10 August 2022

Ike Kleynbos
Principal Advisor Planning – City Planning (E)
Christchurch City Council

By email: ike.kleynbos@ccc.govt.nz

Re: Radio Communication Appendices

The following *Christchurch Justice and Emergency Services Precinct Radio Communications Cost Benefit Analysis* report was completed four months ago. Since then, the findings from this report, another round of public feedback[1], and planning processes around the Housing Supply Amendment Act (HSAA) have progressed[2], which have all resulted in changes to the policy.

The most significant change is that the Justice and Emergency Services agencies have decided not to seek protection for the UHF radio communication pathways. There have also been some minor modifications to the policy to remove trees and some utilities, as these issues are irrelevant (i.e. microwave radio communication pathways are higher than either of these objects). In the following report, the discussion on UHF is no longer relevant to the current policy.

Another significant change is that the policy has been shifted into the planning processes around the HSAA. Specifically, Plan Change 9F has been incorporated into Plan Change 14 (PC14), with the protection of the microwave radio communication pathways being proposed as a Qualifying Matter which modifies the heights enabled within the corridors. The exact nature of PC14 was not defined at the time that the following report and research were conducted.

The following report does include a discussion of HSAA and an indicative assessment. This indicative assessment suggested that at most 18,000m^2 of floorspace could be impacted by the inclusion of microwave radio communication pathways as a Qualifying Matter (see Figure 5.3). However, this assessment was based on the assumption that the land within the microwave radio communication pathways would be zoned City Centre (i.e. unlimited height).

We understand that PC14 is proposing Mixed Use Zone for the land within the microwave radio communication pathways. Also, the land is within the walking catchment of the CBD, which means the height limits are proposed to be 10 levels (32 metres).[3] For the most part, this would mean building

[1] Global Research (2022) Draft Radio Communication Pathways Plan Change PC15 Public Engagement Syntheses Report - 11th April 2022 - 13th May 2022.
[2] Christchurch City Council (2022) Draft Housing and Business Choice Plan Change (PC14)
[3] Christchurch City Council (2022) NPS-UD and Commercial Changes – the detail.

heights that are enabled by PC14 would be lower than microwave radio communication pathways. Council's latest assessment suggests that only 11 sites are now impacted by the microwave radio communication pathways heights. While not assessed, this difference would likely mean that the impacts are much lower than suggested in the following report. Specifically, the inclusion of microwave radio communication pathways as a Qualifying Matter in PC14 would be even more beneficial than what is shown in the following report.

In summary, it is considered that overall findings in the report below that relate to the microwave radio communication pathways are unaffected by these changes and are relevant to the planning process.

Yours sincerely,

Rodney Yeoman

Director

m 021 118 8002

e rodney@formative.co.nz

www.formative.co.nz

Christchurch Justice & Emergency Services Precinct Radio Communication

Cost Benefit Analysis

Ministry of Justice and Emergency Services

17 March 2022

Formative

Authors

Rodney Yeoman
rodney@formative.co.nz
021 118 8002

Derek Foy
derek@formative.co.nz
021 175 4574

Contents

Figures

1 Introduction

Emergency communication are a critical part of the response to both daily and large-scale emergencies. The maintenance of quick and unbroken communications between personnel responding in the field to an incident and the response coordinators at the operation offices is imperative, as delays in response can be the difference between life and death in an emergency situation. Continual and unbroken emergency communications can reduce the potential damages that can occur as a result of an emergency event, which includes a reduction in impacts on property, buildings, injuries and potentially preventable loss of life.

Given the importance of emergency communications, it is clear that for the good of the community they need to be maintained. This report is not focused on whether communications should be maintained, but rather on the options for maintaining these communications.

To avoid any confusion, it is clear that emergency communications must be maintained. This report is tasked with assessing the costs and benefits associated with the alternative options, policy or mitigation, that could be used to maintain the emergency communications in Christchurch.

Following the Christchurch earthquakes, a new Christchurch Justice and Emergency Services Precinct (CJESP)[4] was constructed in the Central City, which brings together all justice and emergency services agencies into one purpose-built precinct that can operate off the grid for 72 hours (IL4 standard).

The design for the communications systems at the CJESP consolidated numerous existing radio systems and services based across Christchurch, to one site. The radio communication facilities installed on the roof of CJESP were constructed to ensure fixed radio links to four key outlying sites. These links provide daily communication coverage for Police, FENZ, and St John, and a direct link to the airport.

The CJESP is presently the tallest building in the southern part of the Central City with the permitted height limits in the operative District Plan mostly being lower than the pathway of the Emergency Radio Communication Links (ERCL).

Recently, there have been two instances where landholders have applied for resource consent to undertake developments that intrude into the pathway of the ERCL. Also, the government has introduced new intensification requirements which are likely to result in more development being enabled in the corridors of the ERCL.

[4] The CJESP is made up of the Justice Building, the Emergency Services Building and a car park for operational vehicles.

The Christchurch City Council (CCC) and justice and emergency services that operate in the CJESP have proposed a change to the District Plan (Plan Change 9F – "PC9F") which would include a new sub-chapter in Chapter 6 to protect ERCL from adverse effects resulting from buildings, structures, utilities, and trees intruding into the pathways. This report provides economic research of the costs and benefits associated with PC9F policy, other policy options, and mitigation options.

1.1 Background

ERCL fall under the definition of "strategic infrastructure" which is necessary infrastructure facilities, services, and installations that are of greater than local importance. The District Plan seeks to protect strategic infrastructure from incompatible development and activities by avoiding adverse effects on them.[5] There are currently no explicit provisions in the District Plan that protect the ERCL. However, the maximum building heights set in the District Plan are mostly lower than the ERCL pathways, which provides implicit protection[6].

Critically important to this report is that the government has made policy changes that are intended to increase intensification, which was first defined in the National Policy Statement for Urban Development[7] (NPSUD) and has recently been codified in the RMA legislation (via the Housing Supply Amendment Act, Schedule 3B)[8].

Under this new policy and legislation Tier 1 councils, which includes Christchurch City Council, will be required to remove maximum height restrictions in the City Centre zone. The NPSUD policy came into effect in August 2020, with councils having until August 2022 to implement the height changes. Also, the Housing Supply Amendment Act (HSAA) has been introduced (under urgency) in December 2021 to bring forward and codify in legislation the implementation of the intensification required in the NPSUD.

Due to the changes in national policy, the risks to the ERCL are:

- That new buildings reach high enough to degrade or completely block existing microwave and UHF communication pathways from CJESP. Also, under the current rules in the District Plan, building and resource consent applications can be approved by CCC without consultation with the CJESP agencies.

[5] Christchurch District Plan 3.3.12(b)
[6] The permitted height limits in the Airport UHF corridor do not exclude all development that could intrude into the pathway.
[7] Ministry for the Environment (2020) National Policy Statement on Urban Development – July.
[8] Government Bill (2021) Resource Management (Enabling Housing Supply and Other Matters) Amendment Act – Passed December 14th.

- Potential for costs to be incurred to supply engineering assessments where there is any likelihood or potential for impacts to ERCL. This could extend to appeals or additional remediation engineering and installation (if any such options exist).

1.2 Scope

The focus of this report is to provide economic research of the costs and benefits associated with maintaining or protecting ERCL from the CJESP, including to:

- Quantify, to the extent possible, costs and benefits of the proposed PC9F relative to the status quo of the operative height limits, and height limits enabled under the national policy.
- Establish which stakeholder groups will bear the costs and benefits. This includes landholders, the Ministry of Justice, and other parties.
- Assess the costs and benefits of alternative options for enabling communications, including increasing the antenna size; increasing the transmitter power; locating antennas and possibly equipment on other buildings to allow transmission over that building; and installing a new site on another building to redirect the beam going around the intrusion.

This report adopts the Cost Benefits Analysis (CBA) method which is an economic assessment framework that is used to assess the outcomes from a policy or investment. CBAs are commonly used by local and central governments to improve decisions on public spending or policy. The key aspect of the CBA method is to quantify the flow of costs and benefits that are expected to be generated in the future from the public spending or policy options. These values can then be compared with the investment of public money to establish whether the benefits of the investment outweigh the costs, i.e. what is the net position of the public spending or policy.

1.3 Structure

This report is structured into five subsequent sections, as follows:

- Section 2 discusses key aspects of the CJESP and ERCL, and the areas that are in the transmission corridors.
- Section 3 outlines the potential options for protecting the ERCL, which includes the operative District Plan, proposed PC9F, HSAA/NPSUD, and the alternative mitigation options that could be adopted.
- Section 4 describes qualitatively the range of costs and benefits that flow from the protection of the ERCL, and to whom these costs and benefits accrue.

- Section 5 quantifies, where possible, the costs and benefits associated with the different potential policy or mitigation options. This assessment provides an estimate of the net outcome, to establish which option produces the best outcome for the community as a whole.
- Section 6 provides the findings of the research.

2 CJESP Emergency Communication

The CJESP houses eight agencies Ministry of Justice, NZ Police, Corrections, Fire and Emergency NZ (FENZ), St John, Christchurch City Council, Emergency Management Canterbury, and Ministry of Civil Defence and Emergency Management. These agencies have critical roles in the response to both daily emergencies and large-scale disasters. The agencies in the CJESP must have the ability to provide communications to the rest of Canterbury, to ensure that personnel can be coordinated to maintain the safety of the community.

The precinct is located on the southern edge of the Central City Business Zone, on the block between Tuam, Lichfield, and Durham Streets. Most of the land to the south and west of the CJESP is commercial, with buildings of less than four levels.

Figure 2.1: Christchurch Justice and Emergency Services Precinct

While the focus of this report is on ERCL, it is acknowledged that the agencies within CJESP use multiple communication links. The other communication links from the CJESP include commercial networks (landline, fibreoptics, and cellular network) for general communications and satellite uplinks as a last resort. [9]

The ERCL is used for daily operational communications for small-scale incidents (business-as-usual) and also for major emergencies. Each of the ERCL is used to provide connections from the Precinct Communications Centres to radio networks that cover Canterbury (Police and Fire) or all New Zealand

[9] Richard Smart (2021) Operational aspects of CJESP Radio Communications and discussion 6/12/2021.

(Ambulance). A vital function of the communications on the ERCL is to alert (turnout) crews to respond, manage and coordinate responding crews and appliances.

The ERCL is in daily and continuous use – not just in extreme circumstances. This daily use of the radio network is important as it ensures that personnel are proficient in the system, so that when a major event occurs communications are easily maintained. Also, the continued use of the system ensures that any faults or failures in the system can be identified and fixed immediately, which ensures that these issues do not result in loss of communications during a major emergency.

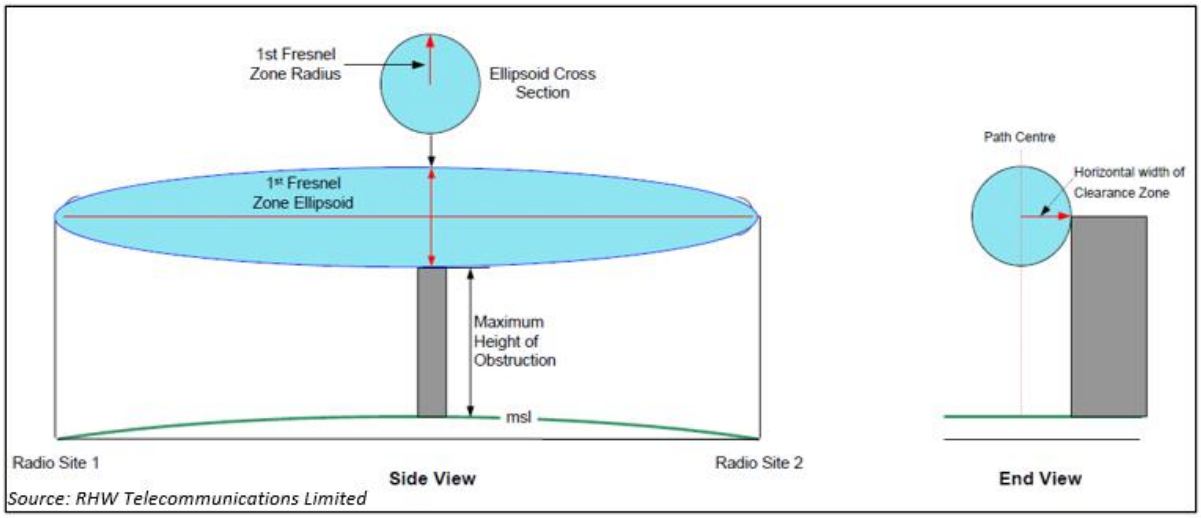
Finally, there are also plans for all of government communication links, with Next Generation Critical Communications group investigating the potential for one combined system for all agencies, which is expected to include radio communication links and potentially satellite links.[10]

2.1 Emergency Radio Communication Links

There are five ERCLs transmitted from the CJESP which provide communications for the various emergency services and one backup corridor which does not currently have communications. The radio links are transmitted from the roof of the CJESP out to receivers to the west of the city at Christchurch Airport (two links), south to the Port Hills (three links), and the backup corridor to Sugarloaf (no link).

There are two types of ERCL transmitted from CJESP, microwave, and UHF. While each of the links has different properties, they have an elongated ellipsoid shape along the pathway, which is narrower at each end with a circular cross-section (Figure 2.2).[11]

Figure 2.2: Emergency Radio Communication Link Pathway

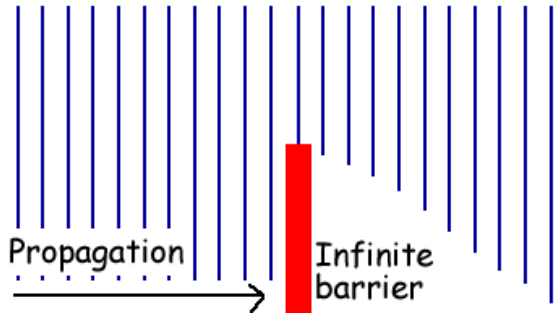


Source: RHW Telecommunications Limited

[10] NGCC (2021) Public Safety Network: Strategy and Benefits.
[11] RHW Telecommunications Limited (2021) Emergency Radio Communication Pathway Diagram.

Any obstruction of the radio pathway by buildings, vegetation, and/or terrain can impact the radio signal. However, the transmission of a signal will generally be partially blocked by a building (infinite barrier), which tends to create a disruption that dissipates because of diffraction (see Figure 2.3). In simple terms, diffraction of the signal can allow the communication link to bend around objects.[12] This issue is taken into account when assessing the extent to which obstructions can be accommodated within the transmission pathway of the ERCL.

Figure 2.3: Radio Communication Propagation, Barrier and Diffraction



2.1.1 Microwave Links

There are two microwave links (11.2 GHz), which are transmitted from CJESP to the Port Hills and are received at Cashmere/Victoria Park and Mt Pleasant (see Figure 2.4). There is also potential for an additional link to Sugarloaf, however this would require new equipment to be installed at the site.

The microwave links carry many voice and data circuits at once. Failure or interruption of the microwave link will impact many radio channels with the potential to lose communications over the whole province or more. The Cashmere/Victoria Park and Mt Pleasant links are bi-directional, they both send and receive the same communications and act together as a circuit to ensure that there is redundancy in the system.

Specifically, if Mt Pleasant fails then Cashmere/Victoria will still carry the communications and vice versa. This is important as the communications are designed for 99.99% of atmospheric conditions, and there is potential for the planned or unplanned interruption in one link.[13]

For example, in extreme rain conditions, there is a risk that one microwave link could fade out and communications are lost on one of the links. Also, the links require maintenance once or twice a year, which means that a link can be planned to be taken down for a short period. There is also a risk of an unplanned outage with a link failing occasionally, however this is very rare and tends to happen only every few years or so. There is also the risk of large-scale natural disasters damaging one of the radio

[12] RHW Telecommunications Limited (2021) Radio Engineering Requirements for CJESP Radio Corridors.
[13] Emergency services in New Zealand use combinations of Fibre Optical circuits, and/or additional microwave circuits to ensure that the service remains as close as possible to 100% available.

masts on the hill sites. All of these reasons justify the use of the two links, which provides redundancy as it is less likely that both sites would be down in the same incident.

