



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

Exemplar for Internal Achievement Standard Geography Level 2

This exemplar supports assessment against:

Achievement Standard 91247

Apply spatial analysis, with guidance, to solve a geographic problem

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	<p>For Excellence, the student needs to comprehensively apply spatial analysis, with guidance, to solve a geographic problem.</p> <p>This involves fully explaining a valid solution, based on the manipulations, that is supported by detailed evidence.</p> <p>This student has investigated the geographic problem of finding the best possible site for a new cell phone tower to service the Queenstown area.</p> <p>The student has fully explained a valid solution through a focus on specific requirements, e.g. the elevation and accessibility of the six possible sites. The evidence for each site is integrated into the response to clearly explain reasons for the decision to recommend Site 1 (3) (4).</p> <p>The overall structure of the response shows a comprehensive application of spatial analysis to solve the problem.</p> <p>The final report includes a summary of the findings (1), showing accurate interpretation of the presented evidence. The introduction shows the relevance and implications of the spatial data to the problem (2). The concluding statement reiterates the recommendation for Site 1 (5).</p> <p>Suggestion of an alternative solution demonstrates depth of understanding of the spatial data and context (6), and the final recommendation shows insight (7).</p> <p>For a more secure Excellence, the student could make more explicit reference to the evidence presented on the layout. This would more clearly demonstrate that the recommendation/solution is based on these manipulations. The detailed evidence currently presented is mostly based on the data from the summary table.</p>

Student 1-Low Excellence

The problem: To find the best possible site for a new cell phone tower to service the Queenstown area.

The solution to this problem needs to address 4 criteria. Possible sites need to be

1. On land that is at least 1500 metres in elevation.
2. On land with as low a slope as possible.
3. Within 4 km of a major road.
4. Within 12 km from the major town of the area.

Summary of findings for each of the 6 locations:

Site #	Name	Position	Elevation (m)	Slope	Nearest road (km)	Distance to Q. (km)
1	Remarkables Range (1)	45°02'23"S, 168°47'50"E	1560	11%	3.5	10.7
2	Remarkables Range (2)	45°04'32"S, 168°48'00"E	1800	6%	3.1	11.7
3	Peninsular Hill	45°02'25"S, 168°43'28"E	834	5%	1.3	5

1

To find a site that meet these requirements in the Queenstown area is difficult because of its mountainous relief. This area has steep sided glacial valleys... While the 1500m high location would offer good reception for the mobile phone users, it is also important to note that line of sight from where the majority of cell phone use is, would be very important to guarantee reception and effective placement of a tower (2).

Of the 6 sites considered, site 1 (Remarkables Range – North) adheres to the criteria and could possibly give better coverage for more of Queenstown's mobile phone users than the other sites.

The first criteria is the elevation, which is needed to ensure the best reception. The site needs to be at least 1500masl, and have direct line of sight with Queenstown. Site 1 meets this criteria as it is at 1560masl and the Google Earth image shows clear line of sight. Other sites which are higher, like Site 2 in the southern Remarkables at 1800masl, would not be able to solve black spots along SH6 to the south from Frankton caused by the terrain... Bowen Point and Ben Lomond have similar issues for ... despite acceptable elevations of...(3)

While elevation is important, the site needs be accessible. Existing roading would be favourable and slope also needs to be considered in situations if roads need to be constructed. Site 1 again meets these requirements as access can be gained from SH6 then up the Remarkables ski road, which although being unsealed is graded and easily accessible by 4x4. Site 4-Skippers Saddle immediately appears the best site when focusing on this criteria as it is close to the Skippers Road and has easy access, however it does not afford good coverage of Frankton, Queenstown CBD and areas to the west along the lake side such as Fernhill...(4)

Slope for each site has been considered and shown on the graph... while this can be overcome it would increase costs...

Of the 6 potential sites, Site 1 would need to be considered as the best site for a new cell phone tower (5). However, in reality, because of issues of line of sight ...for places like the CBD it might be better for a number of cell phone towers to be built in the area. This is indicated by maps such as that of the Vodafone 3G ...satellite imagery which show where the coverage is good and where it is not. Site 4 would provide a suitable location for a second cell phone tower as it would enable Arrowtown to be covered and the area of Arthur's Point, where there are new subdivisions being developed...(6)

I would also recommend that if the company wants to extend their coverage in an area then new sites must be considered that compliment and extend the existing network (7).

