DUNEDIN CITY COUNCIL | kaunihera a-rohe o Ōtepoti

24 November 2023

[redacted]

Dear [redacted]

Local Government Official Information and Meetings Act 1987 (LGOIMA) Request

I refer to your e-mail of 5 October 2023 requesting information relating to the Global Covenant of Mayors and ICLEI. In your refined request you have asked for information from 1990. Please note that the Council joined GCOM in 2015. Despite an extensive search, we have been unable to confirm the exact date when Council joined IClEI. We believe it may have been in 2012/13.

1 Is the DCC currently a member of the Global Covenant of Mayors for Climate & Energy (GCOM)? And Question 2 Is the DCC currently a member of ICLEI?

These are different types of organisations.

ICLEI Oceania is the Secretariat for the GCoM in the Oceania region, providing guidance and technical support to local governments. We are a member of this.

GCOM is an alliance. Dunedin City Council passed a motion to commit to the alliance.

3 Apart from GCOM and ICLEI, what other political or activist or environmental or climate related groups is the DCC a member of?

The Planetary Accounting Network (PAN) (joined August 2022)

Pan is an independent, not-for-profit research centre that specialises in Planetary Accounting, a framework that translates global environmental challenges into actionable impacts on the planet in relation to the Ecological Ceiling component of the City Portrait. The membership gives access to discounted advisory services, training opportunities, learning resources, as well as webinars across topics of sustainability.

Zero Carbon Alliance is a collaboration between organisations in Dunedin that have shared interest in reducing both organisational and city wide greenhouse gas emissions and wish to collaborate on emissions monitoring and reduction initiatives. Current members are: Dunedin City Council, Otago Regional Council, University of Otago, Otago Polytechnic and Te Whatu Ora.

4 For each of GCOM and ICLEI and the other groups mentioned in 3: what amount is being paid by the DCC as a membership fee as represented by the last amount paid as a membership fee?

A search of our records shows that the annual membership fees we have paid to ICLEI are as follows:

Date	Amount	Reason	
03/05/2013	$2384.83	Annual Membership	
01/05/2014	$2,313.03	Annual Membership	
22/04/2015	$2,308.96	Annual Membership	
02/05/2016	$2,572.90	Annual Membership	
09/05/2017	$2,614.38	Annual Membership	
18/05/2018	$3,014.75	Annual Membership	
01/05/2019	$2,914.77	Annual Membership	
14/04/2020	$3,636.36	Annual Membership	
16/03/2021	$3,601.85	Annual Membership	
01/03/2022	$3,654.57	Annual Membership	
01/02/2023	$3,792.54	Annual Membership	
	$37,263.94		

The Planetary Accounting Network = Patron Membership (August 2022 to 2023) - $10,000

There are no fees associated with the Zero Carbon Alliance.

5 Please list all of the payments you have made to ICLEI for membership fees, purchases and everything for the period from January 1990 to now. For each payment include the date, purpose and amount paid.

A substantive search of our records indicates there are no payments other than membership fees.

6 For all the documents that you have at the present time, that are authored by ICLEI, please give me a list showing the names of the documents.

We have searched our records and have only been able to locate the following documents.

- *Memorandum to Executive Leadership team dated 9 February 2016*
- *ICLEI Oceania Membership Booklet 2023*
- *2023 Snapshot of ICLEI Oceania*
- *Report and Minute Extract to Council 28 March 2017 – Compact of Mayors Update: First and Second Year Compliance*

Please note that this is an online portal and there are no actual documents. Should staff need any guidance they will search the website. https://iclei.org/

7 What ICLEI related events have DCC staff or Councillors or Mayors attending for the period from January 1990 to now? For each event give the date, location, name and purpose of the event and who attended it.

The former Mayor Aaron Hawkins was a member of a governing committee and attended these meetings via audio visual link. We decline to provide any further information, as this cannot be supplied without substantial research and collation pursuant to section 17(f) of LGOIMA.

We are not aware of any other events attended in relation to ICLEI, and to search further would require substantial collation and research therefore, pursuant to section 17(f) of LGOIMA your request for this information is declined.

8 Who now represents the DCC at ICLEI and ICLEI oceania conferences and events including on line events? This means who is the DCC's representative for these things.

The Council does not have formal representation to this organisation.

9 Please provide the Commitment Agreement: the agreement with GCOM/Compact of Mayors, signed by the Mayor, which describes your obligations to GCOM. If more than one agreement has been signed, please provide all of them.

Having searched our records we are unable to find any documents and therefore pursuant to section 17(e) of LGOIMA that the document alleged to contain the information requested does not exist or, despite reasonable efforts to locate it, cannot be found.

10 The documents relating to your GCOM commitments that include the action plans, policies, goals, targets and milestones. Please include all of these documents, from any source, that you currently possess.

Having searched our records we are unable to find any documents and therefore pursuant to section 17(e) of LGOIMA that the document alleged to contain he information requested does not exist or, despite reasonable efforts to locate it, cannot be found.

11 The documents that you have sent to GCOM that describe the degree of compliance with the three year commitments as referred to in the Commitment Agreement, as well as any other progress reports, for the period from January 1990 to now.

Having searched our records we are unable to find any documents and therefore pursuant to section 17(e) of LGOIMA that the document alleged to contain the information requested does not exist or, despite reasonable efforts to locate it, cannot be found.

12 It now seems appropriate to review the DCC's membership of GCOM and ICLEI, given that the current Mayor didn't sign the GCOM agreement and you have never asked for the agreement of the Councillors to join, and continue your membership of ICLEI. When will these memberships be reviewed and present to Council for their consideration.

This is not a request for information as defined in the Local Government Official Information and Meetings Act 1987.