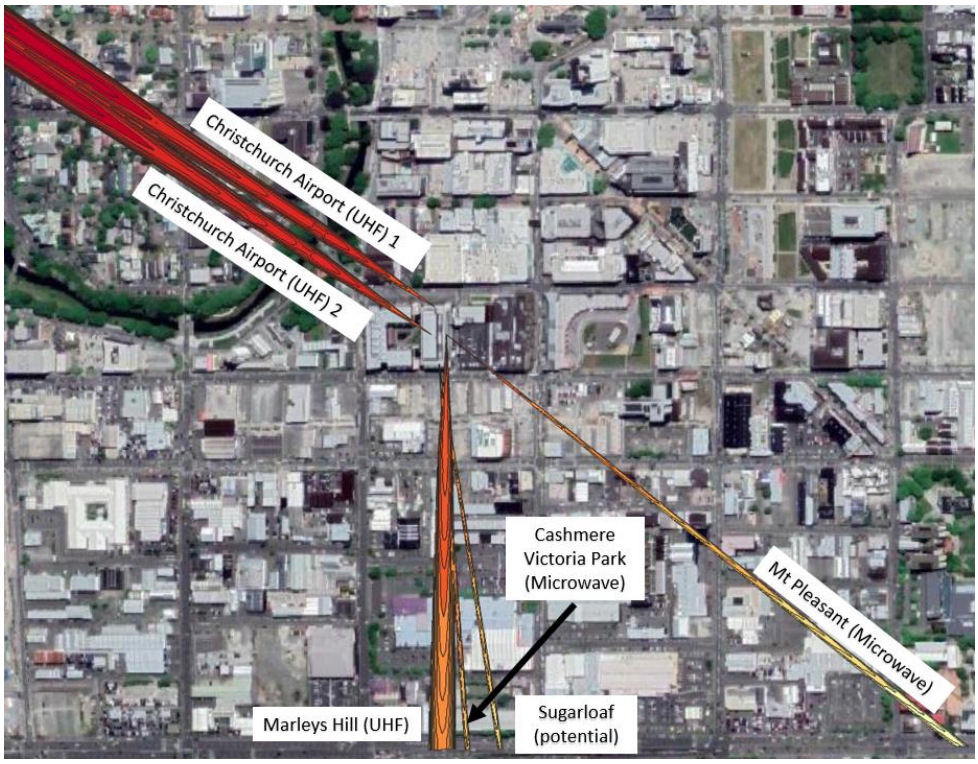
Finally, the Cashmere/Victoria Park and Mt Pleasant sites are linked together with the Sugarloaf in a ring system, which adds further protection of the communication links. The potential for the additional link to Sugarloaf provides an additional medium-term backup, which could be brought into operation if required, with the addition of communication systems at both Sugarloaf and CJESP.

The Cashmere/Victoria Park and Mt Pleasant microwave links are critically important, as they carry communications for the police and FENZ. These ERCL provides the communications between dispatch and personnel, both for day-to-day operations and large-scale emergencies.

The beam of microwave links is much tighter than UHF, which means that any intrusion by a building along the path will significantly reduce the communication link. The tightness of the microwave link also means that volume of airspace that is needed to ensure the link is maintained is relatively narrow (see Figure 2.4). This means that the protections that may be required are relatively confined for these links, both in terms of width (corridor) and height (pathway) of the beam.

At Tuam Street, the airspace is less than 4 metres in diameter, which increases to 20 metres by the time they reach Moorhouse Avenue. The microwave links start at around 26 metres above ground level at the CJESP and all increase to over 50 metres above ground level by the time they reach Moorhouse Avenue.

Figure 2.4: CJESP Emergency Radio Communication Corridors – Microwave Link and UHF Link



2.1.2 UHF Link

There are three UHF links that are transmitted from CJESP. One link is received at Marleys Hill and two at Christchurch International Airport (see Figure 2.4). The contour of the land means that the height (above ground) of the UHF link to Christchurch Airport is much lower than the other links, ranging from 8 metres to 16 metres for the parts of the pathway in the Central City and down to as little as 2 metres in Hagley Park. This compares to Marleys Hill UHF link which increases from 24 metres at the CJESP and reaches 38 metres at Moorhouse Avenue.

The beam of a UHF link is much wider than a microwave link, with the two Airport beams combined having a width of 70 metres when they reach Rolleston Avenue and the Marleys Hill beam having a diameter of around 40 metres by the time it reaches Moorhouse Avenue.

The UHF beam can maintain communications with a large amount of intrusion along the path. For example, the UHF radio link between CJESP and the Airport is partially obstructed by trees and a building along the path (mostly within Hagley Park), and several buildings (Quest on Cambridge, PWC building, EY building, and West End Carpark). While obstructed in part, the UHF link to the airport is still operational. The UHF beam can tolerate intrusions before the communication link is lost, so it needs to maintain at least 60% clearance to be operational.

The broader transmission path of UHF means that the volume of airspace that is covered is relatively large, however the nature of the UHF means that more intrusion into the path can be tolerated. This means that the protections of these links do not need to be as rigid. However, the signal path is narrowest at either end (see Figure 2.2) which means that size of the blockage(s) required to cause a significant impact on the UHF link decreases near the beginning of the corridor, which becomes much less likely to occur outside of the Central City.

Also of importance is that the UHF links are unidirectional, with communications only being sent in one direction. In this case, one of the Airport UHF links transmits out from the CJESP while the other is a receiver of communications from the Airport. The Marleys Hill UHF link only transmits communications out from the CJESP.[14]

The Airport UHF links provide a direct link into the airport's communications network, which is used by St John and FENZ in the event of a major emergency (aviation accident, etc). This link is an official direct link that is a backup to the normal 111 network, which can be overwhelmed in a major emergency.

[14] There is a UHF link transmitted back from Marleys Hill to the CJESP. This link repeats the outgoing message so that the system can confirm that the communication was received at Marleys Hill. This incoming link is encompassed by the outgoing UHF link, so is protected by the same corridor.

The Marleys Hill UHF link is used by St John to send pager messages to personnel. This system is additional to the other communication methods, with St John personnel receiving the same message via multiple links which ensures that messages are received.

2.2 Other Communication Links

The agencies in CJESP also use other methods for communications, which include the commercial landline, cellular networks, and fibreoptics[15]. While these methods of communication are reliable for most emergency incidents, they are vulnerable to large-scale natural disasters, which can disrupt land-based infrastructure. Also, these networks can become overwhelmed by large volumes of public communications, which tend to occur during a major incident.

A clear example of this is the recent earthquakes in Christchurch, where land-based communication infrastructure was knocked out and the large volume of public communications overwhelmed the remaining undamaged system. While major events are rare, these land-based communication infrastructure can be susceptible to disaster, flood, tsunami, weather events, earthquakes, etc.

The CJESP also has satellite links, however these currently have limited capacity and they represent the last resort communication method. They are currently capable of allowing limited communications to other national operation centres, rather than communication to personnel in the field.

Finally, it is important to note that in 2020 the government established the Next Generation Critical Communications Executive Governance Board and Next Generation Critical Communications (NGCC) organisation, who "will replace emergency services radio networks that are up to 30 years old and rely heavily on voice communications, with limited national coverage", with $47.8m budget allocated to develop a combined Public Safety Network (PSN).[16]

The tender process on the PSN (Te Kupenga Marutau Programme) was recently completed, which will purchase "leading-edge communication technology, which will enable the emergency services to maintain law and order, keep people safe, protect life and property, and deal with health events."[17] The project has not yet been awarded to a supplier, however it is the government's plan that Fire and Emergency, Police, and St John will use the PSN by 2022.[18]

---

[15] In the last two years in the South Island alone, there have been two significant bridge washouts that have caused fibre outages that lasted several days. A third event was a 'near miss' and would have caused widespread internet and other service interruptions with a long restoration time.

[16] Minister of Police Stuart Nash (2020) Independent oversight of emergency services communications project – press release 28th August.

[17] GETS 23829934 Public Safety Network – Closed 7th May 2021.

[18] NGCC (2021) Public Safety Network.

While the NGCC organisation is leading a process that will result in an evolution of communications, the organisations at the CJESP considered that ERCL will still be required for many years and that the PSN will be expected to maintain the existing ERCL. It is considered that satellite will be useful for remote areas of New Zealand but given the existing technology that radio communications will still be required for most communications.[19]

The ERCL from the CJESP provides critical daily communication and redundancy for these other communication infrastructures when major events occur, which is vitally important.

2.3 Emergency Radio Communication Link Corridors

As shown in Figure 2.4 the ERCL corridors extend west and south, across land that is mostly used for commercial activity. In total, the ERCL corridors traverse 84 parcels of commercial land, which in total have 20.1 hectares of land (excluding land beyond Rolleston Avenue – i.e. Hagley Park). The ERCL corridors directly cover 4.3 hectares or 21% of the land in the parcels that are traversed by the ERCL corridors. Also, most of the land directly under the corridors is located under the Airport UHF pathway, which has almost half of the land impacted. However, the Port Hill Microwave corridor crosses almost half of the parcels that are within the corridors.

Figure 2.5: CJESP Emergency Radio Communication Link Corridors – Parcels and Land

CJESP Radio Communication Corridors	Parcels in Corridor	Land Area		
		Parcel (ha)	Corridor (ha)	% in Corridor
Port Hills Microwave	47	13.7	0.8	6%
Marleys Hill UHF	16	5.7	1.1	20%
Airport UHF*	26	5.5	2.3	42%
Total CJESP Corridors**	**84**	**20.1**	**4.3**	**21%**

**excludes land beyond Rolleston Avenue, Hagley Park, Botanic Garden and Christ College*

***unique count, only counts a property once if it is in any corridor.*

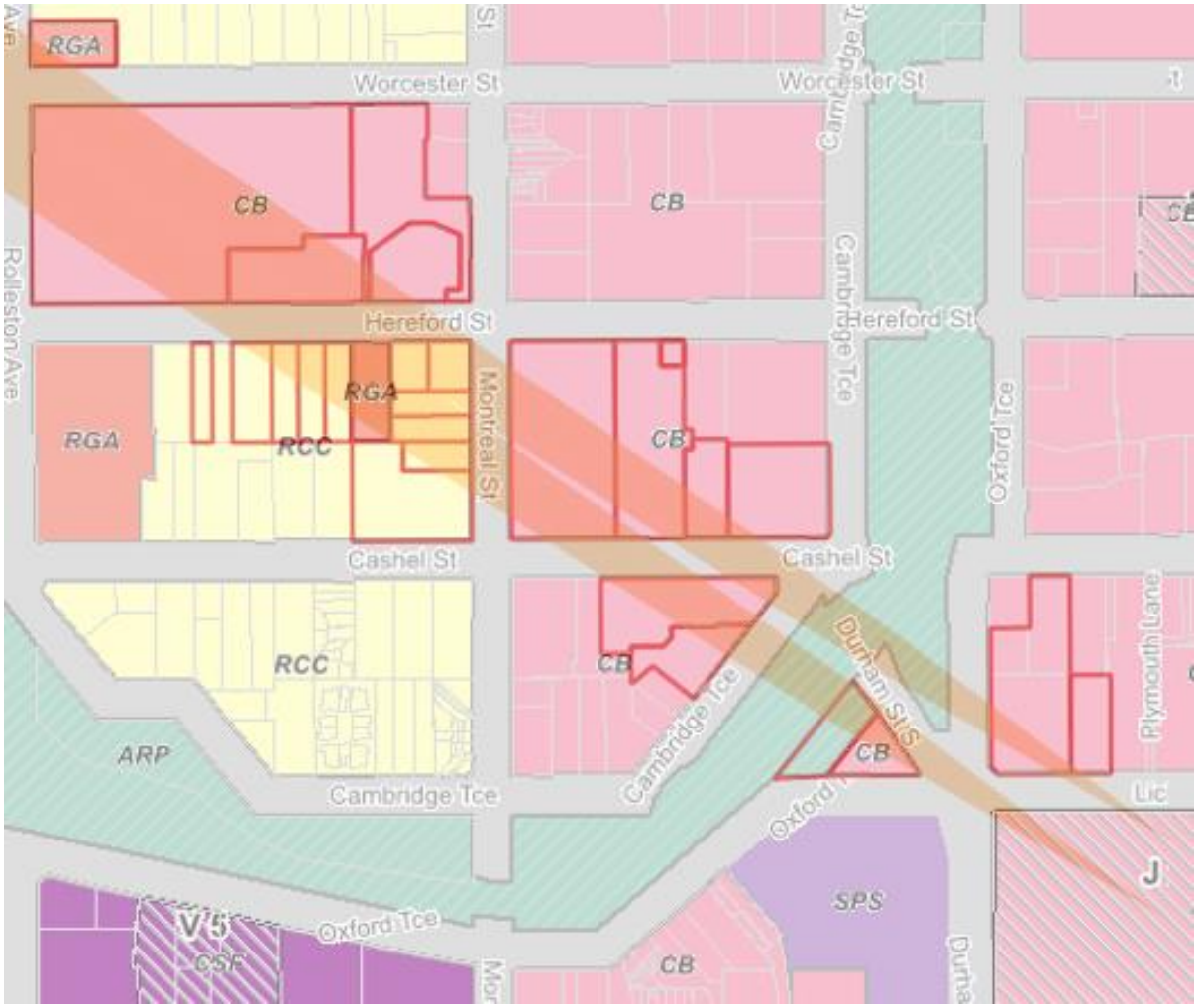
In total, the parcels have buildings with a total floorspace of 150,000m^2.[20] The intensity of development is relatively low with an average Floor Area Ratio (FAR)[21] of less than 1, with very few buildings over four levels. The following subsection describes the types of activity that are currently located within each corridor.

[19] Richard Smart (2021) Operational aspects of CJESP Radio Communications and discussion 6/12/2021.
[20] Christchurch City Council (2021) Rateable Units Database.
[21] The ratio of floorspace to the land area on which the floorspace is accommodated.

2.3.1 Airport UHF Corridors

The Airport ERCL corridors traverse land that is zoned Central City Business (CB), some Residential Central City (RCC), and a small amount of Residential Guest Accommodation (RGA). Much of the land has been redeveloped after the earthquakes and there are several historic buildings in the area.

Figure 2.6: Airport UHF Corridors and Parcels - Zones



Moving along the ERCL corridors east to west out from the CJESP, the following parcels of land and activities are traversed (refer to Figure 2.7).

