
| 8 – Chemist |
| 9 – Sports Club |
| 10 –Teara Tahuna |
| 11 – Maori Sculpture |
| 12 – Wharf |

I chose this route for the shortest path as it is the shortest to reach all destinations. Where there is a choice of paths I have taken the shortest one to get to a destination so for point 11 use the route from 10 which is shorter than the path from 12. From 6 to go 7 which is shorter than going to 10.
It is also good as at the top of the map eaves bush and works it way down.

You have to get off the Segwag, during points 7,8, and 9. This is because of busy traffic and people on the footpaths where the Segways can't go. Points 7,8 and 9 can be walked.
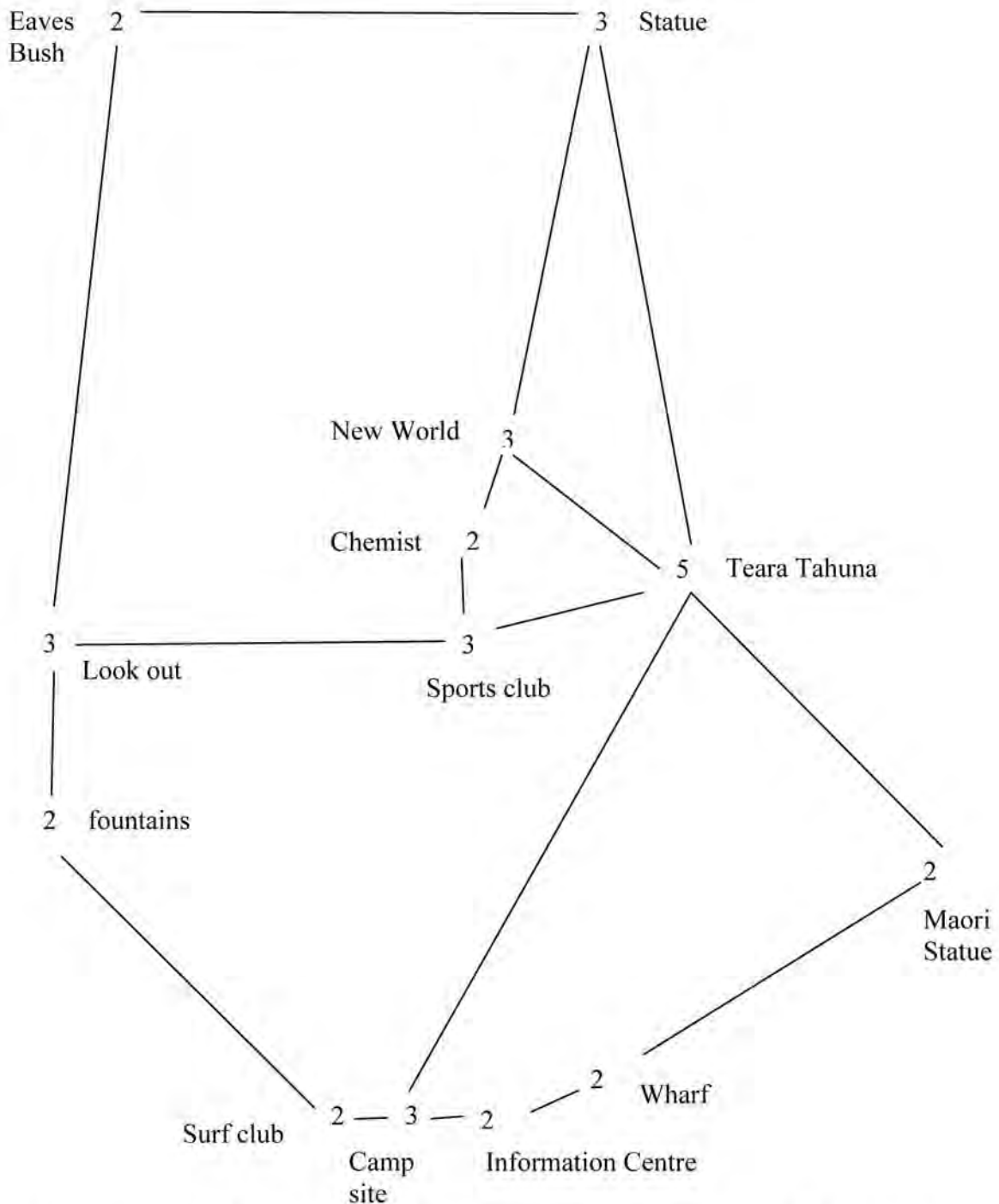
Segway stations are at New World (7) and at the sports club 9. Leave the Segway at one of these stations and walk to the other one to get a new Segway and go to the other places.

The total length for the Segway paths is 960 + 1000 + 680 + 584 + 200 + 440 + 1352 + 128 + 184 + 160 = 5688 m. It is 360 m between the two Segway stations. If they think people might not want to walk they could put a path from 10 to 9 which is 896 m and people would miss the busy traffic.

3 ⟶ **4**

10 ⟶ 11

7 ⟶ **10**

11 ⟶ **12**

9 ⟶ 10

6 ⟶ **5**

6 ⟶ 7

2 ⟶ **3**

6 ⟶ **10**

4 ⟶ 5

	Grade Boundary: High Merit
2.	For Merit a student is required to apply networks, using relational thinking in solving problems. This involves demonstrating understanding of concepts and relating findings to a context or communicating thinking using appropriate mathematical statements. The student has investigated possible paths to justify the shortest path and has demonstrated an understanding of the minimum spanning tree in the explanations relating to the selection of paths (1), (2). To provide evidence of extended abstract thinking for Excellence, the justification of the routes needs to be more clearly related to the context.

1

Eaves Bush   2 ——————————— 3   Statue

New World   3

Chemist   2

5   Teara Tahuna

3 ————— 3
Look out   Sports club

2   fountains

2   Maori Statue

2 — 3 — 2   2   Wharf
Surf club   Camp   Information Centre
       site

You can't travel over all of the map from information centre. To be traversable the network must have 0 or 2 odd nodes. This network has 6 odd nodes (camp site, Look out, Teara tahuna, sports club, New World, statue).
When there are odd nodes you can't start and end at the same point.