	Grade Boundary: High Merit
2.	<p>For Merit, the student needs to effectively apply spatial analysis, with guidance, to solve a geographic problem.</p> <p>This involves:</p> <ul style="list-style-type: none"> • collecting sufficient spatial data to address the geographic problem • completing manipulations of the spatial data to produce an accurate layout related to the problem • explaining, in detail, an appropriate solution, based on manipulations, that is supported by evidence. <p>This student has investigated the geographic problem of finding the best possible site for a new cell phone tower to service the Queenstown area.</p> <p>The student has created an accurate layout (1) made up of a screen shot from Google Earth. This provides a clear indication of the terrain and location of possible sites. The map shows selected buffers for distances from Queenstown and nearby roads, and the graph shows the elevations of each site.</p> <p>The layout (1) overall shows that sufficient relevant spatial data has been collected, appropriate manipulations made, and correct geographic conventions applied.</p> <p>The student has explained in detail an appropriate solution (3), with some reference to the manipulations made. The solution is included, with an overview of the advantages and disadvantages of each of the possible sites (4). Detailed summaries are provided for each site (4) with some direct reference to the spatial data presented on the layout.</p> <p>To reach Excellence, the student could make more effective use of the spatial data to fully explain the solution. The student could further explain the advantages such as elevation providing line of sight, or explain the implications of weaknesses of the proposed site.</p>

Student 2 Page 1: High Merit

NZQA Intended for teacher use only



Student 2-High Merit



100 0 100 200 Kilometers



Queenstown

1

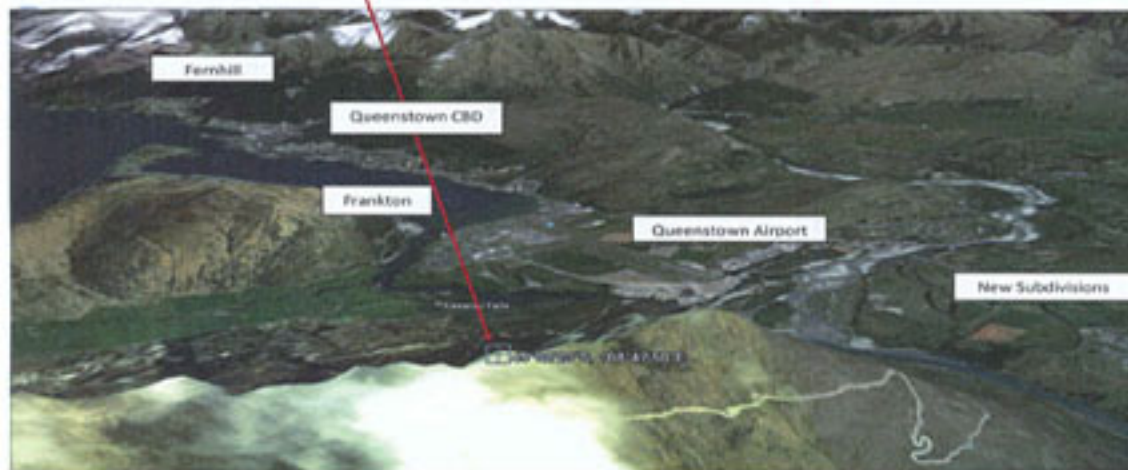
A second Google image showing locations of the 6 sites was also included.

Queenstown Area
Scale: 4Km

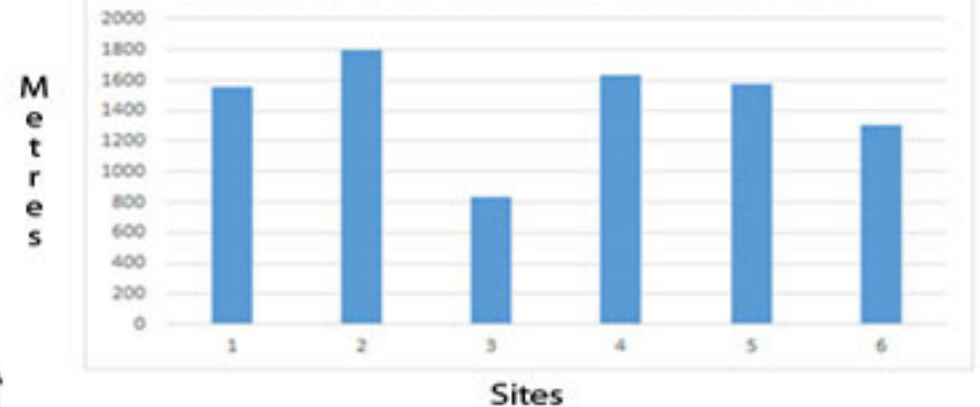
Key

Land over 1500 m asl	
Land over 1200 m asl	
12km buffer from QT	
4km road buffer from sites	