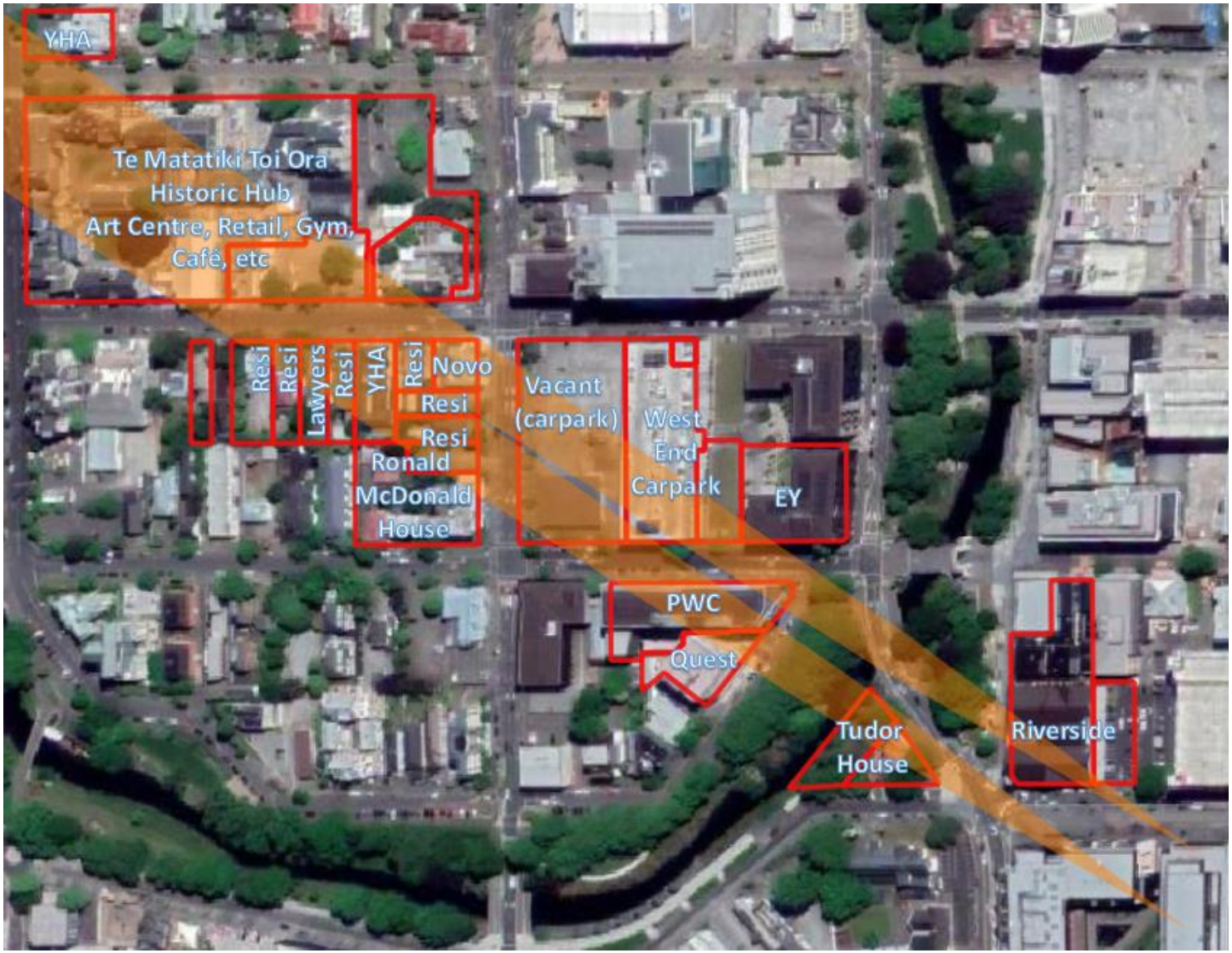
- **Riverside**: on the corner of Oxford Terrace and Lichfield Street, across the road from the CJESP and was built in 2019. It is a delicatessen and marketplace, which has two levels of retail and hospitality space.
- **Tudor House**: is a heritage-listed two-level building that was built in 1907 On a triangular site bordered by Oxford Terrace, Durham Street, and the river. Currently, there is a restaurant operating from the building, Regatta on the Avon.

- **Quest on Cambridge**: Quest will open a new hotel in a renovated six-level building in mid-2022.
- **PWC Centre**: a five-level office and mixed-use building that was constructed in 2016. The building is leased by a range of tenants, including PWC, Tonkin+Taylor, Chapman Tripp, EQ Consultants, etc.
- **Pita Te Hori Centre (EY)**: a five-level office and mixed-use building that was constructed in 2017 by Ngāi Tahu Property. The building is leased by a range of tenants, including EY, Aurecon, Vero, Ministry of Education, etc.
- **West End Carpark**: six levels of car parking, which was constructed in 2017 by Ngāi Tahu Property.
- **Vacant/Carkparking**: a large lot of land that is used for at grade car parking and portable building with NZ Post Private Boxes.
- **Ronald McDonald House**: a new (2015) four-level accommodation building that has 26-bedrooms, with shared facilities, which provides a 'home-away-from-home' for families who must travel to Christchurch for their child's medical treatment.
- **Residential houses**: there are five pre-earthquake single and double-level houses under the pathway.
- **Novo Group Planners**: a heritage art deco office building that is occupied by planners.
- **YHA Hostels**: has two locations in the area, Christchurch Backpackers (36 Hereford Street) and Rolleston House Backpackers (5 Worcester Steet).
- **Brandts-Giesen McCormick Lawyers**: have offices within a double-level residential house.
- **Te Matatiki Toi Ora**: comprises 22 heritage-listed buildings that are being used as an art centre and museum, with some auxiliary commercial activity (café, some retail, and a gym). The buildings were damaged in the earthquakes, but are being progressively restored.

Of the 26 parcels and 5.5ha of land within the Airport corridor, most of the land is heritage (2.5ha) or recently redeveloped (1.7ha), which means that most of these sites are unlikely to be redeveloped in the coming decade(s).

There is one parcel that is vacant and nine with pre-earthquake buildings that may be redeveloped in the coming decades, with a total land area of 1.2 hectares. These sites are mostly less than 700m^2, which also suggests that development potential on these sites may be limited.

Figure 2.7: Airport UHF Corridors - Parcels and Land use



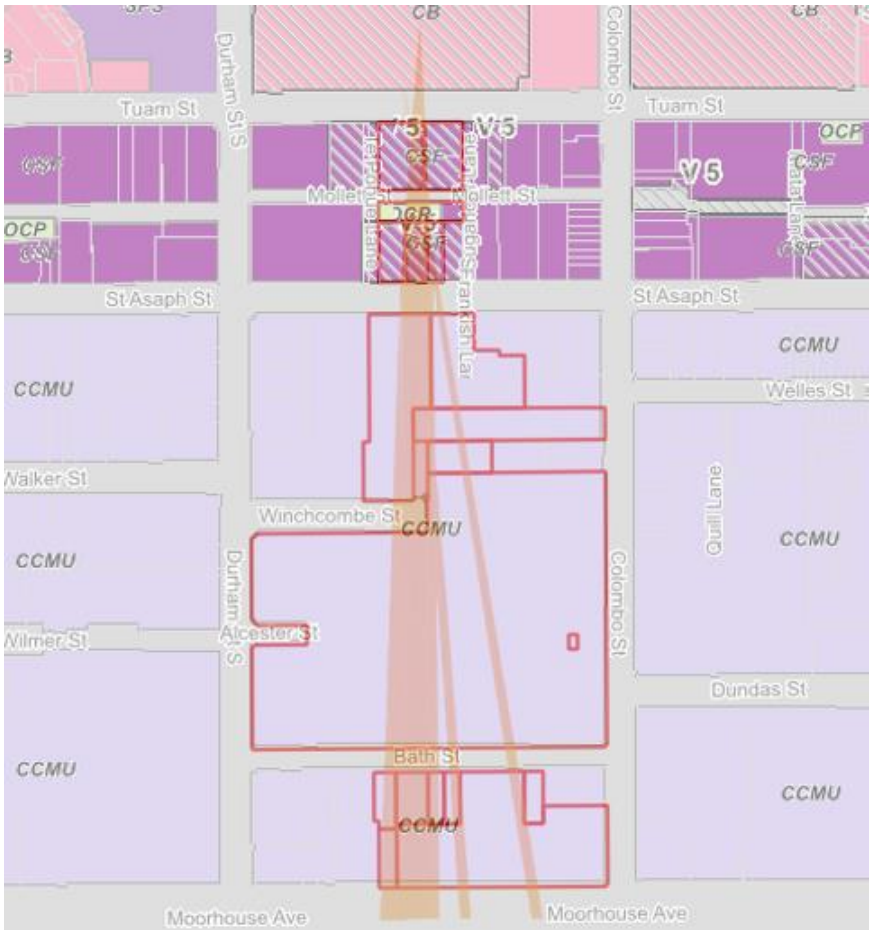
2.3.2 Marleys Hill, Cashmere, and Sugarloaf Corridors

The Marleys Hill, Cashmere/Victoria Park, and Sugarloaf ERCL corridors traverse land that is zoned for mixed-use, City South Frame (CSF) and Central City Mixed Use (CCMU), and a small amount of open space. Most of the land under the ERCL corridors has not been utilised very intensively, with a considerable amount of at grade parking and large-scale retail.

There was recently a resource consent application to build a six-level building, at 150 Tuam Street and 9 Mollet Street which is directly opposite the CJESP. This development was granted consent and will include commercial on the ground floor, residential apartments above, and a car parking area. It is also understood that a resource consent has been submitted for a six-level hotel immediately adjacent to the residential apartments. Both applications sought to exceed the 17 metre permitted height limit (Rule 15.12.2.1 Building height) and impacted the microwave pathways.

One of these paths was (just) able to clear the building, however, the second path required a microwave antenna to be relocated, as this would have completely blocked the pathway, cutting off communications. The affected agency was able to relocate this antenna, but at a cost of tens of thousands of dollars.

Figure 2.8: Marleys Hill, Cashmere, and Sugarloaf Corridors - Zones



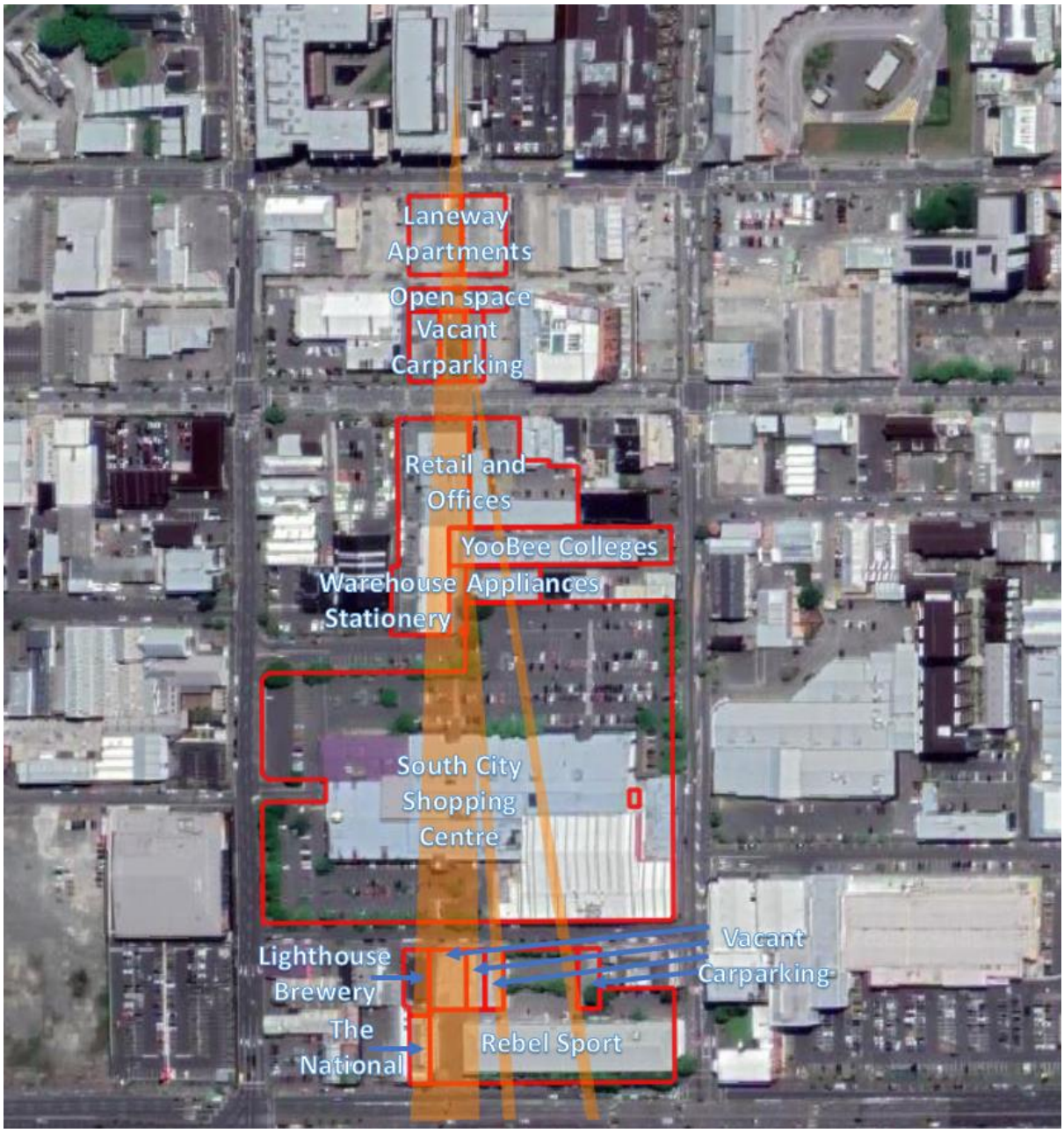
Moving along the ERCL corridors north to the south out from the CJESP, the following parcels of land and activities are traversed (refer to Figure 2.9).

- **Laneway Apartments**: a six-level building currently under construction, immediately opposite the CJESP on Taum Street (as discussed above).
- **Carparking St Asaph Street**: at grade car parking lot, which is vacant.
- **Retail/Offices**: two-level buildings with retail on the ground and offices above. The tenants include lawyers, a boxing gym, handmade goods, and Warehouse Stationery.
- **YooBee Colleges**: a two-level building which has a school of design, animation, film, and technology, which offers short courses and online study.
- **Appliances Store**: a two-level building which is used for retail.
- **South City Shopping Centre**: a shopping mall that has a range of retail and services, which includes major anchor tenants, The Warehouse and Chemist Warehouse. The mall was built in 1990s.
- **Lighthouse Brewery:** is located within a single-level warehouse building.
- **Carparking Bath Street (20, 24, 26, and 36):** several small parcels that have at grade car parking lot, which is vacant.
- **The National**: is an art dealer/gallery that specialises in jewellery, which is located in the old Lime Works building.
- **Rebel Sport**: a large format retail store that extends across most of the block.

Of the 18 parcels and 5.8 hectares of land within the Marleys Hill, Cashmere/Victoria Park, and Sugarloaf ERCL corridors, most are either pre-earthquake buildings (5.3ha) or vacant (0.3ha). Many of these sites in the area are large, ranging from 2000m^2 to upwards of 30,000m^2, which suggests that development potential on these sites could be considerable.

As discussed above, two parcels are currently under construction, with a total land area of 0.2 hectares. Once completed, it is considered that these sites are unlikely to be redeveloped in the coming decades.

Figure 2.9: Marley Hill, Cashmere, and Sugarloaf Corridors - Parcels and Land use



2.3.3 Mt Pleasant Microwave Corridor

The Mt Pleasant ERCL corridor traverses land that is zoned for mixed-use, City South Frame (CSF) and Central City Mixed Use (CCMU), and a small amount of Specific Purpose Tertiary Education (SPT). More of the land has been utilised, however still at low intensity, with considerable numbers of small-scale retailers and some large-scale retail.

Figure 2.10: Mt Pleasant Microwave Corridor - Zones

Moving along the ERCL corridor west to the east out from the CJESP, the following parcels of land and activities are traversed (refer to Figure 2.9).