Yours faithfully

Jennifer Lapham
GOVERNANCE SUPPORT OFFICER

DUNEDIN CITY COUNCIL
Kaunihera-a-rohe o Otepoti

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18 January 2016

Compact of Mayors

Dear Compact of Mayors Secretariat

I hereby declare the intent of the city of Dunedin to comply with the Compact of Mayors, the world's largest cooperative effort among mayors and city leaders to reduce greenhouse gas emissions, track progress, and prepare for the impacts of climate change.

The Compact of Mayors has defined a series of requirements that cities are expected to meet over time, recognizing that each city may be at a different stage of development on the pathway to compliance with the Compact.

I commit to advancing the city of Dunedin along the stages of the Compact, with the goal of becoming fully compliant with all the requirements within three years. Specifically, I pledge to publicly report on the following within the next three years:

- The greenhouse gas emissions inventory for our city consistent with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC), within one year or less
- The climate hazards faced by our city, within one year or less
- Our target to reduce greenhouse gas emissions, within two years or less
- The climate vulnerabilities faced by our citiy, within two years or less
- Our plans to address climate change mitigation and adaptation within three years of less

Yours sincerely

Dave Cull
Mayor of Dunedin

ICLEI OCEANIA

Local Governments for Sustainability

Membership Booklet 2023

JOIN ICLEI

ICLEI is a global network of more than 2,500 local and regional governments committed to sustainable urban development. ICLEI Oceania serves the interests of local government in Australia, New Zealand and Pacific Nations.

"The most significant action globally has always been at the level of local government. On climate action, halting biodiversity loss, building resilience, creating circular economies and addressing inequality, ICLEI is the one global organisation which can connect, support and enhance the capacities of local governments everywhere to maintain and intensify their efforts. Our collective action as local governments is powerful and I invite our members to stay in touch to drive a sustainable future together."

— Cr Amanda Stone, Oceania Regional Executive Committee Chair

Unique role of ICLEI

We work directly with local and regional governments to support their sustainability efforts, offering capacity building, technical expertise, and access to peer networks and best practices. ICLEI's approach focuses on local governments' specific needs and opportunities, championing the idea that local action is critical to achieving global sustainability goals. ICLEI's global presence, with a network of over 2,500 local and regional government members across more than 125 countries, makes it a unique platform for sharing knowledge and connecting local governments worldwide.

Benefits for Councils

Councils rely on their peers for advice, which is why **relationships** are at the heart of our global local government network. We connect a diversity of Mayors, councillors and practitioners through our programs and events, knowledge exchange, peer-to-peer learning, and sharing common challenges..

Local governments have to manage local responsibilities in a global context. Belonging to a global network of over 2,500 local governments, ICLEI members can align their actions with international standards and make a direct contribution to achieving both local and global targets in climate change, biodiversity, or sustainable urban development goals.

All municipalities are different and face unique challenges. That's why ICLEI provides tailored programs and technical expertise for your own priorities, while also providing entry to global platforms such as the Global Covenant of Mayors for Climate & Energy, CitiesWithNature, or with Frontline Cities and Islands.

Participate in ICLEI initiatives and programs

Internationally recognised networks and programs tailored for local governments

Roadmap to the Conference of Parties (COP)

The Conference of Parties (COP) is an annual United Nations climate summit where countries come together to negotiate and discuss global climate action. From a local government perspective, the COP provides an opportunity for municipalities to advocate for their priorities on the international stage and learn about new climate policies and best practices from around the world.

By participating in the COP and leveraging ICLEI's resources, local governments can enhance their capacity to implement effective climate policies and advance their sustainability goals on the global stage.

United Nations Framework Convention on Climate Change

Global Covenant of Mayors (GCoM)

The Global Covenant of Mayors for Climate and Energy (GCoM) is a global alliance of over 12,000 cities committed to accelerated climate action and has over 100 global partners. GCoM serves as a guide to elevate city climate action by providing guidance in setting emissions targets, creating action plans and reporting on progress, with the support of a global network of cities advocating for urgent climate action.

ICLEI Oceania is the Secretariat for the GCoM in the Oceania region, providing guidance and technical support to local governments to achieve their climate goals. By partnering with city networks, and local and national associations, GCoM offers strategic and technical assistance for local government climate action.

ICLEI Oceania also provides a GCoM Helpdesk and resources to help local governments with action, reporting, and achievement of milestones. GCoM has a strong research and innovation background which provides the foundation for meeting science-based targets, establishing emissions profile data, and ensuring reporting is standardised. By being a part of GCoM, local government leaders can learn from the experiences and examples of the world's leading cities and councils, and advocate for stronger climate action from national governments.

CitiesWithNature

CitiesWithNature
LOCAL & SUBNATIONAL GOVERNMENTS COMMITTED TO SUSTAINABILITY

The CitiesWithNature program is an important tool for local governments and practitioners who are working to advance sustainability, resilience, and liveability in the region. ICLEI Oceania is an active partner of the program and provides support to member cities and regions who wish to participate.

Through the CitiesWithNature program, ICLEI Oceania local governments and practitioners can access a range of resources, including tools for urban planning and design, case studies, webinars, and peer-to-peer learning opportunities. The program also provides a platform for local governments and practitioners to showcase their successes and share their experiences with other like-minded individuals and organisations.

CitiesWithNature Academy

The CitiesWithNature Academy is a training and capacity-building program that is designed to support local governments and practitioners who are working to integrate nature-based solutions into their urban planning and design. It is an initiative under the CitiesWithNature program

The Academy provides a unique opportunity for local government officials, planners, and practitioners to deepen their knowledge, skills, and understanding of nature-based solutions, as well as to connect and learn from other like-minded individuals from around the world. Through a range of resources, training programs, and events, the Academy helps build the capacity of cities and regions to implement nature-based solutions in their communities.