Preferred Site – Remarkables Range



Elevation for 6 selected sites around Queenstown



Student 2 _ High Merit

Summary of findings for each of the 6 locations:

Site	Name	Position	Elevation (m)	Slope	Nearest road (km)	Distance to Q. (m)
1	Remarkables Range (1)	45°02'23"S, 168°47'50"E	1560	11%	3507	10724
2	Remarkables Range (2)	45°04'32"S, 168°48'00"E	1800	6%	3126	11786
5	Ben Lomond	45°00'48"S, 168°36'48"E	1580	11%	2905	4304

2

Problem: Where to locate a new cell phone tower to serve Queenstown?

The problem results from black spots being experienced and limited reception in some areas.

The best location for a new cell phone tower in the Queenstown region needs a location over 1500masl to ensure good reception, within 12km of the major town and within 4km of a major road. This shows the need for accessibility as well.

Recommendation and Summaries for each site:

Remarkables Range -1: PREFERRED SITE THAT MEETS ALL PARAMETERS.

Evidence from the layout shows that site one meets all the guidelines. It is at an altitude of 1560masl showing that it will be high enough to provide reception to Queenstown and this is shown on the Google image...It is on a slope of 11% which equates to 5 degrees. A disadvantage of this site is that it may be above the snowline in winter...

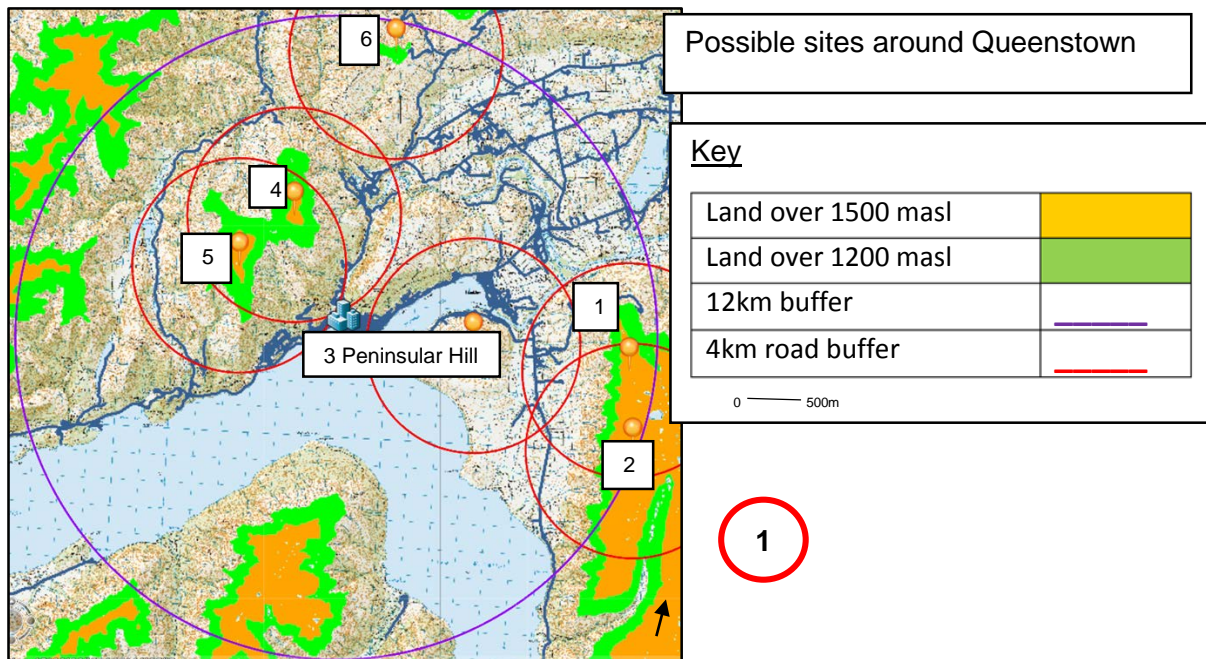
This site is easily accessed by SH6 and the Remarkables ski road. Even though parts of this road is unsealed, it is graded and easily accessible by 4x4. This site is also fairly close to Queenstown. This accessibility advantage will mean that the costs of construction and ongoing maintenance of the cell phone tower could be less than some of the other sites.