2

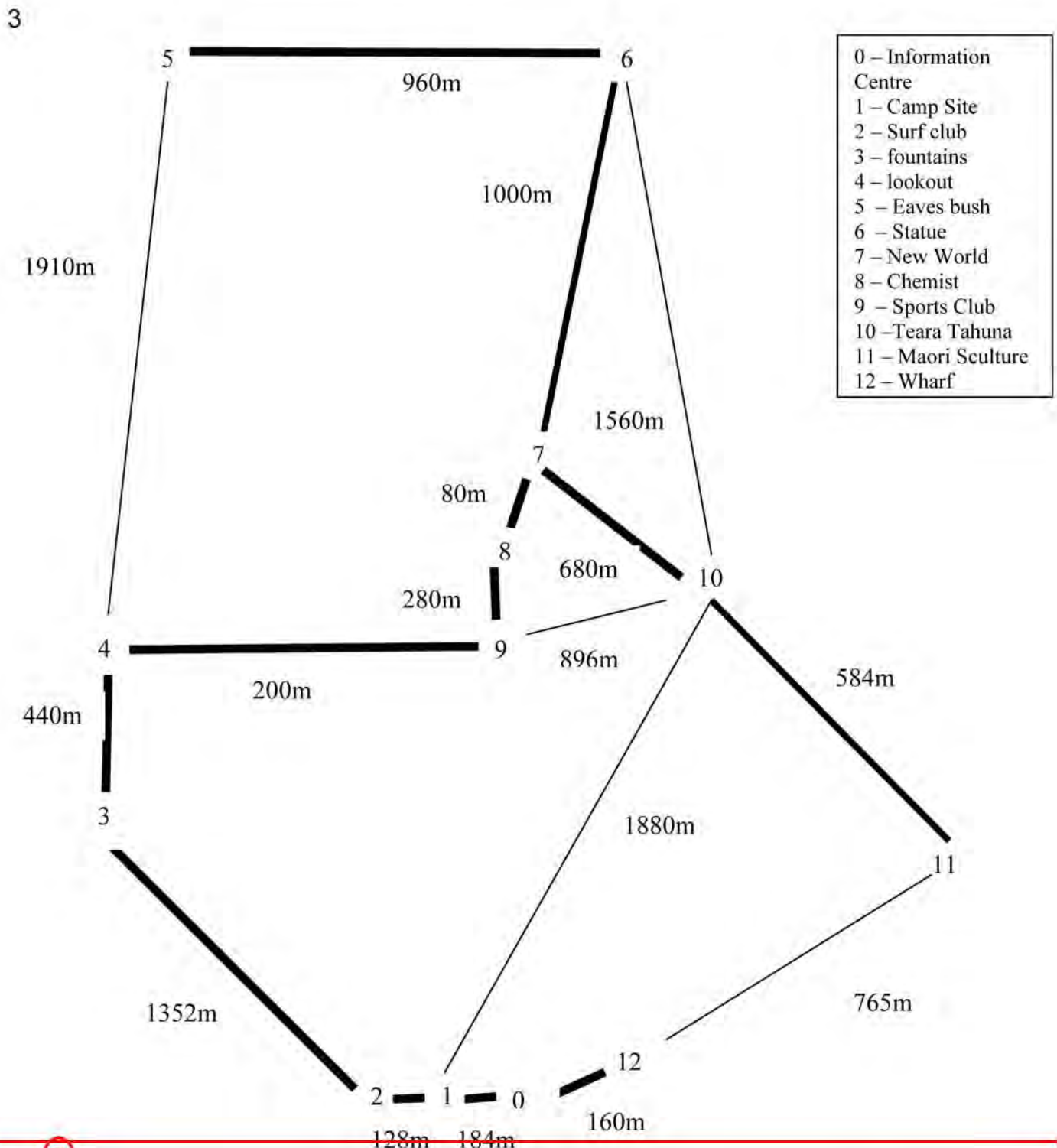Route 2 is the shortest path from the Information centre to the statue   ①

Info – camp – surf – fountains – look – bush – stat = 4974 m
Info – camp – surf – fountains - look – sport – chem – new - stat = 3664m

Info – wharf – Maori – Teara - statue = 3069 m
Info – camp – Teara – look = 3624 m

I have chosen Information centre – wharf – Maori – Teara - statue because all the other
routes as shown above are further and it asks for the shortest possible route.

3

Legend
0 – Information Centre
1 – Camp Site
2 – Surf club
3 – fountains
4 – lookout
5 – Eaves bush
6 – Statue
7 – New World
8 – Chemist
9 – Sports Club
10 –Teara Tahuna
11 – Maori Sculture
12 – Wharf

②

For the Segway, each point has to be connected to another point and the shortest length is needed.
For 0 go to 1 and 12
For 12 don't go to 11 because you can go to 11 from 10 which is shorter than 765 m
For 1 go to 2 but not to 10