Cities Race-to-Zero

CITIES
RACE TO ZERO

Cities Race to Zero is a global campaign that aims to rally local governments to take urgent climate action and commit to reaching net-zero carbon emissions by 2050. The initiative is aligned with the Paris Agreement's goal of limiting global warming to 1.5 degrees Celsius above pre-industrial levels and is part of the broader UN Race to Zero campaign.

ICLEI Oceania is a regional supporter of the CitiesRacetoZero campaign and provides technical assistance and capacity-building support to help local governments set science-based emissions reduction targets and implement climate action plans.

Pacific Islands Resilience Program

ICLEI Oceania supports Pacific Island towns and cities to become more resilient to global shocks, particularly through disaster risk reduction, low emissions development and climate adaptation.

ICLEI Oceania partners with organisations and networks in the Pacific including the Pacific Partnership New Urban Agenda - a consortium of international partners dedicated to sustainable urban development as well as with the Global Island Partnership and Local2030 Islands Network. Pacific Island towns and cities can join ICLEI or become beneficiaries. Australian and New Zealand councils are invited to contribute to mentoring and technical assistance.

ICLEI Oceania Regional Executive Committee

ICLEI is governed by three main bodies: the Global Executive Committee (GexCom), the RexComs, and the ICLEI Council. GexCom represents ICLEI in international institutions and makes strategic decisions for the organization. The RexComs are established in each of the nine ICLEI regions (Europe, Africa, North America, South America, Oceania, East Asia, Southeast Asia, South Asia, and West Asia) and approve new initiatives and programs within their respective regions. These nine RexComs form the ICLEI Council, which is the overarching decision-making and guiding body. The Council shapes and approves the ICLEI strategy, amends the organisation's statutes, and elects the GexCom portfolio seats.

Becoming an ICLEI member provides an opportunity for local government leaders to participate in ICLEI's governance structure by being elected to the Regional Executive Committee (REXCom) in their region.

ICLEI OCEANIA REGIONAL EXECUTIVE COMMITTEE 2021-2024

Lord Mayor Anna Reynolds

Cr Amanda Stone
RexCom Chair

Lord Mayor Nuateli Nelmes

ICLEI Local Governments for Sustainability OCEANIA

Regional Executive Committee (RexCom) Members Cr
Cr Anna Reynolds, Lord Mayor City of Hobart
Cr Amanda Stone, City of Yarra, RexCom Chair
Cr Nuatali Nelmes, Lord Mayor City of Newcastle

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www.icleioceania.org

2023 SNAPSHOT OF ICLEI OCEANIA

2022 Events in Review

2022 was a big year. We held 13 member events, webinars and roundtables. At one of our most popular Mayoral Roundtable events we hosted the current Minister for Industry, Energy and Emissions Reduction of Australia, the Honourable Chris Bowen. At our very popular Local Government Solutions Exchange event we welcomed the innovative Australian engineer and entrepreneur Saul Griffith who joined us to talk about the electrification of our energy system in Australia.

Combined our events, webinars and roundtables brought together over 1300 practitioners, elected officials, academics and others from across the Oceania region and throughout the globe. We are looking forward to bringing more advocacy, knowledge sharing and capacity building events and activities to accelerate your globally connected sustainability and climate action goals for 2023.

Who we are

ICLEI Oceania - Local Governments for Sustainability supports local governments across Australia, New Zealand and the Pacific to accelerate sustainable urban development and climate action. ICLEI Oceania is a member organisation part of the global ICLEI network of more than 2500 local and regional governments worldwide.

What we do

Sustainable urban development that is:

- Nature-based
- Low emissions
- Resilient
- Circular
- Equitable & people-centred

How we do it

We provide a platform for local governments to achieve their climate and sustainability goals:

- Advocacy and knowledge sharing
- Capacity building
- Global connections

Member benefits

- Leadership recognition
- Peer-to-peer connection
- Collective action

Advocacy and knowledge sharing

ICLEI Oceania supports its members and those who want to take greater action to work together to learn, share and take collective action connected to regional and global outcomes.

Member Corner

Who: ICLEI Members - Staff
When: bi-annual, virtual
These virtual forums bring together ICLEI Oceania members to connect, learn and share about climate and sustainability priorities with like-minded colleagues. You can share what you are working on, ask for help and shape the direction of ICLEI Oceania as we work together toward a climate safe and sustainable future. The forum opens opportunities for collective action and local to global impact.

Mayoral Roundtables

Who: ICLEI Members - Mayors and elected members
When: On a needs basis
ICLEI Oceania convenes Mayors and elected members to provide guidance to ICLEI and partners on how to take collective action and advocacy on critical issues facing local governments such as on climate change. In 2023, several roundtables will be co-hosted with partners to help local government leaders to work together to accelerate climate action by making clear the vital role local governments play in meeting national emissions targets, and to help Federal Governments to deliver ambitious 2030 targets as per the Glasgow Pact.

Local Government Solutions Exchange

Who: Local government staff, practitioners or anyone interested
When: quarterly, 1.5 hr virtual forum
The Solutions Exchanges are for representatives of local governments to connect, learn and share about what is working and what isn't in sustainability solutions. The Exchanges are thematically based on issues from climate action to local implementation of the UN 2030 Sustainable Development Goals as guided by our members. The forums use breakout groups to encourage peer to peer sharing.

Capacity Building Programs

Offered free of charge or discounted to our ICLEI Oceania members, our programs use globally proven, locally tailored methodologies to help local governments take action without reinventing the wheel. ICLEI Oceania provides tailored training, facilitated workshops and technical advice to help you on your sustainability journey.

Green Climate Cities (In development)

Green Climate Cities offers cities a proven process methodology for walking step-by-step toward climate neutrality. This program combines ICLEI's international Climate Neutrality Framework and integrated climate planning guide with locally tailored tools, events and partner programs.