Considering the advantages of this site I recommend that it is investigated by a team of structural engineers...(3)

Ben Lomond Peak – 5: This site is in a good position from Queenstown as shown on the map. It is 1780masl and has a clear view of Queenstown, Fernhill and Kelvin Heights Peninsular. It is 4.1km to the nearest highway, (4) Gorge Road to Arthur's Point. It would enable good reception to most of the Queenstown area. However, it does have a relatively steep slope and in winter could be above the snow line. Access could also be secured by helicopter from Queenstown Airport.

	Grade Boundary: Low Merit
3.	<p>For Merit, the student needs to effectively apply spatial analysis, with guidance, to solve a geographic problem.</p> <p>This involves:</p> <ul style="list-style-type: none"> • collecting sufficient spatial data to address the geographic problem • completing manipulations of the spatial data to produce an accurate layout related to the problem • explaining, in detail, an appropriate solution, based on manipulations, that is supported by evidence. <p>This student has investigated the geographic problem of finding the best possible site for a new cell phone tower to service the Queenstown area.</p> <p>The student has collected data for six possible sites and completed manipulations to produce an accurate layout, one part of which is exemplified (1).</p> <p>An appropriate solution to the problem has clearly been based on the manipulations (2). Parts of the explanation are in detail when distance and elevations (3) are given.</p> <p>For a more secure Merit, the student could include more specific detailed evidence to support their solution. Detail could also be provided of the weaknesses of the alternative sites, which would emphasise the strengths of the recommended option.</p>

Student 3-Low Merit



My solution to the problem of where to locate a new cell phone tower for the Queenstown region is to focus on the Peninsular Hill-Site 3.

	Position	Elevation	To Queenstown	Slope
Peninsular Hill	45°02'S, 168°43'E	834masl	4.9km	5%

The map clearly shows that it meets several of the criteria because it is so close to Queenstown. The 4km buffer shows that it clearly covers the CBD through to the Frankton Arm (2) where a lot of new development is going on...

This site has an access road and because it is so close the construction and maintenance would be easy...

The recommended elevation is 1500 metres, and Peninsular Hill is only 834 masl... While its elevation is less than the other sites, it is closer to Queenstown and there are no hills blocking it to create black spots (3).

The slope of this site...

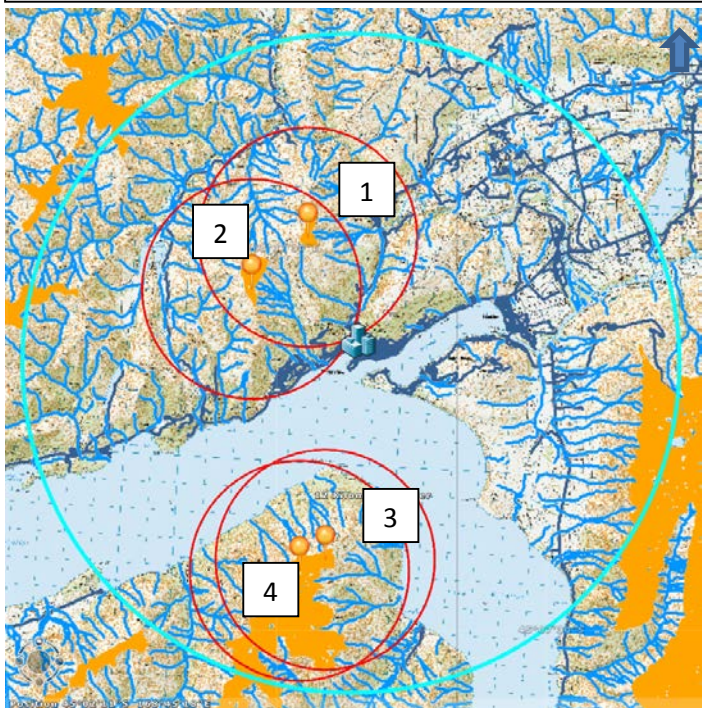
If a second site was to be considered I would recommend one in the Remarkables Range which have a higher elevation and is relatively close...