From 2 you have to go to 3 and 4

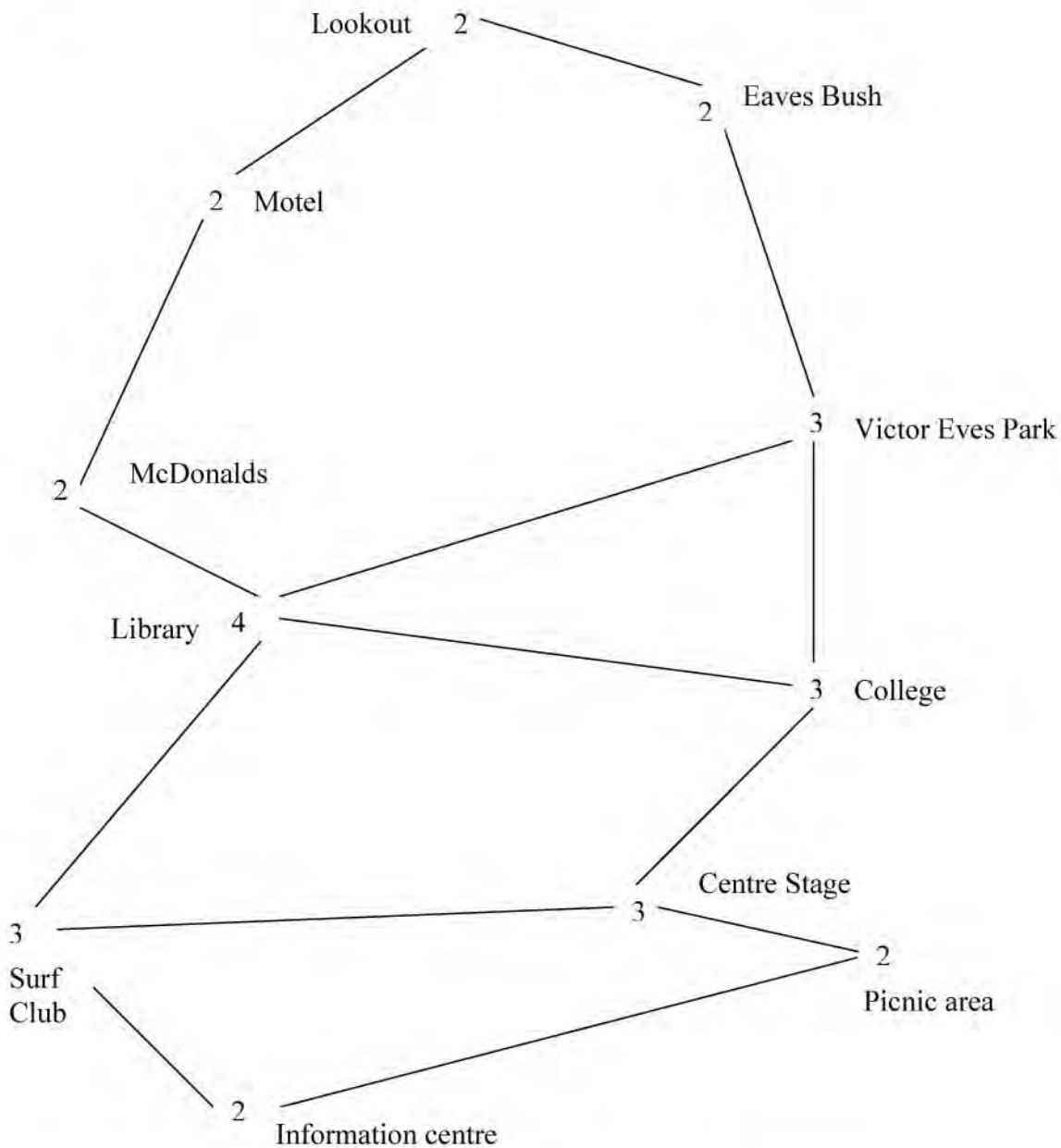For 4 keep 200 but don't do 1910 to 5

For 9 go to 8 but not 10. It is better to go to 10 from 7.

From 10 you need to go to 11 because 584 is the smallest one going to 11. Don't go to 6 from 10 because it is better to go to 6 from 7 which is 1000 compared to 1560

The Segway can visit all the points and the length of the paths is 160 + 184 + 128 + 1352 + 440 + 200 + 280 + 80 + 680 + 584 + 1000 + 960 = 6048 m

	Grade Boundary: Low Merit
3.	The student has demonstrated an understanding of shortest path in the investigation of the lengths of the possible paths in route 2 (1). For route 1, the student has related the condition for traversability to the network but has not explained when a network with two odd nodes would be traversable and for route 3 there is an understanding of the requirement to use the shorter paths (2), (3). For a more secure Merit the explanations for traversability and minimum spanning tree need to be extended.

Route 1

Lookout   2

Eaves Bush
2

2   Motel