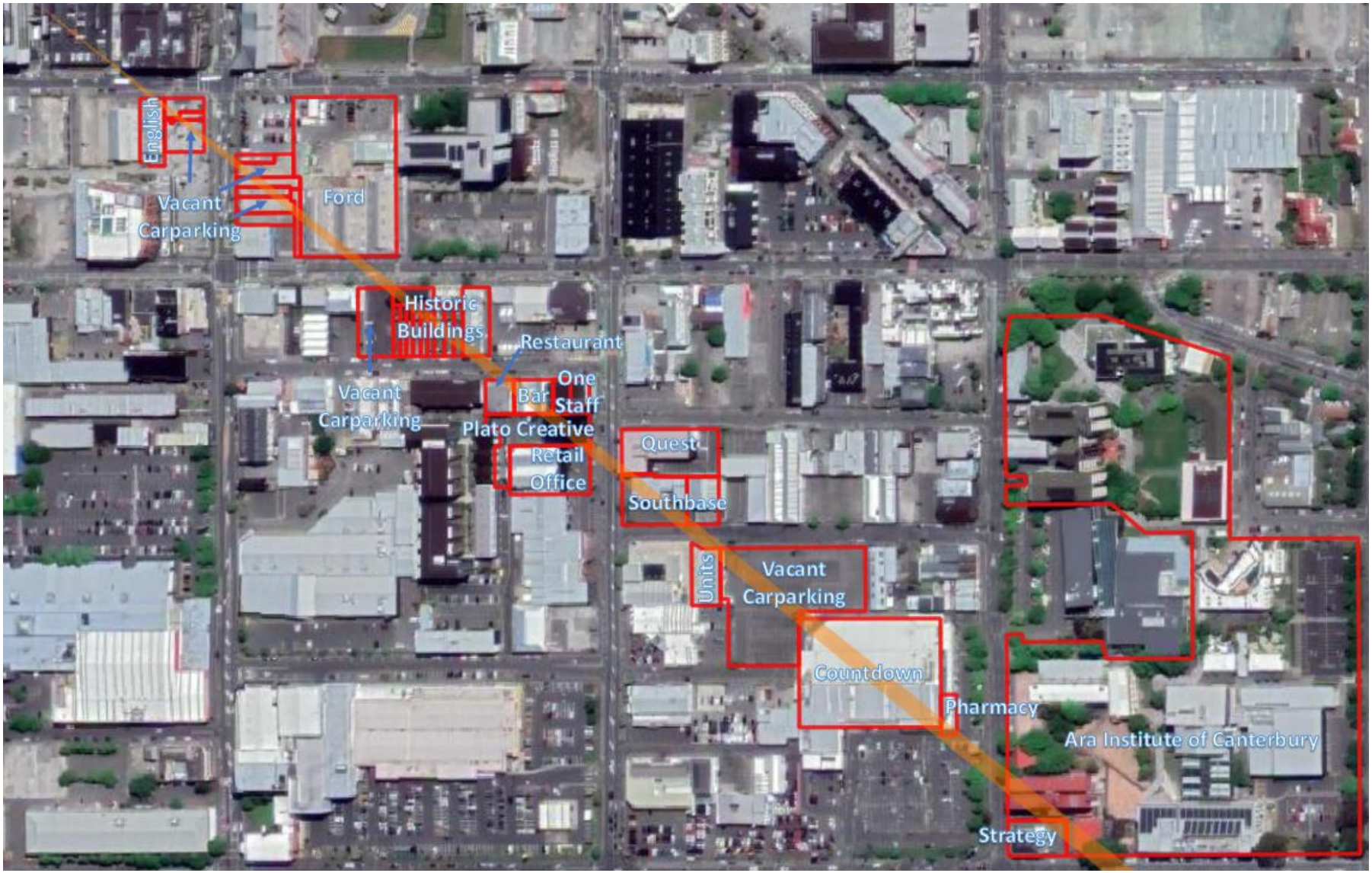
- **English School:** the Canterbury College operates out of a single-level building, providing English courses.
- **Carparking Colombo Street**: several small parcels that have at grade car parking on both sides of Colombo Street, which is vacant.
- **Ford**: a dealership yard and showrooms, with a large service and tyre centre in an old warehouse.
- **Historic Buildings**: there are several two and three-level historic buildings on St Asaph Street, ranging from 1878 to 1903, which are currently used for offices with car parking along Welles Street.

- **Carparking Welles Street**: a group of small parcels that have a car parking lot, which is vacant.
- **Restaurant**: the Winnie Bagoes City restaurant is located in a newly refurbished two-level building.
- **Bar**: the Welles Street pub, operates out of an old single-level warehouse building.
- **One Staff**: a newly constructed four-level building with offices on the upper floor (One Staff) and a café on the ground floor (Raw Sugar).
- **Plato Creative**: a newly constructed two-level building with offices in the upper level (Plato Creative) and a gym on the ground floor (Iron Hood).
- **Retail and Office**: several small retail businesses operate out of this older two-level building (Hi Tea, Kiwi grab, etc).
- **Quest on Manchester**: a new three-level commercial hotel built in 2019, which includes 46 serviced apartments including studio, one, and two bedroom apartments.
- **Southbase**: a construction company, which includes offices and storage/warehouse.
- **Shop Units**: two units that are occupied by a screen printer (Goose) and a motorbike rental/tour operator.
- **Countdown/Pharmacy**: several retail activities are located in this large building, including a supermarket and a pharmacy.
- **Ara Institute of Canterbury**: operates on most of the block between Moorhouse Avenue and St Asaph Street, which means that only a small part of the campus is under the ERCL corridor.
- **Strategy**: a heritage two-level building which is used for offices by a creative branding company.

Of the 40 parcels and 8.8 hectares of land within the Mt Pleasant corridor, most of the land is either pre-earthquake buildings (7.1ha) or vacant (0.9ha). While most of these sites are small in the area, there are some large sites over 5,0000m^2 or upwards, which suggests that development potential on these sites could be considerable.

There is some heritage (0.3ha) or recently redeveloped (0.4ha) land, which is not likely to be developable in the coming decades.

Figure 2.11: Mt Pleasant Microwave Corridor - Parcels and Land use



2.4 Summary of CJESP Emergency Radio Communication Links

In summary, the CJESP communication links are critical to emergency response, both day-to-day events, and large-scale disasters. Although the agencies use multiple communication links, it is clear that ERCLs is vital.

While the government has begun the process of developing a new Public Communication Network that will consolidate and change the existing communication links, this process will evolve over the coming decade, which means that the ERCL from CJESP are likely to be needed for many years, if not the entire life of the District Plan. The agencies in the CJESP consider that the existing technology (cellular and satellite systems) are not currently at a sufficiently advanced point to allow CJESP to switch from the ERCL.

There are currently five ERCLs and one potential backup link. The microwave links to Cashmere and Mt Pleasant provide critical links for Police and FENZ, to allow communication to personnel in the field both for day-to-day events and large-scale disasters. Given the critical importance of the microwave links, there is a third potential link to Sugarloaf which could be used in new equipment was installed. The microwave links are much tighter, which means that disruption of communications can occur more easily. Also, the links are transmitted up to the Port Hills, which means that they increase in height quickly and are relatively high.

The three UHF links provide backup services, to allow direct communication with Christchurch Airport if a major event occurs (two links) and an outgoing pager service for St Johns ambulances which provides redundancy for other communication links. The UHF links are much wider, which means that they can maintain a link even if there are several intrusions into the pathway. However, this means that the UHF pathways are much lower to the ground, which means that new buildings can more easily intrude into the pathway.

The recent application for a six-level building at 150 Tuam Street and 9 Mollet Street, directly opposite the CJESP, shows a situation where development has interrupted one of the microwave links. This example shows that there is a real risk to the ERCL, even under the existing planning framework.

The review of activity along the ERCL shows that there are considerable differences between each of the corridors:

- **Airport Corridors (UHF)**: there is a lot of newly constructed buildings and heritage buildings in this pathway. This means that there is a limited number of places where new buildings could be constructed along the pathway and there are fewer opportunities for the ERCL to be disrupted.

- **Marleys Hill (UHF), Cashmere/Victoria Park (MW), and Sugarloaf Corridors**: there is a lot of pre-earthquake buildings in this corridor, with the parcels tending to be relatively large. This suggests that development potential on these sites could be considerable and there is further opportunity for the ERCL to be disrupted.
- **Mt Pleasant Corridor (MW)**: there is a lot of pre-earthquake buildings and vacant land in this corridor, which also tend to be relatively large. This suggests that development potential on these sites could be considerable and there is an opportunity for the ERCL to be disrupted.

3 Protection Options

This section draws information from the agencies in the CJESP and Christchurch City Council to define three policy options to manage the ERCL and four mitigation options. This is a fundamental step in the economic assessment, as the first step of the CBA is to define the counterfactual and alternative options that will be used in the remainder of the assessment.

The counterfactual is used as the baseline from which alternative options are tested, i.e. relative to the counterfactual does the option produce a better outcome (greater benefits than costs)? The correct definition of the potential options, including counterfactual and alternative options, is vital as it directly impacts the range of costs and benefits examined, and the resulting quantum.

Generally, the counterfactual is defined as the 'do nothing', 'do minimum', or even 'business-as-usual', whereas the alternative options allow for intervention or change. While this step may seem relatively uncontroversial, the definition of the options may not always be straightforward and could evolve over the research period, as has happened in this situation. In this study, there are both policy and mitigation options, which are discussed in the following subsections.

3.1 Policy Options

First, there are four policy options that need to be considered. These include the rules in the current operative district plan, the proposed PC9F, designation, and potential intensification enabled under the NPSUD (and codified in HSAA).

Based on the knowledge of the agencies in the CJESP, and of Council's planner and other communication experts, it is considered that there are no known instances in New Zealand where an ERCL has been protected explicitly within a District Plan or national policy. However, it may be that some plans have implicit protections which relate to maximum height limits in the district plan. Therefore, there is no existing precedent in any other jurisdiction on this type of protection.

The Christchurch situation may be unique because the government decided, after the earthquakes, to build a single precinct to house all the agencies in one location, which in turn resulted in the consolidation of emergency communications to this single location. Potentially this unique outcome has not been repeated elsewhere in the country as there has been no need for a complete rebuild of the emergence networks in other cities.

3.1.1 Operative District Plan

The Operative District Planning (ODP) framework was established following the earthquakes. It provided for a range of building heights in the Central City, with a maximum height limit for buildings of 30 metres. CJESP land is within the 28-metre height limit overlay.

The land to the south of the CJESP is within the 17-metre height limit overlay. This covers all of the land within the Marleys Hill, Cashmere, Sugarloaf, and Mt Pleasant ERCL corridors. The CCC building height data shows that currently there are no buildings in the corridor that exceed the overlay.[22] The new One Staff 4-level office building is the highest, at 14.6 metres. There are also taller buildings on the Ara Campus (at 23 metres), but these are located on the northern edge of the campus which is removed from the Mt Pleasant corridor. However, there is one building currently under construction which is going to reach 20.9 metres when completed, Laneway Apartments, 150 Tuam Street.

The land under the Airport ERCL corridors is mostly within the 28-metre height limit overlay, which covers the Commercial Central City Zone immediately to the west of the CJESP, either side of the Avon River. The three tallest buildings in this area reach up 24 metres[23], with the PWC, Quest, and EY buildings all intruding into the Airport ERCL corridors which is between 16 to 18 metres at this location. Further to the west, the block next to Hagley Park is within a 14-metre height limit overlay and with the highest building being Ronald McDonald house at just under 10 metres[24].

Under the current Christchurch District Plan provisions, exceeding the height limits relating to buildings in the Central City zones is mostly a restricted discretionary activity status and the matters of discretion do not include effects on ERCL. Therefore, the ERCL cannot be considered when assessing an application to breach the permitted height limits.

In a permitted activity context, the height limits in the District Plan are currently sufficient to ensure that the ERCL to the Port Hills is maintained and not disrupted. However, the permitted height limits in the Airport ERCL corridor do not exclude all development that could intrude into the pathway.

It has become apparent through recent developments that have breached the permitted height limits that there are limitations with the restricted discretionary activity rule framework meaning that the effects on the ERCL from new developments are unable to be considered.

3.1.2 Proposed Plan Change 9F

The purpose of PC9F is to include a new sub-chapter in Chapter 6 to protect ERCL from adverse effects resulting from buildings, structures, utilities, and trees intruding into the pathways. The Plan Change proposes the following amendments:

- Changing the definition of 'height' to remove the exceptions that may affect radiocommunication pathways;
- Inserting a new sub-chapter into Chapter 6 for the protection of Radio Pathways;

[22] Christchurch City Council (2021) Light Detection and Ranging Data.
[23] Ibid.
[24] Ibid.

- Inserting a new objective, policies, and rules requiring consent as either a restricted discretionary or non-complying activity for any buildings, structures, utilities, and trees above the maximum height limit;
- Inserting standards for the protection of radio pathway corridors including the requirement for an assessment of effects by a suitably qualified and experienced radio engineer and tables specifying the maximum height limit for any building, structure, utility, or tree within the pathway;
- Inserting an appendix which includes diagrams for interpreting the radio pathway corridors; and
- Amending Planning Map Central City Zoning, Other Notations, Designations, and Heritage Orders Planning Map to include a new overlay identifying each of the radio pathway corridors.

The area identified as being within the ERCL corridors is where a building has the potential to protrude into the radio communication path causing diffraction and hence the attenuation of the radio signal. The protections are identified in the new appendix as the bottom or lowest point of the pathway i.e. “Maximum Height Limit”, and the horizontal width as the widest part of the pathway i.e. “Clearance zone”. This protection is a box-like in shape, which is larger than the ERCL pathway, which is ellipsoid in shape (as shown in Figure 2.2).

The ellipsoid of the microwave ERCL pathways will be close in size to the protections proposed in PC9F. From a practical perspective, the two-dimensional protection that is proposed in PC9F is likely to be reasonably close to the actual three-dimensional communication pathway.

Conversely, the ellipsoid of the UHF ERCL pathways is much wider, which means that there will be more variance between the two-dimensional protection that are proposed in PC9F and the actual three-dimensional communication pathway. For example, on the outer parts of the corridor, the height of the ellipsoid of the UHF can be upwards of 10 metres higher than the heights proposed in PC9F. We note that during this project that Council has developed 3-dimensional model of the pathways. This report has been based on the PC9F two-dimensional protection, and if these were changed to the 3-dimensional model then the assessment could be updated.

It is acknowledged that the definition of the protections in PC9F is a balance between accuracy and clarity of information and that this simplified approach avoids having a complex three-dimensional matrix in the District Plan. In the UHF ERCL pathways, the applicants can still apply to build above the Maximum Height Limit.

For UHF ERCLs, development above certain heights would be a Restricted Discretionary activity, which reflects the fact that this link may not be impacted by some intrusions into the communication

pathway and that the Maximum Height Limit does not reflect the three-dimensional cross-section of the pathway. The purpose of PC9F is not necessarily to prevent development in the pathways but to require consent so an assessment can be made of the potential effects on the pathway and mitigation investigated. The radio engineering assessment commissioned by CJESP agencies suggests "that mitigation is unlikely to be required unless the path is obstructed close to CJESP (20m away)" or if multiple buildings are obstructing the ERCL.[25]

For the Microwave links, development above certain heights would be a Non-complying activity, which reflects the fact that this type of link is more easily impacted by intrusions into the communication pathway.

In summary, PC9F would restrict the development heights in the ERCL corridors. The plan change introduces rules that trigger a need for developers to communicate with the agencies in the CJESP, so that the effects on the ERCL can be considered and where possible mitigations can be established.

3.1.3 Designation

Consideration was given to designating the radiocommunication pathways. The pathways would be included on the District Planning Maps and would place restrictions on what anyone other than the designating authority (CJESP) could do within the designated airspace.

This option is inconsistent with how similar protection corridors have been included in the Christchurch ODP. Specifically, the airspace around the Christchurch International Airport is managed by the way of objectives, policies, and rules to protect the approach to the airport to maintain a satisfactory level of safety. Designations have generally been used for land parcels rather than air space and provide less flexibility in terms of allowing development where alternative mitigation can be adopted.