	Grade Boundary: High Achieved
4.	<p>For Achieved, the student needs to apply spatial analysis, with guidance, to solve a geographic problem.</p> <p>This involves:</p> <ul style="list-style-type: none"> • collecting spatial data relevant to the geographic problem • completing manipulations of the spatial data to produce a layout related to the problem • explaining an appropriate solution, based on the manipulations, that is supported by evidence. <p>This student has investigated the geographic problem of finding the best possible site for a new cell phone tower to service the Queenstown area.</p> <p>The student has collected spatial data relevant to the problem, such as site elevations, and distances from Queenstown. This data has been manipulated through the use of buffers and additional shading to produce a layout related to the problem (1).</p> <p>An appropriate solution has been explained through the comparison of the recommended site with three alternatives (3). Some reference to the layout (2) (4) has been made to show that the manipulations influenced the site selection.</p> <p>To reach Merit, the student could improve the accuracy of the layout (1) by applying geographic conventions to all images, e.g. scale and orientation. Both buffers need to be keyed and more clearly labelled to indicate what they are showing. The Google screen shot should be annotated, conventions applied and irrelevant information deleted.</p> <p>The slope for each site could also be determined and more closely examined, as this is a significant factor when selecting a site for the construction of a cell-phone tower. More effective use of the spatial data could add depth to the explanation. For example actual distances from Queenstown and accessibility of each site.</p>

Layout for Queenstown – The problem is where to put the best cell phone tower?

Student 4-High Achieved

Map showing the 4 possible sites for a cell phone tower



A graph and a second Google image completed the layout

Screenshot to show the best site



Key

Land over 1500 m asl	
Rivers	
Buffers	

1=Bowen peak 3=Island Spur
 2=Ben Lomond 4=Garden Spur

1

Student 4-High Achieved

Finding the best site – Cell phone towers

My Recommendation

Site No	Site Name	Position	Elevation (m)	Distance To Queenstown (m)	Nearest Highway (m)	Slope
1	Bowen Peak	44°59'S, 168°38'E	1631	4286	2869	Top of Mountain
2	Ben Lomond	45°00'S, 168°36'E	1580	4304	2905	Flat slope between contours
3	Island spur	44°59'S, 168°38'E	1670	11586	8607	Flat on top of spur
4	Garden Spur	45°00'S, 168°36'E	1800	11592	9879	Area of flat land

All of the 4 sites are in the 12km buffer zone of Queenstown and all meet the elevation requirements...

The site that I recommend for the location of a cell phone tower is Site 1. It is closest to Queenstown and closest to a major road, see map (2)... Site 2 is also quite close, but it is the lowest site, only 1500masl and this could affect reception quality for some parts of Queenstown such as ...

The two sites to the south of Queenstown are less accessible... Site 3 could give very good reception because of uninterrupted view to the CBD, and it is similar in elevation to Site 1, but it is across the lake and there is only one unsealed road (3)...

These two sites have advantages of large relatively flat platforms for building, but the disadvantage of Garden Spur the 4th site is its altitude...

The access and low cost of construction are in favour of Site 1. It has a good view of Queenstown and the surrounding area, see Google Earth image. This site would offer the best cell phone coverage (4).

	Grade Boundary: Low Achieved
5.	<p>For Achieved, the student needs to apply spatial analysis, with guidance, to solve a geographic problem.</p> <p>This involves:</p> <ul style="list-style-type: none"> • collecting spatial data relevant to the geographic problem • completing manipulations of the spatial data to produce a layout related to the problem • explaining an appropriate solution, based on the manipulations, that is supported by evidence. <p>This student has investigated the geographic problem of finding the best possible site for a new cell phone tower to service the Queenstown area.</p> <p>The student has collected relevant spatial data to solve the problem and created buffers to show distances to Queenstown (1). Each site has been commented on as to its suitability for solving the problem. The map has been used to support the explanation.</p> <p>Site 2 is identified as the best location and solution to the problem of cell phone reception. Some of the reasons given are based on the manipulations (2).</p> <p>For a more secure Achieved, the student could show application of basic geographic conventions to the presented data, such as scale and orientation. This spatial data should be presented as a layout.</p> <p>More spatial data, such as a 3D Google image could be included. This would provide the student with the opportunity to show relationships between the data. For example, elevations shaded on the map could be shown beside the 3D Google image to more clearly indicate the implications of terrain for cell phone reception.</p> <p>A more complete layout would enable the student to show clear links to the manipulations when explaining their solution. This would show more effective use of the spatial data.</p>