2   McDonalds

3   Victor Eves Park

Library   4

3   College

Centre Stage
3

3

2
Surf
Club

Picnic area

2
Information centre

This network can't be traversed from the information centre. To be traversable the network must have all even nodes or exactly 2 odd nodes but this network has 4 odd nodes (centre stage, College, Victor Eaves Park, Surf club). **2**

Route 2

7   0.44 km

0.72 km

6

8

1.28 km

0.72 km

1 – Information Centre
2 – Picnic area
3 – Centre stage
4 - College
5 – Victor Eves park
6 – Eaves bush reserve
7 – Lookout
8 – Motel
9 – McDonalds
10 – Library
11 – Surf Club

5

9

0.65 km

0.76 km

0.47 km

10   0.78 km

4

0.74 km

0.48 km

0.42 km

3   4.08 km

11

2

1.2 km

2.84 km

1
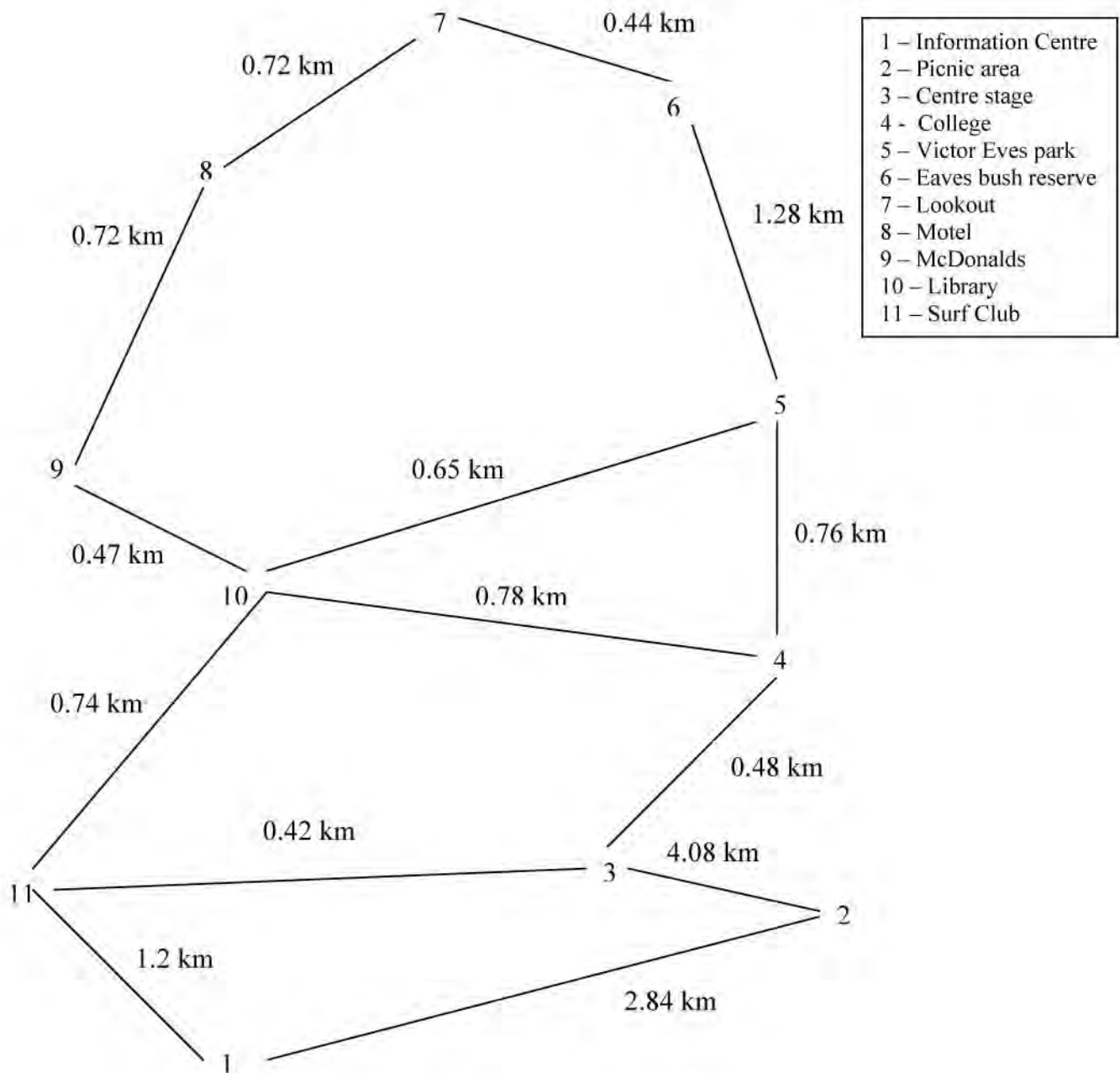
The shortest route from the information centre (1) to the look out (7)
Path 1: 1 – 11 – 3 – 4 – 5 – 6 – 7 4.58 km
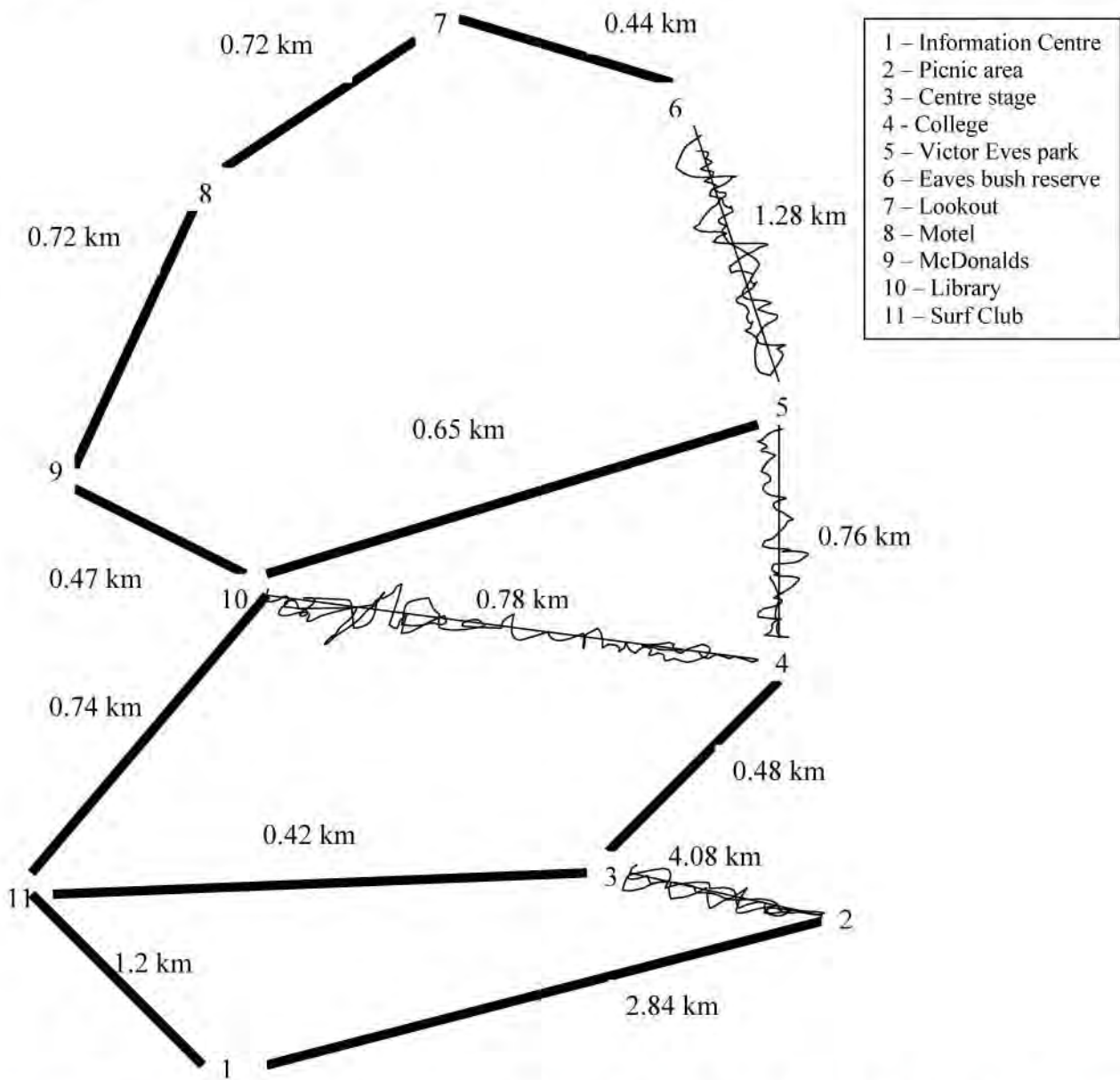Path 2: 1 – 2 – 3 – 4 – 5 – 6 – 7 9.88 km
Path 3: 1 – 11 – 10 – 5 – 6 – 7   4.31 km
Path 4: 1 – 11 – 10 – 9 – 8 – 7 3.85 km
Path 4 is the shortest at 3.85 km.