CitiesWithNature

CitiesWithNature is a global program that helps councils to bring nature back to our cities. Participating councils demonstrate their commitment to nature-based solutions by registering on the global platform, populating the new Actions Platform and becoming part of the knowledge-exchange network. The Actions Platform provides an easy means of generating reports for your internal requirements. Sign up to get involved in the tailored webinars, make best use of the global platform and in accessing tools and guides.

CitiesWithNature Academy

The Academy was launched in October 2022 and a small cohort of leader councils will form a Founders Group to help co-design the Academy offerings during 2023. The aim of the Academy is to develop a high-value package of resources, training and events based on the expressed needs of CWN cities. It will target council decision makers (elected and executive), professional staff and community. A small participation fee will be charged to be a Founder, with discount for ICLEI members.

Pacific Islands Resilience

ICLEI Oceania supports Pacific Island towns and cities to become more resilient to global shocks, particularly through disaster risk reduction, low emissions development and climate adaptation. ICLEI Oceania partners with organisations and networks in the Pacific including the Pacific Partnership New Urban Agenda - a consortium of international partners dedicated to sustainable urban development as well as with the Global Island Partnership and Local2030 Islands Network. Pacific Island towns and cities can join ICLEI or become beneficiaries. Australian and New Zealand councils are invited to contribute mentoring and technical assistance

Globally connected

ICLEI Oceania helps local governments commit, act and track their locally relevant progress toward global goals to show the momentum for change from communities. ICLEI Oceania is focused on impact on the Paris Agreement on climate change, the UN 2030 Sustainable Development Goals and the Sendai Framework on Disaster Risk Reduction. ICLEI is the Local Government and Municipal Authority Focal Point to the UNFCCC.

Global Covenant of Mayors for Climate and Energy

ICLEI Oceania is the Regional Secretariat of the Global Covenant of Mayors for Climate and Energy. This global alliance of cities and local governments supports an action-oriented approach to climate change for the transition to low-emission and resilient societies. ICLEI Oceania helps committed mayors and local governments from across the region work in alliance with partners to accelerate ambitious, measurable climate and energy initiatives and connect this effort in the global race to zero with the more than 12,500 cities making change.

To get involved

Email Admin.Oceania@iclei.org
Website www.icleioceania.org

Benefits of Membership

2022 Offering	Invitees	ICLEI Members	Non-Members
Advocacy & knowledge sharing			
Mayoral Roundtables	Elected Members	✔	✔
Member Corner	Staff	✔	-
Local Government Solutions Exchange	Staff	✔	✔
Advocacy and collective actions/campaigns	Elected members	✔	✔
Capacity building programs			
Green Climate Cities	Elected members + staff	✔	✔
Cities With Nature	Elected members + staff	✔	✔
Cities With Nature Academy	Elected members + staff	$1,500	$2,000
Pacific Islands Resilience	Elected members + staff (Pacific)	✔	✔
Tailored training, facilitation and capacity building	As relevant	Discounted rate by negotiation	Fee based
Globally connected impact			
Guidance on global initiatives such as Global Covenant of Mayors, Race To Zero etc.	Elected members + staff	✔	Fee based
Funding assistance to attend ICLEI events such as the ICLEI World Congress	Elected members + staff	✔	-
Engagement in relevant international meetings such as UN Climate Conference etc.	Elected members	✔	-

COMPACT OF MAYORS UPDATE: FIRST AND SECOND YEAR COMPLIANCE

Department: Community and Planning

EXECUTIVE SUMMARY

1 This report provides an update on work to ensure Dunedin meets its requirements for participating in the Compact of Mayors. Work has been completed on the city-wide greenhouse gas emissions inventory (Attachment A) and the climate hazards and risks assessment (Attachment B), and both are ready to be submitted to meet compliance.

RECOMMENDATIONS

That Council:

a) **Approves** the attached greenhouse gas inventory report and risks assessment report for submission to the Compact of Mayors.

BACKGROUND

2 On 30 November 2015 the Council resolved to commit to the international Compact of Mayors (the Compact). The Compact is the world's largest coalition of city leaders addressing climate change by reducing their greenhouse gas emissions (GHGs), tracking their progress and preparing for impacts of climate change through standardised measurement protocols and consistent reporting. Wellington City Council, Auckland Council and Dunedin City Council (DCC) have joined the Compact in recent years.

3 Delivering on the Compact commitment requires the following:

- Completing a citywide GHG inventory by sector and assessing the current impacts of climate change, publicly reporting both via the required platform within one year of commitment.
- Setting reduction targets, and a way to track progress on these targets, and conducting a climate change vulnerability assessment consistent with Compact guidance within two years.
- Establishing an action plan within three years of commitment. This is intended to demonstrate how the city will deliver on its commitment to reduce GHGs and adapt to climate change.

4 Following a request for proposal process, consultants AECOM New Zealand Limited (AECOM) was awarded a contract to provide assistance to Dunedin in meeting the years one and two requirements. AECOM previously worked on Greater Wellington's GHG inventory and are familiar with the reporting framework required by the Compact. Work with the DCC started in June 2016 and AECOM has produced a complete city-wide GHG inventory for Dunedin (Attachment A) and a climate risks and vulnerability assessment (Attachment B).

DISCUSSION

5 The inventory shows: almost half of Dunedin's GHGs (48.2%) come from the agriculture sector; transportation is second at 28.4% of the total emissions; stationary energy represents 13.4%; waste represents 7.4%; and industry related GHGs contribute 2.4%.

6 Dunedin's inventory is distinct from other New Zealand Compact cities (Auckland and Wellington) with a very large proportion of GHGs coming from the agricultural sector. In this sense, Dunedin is representative of New Zealand as a whole. This has implications for reduction targets, as committing to similar reduction targets as these cities (e.g. Wellington's 80% target by 2050) will imply a commitment to a significant reduction in agricultural emissions.