However, there are examples of television communication links being protected in the old Christchurch District Plan using designations, and also examples in the existing Auckland Plan.

- **Christchurch TVNZ**: two designations restricted the development of structures into the airspace between the Gloucester Street Studios and Sugar Loaf (to south) and Mt Grey (to the north).[26] These pathways were relatively confined, but much lower heights than those in the ERCL from the CJESP.
- **Auckland TVNZ**: two designations restrict structures around the Auckland CBD television studios. The designation restricts development to the west and north, which

[25] RHW Telecommunications Limited (2021) CJESP Radio Corridors Link Mitigation Options, page 7.
[26] Christchurch City Plan 2005 – Appendix 4.

protect the microwave transmission and satellite path.[27] Given the contour of the land, the protections have a limited impact on development potential. For example, much of the designation is more than 200 metres above ground level, which is beyond the height of most buildings.

3.1.4 National Policy Statement Urban Development and Housing Supply Act

The NPSUD and HSAA are intended to remove overly restrictive barriers to development to allow growth up and out in locations that have good access to existing services, transport networks, and infrastructure.

Christchurch City is identified as a Tier 1 urban environment which means that the Policy 3 directive applies, and the Council is required to ensure that the District Plan enables building heights that provide "as much development capacity as possible" in city centre zones.

Councils can modify this requirement but only to the extent necessary to accommodate a qualifying matter in that area (Policy 4). Qualifying matters and how the intensification requirements can be modified are described in subpart 6 of the NPSUD. ERCL is not defined as nationally significant infrastructure and therefore are not considered a qualifying matter by clauses specifically stated in the NPSUD.

Clause 3.33(3) sets out that a matter is not a qualifying matter under clause 3.32(1)(h) unless the evaluation report also identifies the specific characteristic that makes the level of development directed in Policy 3 inappropriate and justifies why it is inappropriate in light of the national significance of urban development and the NPSUD. The evaluation must also include a site-specific analysis that identifies the site to which the matter relates, evaluates the specific characteristics on a site-specific basis to determine the spatial extent where intensification needs to be compatible with the specific matter and evaluates a range of options to achieve the greatest heights and densities directed by Policy 3 while managing the specific characteristics.

This policy has been codified within the Housing Supply Amendment Act, which also brings forward the requirement of councils to implement changes in their planning frameworks to enable intensification via an Intensification Streamlined Planning Process (ISPP). The HSAA is directive, it requires unlimited heights and densities within the Central City, and a minimum of six-levels within a walkable catchment of the Central City (unless a qualifying matter applies, as discussed above).

It is understood that the Council is considering the inclusion of ERCL as a qualifying matter by way of a plan change that will be notified in 2022. At this point, the Council is still assessing how it will

[27] Auckland Unitary Plan – 8301 and 8302.

implement the intensification requirements and is commissioning research on the amount of intensification that should be enabled as well as qualifying matters.[28]

CCC has suggested that the following assumptions be adopted for determining the potential development that could be enabled within the ERCL corridors:

- **City Centre Zone**: for this assessment, it is assumed that the City Centre Zone comprises the area within the four avenues – i.e. area bounded by Bealey, Deans, Moorhouse and Fitzgerald Avenues. However, Hagley Park and the Botanic Gardens would be excluded.
- **Building Heights**: for this assessment, it is assumed there are no height limits within the City Centre Zone.

The above is based on an interpretation of the NPSUD that is more permissive and is one of several options still being considered. However, for the economic analysis, the above should be viewed as the maximum potential and there are several reasons why land within the four avenues will not be developable which includes heritage, open space, qualifying matters, other market factors, etc.

3.2 Mitigation Options

The agencies that rely on the ERCL could undertake mitigation to avoid the potential disruptions of the pathways. The range of mitigation options has been assessed by RHW Telecommunications Limited[29] and Kordia[30], who have estimated the cost and feasibility of the alternatives mitigations that could be employed. The following discussion provides a summary of the different mitigation options, which includes increasing the antenna size, increasing transmitter power, shifting the antenna on the CLESP, new relays on other buildings, and other communication links (i.e. consolidate ERCL).

3.2.1 Increasing the antenna size

The receive level can be increased by increasing the antenna size, increasing the antenna gain at an end will improve the receive level in both directions and increase the height of the ERCL pathway.

For the CJESP, the current antenna pole arrangement was designed with little or no capability for expansion, being constrained by the weight-bearing capacity of the main beams and columns of the building. RHW Telecommunications has suggested the following option for each of the radio communication pathways – which is called Mitigation Option 1:

[28] Christchurch City Council (2022) GETS - Request for Proposal Economic Cost Benefits Advice for Intensification – Closed 28th January.
[29] RHW Telecommunications Limited (2021) CJESP Radio Corridors Link Mitigation Options.
[30] Kordia (2021) Justice and Emergency Services Precinct – Te Omeka Radio Corridor Protection Project – Structural
Engineering Response.

- **Airport**: there is no option available, as the antenna at the Airport cannot be increased in size.
- **Marleys Hill**: there is no option available, as the antenna at the Marleys Hill cannot be increased in size.
- **Cashmere**: the antenna could be increased in size by using an antenna of 1.2m diameter, and would increase the height that a building could reach by one floor at 20 metres from CJESP and two floors at 50 metres from CJESP.
- **Mt Pleasant**: the antenna could be increased in size by using an antenna of 1.2m diameter, and would increase that a building could reach by one floor at 50 metres from CJESP and two floors at 200 metres from CJESP.

The cost of the equipment and works to install the new antenna is expected to be in the order of $212,000. However, the feasibility of this mitigation option will depend on whether the building structure is strong enough to enable the larger antenna to be located on the roof of the CJESP and whether the Port Hills masts are strong enough.

3.2.2 Increasing the transmitter power

To increase radio transmitter power, the level must be increased at both ends of the link to be effective. According to RHW Telecommunication, it is unlikely that transmitter power can be increased without replacing the radio equipment, assuming suitable equipment can be found. Also, increasing transmitter power may not be possible because it will cause adverse interference to other radio links using the same frequency band.

RHW Telecommunication considers that the receive level cannot be practically increased for either the UHF or Microwave ERCL.

3.2.3 Shift antenna on CJESP to alternative pole

According to the RHW Telecommunication report, there is limited scope for changing the antenna position on the CJESP. One option would be to shift the microwave antennas to Pole 10 on the Justice Building, however this building is not IL4 standard and would need to be improved to ensure resilience in major events. RHW Telecommunication considers that there may be issues with the rigidity of the pole, in terms of the maximum deflection requirement for the microwave antennas.

Also, given the geometry, this option is likely only to be effective if the obstruction building is close to CJESP (within 100 metres) and the south. This option will only be useful for the microwave radio link to Cashmere, which could be employed if the car parking lot on St Asaph street was redeveloped and a building intruded into the pathway.

3.2.4 New relay antennas on another building

The ‘relay’ or middle site would ideally be located on the top of the building obstructing the current ERCL pathway, but it could be another location provided it had clearance back to CJESP and the Port Hills/Airport, and the agreement of the property owners.

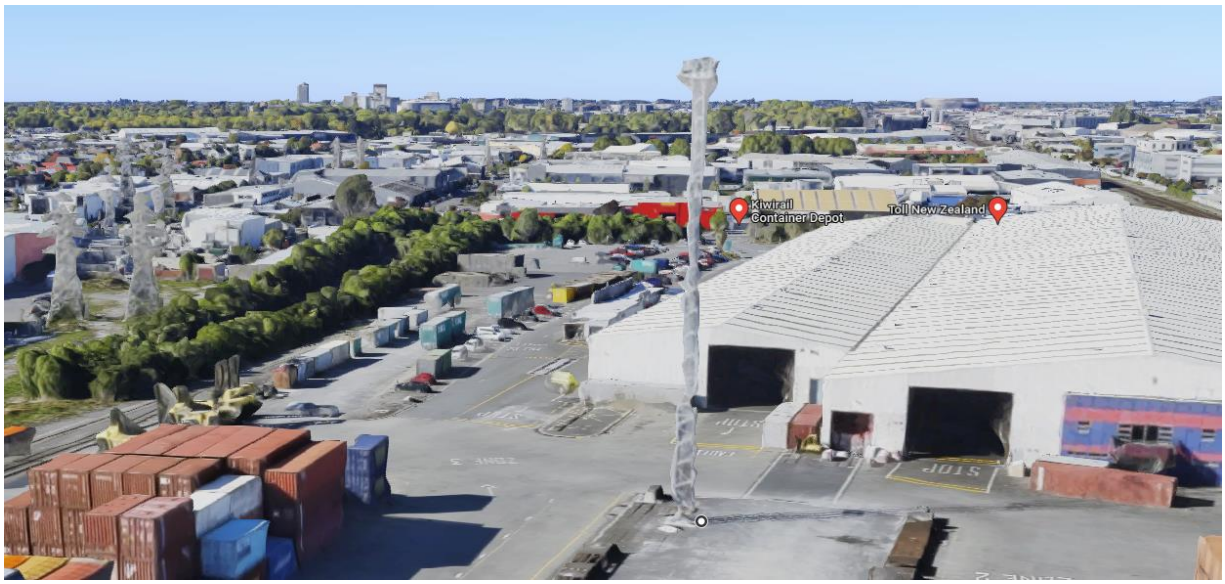
To maintain the resilience of the ERCL any buildings used for the ‘relay’ site would need to be IL4 rated (NZ Building Code), capable of operating off the grid for at least 72hrs, and the means for mounting antennas with sufficient rigidity. This requirement is unlikely to be met by any commercial building since it is likely to be uneconomic for any developer. Therefore, a likely alternative location for the relay site could be the Middleton Railyards, which is a good location because:

- the path to this location probably has the lowest risk of being obstructed as most of the path is outside the “four avenues” crossing either South Hagley Park or low-density office/warehouse building along Blenheim Rd.
- There are already two high communications poles/towers in the area so getting resource consent for a 40-50m tower/pole is likely to be possible.

RHW Telecommunication has suggested the following option for each of the microwave ERCL pathways - which is called Mitigation Option 3a and 3b:

- **Building in Pathway**: the relay transmitter on the new building, which would cost $50,000 for equipment and upwards of $140,000 for engineering installation. However, relay site-building is unlikely to meet IL4 and hence the site is not considered resilient for emergency communications.
- **Other IL4 Building**: the relay transmitter on another public IL4 constructed building, which would cost $50,000 and upwards of $1.1 million for engineering installation. For example, a purpose built IL4 facility at Middleton Railyards with a 40+ metre tower.

Figure 3.1: Middleton Railyard and Antenna view back to Central City and CJESP



3.2.5 Other Communication Links or Consolidation

Once cost-effective and fit for purpose, the NGCC will evolve PSN's capability, transforming to digital radio – with full capability and nationwide accessibility.[31] However, it is not clear when this will occur and is beyond the control of the agencies in CJESP.

This option will only be feasible if the government invests considerable money in a national level system upgrade. The agencies in CJESP consider that radio communications will be required for the coming decade or more.[32]

Also, there is potential for some ERCL from CJESP, such as the Marleys Hill UHF, to be consolidated with other communications in the coming years as the PSN programme develops into one system.[33] As discussed in RHW Telecommunication report the Marleys Hill UHF could be consolidated with the microwave links.

3.3 Summary of Protection Options

In conclusion, there are several alternatives for maintaining ERCL from the CJESP. For the remainder of this report, the Operative District Plan (**ODP**) has been used as the counterfactual from which all other options are tested. Specifically, the assessment of costs and benefits compare the outcome under the alternative options as compared to the ODP.

[31] NGCC (2021) Public Safety Network: Strategy and Benefits.
[32] Richard Smart (2021) Operational aspects of CJESP Radio Communications and discussion 6/12/2021.
[33] Richard Smart (2021) Operational aspects of CJESP Radio Communications and discussion 6/12/2021.

The following alternative protection options have been assessed:

- **PC9F**: the policy option that has been proposed by CCC and the agencies in the CJESP.
- **Designation**: a policy option of defining designations to protect the ERCL.
- **Mitigation Option 1**: the mitigation option to increase antenna heights to avoid intrusions in the microwave links and PC9F is updated to the new heights.
- **Mitigation Option 3**: the mitigation option to relay to another building or Middleton Railyards to avoid intrusions in the microwave links and no protection is afforded to UHF pathways. This reflects the intensification that may be enabled under the NPSUD and HSAA.

The PSN and potential for links have not been assessed independently. The PSN will evolve emergency communications over time, which will mean that the need for policy or mitigation options for CJESP can be expected to change accordingly. The PSN and potential for new links are a medium-term solution, which impacts the time over which the alternative options can be expected to have effects and is used to define the temporal extent of the CBA.

Finally, we also note that not all Emergency Services agencies are part of or able to access PSN services (e.g. Ministry of Civil Defence and Emergency Management are not). While Ministry of Civil Defence and Emergency Management have not yet implemented ERCL from CJESP, any such future deployments may use the same corridors as the existing ERCL.

4 Protection Assessment Framework

The following section establishes a qualitative framework of the range of costs and benefits that can be expected to accrue from each policy or mitigation option associated with the protection of ERCL from the CJESP. This step is important as it provides a robust framework from which to ensure that all aspects of the policy and mitigation options are covered.

The framework uses first principles to develop a list of the stakeholder groups which will be impacted and the types of cost and benefits and to whom they will flow. The framework was informed by information discussed in the preceding sections of this report, literature review, the feedback received on PC9F, and information drawn from the agencies and experts involved in the development of PC9F.

4.1 Stakeholders

First, the ERCL can be expected to affect several stakeholders, which includes landholders, community (and representative public bodies), Tangata Whenua, and the agencies within the CJESP.

The protection of the ERCL pathways will mostly generate benefits for the wider community and the agencies in the CJESP, in terms of reduced risks from major emergencies. However, these groups will also bear some costs, which may include direct costs to the agencies and the community could lose some wider economic benefits. But overall, it is expected that these groups will receive net positive benefits from the protection of the ERCL pathways.

Conversely, the landholders that own property under the ERCL corridors are expected to mostly bear negative costs associated with the protection of the pathways. The following discussion outlines the feedback received on PC9F that relates to each group, which provides an indication as to some of the costs and benefits associated with the protection of the radio communication pathways.

4.1.1 Landholders

There are approximately 84 parcels that are within the ERCL pathways, which have a total land area of 20.1ha (excluding open space), of which 4.3ha is directly under the pathways (Figure 2.5). Ten landholders provided feedback, nine of whom have property immediately within the corridors and one that was in the vicinity.

First, eight of the landholders provided the same feedback which was assisted by Novo Group planning[34]. This included the Carter Group, Caisson Group, JPA Holdings, Peebles Group, and IPG (181

[34] Novogroup (2021) Jeremy Philips email of feedback.

High Limited, Riverside Limited, Percasky Holdings Limited, and Duncans Lane Limited). The following points were raised:

- there are economic costs associated with lost site utilisation and development potential.
- alternative mitigation options could achieve satisfactory communication for the CJESP.
- there is a need to compensate for any lost site or development potential.
- the proposed protections have inadequate regard to the NPSUD.
- introduce additional consenting timeframes, costs and uncertainty.
- inconsistent with aims for recovery and regeneration.
- could generate perverse or undesirable outcomes e.g. poor urban design/form, diminished Central City intensification/development, diminished confidence in Central City investment and development, etc).
- practical testing/application of the rules to real world scenarios and/or the appreciation of the commercial/cost implications.

Also, the SSJ Family Trust, which owns 162 – 166 Tuam Street, which is across the road from the CJESP under the Mt Pleasant microwave pathway (i.e. Canterbury College), provided feedback that they had plans to build up to 17 meters high, which was the height limit under the ODP and are concerned that the protections might constrain the development opportunity on their land. They consider that control of building heights in Central City is a temporary solution, which will give way to pressure from political and business interests. They also question whether a satellite link may provide secure links to the CJESP.