1

Route 3

0.72 km 7 0.44 km

1 – Information Centre
2 – Picnic area
3 – Centre stage
4 - College
5 – Victor Eves park
6 – Eaves bush reserve
7 – Lookout
8 – Motel
9 – McDonalds
10 – Library
11 – Surf Club

6

1.28 km

8

0.72 km

5

0.65 km

0.76 km

9

0.47 km

10

0.78 km

4

0.74 km

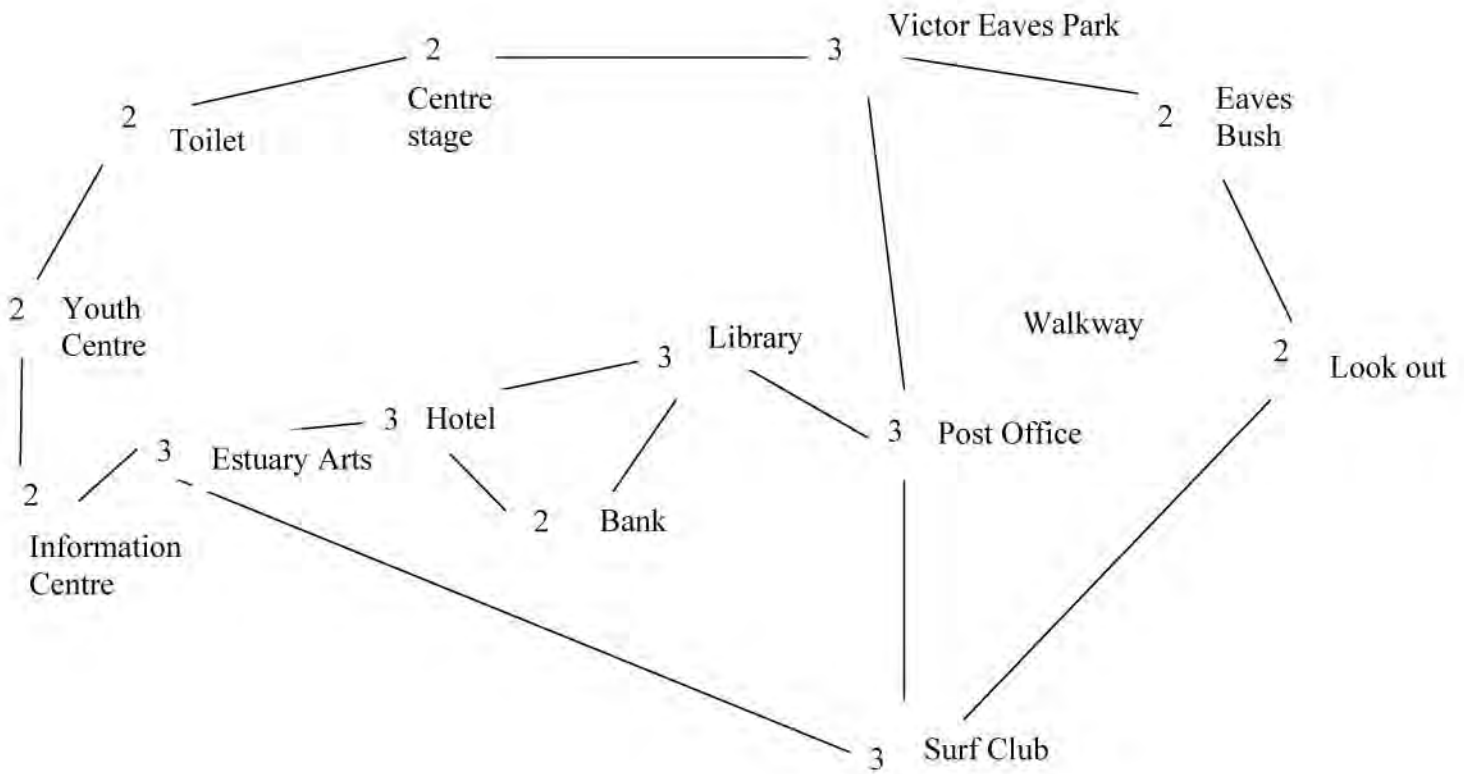0.48 km

0.42 km

3 4.08 km

11

2

1.2 km

1

2.84 km

Distances longest to smallest 4.08, 2.84, 1.28, 1.2, 0.78, 0.76, 0.74, 0.72, 0.72, 0.65, 0.48, 0.47, 0.44, 0.42.

You want the minimum length so don't use a long length if you can get there with a shorter one. **3**
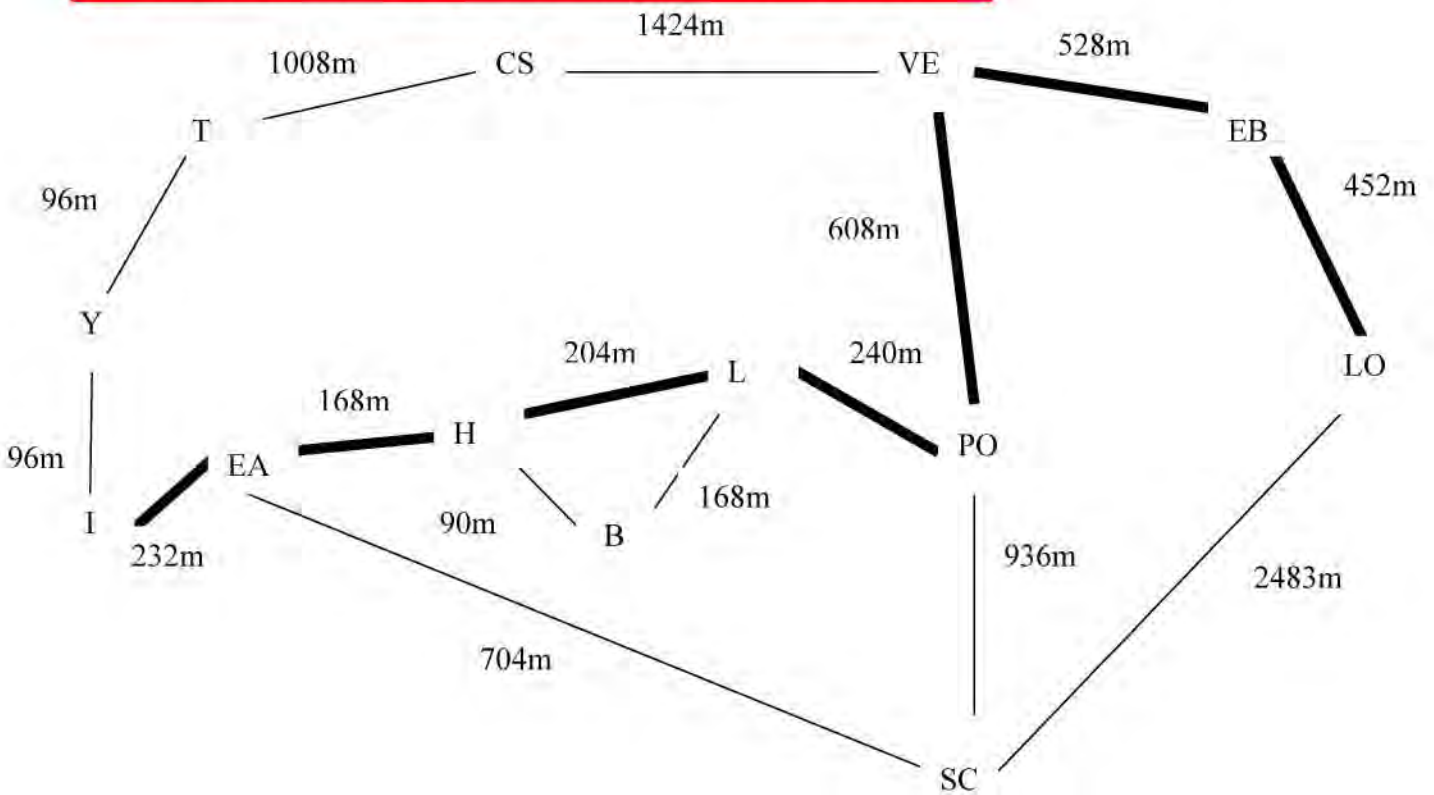
At Mcdonalds (9) I will park one of the Segways and this will become one of the Segway stations. There will also be another Segway Station at the surf club (11). You can park at McDonalds and then walk through the town to the other station and get another Segway.

	Grade Boundary: High Achieved
4.	For Achieved a student is required to apply networks, in solving problems. This involves selecting and using methods associated with networks, demonstrating knowledge of concepts and terms associated with networks and communicating using appropriate representations.

The student has used networks to develop routes for the tourist office and has provided evidence to support the route for the shortest path (1). For the award of Merit an explanation for the selection of another route is required.

For the award of Merit, the student needs to demonstrate an understanding of concepts so an explanation for the selection of another route is required. |

Victor Eaves Park

2 ——— Centre stage ——— 3

2 Toilet

2 Eaves Bush

2 Youth Centre

Walkway

3 Library

2 Look out

3 Hotel

3 Estuary Arts

3 Post Office

2 Information Centre

2 Bank

3 Surf Club

The network is not traversable from the information centre. To be traversable the network must have all 0 or 2 odd nodes.