7 Agricultural emissions are not mandatory for Compact reporting – only energy, transport and waste related sector emissions are needed. However AECOM recommended including the emissions in Dunedin's inventory for completeness and consistency with other New Zealand Compact cities. Whether or not to include agricultural emissions for the purposes of target setting can be considered by the Council now, or as part of adopting reduction targets for the city.

8 The climate risks and vulnerability assessment reviewed existing literature on climate change and sea level rise to identify Dunedin's risks. References included the Council's Climate Change Predictions Policy, Otago Regional Council's *The Natural Hazards of South Dunedin,* and the 2010 Fitzharris study *Climate Change Impacts on Dunedin.* A workshop was also held with DCC staff to evaluate the risks identified and provide subjective 'first-cut' ratings of their likelihood and consequence. Priority risks (risks that are high or extreme) are reported in the assessment.

9 Achieving compliance for the Compact requires cities to report their inventory data and risk assessments. This can be done through one of two platforms mandated for use by the Compact – the 'CDP' platform or the 'Carbon*n* Climate Registry.' Both reporting platforms provide a form/questionnaire that is used to collect the information. ICLEI: Local Governments for Sustainability recommends reporting through Carbon*n*. The DCC is an ICLEI member and opted for the Carbon*n* platform.

10 The documentation required for reporting has now been completed in the spreadsheet format required by Carbon*n*, which closely reflects the content of Attachments A and B. These deliverables should be submitted as soon as possible in order to meet first year Compact compliance. Once these deliverables are approved for submission, the focus of work will be on meeting second year Compact compliance.

11 To fully meet second year compliance requires setting reduction targets for the city and completing a vulnerability assessment. Work has been completed on the assessment, and AECOM has now been contracted to assist with drafting potential reduction targets. A staff workshop was held in December 2016 to obtain initial input on the target setting for the Compact. When the GHG inventory has been approved by Council for submission, staff will hold a workshop with two of the strategy partnership groups (the Te Ao Tūroa and Grow Dunedin Partnerships) by the end of March 2017. This is intended to obtain initial input from external stakeholders before presenting proposed targets to Council.

OPTIONS

Option One (Recommended Option)– Approve the content of the attached reports for submission to the Compact of Mayors

12 Council approves the submission of the city-wide greenhouse gas inventory and risks assessment as reflected in Attachments A and B of this report.

Advantages

- Will allow the DCC to achieve Compact first year compliance, and partial second year compliance.

Disadvantages

- No disadvantages have been identified.

Option Two – Approve the attached reports with amendments for submission

13 Council approves the submission of the city-wide greenhouse gas inventory and risks assessments with any amendments (e.g. excluding agricultural GHGs from the inventory, or revising statements about climate change hazard and risk assessments).

Advantages

- Will still allow the DCC to achieve Compact first year and partial second year compliance.

Disadvantages

- No disadvantages have been identified.

NEXT STEPS

14 If approved, the attached reports will be submitted to the Compact of Mayors through the Carbon*n* registry.

Signatories

Author:	Bill Frewen - Senior Policy Analyst
Authoriser:	Maria Ioannou - Corporate Policy Manager Nicola Pinfold - Group Manager Community and Planning

Attachments

	Title	Page
A	Dunedin's Community Carbon Footprint Report	161
B	Dunedin's Vulnerability and Risks Assessment Report	186

SUMMARY OF CONSIDERATIONS

Fit with purpose of Local Government

This report enables democratic local decision making and action by, and on behalf of communities. It also relates to providing local infrastructure and regulatory function, and is considered good quality and cost effective.

Fit with strategic framework

	Contributes	Detracts	Not applicable
Social Wellbeing Strategy	☒	☐	☐
Economic Development Strategy	☒	☐	☐
Environment Strategy	☒	☐	☐
Arts and Culture Strategy	☒	☐	☐
3 Waters Strategy	☒	☐	☐
Spatial Plan	☒	☐	☐
Integrated Transport Strategy	☒	☐	☐
Parks and Recreation Strategy	☒	☐	☐
Other strategic projects/policies/plans	☒	☐	☐

Meeting the Compact of Mayors requirements will contribute to a number of goals and objectives of the Council's strategies that relate to reducing our city's carbon emissions. These include; Te Ao Turoa: Dunedin's Environment Strategy, Economic Development Strategy, Integrated Transport Strategy and the Energy Plan 1.0.

Māori Impact Statement

No known impacts for Tangata Whenua.

Sustainability

Measuring and managing our city's greenhouse gas emissions will support Dunedin's sustainability goals.

LTP/Annual Plan / Financial Strategy /Infrastructure Strategy

This is a city-wide commitment and implications will become clearer at the Action Plan stage. These will be discussed with the Council and stakeholders.

Financial considerations

Budget for meeting the Compact requirements has come from existing operational budgets. However, this will need to be revisited in the next Long Term Plan to ensure that adequate budget is allocated for future updates of the greenhouse gas emissions inventory (ongoing commitment to the Compact requires a new inventory every four years). There may also be other potential unbudgeted spending for the DCC and other stakeholders when it comes to implementing actions to reduce emissions.

Significance

Although the Council's commitment to the Compact is of interest to the community, this report has been assessed to be of low significance in terms of the Council's Significance and Engagement policy.

Engagement – external

No external engagement has been carried out to date.

Engagement - internal

Staff from City Planning, Parks and Recreation, Water and Waste and Transport participated in the workshop on the risks and vulnerability assessment.

Risks: Legal / Health and Safety etc.

No known risks.

SUMMARY OF CONSIDERATIONS
Conflict of Interest No known conflicts of interest.
Community Boards There are no known implications for Community Boards.