Finally, the owners of Pak'n Save on 299-305 Moorhouse Avenue, supports the proposed radio pathway protection corridors as long the ERCL corridor do not affect their property. Based on the spatial layers provided by Council this property is not within the pathways, so is unaffected.

The landholders are likely to bear direct costs associated with the protection of the communication pathways, which will include lost development potential and consenting costs.

4.1.2 Community

The wider community, as a combined group, will receive benefits and costs associated with the protection of ERCL pathways. While there has not been any feedback from the wider community, there has been feedback from public entities that are tasked with representing them, which includes Environment Canterbury and Kāinga Ora.

Environment Canterbury (ECan), which has a statutory obligation to represent the regional community, has submitted feedback in support of the proposed protection of ERCL corridors in PC9F. Ecan considered that the draft amendments will ensure that development does not create adverse effects on regionally significant infrastructure, or strategic infrastructure and better give effect to the objectives and policies of the Canterbury Regional Policy Statement.

Kāinga Ora, which has a statutory objective to contribute to sustainable, inclusive and thriving communities, has significant concerns regarding the potential impacts of the controls on the ability of Christchurch City to thoroughly enable intensification in the Christchurch City Centre as mandated by the NPSUD. It is concerned that PC9F prioritises the protection of ERCL pathways at the cost of intensification and development potential. It is considered important that matters such as those in the proposed PC9F can be considered more cohesively at the same time that responses to the NPSUD are being considered.

Moreover, the non-complying activity status that is proposed for infringements of maximum height standards in the microwave ERCL does not offer much option or flexibility for those sites within the identified pathways.

Also, Christchurch City Council, which has a statutory obligation to represent the local community, is the body that has submitted the proposed plan change. The council is supporting PC9F, having borne some of the cost of developing PC9F and has presented supporting material. The council will also have to administer the rules and assess consent applications, which will be a cost to the council and local ratepayers.

The wider community may be expected to bear the burden of the potential change in development activity in these locations, which will include the administration costs and potential impacts on the well-function urban environment. Conversely, much of the benefits from the protection, in terms of emergency response during major events, will flow to the wider community.

4.1.3 Iwi

There has been no feedback from Tangata Whenua about the proposed protections for the ERCL pathways. Ngāi Tahu is a major landholder and developer, they have constructed the West End carpark and Pita Te Hori Centre (EY), which both fall within the Airport UHF pathways. Both buildings intrude into the pathway.

The iwi may also own other land that is under the pathway. Neither Ngāi Tahu nor Ngāi Tahu Property Development provided feedback on the PC9F, so it is not possible to establish the extent to which the proposed projections may impact the Tangata Whenua.

4.1.4 CJESP Agencies

The CJESP agencies will benefit from protections of the ERCL pathways, which will maintain the overall operational efficiency. The agencies have provided information and supported the development of PC9F which has been a real cost in terms of internal staff time and external expert consultant time.

The agencies will need to engage with Council and landholders when there are applications for development that exceed the height limits. Conversely, if no protections are implemented then the agencies may have to invest money to mitigate the potential loss of an ERCL, which can be much more costly or not feasible to implement.

4.2 Protection of Emergency Communication Costs and Benefits

The literature review research conducted in this study indicates that there is little research on the costs and benefits associated with the protection of ERCL, either in terms of international or domestic literature. Discussion with the CJESP agencies and communication experts also indicated that they are unaware of any study on the topic.

While not directly relevant, Caravel Group researched the benefits and costs associated with integrated radio communications for land-based search and rescue in New Zealand.[35] This study was conducted for New Zealand Search and Rescue but was focused on operational or in-field communications in remote locations (HF, VHF, and satellite) and the scope of research does not include communications through urban areas back to head office (UHF, Microwave, etc). The assessment was qualitative and did not assess the relative costs and benefits of the alternatives. This study provides limited information that applies to this situation.

Also in 2013, the Whole of Government Radio Network was developed to integrate communications by all agencies into a single network[36], and the Whole of Government Critical Communications Strategy has a goal to develop and adopt alternate mobile digital technologies such as Long Term Evolution (LTE) and Satellite.[37] However, these plans were replaced recently by the Next Generation Critical Communications project and the PSN[38]. However the CJSEP consider that LTE and satellite solutions are not yet mature enough, nor provide adequate coverage, to provide the functionality required for mission critical communications.[39] While there may be some research on the costs and

[35] Caravel Group (2016) Integrated Radio Communications Framework for New Zealand Land-Based Search and Rescue Operations.
[36] NZ Police (2013) Aggregated model for Whole of Government Radio Network (WGRN).
[37] CDEM (2016) CDEM Sector - Alternate Communications.
[38] As discussed above the PSN does not include the Ministry of Civil Defence and Emergency Management.
[39] Richard Smart (2021) Operational aspects of CJESP Radio Communications and discussion 6/12/2021.

benefits of emergency communication links and their protection, this research does not appear to be publicly available and could not be found in the literature search.

4.2.1 Protection Benefits

The research undertaken in this study suggests that the benefits associated with the protection of radiocommunication pathways mostly relate to efficient coordination and response during daily events and large scale emergencies.

The wider community is expected to receive the following main benefits, which includes:

- A reduction in the risk to life and property.
- Reduce the impact on the environment through efficient response to hazards, and
- Maintain community trust and confidence in these services.

In theory, it would be possible to quantify these three benefits. However, this would require extensive scientific study of the risks that could be avoided, which would need to assess the probability of the emergencies occurring, the potential impacts of those events and then the improvement in response that the ERCL would provide. While in theory this could be conducted, it would be a substantial task and require many experts from a range of fields. Therefore, it is considered that it is not practical to provide an estimate of these benefits. However, the protection of these ERCL could result in lives being saved or property not being damaged, which is likely to be significant.

Indicatively, the communications on the ERCL relate to approximately 60,000 serious incidents each year. Most of the incidents are handled on the Microwave pathway, with around 37,000 serious ambulance calls[40], 20,000 police priority one calls[41], and 1,500 life-threatening fire call outs[42]. The Marleys Hill pathway handles pagers to all events, which provides additional backup to the microwave communications. The Airport UHF handles a few major events, while no data was available it may handle less than 10 per annum.

It is clear that fast and efficient communication results in lives being saved during these serious incidents. In the indicative assessment, we have assumed that communications result in an avoided fatality for 0.5% of the serious incidents. If this was the case then this would mean the communications result in around 300 fatalities avoided in a year, most of which would relate to microwave (295) and Marleys Hill (8). The avoid fatalities associated with the Airport UHF would be relatively small. However, we stress that the number of avoided fatalities would be different for every incident which means that this indicative assessment is overly simplistic. For example, an ambulance call to a cardiac

[40] St Johns (2020) Ambulance Incidents – Purple and Red Triage Priority.
[41] NZ Police (2022) Priority 1 Events by Offence/ Incident Types.
[42] NZ Fire (2022) Major Fire events – Purple and K41.

incident is incredibly time-critical and any delay could result in an avoidable fatality. Conversely, a delay in response to a priority one property offence is much less likely to result in an avoidable fatality. As noted above, while in theory these differences could be assessed it would be a costly and time-consuming endeavour.

The economic value associated with the avoided fatalities can be estimated using the standard Value of a Statistical Life (VoSL) that is developed by the Ministry of Transport to assess the benefits associated with road safety outcomes and updated by the NZ Treasury for other government policy assessments. The latest estimate by NZ Treasury shows that the VoSL is $4.89m.[43] Applying this value to the avoided fatalities shows that the communications could generate $1.48 billion each year. This outcome merely reflects the opening statement in this report,

> "*Given the importance of emergency communications, it is clear that for the good of the community they need to be maintained. This report is not focused on whether communications should be maintained, but rather on the options for maintaining these communications.*"

Finally, to understand the value of the ERCL themselves we would then need to establish the portion of the economic value related to the maintenance of the UHF and Microwave, as a method for handling the communications. We consider that it is likely that the ERCL represent the best and most efficient alternative for handling the communications and that the alternatives may be marginally worse. However, there is no information available on the quantum of the potential margin. Indicatively, if we assume ERCL is 0.2% faster/better than the second-best alternative then the potential impact of disruption of the links could be in the order of $3.0 million. Most of this benefit would be linked to the Microwave ($2.9m), followed by Marleys Hill UHF ($0.1m), and then a small amount for the Airport UHF.

Figure 4.1: Indicative Value of Major Incidents handled by CJESP Communication Corridors

CJESP Radio Communication Corridors	Incidents	Lives Saved*	Economic Value ($m)**	Impact of Link Disruption*
Port Hills Microwave (Police/Fire and St John)	58,966	295	$ 1,441	$ 2.9
Marleys Hill UHF (St John pager)	1,583	8	$ 39	$ 0.1
Airport UHF	< 10	< 1	<$1	<$0.1
Total CJESP Corridors	60,549	303	$ 1,480	$ 3.0

**assumes that for 0.5% of incidents that communication results in a life saved.*

*** value of statistical life of $4.9m*

**** assumes that there is 0.2% drop in service if link disruption occurs and a pro rata loss of life.*

[43] NZ Treasury (2022) CBAX Model Inputs.

The communications will also result in a reduction of other impacts, including injuries and property damage. However, given the available information, we do not consider that providing further indicative analysis will improve the understanding of the situation.

Also, the agencies themselves will benefit from the protection of the ERCL, because it will enable services to operate on a cost-effective basis, and protect staff who operate in the field during an emergency[44]. While these benefits could be quantified, they are expected to be relatively small compared to the other benefits (and costs). Therefore, this benefit is not quantified in the CBA.

The other main benefit is that the potential requirement for resource consent means that the effects of any specific intrusion can be considered on a case-by-case basis, and can be approved in appropriate circumstances and declined where not appropriate. This would potentially enable the agencies to avoid the cost of mitigation measures.[45] These have been assessed by RHW Telecommunications, and are incorporated in the CBA below.

4.2.2 Protection Costs

The research undertaken in this study, suggests that the costs associated with the protection of ERCL mostly relate to the development potential that could be impacted.

The most significant cost associated with the protection of the ERCL is the lost development potential, which will mostly flow directly to the landholders in the pathway. Protection of the ERCL may restrict the height of development within the affected corridor, resulting in a cost to the landholder. This cost can be estimated using the land use planning rules that are proposed under each of the policy options and potential returns that could be lost. This cost is important and should be considered within the CBA.

The loss of development potential can result in less efficient use of land, which can be expected to generate costs that arise as a less well-function urban environment. This cost will accrue broadly across the community in the form of reductions in wider economic benefits, because of the potential reduction in intensification. There are qualitative methods that can be adopted for assessing these wider economic values. For example, Waka Kotahi NZTA provides a method for estimating these values[46], which is generally applied to large roading projects that will transform the network. Given the limited scale of the land potential impacted by the ERCL pathways, it is considered that it would not be justified to apply this method. For this CBA the wider economic values are not quantified.

[44] There is a risk to the safety of operations staff if situational knowledge cannot be passed on prior to arriving event. Loss of communications with front line staff hinders the ability of essential services to react in real time.
[45] i.e. the avoided costs associated with the need to redesign/shift radiocommunication facilities on the CJESP building due to disruption to the network (if practicable).
[46] Waka Kotahi NZTA (2020) Monetised Benefits and Costs Manual.

In the case that a landholder wishes to develop there will be additional application costs, both in terms of direct costs (application, expert reports, etc), time costs (consenting period) and additional uncertainty. These costs could be significant and are being considered in the CBA.

Also, CCC will have to administer the policy and will need to assess applicants' material to establish whether any proposed development should be approved. These administration costs are likely to be relatively small but can be easily quantified based on information that CCC has provided about other application processes that they administer.

Finally, the costs associated with progressing PC9F which have been expended by CCC and the agencies at the CJESP are sunk costs. These costs have already occurred and will not change regardless of the outcome of the process. It is standard in CBA that sunk costs should not be included in the assessment.

4.3 Summary of Assessment Framework

The research on the assessment framework has shown that the CBA should focus on some key costs and benefits and that some important benefits cannot easily be quantified. The protection of the ERCL pathways will mostly generate benefits for the wider community and the CJESP, in terms of reduced risks from major emergencies and daily events. However, these groups will also bear some costs, which may include direct costs to the agencies and the community could receive less value in terms of wider economic benefits. However, overall it is expected that these groups will receive net positive benefits from the protection of the radio communication pathways. Conversely, the landholders that own property under the ERCL corridors are expected to mostly bear negative costs associated with the protection of the pathways.

In summary, the benefits and costs of the protection are:

- A reduction in the risk to life and property during a hazard event, both daily events and major emergencies.
- Reduce the impact on the environment through efficient response to hazards.
- Maintain community confidence in these services.
- Ensure cost-effective services are maintained.
- Protect staff who operate during an emergency.
- Potential reduction in mitigation costs for agencies in CJESP.
- Lost development potential will mostly flow directly to the landholders.
- Potential reduction wider economic benefits from reduced intensification.
- Increased compliance and application costs to landholders.

- Increased administration costs for CCC.

Where possible, the CBA presented in the remainder of this report will quantify the scale of the costs and benefits.

5 Protection Economic Assessment

The third step of the research was to quantify the costs and benefits using the CBA approach. As with any CBA, the most important, and difficult, task is to value the cost and benefits associated with the proposed policies. Broadly, the valuations in the CBA are established by developing an understanding of the key economic processes through which these benefits arise and the cost implications – as well as the trade-offs, implied choices, opportunity costs and foregone options (as these also have cost). In many cases, there are no direct market values that can be used, so it is common to identify proxy measures for the costs and benefits that are not already expressed in monetary terms.

5.1 Model Structure

The following discussion outlines the key model structure and assumptions that have been used to develop the estimates of values for each cost and benefit. This study has included sensitivity analysis to establish which assumptions are critical to the findings of the economic assessment.

The following key model assumptions have been applied in the assessment:

- **Temporal** – a key assumption is the period over which the costs and benefits are assessed. The setting of the period over which the CBA is conducted is critically important in most assessments. This is because the proposed policy will generally have an upfront investment (cost) in the early years while the benefits will generally accrue over the life of the investment.[47] This evaluation period can be chosen to provide information about the relative merits of the options while not being so long as to include too much uncertainty. For this study, the selected period is a decade, which is generally the lifespan of the District Plan policy. Also, the PSN and new technologies will likely mean that the need for ERCL may be change after this period.
- **Spatial** – the geographic locations over which the costs and benefits are assessed. The spatial element of the CBA is also important as it defines what parts of the activity may be viewed as new or additional, and the extent of the activity that may simply be a transfer.[48] The perspective of the assessment should link to the level of the decision-maker, with local decisions assessed at the local level. In this report, the spatial geography applied is Christchurch City.

[47] Generally, the assessment Period is set at the length of the life of the key investment or policy – mostly between 10 to 20 years. However, it is acknowledged that it may be argued that the assessment period could be longer (60 years) to match the life of assets (road, building etc).

[48] For example, a regional level assessment would result in domestic tourist activity being included, while a national level assessment would exclude domestic spend.

- **Discount Rate** – is the value of time used to convert costs and benefits into today's values. The following CBA was conducted using a common unit of value – today's dollars, which is presented using standard Net Present Value (NPV). Simply, the NPV is the sum of all quantified benefits and costs (in today's value) that accrue from the public spending or policy. This is important as in many cases governments tend to invest in a project today, which then generates a flow of benefits and costs that accrue in the future. In a CBA, the future cost and benefit values are discounted to present value using a 'discount rate', which has been set at 5% that is defined by Treasury.[49] Broadly, a larger Discount Rate will result in future values (which are generally benefits) being discounted to a lower value. Conversely, a lower Discount Rate will result in future values being discounted by less.