1 Shortest route to key point of interest the Lookout (LO)

1424m

1008m   CS   VE   528m

T   EB

96m   608m   452m

Y   240m   LO

204m   L

96m   168m   H

EA   PO

I   90m   168m   936m

232m   B   2483m

704m

SC

I – Information centre
T – Toilets
CS – Centre Stage
VE – Victor Eaves
LO – Look Out
SC – Surf Club
EB – Eaves Bush
PO – Post Office
L – Library
B – Bank
H – Hotel
EA – Estuary Arts
Y – Youth Centre

1
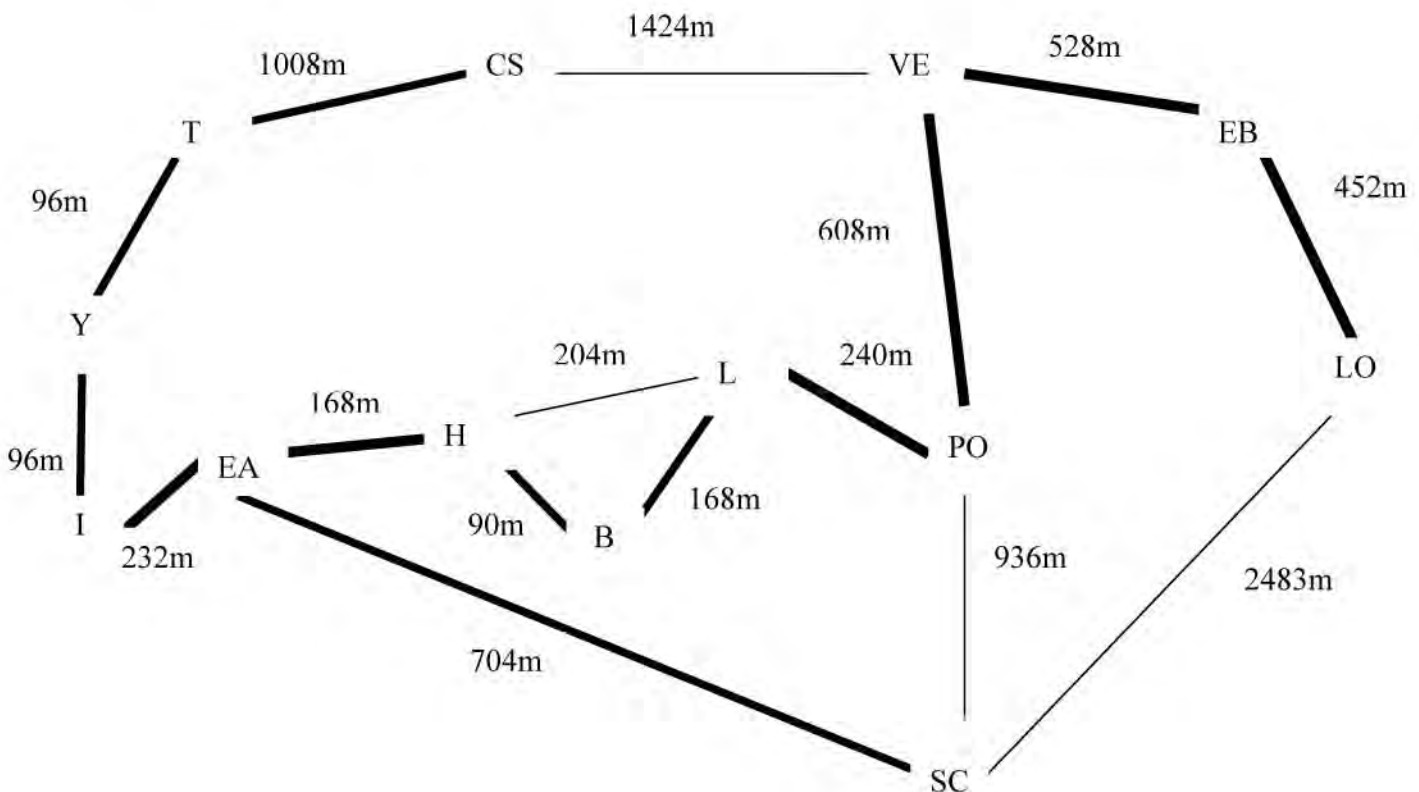
The shortest route is Information Centre – Estuary Arts – Hotel – Library – Post Office – Victor Eaves – Eaves Bush – Lookout = 232 + 168 + 204 + 240 + 608 + 528 + 452 = 2432 m

Other routes are further
I – Y – T – CS – VE – EB – LO = 96 + 96 + 1008 + 1424 + 528 + 452 = 3604 m
I – EA – SC – LO = 232 + 704 + 2483 = 3419 m

Segway paths

The paths for the Segways are shown above.

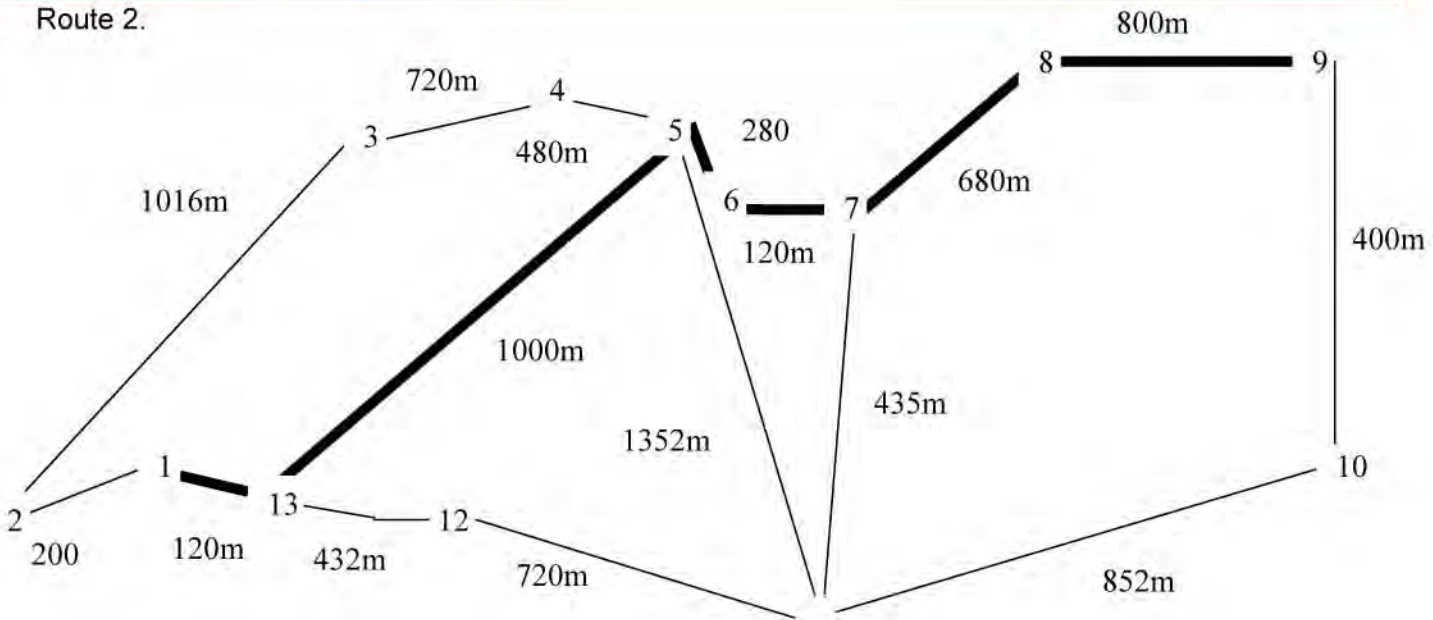|	
	Grade Boundary: Low Achieved
5.	The student has used traversability and found the minimum spanning tree (1).
	The shortest path is incorrect (2).
	While there is some understanding of the requirements for traversability, for a more secure Achieved, the explanation needs to be complete to provide evidence of demonstrating knowledge of concepts and terms.