AECOM

Dunedin City Council
16-Sep-2016

DRAFT

Dunedin City Council Compact of Mayors Obligations

Part 1: Community Carbon Footprint

DRAFT

Dunedin City Council Compact of Mayors Obligations

Part 1: Community Carbon Footprint

Client: Dunedin City Council

Co No.: N/A

Prepared by

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16-Sep-2016

Job No.: 60507395

AECOM in Australia and New Zealand is certified to the latest version of ISO9001, ISO14001, AS/NZS4801 and OHSAS18001.

G:\ANALYSTS\Projects\Compact of Mayors\Reports\Dunedin Community Carbon Footprint report.docx
Revision – 16-Sep-2016
Prepared for – Dunedin City Council – Co No.: N/A

DRAFT

Quality Information

Document	Dunedin City Council Compact of Mayors Obligations
Ref	60507395
Date	16-Sep-2016
Prepared by	Maurice Marquardt, Zoe Thompson and Chris Barber
Reviewed by	Marta Karlik-Neale

Revision History

Revision	Revision Date	Details	Authorised	
			Name/Position	Signature
A	16-Sep-2016	Draft Report	Maurice Marquardt	
B	30-Sept-2016	Updated Draft Report	Maurice Marquardt	

DRAFT

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Prepared for – Dunedin City Council – Co No.: N/A

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1.0 Introduction

1.1 Background

Dunedin City Council (DCC) committed to the Compact of Mayors in December 2015. Dunedin is one of three cities within New Zealand to pledge to the Compact of Mayors. The aim of the Compact is to reduce Greenhouse Gases (GHGs) and prepare for the impacts of climate change whilst tracking progress on a common platform against a magnitude of cities worldwide.

AECOM have been engaged to assist DCC in achieving compliance with the first and second year obligations of the Compact of Mayors. The obligations are:

a. Develop a community carbon footprint following the Global Protocol for Community Scale Greenhouse Gas Emissions (GPC) Standard, including stationary energy, transport and waste related emissions,

b. Develop draft GHG emission reduction targets for Dunedin City,

c. Report the inventory results on either the CDP or carbon*n* platform

d. Identify climate hazards and complete a climate change risk and vulnerability assessment,

The Dunedin City Council Compact of Mayors Obligations reports Part 1 and 2 are aimed at assisting Dunedin with the fulfilling the Compact of Mayor obligations. The Dunedin City Council Compact of Mayors Obligations Part 1 report covers items a), and c) listed above; the community carbon footprint assessment and the results reported on the CDP platform. Item b) is covered in a separate memorandum provided to DCC to assist with their development of city wide emission reduction targets. Item d) is covered in the Part 2 "Dunedin City Council Compact of Mayors Obligations" report.

1.2 Compact of Mayors Obligations

Cities participating in the Compact of Mayors are required to complete a number of obligations. These include:

- Complete a GPC compliant Greenhouse Gas Inventory ("Carbon footprint")
- Develop GHG emission reduction targets
- Undertake a climate change risk assessment and report climate hazards
- Undertake a climate change vulnerability assessment
- Report the carbon footprint results under the CDP or Carbonn*e* reporting platforms
- Develop a climate change action plan (beyond the scope of this project)
- Develop a climate change adaptation plan (beyond the scope of this project)

1.3 Scope and Approach for Community Carbon Footprint

This inventory report follows the methodology outlined in the Global Protocol for Community Scale Greenhouse Gas Emissions Inventory (GPC), 2014.

This inventory assesses both direct (production-based) emission sources within the geographic area (Scope 1) and indirect (consumption-based) emission sources associated with goods and services imported into the geographic area. Examples of indirect emission sources include electricity from the national grid (Scope 2), transport into the area that originates or terminates outside the area (e.g. aviation Scope 3). The GPC methodology represents international best practice for city and community level GHG emissions reporting.

Due to differences in methodological approach, the city level absolute and per capita emissions cannot be compared directly to the absolute and per capita emissions reported in the New Zealand National GHG Inventory or emissions counted under the New Zealand Emissions Trading Scheme. However, relative trends and the significance of individual emissions sources can still be compared in many cases.

The following aspects are particularly worth noting:

- Due to data limitations, this inventory does not assess emissions from international shipping,

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- Due to data limitations, this inventory estimates regional emissions from industrial product use by scaling national emissions from industrial product use on a population basis after removing large point sources,
- This inventory accounts for forest carbon stock changes from afforestation, reforestation, deforestation and forest management (i.e. it applies land-use accounting conventions under the UN Framework Convention on Climate Change rather than the Kyoto Protocol). It treats emissions from harvesting and deforestation as instantaneous rather than accounting for the longer-term emission flows associated with harvested wood products,
- This inventory accounts for waste-related emissions from both open and closed landfills.

Emissions are expressed on a carbon dioxide-equivalent basis including climate change feedbacks using the 100-year GWP (Global Warming Potential) values from the Intergovernmental Panel on Climate Change Fifths Assessment Report: Climate Change 2013[1].

[1] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (p. 714)

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2.0 Community Carbon Footprint

2.1 Overall results

In 2014/15, Dunedin City generated estimated gross emissions of **1,423,116 tCO_2e** and net emissions of **1,086,978 tCO_2e**. The city population in 2014/15 was 125,200 people, resulting in per capita gross emissions of 11.4 tCO_2e/person and net emissions of 8.7 tCO_2e/person[2].

Agricultural emissions represent the largest emissions sector for Dunedin. Similar to the national trend this represents approximately 48% of the total emissions. The Transport sector is responsible for 28.4%. Emissions from stationary energy contributed 13.4% over the reporting period. Waste and industry related emissions are comparatively low, at 7.4% and 2.5% respectively (see Figure 1 below).

The amount of carbon sequestered in forests represents approximately 24% of the annual emissions in 2014/15. An overview table of emissions generated by each source is provided in Appendix B – GPC Summary Table.