Finally, a core step in a CBA and economic modelling is to test the sensitivity of outcomes to key assumptions. All economic models apply assumptions because an economy is too complex to replicate in a mathematical system and there is inherent uncertainty associated with the future. This means that it is common practice to test the results from CBA and economic models by varying key assumptions, to ensure that the findings are not 'sensitive' to an unknown factor. The sensitivity analysis is presented in Appendix A.

5.2 Assessment of Costs

The costs associated with the ERCL corridors are mostly quantifiable as they relate to the potential use of the land that is impacted by the policy, both to the landholder (compliance costs and lost development potential) and the wider community (council administration costs and wider economic benefits).

First, the lost development potential and wider economic benefits associated with the ERCL corridors is related to the capacity of the parcels to be developed (potential for development heights and proportion of the parcel impacted by the corridors) and the potential for the development to be achieved.

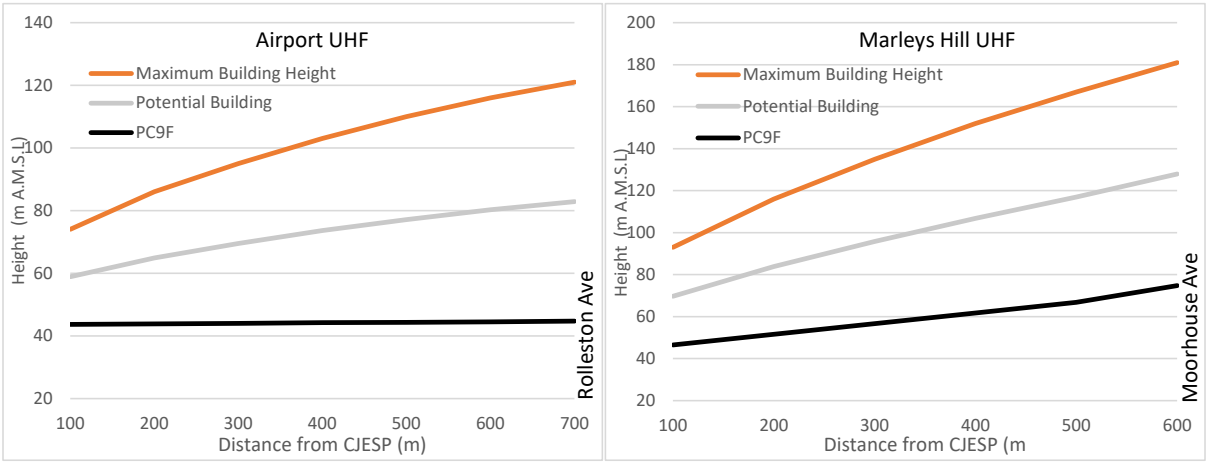
The land use assessment that was conducted for this research shows that the number of parcels in each corridor has limited development potential because of their use which includes heritage, open space or having been recently developed. Most importantly, the assessment of land use showed that less than half the parcels in the Airport UHF corridor are potentially developable over the coming decade, which is less than half the land in this corridor. The Port Hills Microwave has the largest number of developable parcels, with 31 being available for redevelopment. The Marley Hill UHF has 14 developable parcels.

[49] The Treasury (2020) Discount Rates.

The capacity of these developable parcels was established for each protection option as follows. First, the assessment adopted the following building heights for each protection option.

- **Operative District Plan**: set using the height limits in the existing operative District Plan rules, with 17 metres in the Port Hills microwave and Marleys Hill UHF, and between 14 metres to 28 metres in the Airport UHF.
- **Designation**: set using the heights defined in the communication pathways, with Port Hills microwave ranging from 30-62 metres, Marleys Hill UHF ranging from 24-38 metres, and Airport UHF ranging from 10-12 metres.
- **PC9F**: set using the heights defined in the communication pathways, plus an allowance for some intrusion into the UHF. The RHW Telecommunication report indicates that obstruction margin may be allowable for UHF, in this report it is assumed that half of the difference between PC9F and Maximum Building Height can still be achieved within the rules of the policy. The outcome is depicted in the figure below that shows potential buildings PC9F (black line) and max. Figure 5.1 shows the PC9F heights (black line) and maximum building height from RHW Telecommunication report (orange line), along with the potential building height (grey line) which is halfway between the policy and the maximum.

Figure 5.1: CJESP UHF – Building Heights (metres A.M.S.L)



- **Mitigation Option 1**: assumes that the antenna is increased on the Port Hills microwave and that heights in PC9F are increased for the pathway, ranging from 39-65 metres. The heights achievable in the UHF are assumed to be the same as PC9F.
- **HSAA and Mitigation Option 3**: assumes no protection and allows unlimited building height within the Four Avenues. The agencies develop alternatives, as required, to maintain microwave links. Given recent development trends within the Four Avenues, it is possible that there could be buildings of over 65 metres tall developed within the

corridors.[50] For this assessment, it is assumed that the development potential may be as high as 65 metres. However, we note that the potential new pathway to Middleton could impact development in other locations, which has not been assessed because the GIS spatial information on the alternative pathway is not available. Also, it may be that when Council completes the intensification assessment required by the HSAA, that some zones within the Four Avenues could have height limits. If the proposed height limits are lower than the ERCLs then this could reduce the impacts on development potential and also implicitly protect the communication links in those locations.

Figure 5.2: CJESP Communication Pathways – Building Heights (metres)

CJESP Radio Communication Corridors - Heights	Port Hills Microwave	Marleys Hill UHF	Airport UHF
Operative District Plan	17	17	14-28
Designation	30-62	24-38	10-12
PC9F	30-62	56-65	39-45
Mitigation Option 1	39-65	56-65	39-45
Mitigation Option 3 and HSAA	65+	65+	65+

The building heights are then combined with assumed site coverage[51], height per level of 4 metres[52], existing floor space and the area of each of the developable parcels within the corridor to estimate total floorspace under each of the five options. While this simple assessment does not model built form that could be developed, as this would require urban design assessment which is beyond the scope of this research, it provides sufficient detail to understand the potential quantum of the capacity that could be achieved on the land under each of the ERCL corridors. Figure 5.3 shows the additional built space for the four protection options for the radio communication corridor.

In summary, compared to the operative District Plan the other four protection options will allow more development potential (except the Designation for Airport UHF). The Mitigation Option 3 would enable an additional 146,000m^2 of development potential across the three ERCL as compared to the supply in the ODP. The designation would enable the smallest increase of supply, at 29,000m^2. The proposed PC9F would enable 101,000m^2 and Mitigation Option 1 would provide 110,000m^2.

[50] Under the existing District Plan there have been proposed developments for new buildings ranging from 12 to 16 levels, which would be up to approximately 65 metres. The HSAA will enable unlimited heights which may encourage the development of buildings that are greater than 16 levels. For the purposes of this report, it is considered conservative to apply 65 metres within the corridors. The development may actually be lower or higher, the impact of this assumption was tested in the sensitivity analysis in Appendix A, and the findings of this report do not change within the range of 12 to 20 levels (48m to 80m).

[51] Christchurch City Council uses a site coverage of 50% for their capacity assessment for the NPSUD, which is also adopted in this report.

[52] The twenty tallest buildings in Christchurch have an average height of 48 metres and 12 levels, which suggests that the average level is 4 metres.

The assessment shows that the Airport UHF corridor has the least development potential, which mostly relates to the fact that much of the land in this corridor is not developable, either because of heritage or because the land has recently been developed. The Marleys Hill UHF has the most potential supply, which relates to the width of the pathway and the nature of the existing activity in the pathway. Finally, while the Port Hills Microwave affects a large number of properties and these properties have development potential, it is much narrower than the UHF pathways so impacts less development potential.

Figure 5.3: CJESP Emergency Pathways – Potential Additional Built space (m^2)

CJESP Radio Communication Corridors - Floorspace	Port Hills Microwave	Marleys Hill UHF	Airport UHF
Designation	22,000	15,000	- 8,000
PC9F	22,000	60,000	19,000
Mitigation Option 1 (and PC9F)	31,000	60,000	19,000
Mitigation Option 3 (and HSAA)	40,000	64,000	42,000

While the capacity in Figure 5.3 could in theory be developed, it is likely that much of the potential will not be developed in the coming decade. This is because of the likely scale of demand and the remaining development capacity in other parts of the Central City and the rest of Christchurch.

Christchurch City Council has recently commissioned research on the amount of demand over the coming three decades as required under the NPSUD, which includes both residential and commercial. The residential research does not provide demand projections or capacity assessment for the central city area, that more work needs to be undertaken.[53] The business research suggests that demand in the wider Central and West quadrant of the city is expected to be less than 16,000m^2 of floorspace (commercial and retail) per annum over the coming decade.[54] Even if all this demand was located within the Four Avenues it could be accommodated in less than one hectare of land each year.[55]

Also, Council capacity assessment research shows that there is still considerable development potential within the Four Avenues, both on vacant land that is yet to develop since the earthquakes and redevelopment potential on other underutilised parcels. Christchurch City Council has recently estimated that there are 32 hectares of vacant land available in the Four Avenues.[56] The Council has not assessed the redevelopment potential in the Four Avenues, however, council officers acknowledge that redevelopment will provide even more supply.

[53] Greater Christchurch Partnership (2021) Housing Development Capacity Assessment.
[54] Greater Christchurch Partnership (2021) Business Development Capacity Assessment – draft November.
[55] Assuming a building coverage of 50% and height of 6 levels, this demand could be accommodated within 0.52 hectares of land.
[56] Greater Christchurch Partnership (2021) Business Development Capacity Assessment – draft November.

The parcel-level assessment conducted in this research for the ERCL corridors showed that approximately half of the development potential under the operative District Plan is on vacant land, with the other half on redevelopment land. While no assessment has been conducted for the entire Four Avenues area it is reasonable to expect that there will be a considerable amount of redevelopment potential in the Central City.[57]

Based on the Council's projected business demand and the vacant land supply alone, there would be sufficient capacity in the Four Avenues to accommodate over half a century's demand. However, it is acknowledged that there is growing demand for residential within the area, with building consents for new dwellings issued in the Four Avenues increasing from 200 per annum in 2015 to 400 in 2021.

Also, the redevelopment parcels would also allow considerable development which suggests an even larger pool of capacity. This is important as it shows that a large share of the development potential in the Four Avenues, and the ERCL corridors, will not be reasonably realisable in the coming decade. That is only a small share of the capacity in the Four Avenues and the ERCL corridors can be expected to be developed over the coming decade.

Finally, the HSAA will require CCC to establish plan changes to allow even more capacity in the Four Avenues (and other locations within the urban environment) to meet the intensification requirements. The Council is commissioning research on the amount of intensification that should be enabled.[58] Based on our understanding of the intensification requirements and capacity modelling, it is considered likely that the Council will be required to introduce additional intensification in the Four Avenues and the rest of the urban environment that will significantly increase the development potential, both on vacant land and redevelopment potential.[59] The supply in the Four Avenues will be substantially increased[60], which will mean that the amount of land required in each year to accommodate demand can be expected to decrease and the chances of parcels within the ERCL corridors being redeveloped can be expected to decrease.

Therefore, under either the ODP, Designation, PC9F, or HSAA it is very likely that most of the development potential within the Four Avenues or the ERCL corridors will not be acted on in the medium term, or even within the long term. This means that a significant portion of the development potential in Figure 5.3 will not be developed in the coming decade.

---

[57] Much of the land in the four-avenues has height limits in the operative District Plan that are higher than those that apply within the radio communication pathways.

[58] Christchurch City Council (2022) Request for Proposal Economic Cost Benefits Advice for Intensification – Closed 28th January.

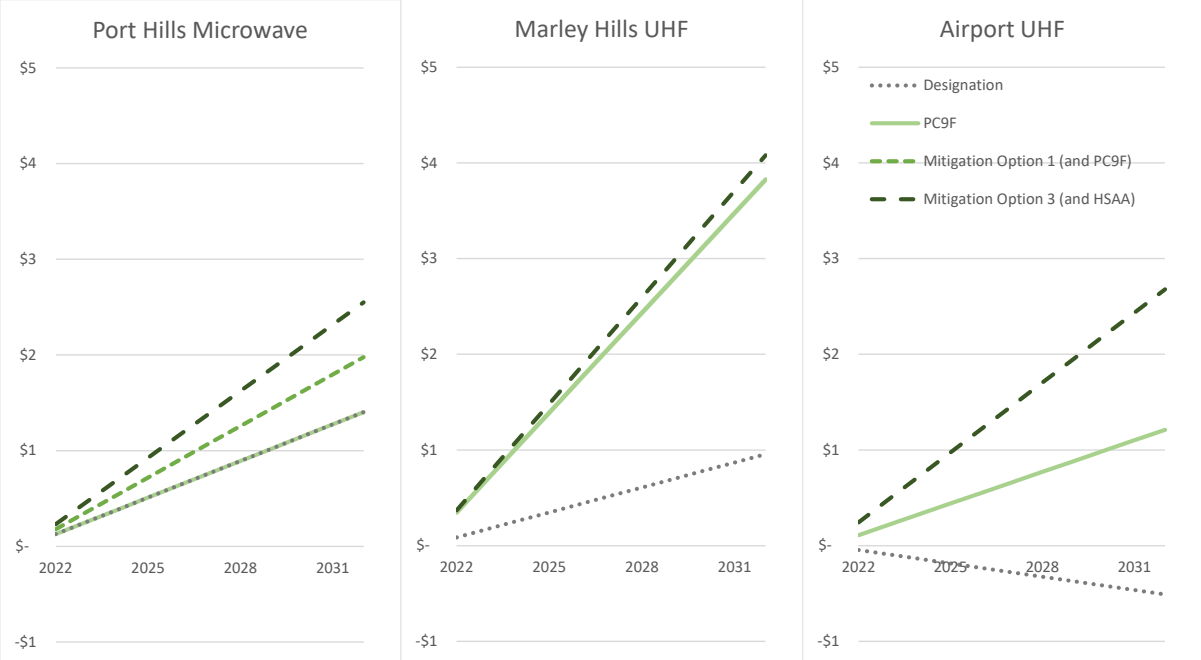
[59] This is likely to be unlimited for most of the area in the four-avenues Policy 3(a), or at least 6-levels Policy 3(c), with some parcels excluded to accommodate qualifying matters.

[60] The requirement to enable intensification in the rest of the urban area will also increase capacity significantly in Christchurch – Policy 3(b-d). This may further disperse growth into the urban area outside of the four-avenues.

In the following assessment, it is assumed that 1.6% of the potential capacity is developed each year, which results in 16% being developed over the decade. This is a conservative assumption, which results in development activity in the ERCL corridors that is similar to the rest of the Four Avenues. This uptake has been defined using the CCC's draft Business Land Assessment which shows a similar implied uptake rate over the coming decade.[61]

The development in each year is then combined with average rents for office space in the Four Avenues of $358 per square metre.[62] The results show that rents that could be achieved are highest for Marley Hills UHF and then Port Hills microwave, with lower rents for Airport UHF (see Figure 5.4). The Mitigation Option 3 (dark green dotted line) has the highest rent, followed by Mitigation Option 1 and then PC9F.

Figure 5.4: CJESP Communication Pathways – Rental by Protection Options ($million)



Also, as discussed above if development potential is not enabled in this area there is likely to be substantial potential in other parts of the Four Avenues to accommodate growth. Therefore, the local loss within the corridors may not result in a reduction in overall activity within the Christchurch City or the Four Avenues. This report has not made any assumption about the proportion of the development potential and rent that may be lost.