Route 1
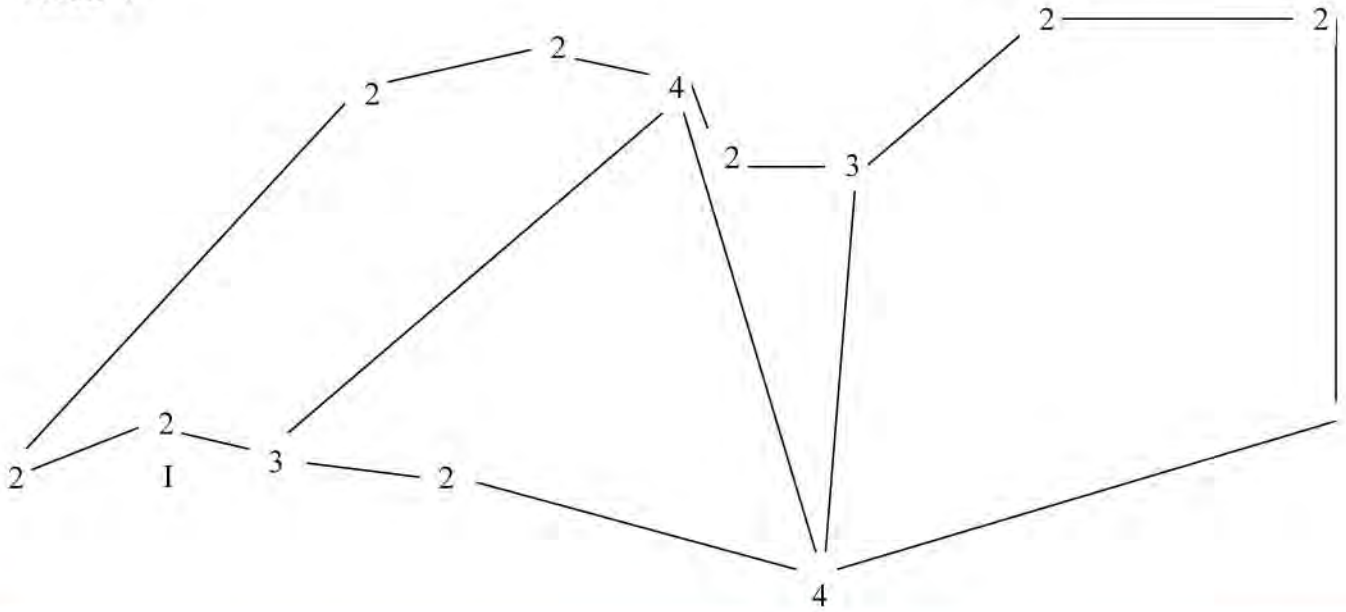
Route 2.

1 – Information centre
2- The māori statue
3 – Surf Club
4 – Toilets
5 - Supermarket
6 – Hillary square statue
7 – Post Office
8 - Motel
9 – Look Out
10 – Alice eaves reserve
11 – millennium walkway
12 – Centre Stage
13 – Arts centre

2 I planned out the shortest route to one point of interest this was the look out. I chose the lookout as a tourist would want to look out over the town and see other areas of interest for them.
The shortest path was a total of 3000 m and went from the information centre to the look out.

Route 3

800m

8 ——————— 9

720m

4

3   480m   5   280

1016m   6   7

680m

120m

1000m   400m

1352m

435m

2   1   13   12   11   10

200   120m   752m   720m   852m

	Grade Boundary: High Not Achieved
6.	The student has found the network for the shortest path. While there is an error in the listed paths, the distance is consistent with the path shown (1). The minimum spanning tree for the Segway path is incorrect (2). To be awarded Achieved, the student needs to provide some support for the conclusion about traversability to provide sufficient evidence of selecting and using methods and demonstrating knowledge of concepts and terms.

Starting and finishing at the information centre.

Scenic
Reserve   2   2   Look
                                                                Out

                                              Toilets   4

                                                              2   Beach

                                    Scenic
                                    reserve   3   Bank
                                              4

3   Grant
      Park   Library   2
                                                     2   Sushi
                                                           shop

      Arts
2   event
      centre   3   Play
                                                                        ground

1:8000   Skate
             Park   2 ——— 2   Information
                                    centre
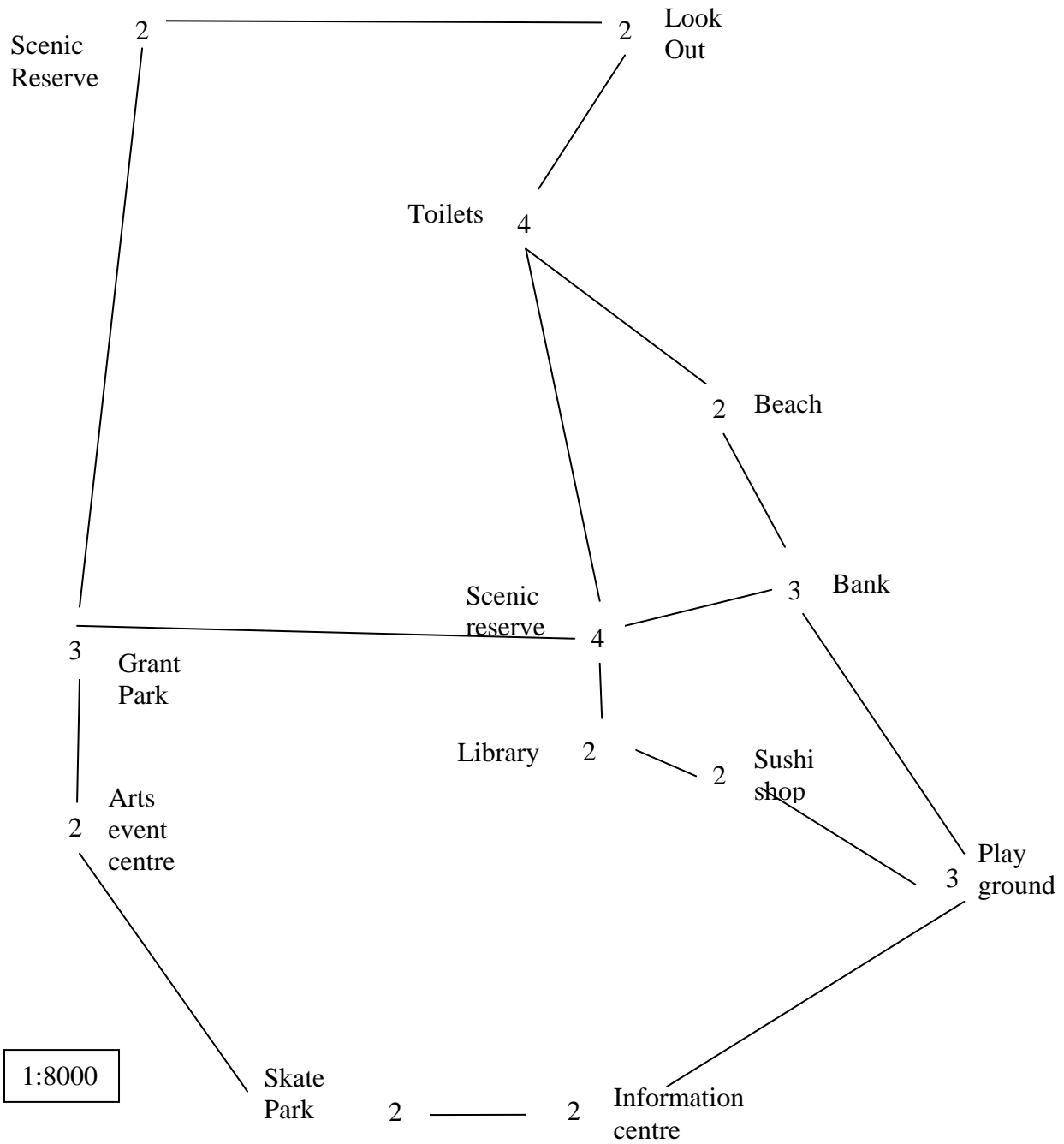
It is not possible to go to all points and end back at the information centre.