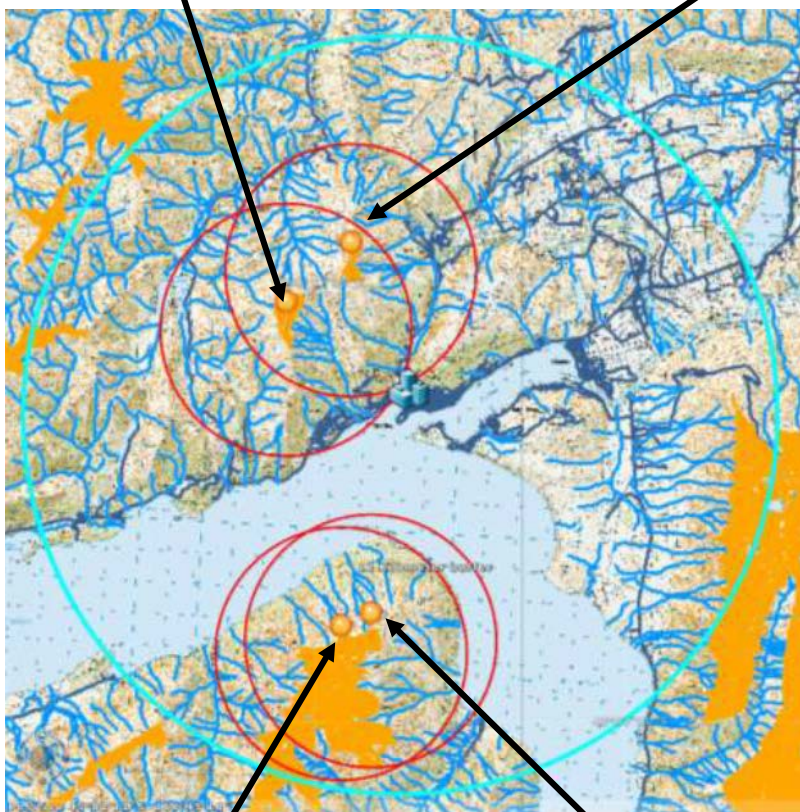
Student 5 – Low Achieved

Site 1




This is the lowest of all sites. It is the second closest to a highway and the second closest to Queenstown. You can see the CBD and Arthur's Point from this site...

Site 2: This site is the closest to Queenstown and the CBD can be seen. This shows that reception quality will be good... It is above the 1500masl needed for a cell phone tower ...(2)

This site is quite steep which could make it difficult to access...a track from...