CO_2 emissions from biogenic sources are not included in the overall emissions results. Biogenic CO_2 emissions are part natural carbon cycle, such as the combustion or digestion of biological materials and do not directly contribute to climate change. The GPC Standard recommends reporting these emissions outside the total greenhouse gas emissions. Dunedin generated approximately 2,933 tCO_2 from biogenic source (i.e. from combustion and flaring of landfill gas). CH_4 and N_2O emissions from combustion and flaring of landfill gas are however included in the overall GHG emissions, due to their higher radiative forcing.

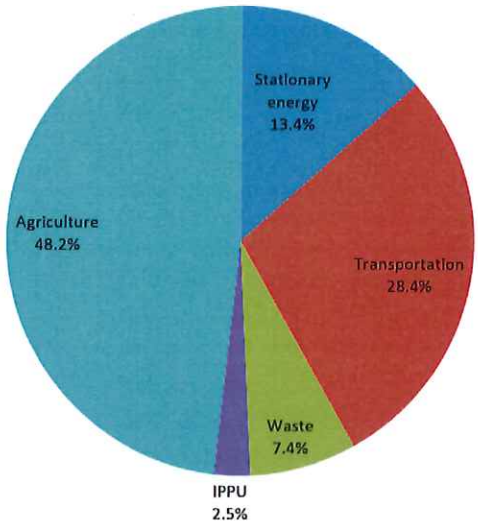

Figure 1 Dunedin City Emissions by Source

[2] Gross emissions only include emissions generated within the City boundary, whilst net emissions also consider the effects of sequestering carbon in standing forests, thereby reducing the overall emissions.

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2.2 Stationary Energy Emissions

Stationary energy use within the region generated an estimated **191,263 tCO_2e** in 2014/15; representing 13% of gross emissions.

The main source of emissions from stationary energy is electricity consumption (Scope 2), contributing approximately 56% towards the total emissions of stationary energy use (see Figure 2 below).

Emissions from coal use (Scope 1) represent the second largest stationary energy use emission source. In 2014/15 coal use contributed approximately 24% to total stationary energy emissions.

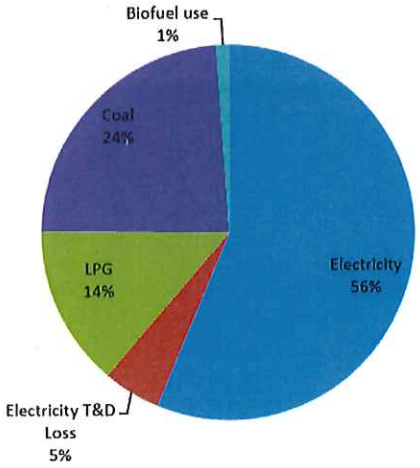

Figure 2 Stationary Energy Use GHG Emissions 2014/15 by Source

Greenhouse Gas emissions from bottled LPG (Scope 1) represented 14% of stationary energy emissions in 2014/15. Emissions from electricity transmission and distribution losses represented 5%, and biofuel (Scope 1) represented the remainder of the stationary emissions (1%).

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2.3 Transportation Emissions

In 2014/15 transportation sources contributed **404,398 tCO_2e**, representing 29% of Dunedin City's overall emissions.

As shown in Figure 3 the emission profile for mobile sources is dominated by road transport (predominantly Scope 1). Road transport emissions contributed approximately 97% of total emissions from mobile sources (incl. petrol, diesel and LPG) in the 2014/15 financial year. Road transport emissions (petrol, diesel and LPG) were estimated based on fuel sales figures. This approach however, does not allow for separate reporting of cross boundary road transport under Scope 3. Rail related emissions were estimated based on freight volume transported by KiwiRail within Dunedin's boundary and represent approximately 1% of the Transport emissions. Aviation related emissions contributed 2% towards the transport related emissions. No emissions were estimated for marine transport, due to lack of available bunker fuel data.

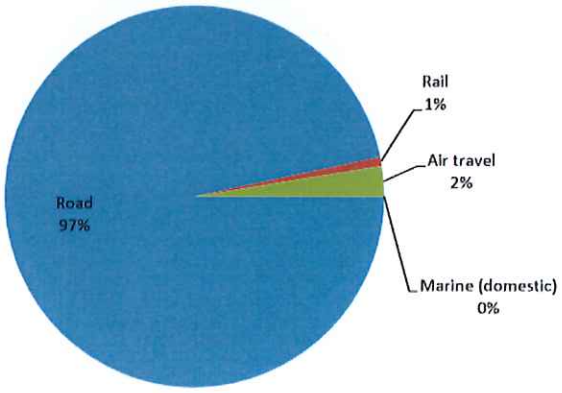

Figure 3 Transport GHG Emissions 2014/15

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2.4 Waste Emissions

In 2014/15 GHG emissions from Municipal Solid Waste (MSW) were responsible for **105,259 tCO_2e**, representing 7.4% of Dunedin City's gross emissions in 2014/15.

Municipal solid waste generated within Dunedin City is mostly disposed of at the Green Island landfill (Scope 1), with a small proportion being disposed at Fairfield Landfill, and historically at Sawyers Bay Landfill (Scope 1), which closed in 2001.

The Green Island landfill contributed approximately 73% of the estimated MSW-related emissions in 2014/15, 23% from the Fairfield landfill and the remaining emissions were emitted from other landfills that are now closed. Both the Green Island and Fairfield landfill sites collect landfill gas for electricity generation (Green Island) or flaring (Fairfield). However, the collection efficiency of both landfill sites is relatively low, 20% at Green Island and approximately 40% at Fairfield[3] (see Figure 4 below).

Figure 4 indicates the overall emissions from waste treatment including Scope 1 and Scope 2 emissions.