The wider economic benefits associated with the potential development and economic activity within the ERCL corridors can be expected to generate additional benefits in the economy. However, given the small scale of the land potential impacted by the ERCL corridors, it is considered that it would not

[61] Greater Christchurch Partnership (2021) Business Development Capacity Assessment – draft November.
[62] CBRE (2021) Christchurch CBD Office – Sept 21st.

be justified to apply this method. For this CBA the wider economic values are not quantified but are considered to be negative.

Next, the administration and compliance costs can be estimated using the number of developable parcels in each ERCL corridor and assumptions about the potential application costs. The assessment of land use shows that less than half the parcels in the Airport UHF corridor are potentially developable over the coming decade, which is less than half the parcels in this corridor. The Port Hills Microwave has the largest number of developable parcels, with 31 being available for redevelopment. The Marley Hill UHF has 14 developable parcels.

As set out above, if 1.6% of the developable parcels are subject to an application for a development per annum, then there would be less than one application per annum in each of the corridors. Applying assumed administration costs for the Council of $20,000 per application and compliance costs for the landholder of $40,000 per annum would indicate that the cost associated with resource consent applications could be a total of less than $60,000 per annum. Most of this cost could be expected to be related to the Port Hills Microwave.

While this quantification is based on the assumption of the potential cost per application, it is considered that these values will be within the correct order of magnitude and the Council has suggested that the costs could be in the tens of thousands per application.[63]

Figure 5.5: CJESP Communication Pathways – Administration and Compliance Costs

CJESP Radio Communication Corridors	Developable Parcels*	Develop p.a.	Admin Cost	Comply Cost
		1.6%	$ 20,000	$ 40,000
Port Hills Microwave	31	0.5	$ 10,036	$ 20,071
Marleys Hill UHF	14	0.2	$ 4,532	$ 9,064
Airport UHF	10	0.2	$ 3,237	$ 6,475
Total CJESP Corridors	**55**	**0.9**	**$ 17,805**	**$ 35,610**

**excludes heritage, openspace, and new buildings*

In terms of the avoided mitigation costs that the CJESP agencies may have to bear, the assessment provided by the communications expert suggests that mitigation is only feasible for the Port Hills microwave. The cost ranges from $212,000 for Mitigation Option 1 (taller antenna) up to $1.125 million for Mitigation Option 3 (new relay).

5.3 Assessment of Benefits

The majority of the benefits associated with the ERCL pathways are not quantifiable as there is limited information about the potential risks or the level to which the protection of the communication links

[63] Council officers consider that the cost could $10,000 per application for the UHF Corridors and $20,000 for the Microwave.

enables the emergency services to moderate these risks. If there was scientific research on the probability of the events that are handled on each of the communication links and the associated impacts of those events, then it would be possible to quantify the relative benefits.

Notwithstanding the lack of scientific research, it is evident that each of the ERCL pathways will produce benefits in terms of reduction in injury, loss of life, property damage, environmental impacts and will ensure that community confidence is maintained. Given the nature of the communications that are enabled on each ERCL pathway, it is considered that the benefits will be largest for Port Hill microwave which is used for a wide range of events and services, followed by Mt Pleasant UHF which provides communications for the ambulance services and lastly the Airport UHF which just provides communication if a major event occurs at the airport.

The following table provides a qualitative presentation of the relative benefits for the community.

- **Port Hills Microwave**: while this communication system is mostly used for small scale daily emergency events, it is also designed to help coordinate services for large scale events where the impacts can be severe and wide ranging across the local and regional community. It may be expected that this system could be used to respond to major events within the assessment period. Therefore, in terms of the risk to life and property and community confidence, it is likely that the benefits are largest for the Port Hills microwave. Also, this system could result in the mitigation of damage to the environment, mostly as a result of FENZ being able to mitigate the impacts of hazards.
- **Marleys Hill UHF**: while similar to Port Hills in terms of responding to large scale events where the impacts can be severe and wide ranging across the local and regional community, this system relates to a backup one-way pager link to ambulances. This link supports fewer communications and benefits, than the multi-service and multidirectional microwave link. Therefore, in terms of the risk to life and property and community confidence, it is likely that the benefits are smaller for the Marleys Hill UHF. This system is unlikely to mitigate damage to the environment.
- **Airport UHF**: handles communications relating to a few specific events, which will have very localised impacts. While these can be large scale, they impact a comparatively smaller amount of property or people than the other two links. This system is unlikely to mitigate damage to the environment.

Figure 5.6: CJESP Communication Pathways – Community Benefits

Community Benefits	Port Hills Microwave	Marleys Hill UHF	Airport UHF
Risk to life and property	+++	++	+
Damage to environment	+		
Community confidence	++	+	+
Total Benefits	**+++**	**++**	**+**

The other main benefits of the protection of the ERCL pathways relate to the potential savings that the CJESP agencies receive costs savings from the protection of the current system. This includes cost-effective communications and the protection of staff.

While it is likely that the current set of communication systems will generate gains to CJESP agencies from efficient coordination of operational staff and potential to protect staff in life-threatening situations, the agencies have not provided information about these benefits which means that we cannot quantify these benefits. However, based on the nature of the communications on each link it is likely that most of the benefits will relate to the Port Hills microwave, and less so for the UHF links.

Figure 5.7: CJESP Communication Pathways – Agencies Benefits

CJESP Agencies	Port Hills Microwave	Marleys Hill UHF	Airport UHF
Cost effective system	++	+	+
Protect staff	++		
Total Benefits	**++**	**+**	**+**

The CJESP agencies have designed each of the protection options to ensure that communications are maintained, this means that the benefits should be approximately the same under all the protection options. The only difference is the Mitigation Option 3 (and HSAA), where the benefits of the UHF links could be lost as development occurs.

5.4 Net Outcome CBA

The following tables present the net outcomes for the different protection options for each of the three ERCL corridors. The assessment has been conducted using the assumptions in the model structure, which includes a 10 year assessment period, spatial area of Christchurch City and a discount rate of 5%.

First, the benefits associated with the Port Hill Microwave should be approximately the same for all options, as they are all designed to protect this critical communication link. While it is not possible to quantify these benefits, they are likely to be more significant than the other corridors as this link handles more communications and for a wider range of emergencies (which is why the "+++" is used in Figure 5.8).

The compliance costs, administration costs and mitigation costs are all less than $1.1 million, which suggests that these costs are not likely to be critical to the decision around the choice of protection option.

The largest cost is the development potential that is enabled under each protection option. The table shows the development potential relative to the largest development option (HSAA), which shows that the value of the development potential may be in the order of several million.

Broadly the benefits associated with the Port Hills Microwave do not change between the options and the compliance costs, administration and mitigation costs are relatively small. This means the only material difference between the options is the extent of the development potential. Therefore, at a community level, Mitigation Option 1 and Mitigation Option 3 are likely to be preferred over the policy options (PC9F or designation).

However, the engineering reports suggest that it may not be feasible to implement the mitigation options. Given the critical nature of the communications on the Port Hills microwave, these links do need to be maintained and if the mitigation options are not feasible then one of the policy options will need to be adopted.

Figure 5.8: Cost Benefit Analysis Net Outcome for Port Hills Microwave

CBA - Net Present Value	Port Hills Microwave			
	Designation	PC9F	Mitigation Option 1	Mitigation Option 3
Benefits	+++			
Costs				
Lost Development Potential	-$4.8	-$4.8	-$2.4	$0.0
Compliance Cost		-$0.15		
Administration Cost		-$0.08		
Wider economic benefits	-			
Mitigation Costs			-$0.21	-$1.13
Total Costs	**-$4.8**	**-$5.0**	**-$2.6**	**-$1.1**
Net Outcome	**3rd**	**4th**	**2nd**	**1st**

The Marleys Hill UHF has the same benefits associated with the two protection options that are available, as they are both designed to protect the communication link. While it is not possible to quantify these benefits, they are likely to be smaller than the microwave ERCL, as the UHF link handles fewer communications and for a narrow range of emergencies (which is why the "++" is used in Figure 5.9).

The compliance costs and administration costs are both less than $0.1 million, which suggests that these costs are not likely to be critical to the decision around the choice of protection option.

The largest cost is the development potential that is enabled under each protection option. The table shows the development potential relative to the largest development option (HSAA), which shows that the value of the development potential may be in the order of millions.

Broadly the benefits associated with the Marleys Hill UHF do not change between the options and the compliance costs and administration are relatively small. This means the only material difference between the options is the extent of the development potential. Therefore, PC9F is likely to be the preferred protection option over designation. However, it is not clear whether PC9F would be preferred over the Housing Supply Amendment Act.

Figure 5.9: Cost Benefit Analysis Net Outcome for Marleys Hill UHF

CBA - Net Present Value	Marleys Hill UHF		
	Designation	PC9F	HSAA
Benefits	++		$0.0
Costs			
Lost Development Potential	-$13.0	-$1.1	$0.0
Compliance Cost		-$0.07	
Administration Cost		-$0.03	
Wider economic benefits	-		
Total Costs	**-$13.0**	**-$1.2**	**$0.0**
Net Outcome	**2nd**	**1st**	**?**

The Airport UHF has the same benefits associated with the two protection options that are available, as they are both designed to protect the communication link. While it is not possible to quantify these benefits, they are likely to be smaller than the other two corridors as this link handles fewer communications and for a small number of emergencies (which is why the "+" is used in Figure 5.9).

The compliance costs and administration costs are both less than $0.1 million, which suggests that these costs are not likely to be critical to the decision around the choice of protection option.

The largest cost is the development potential that is enabled under each protection option. The table shows the development potential relative to the largest development option (HSAA), which shows that the value of the development potential may be in the order of millions.

Broadly the benefits associated with the Airport UHF do not change between the options and the compliance costs and administration are relatively small. This means the only material difference between the options is the extent of the development potential. Therefore, PC9F is likely to be the preferred protection option, over designation. However, it is not clear whether PC9F would be preferred over the Housing Supply Amendment Act.

Figure 5.10: Cost Benefit Analysis Net Outcome for Airport UHF

CBA - Net Present Value	Airport UHF		
	Designation	PC9F	HSAA
Benefits	+		$0.0
Costs			
Lost Development Potential	-$13.3	-$6.1	$0.0
Compliance Cost		-$0.05	
Administration Cost		-$0.02	
Wider economic benefits	-		
Total Costs	**-$13.3**	**-$6.2**	**$0.0**
Net Outcome	**2nd**	**1st**	**?**

6 Conclusion

The economic research conducted for this report has established the following key findings on the protection options for the ERCL pathways that connect to the CJESP:

- While it is not possible to quantify the benefits associated with the protection of the ERCLs, these will likely be significant – including a reduction in risks to life and property. Also, the nature of the communications on each link suggests that the Port Hill Microwave will have the largest benefits from being protected. The two UHF links are expected to have fewer benefits from being protected.
- The development potential that could be enabled within the corridors could be significant, generating millions of economic value over the coming decade. The method that is employed to protect the ERCL pathways can be expected to impact this value, which will be an important issue when considering which protection option is employed in each pathway.
- The administration, compliance and mitigation costs are all relatively small, which suggests that these costs are not likely to be critical to the decision around the choice of protection option.

For each of the ERCL pathways the CBA shows:

- For the Port Hills Microwave link, the community would receive a better net outcome if the mitigation Option 3 or Option 1 were employed, rather than implementing PC9F. This is primarily because of the close balance between the value of development potential in the corridor as compared to the potential mitigation options that are relatively low in cost. That is an investment by the CJESP (a million) could enable development potential (several millions of dollars). However, this assumes that the mitigation options can be feasibly implemented. The engineering[64] and planning assessments[65] suggest several issues that may mean that the mitigation options are not feasible and/or that they would take some time to implement. If a building is developed that blocked the path of a microwave link it could be 12 months or more before mitigation could be implemented to restore the link. During this time the resilience of the communications could be jeopardised, and there could be potential for damage to buildings, injuries or loss of life during a major event.

[64] RHW Telecommunications Limited (2021) CJESP Radio Corridors Link Mitigation Options.
[65] Incite (2021) Plan Change 9f - Planning Assessment.

- For the Marleys Hill and Airport UHF link the community would receive a better net outcome if PC9F was implemented, as compared to the alternative policy option (Designation). However, it is not possible to establish whether the protection of these two ERCL pathways would represent a better outcome than no protection – i.e. unlimited height and no protection under the HSAA may or may not be better than the PC9F.

This outcome is somewhat counter-intuitive. The Marleys Hill and Airport UHF link are likely to generate fewer benefits than the Port Hills Microwave link. Also, Marleys Hill and Airport UHF corridors impact more land than Port Hills Microwave corridors.

This outcome is mainly driven by the fact that the CBA has only been able to consider mitigation options for the Microwave links and not the UHF links. Given the critical nature of the communications on the Port Hills microwave, these links do need to be maintained, and the question is which protection method is the most efficient. This assessment indicates that the cost to the community would be lower if either of the mitigation options were implemented by CJESP agencies, as opposed to each landholder bearing the cost.

However, the engineering reports suggest that it may not be feasible to implement the mitigation options. Given the critical nature of the communications on the Port Hills microwave, these links do need to be maintained and if the mitigation options are not realistically feasible then one of the policy options will need to be adopted.

Given that the costs associated with protecting the ERCL Microwave are likely to be relatively small, and issues around implementing the mitigation options could mean that the resilience of the communications could be jeopardised it would be prudent to apply a precautionary approach and protect this system using the policy suggested within PC9F.

Specifically, if there were no protection of the microwave ERCL and a pathway was affected, there would be a timing issue associated with the implementation of any mitigation option, that could impact the resilience of the communications and result in a cost in terms of property damage or even loss of lives. While from a CBA perspective this outcome is a positive position, it may be from a social perspective that this outcome would not be acceptable.

The core of the situation is that the CJESP agencies can only mitigate the effects if they are aware that ERCL will be blocked. If the corridors are obstructed such that a link fails, there will be a window of time before any mitigation can be implemented, during which there is a heightened risk to the public.

Appendix 1 Sensitivity Analysis

The model was tested for the following assumptions, Discount Rate, Period, Development Uptake, Mitigation Costs, Administration Cost, Compliance Cost, Floor height, Building Coverage, PC9F additional Building Height in UHF and HSAA Building Height. Figure A.1 shows the base assumptions that we applied in the body of this report and the sensitivity tests (High and Low) that were applied to test the sensitivity of the CBA to these assumptions. The outcome of the sensitivity testing showed **that none of the findings in this report change in any of the testing,** this means that the findings in this report are **not sensitive to the assumptions**.

Notwithstanding the above, the model is most sensitive to Period, Development Uptake, PC9F additional Building Height for UHF, and the HSAA Building Height which have larger impacts on the values than the other assumptions. Specifically, if the period is increased (to 20 years), development uptake increases (3% p.a), consents issued up to 40% of UHF pathway, or building heights increased (20 levels) the costs associated with the development potential increase significantly (in millions). This means that the CBA outcome suggests that the mitigation options are even more preferred.

The other assumptions have a medium or small (less than 10%) impact on the CBA outcome.

Figure A.1: CBA Sensitivity Analysis

Assumptions	Sensitivity			
	Base	High	Low	Impacts
Discount Rate	5%	7%	3%	Small (10%)
Period (years)	10	5	20	Large(million)
Development Uptake (per annum)	1.6%	1%	3%	Large(million)
Mitigation Costs	Budget	-50%	+50%	Medium
Administration Cost (per consent)	$20,000	$10,000	$30,000	Small (10%)
Compliance Cost (per consent)	$40,000	$30,000	$60,000	Small (10%)
Floor Height (m)	4.0	3.5	5.0	Medium
Building coverage	50%	60%	40%	Small (10%)
PC9F additional Building Height UHF	50%	60%	40%	Large(million)
HSAA Building Height (levels)	16	12	20	Large(million)