Map of Queenstown showing 4 possible sites

Land over 1500 m asl	
Rivers	
Buffers – 4km	

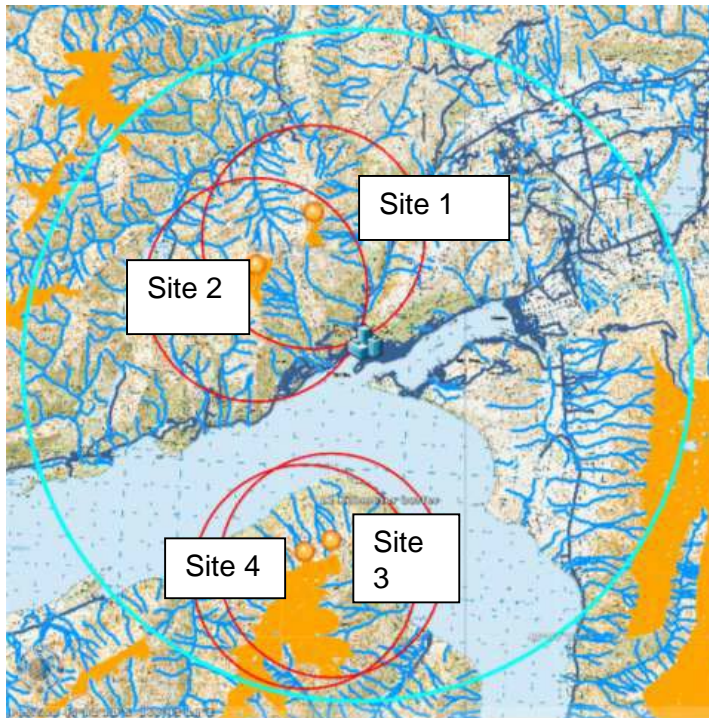
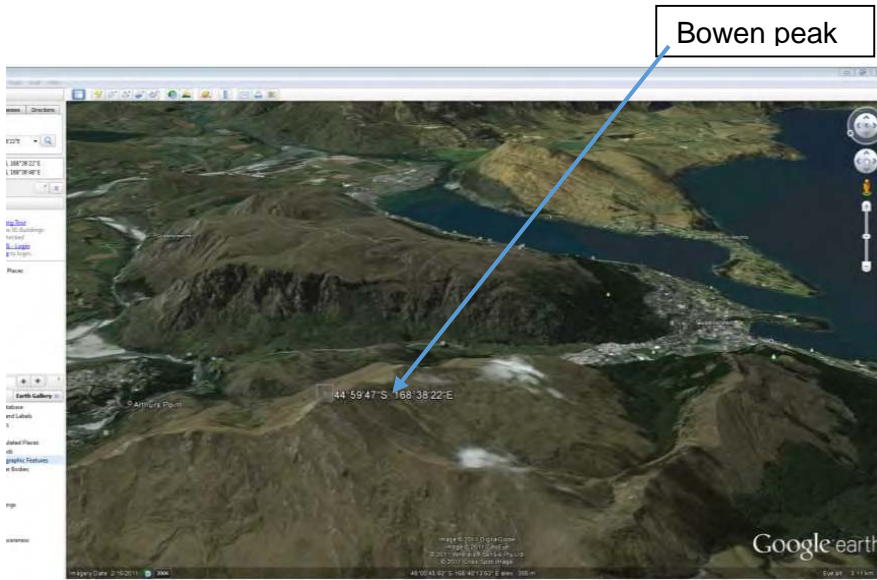
1





Site 3: This is also to the South of Queenstown and the highest site. There is a larger area of flat land on a gentle slope. It faces the Queenstown CBDThis site could be considered for a cell phone tower.

Site 4: This site is to the South of Queenstown on a long spur which is a gentle slope. It is the furthest away from Queenstown... There is only one road and it is unsealed.

	Grade Boundary: High Not Achieved
6.	<p>For Achieved, the student needs to apply spatial analysis, with guidance, to solve a geographic problem.</p> <p>This involves:</p> <ul style="list-style-type: none"> • collecting spatial data relevant to the geographic problem • completing manipulations of the spatial data to produce a layout related to the problem • explaining an appropriate solution, based on the manipulations, that is supported by evidence. <p>This student has investigated the geographic problem of finding the best possible site for a new cell phone tower to service the Queenstown area.</p> <p>This student has collected some spatial data, and completed manipulations (1) such as creating buffers and adding shading to show general site elevations. An appropriate solution is explained with a valid reason (2).</p> <p>To reach Achieved, the student could improve the accuracy of the layout by applying basic geographic conventions such as title, scale etc. The naming conventions used on the layout need to be consistent with those used in the explanation of the solution. For example, Bowen Peak is identified by name in the recommendation, but shown on the map with a site number.</p> <p>The evidence provided is largely descriptive (3). This needs to be further developed to provide explanations supporting the recommendation.</p> <p>Overall, the evidence needs to more clearly reflect the quality expected of Level 7 of the New Zealand Curriculum.</p>

Student 6-High Not Achieved



KEY	
Land over 1500 m	
Roads	
Rivers	
	



Bowen Peak is the best site because it is closest to Queenstown and there are no other hills to block reception... Blackouts are the reason a new cell phone tower is needed... (2)

There are two possible construction platforms on Bowen Peak...the slope at the higher one is fairly steep...

A track gives access to the site ... (3)

Sites 3 and 4 are quite close to Queenstown but they are much lower in elevation...