Shortest route

4

480m

5

568m

392m

3280m

6

960m

1408m

S/F – Information Centre
1 – Skate Park
2 – Arts/Events Centre
3 – Grant park
4 – Scenic Reserve
5 – lookout
6 – Toilets
7 – Beach
8 – Bank
9 – Hillary Square
10 – Library
11 – Sushi Shop
12 – Play ground

7

360m

952m

8

3

224m

9

296m

130m

586m

2

10

24m

11

128m

12

1352m

840m

1:8000

152m

1

Start/
Finish
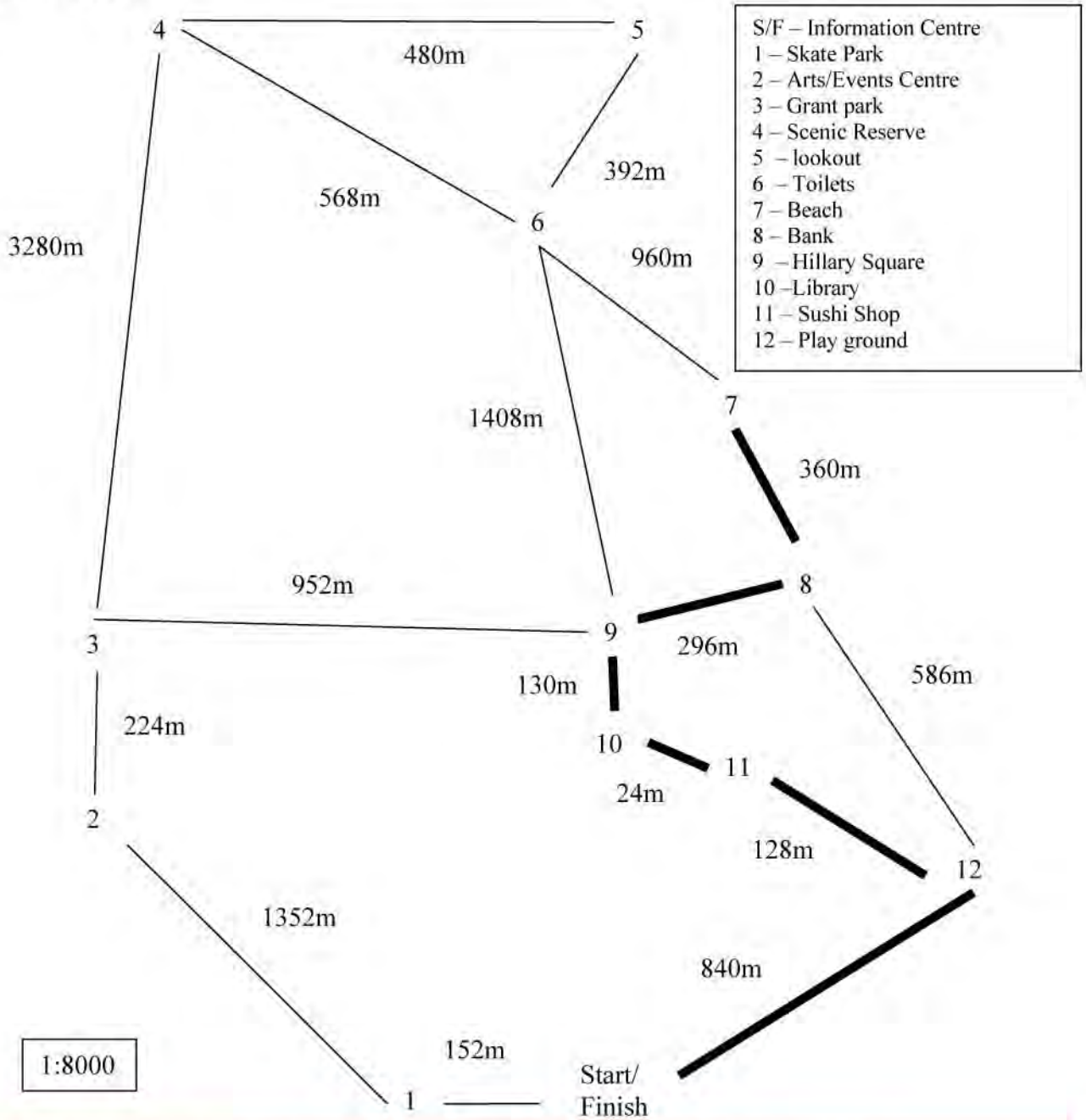
The shortest route between the information centre and the beach = 1778 m

Information → Play   → Sushi → Library → Hillary → Play ground → Bank → Beach
Centre   ground   shop   Square

1

2

Shortest route for Segway path

S/F – Information Centre
1 – Skate Park
2 – Owera Arts/Events Centre
3 – Grant park
4 – Alice Eaves Scenic Reserve
5 – Hatfeilds lookout
6 – Toilets at Arunde Reserve
7 – Beach for swim
8 – ASB Bank
9 – Sightseeing at Hillary Square
10 – Library
11 – Sushi Shop
12 – Play ground near beach

4

5

480m

568m

392m

6

3280m

960m

1408m

7

360m

952m

8

3

296m

616m

9

224m

130m

2

10

11

24m

728m

12

1352m

840m

1:8000

152m

1

Start/
Finish