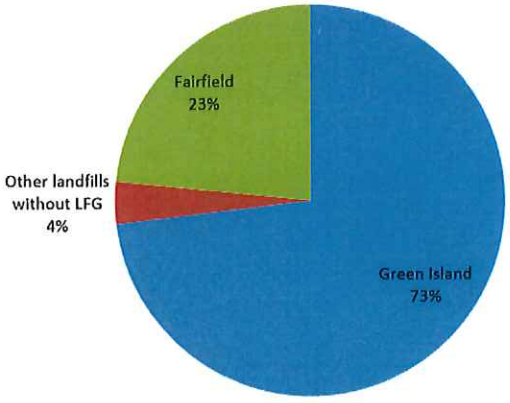

Figure 4 Emissions from Solid Waste Disposal

Emissions from waste water treatment (excluding the digestion, disposal or incineration of sludge which are included in the solid waste emissions) represented about 0.08% of Dunedin's gross emissions in 2014/15, generating an estimated **1,150 tCO_2e**.

Sludge sent to landfill from the Green Island and Mosgiel waste water treatment plants is regarded to be stabilised, resulting in minimal methane emissions. Sludge from the Tahuna waste water treatment plant is incinerated and regarded to be fully inert. The remaining waste water treatment plants use oxidation ponds as a final treatment option. On average these ponds get dredged every 5 years. The resulting sludge is also understood to be largely inert. As a result emissions associated with disposal of sludge have not been calculated as part of landfill emissions.

The incineration of sludge and the combustion of landfill gas generated at landfills or waste water treatment plants also generates CO_2 emissions. These CO_2 emissions are considered to be biogenic (i.e. non-fossil) and are excluded from the emissions reporting. According to the GPC it is good practice to report biogenic emissions outside the reporting boundary.

Burning of combustion of landfill gas and sludge incineration generated approximately **2,933 tCO_2** (biogenic).

[3] Due to lack of landfill gas collection data, the Fairfield landfill operator advised to use the lower end of the nationally reported landfill gas collection efficiencies (MfE, 2016), i.e. 42%.

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2.5 Industrial Emissions

Emissions for industrial product use include emissions from hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) (Scope 1) and were estimated at **36,214 tCO_2e** for 2014/15, representing approximately 2.5% of Dunedin City's gross emissions in that year. These emissions were estimated based on New Zealand's average emissions per capita and Dunedin's population. Only GHG emissions from industrial product use (HFCs, PFCs and SF_6 (Scope 1)) have been included in this inventory. Nitrogen trifluoride emissions do not occur in New Zealand, and therefore are not included in this report.

No emissions from industrial processes have been estimated, due to a lack of specific data. Any potential emissions are assumed to be insignificant within the Dunedin City Council boundary, given the small amount of heavy industry operating in Dunedin. Energy used in industrial processes is included in the stationary energy sector.

2.6 Agricultural Emissions

In 2014/15 agricultural GHG emissions contributed 685,982 **tCO_2e (48.2%)** towards Dunedin City's gross emissions (Scope 1). Methane (CH_4) is the most significant emission source (80%), predominantly from enteric fermentation of farmed animals (e.g. cows, sheep, horses, deer and goats). Nitrous oxide (N_2O) emissions from agricultural soils (e.g. farming of animals, e.g. through dung and urine deposited on paddocks and fields) contributed approximately 15% of emissions in 2014/15 (see Figure 5).

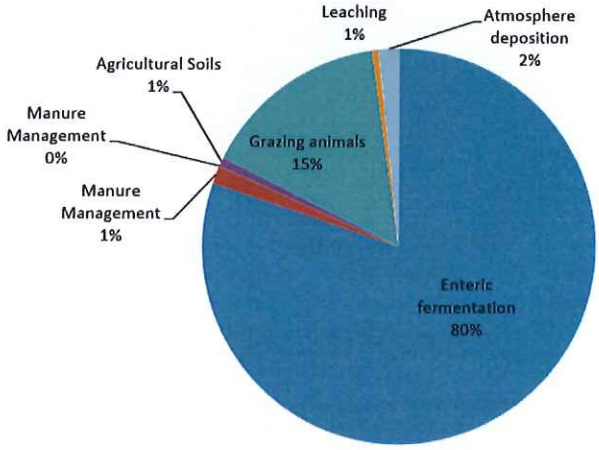

Figure 5 Emissions from Agricultural activities by source

The majority of the agricultural emissions (60%) are a result of sheep farming within the Dunedin Council boundary, while dairy and beef production are responsible for 36.5%

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2.7 Forestry Carbon Sequestration and Emissions

Land use, land use change and forestry (LULUCF) activities in Dunedin sequestered an estimated **-336,138 tCO_2e**. This is equivalent to 24% of gross city emissions.

The majority of carbon removed from the atmosphere by the forestry sector was absorbed by exotic forest plantations (79%). Still maturing native forests (i.e. manuka and kanuka forest stocks) sequestered the remaining 21%.

Harvesting related emissions were estimated based on harvesting volumes reported by Statistics New Zealand (StatsNZ 2015)[4] and resulted in 231,506 tCO_2e.

2.8 Data Sources

Data for the community carbon footprint was collected from a number of data sources. The Key data sources are outlined below in Table 1 below.

Table 1 Dunedin City Council Greenhouse Gas Inventory 2016- Data Sources

Emissions Category		Data Source
Stationary Energy		- Delta - LPG Association - PowerNet Ltd - Dunedin City Council Baseline Energy Study (existing) - MBIE (2015) Energy in NZ, Section K - MfE (2015) National Greenhouse Gas Inventory Report - Ravensdown
Transportation		- Dunedin City Council (internal) - KiwiRail - LPG Association - Z Energy - Air BP - Dunedin Airport
Waste	Solid Waste	- Dunedin City Council (internal) - Fairfield Landfill
	Waste Water	- Dunedin City Council (internal)
Industrial		- MfE (2016) 1990-2014 National Greenhouse Gas Inventory Report
Agriculture		- MfE (2016) 1990-2014 National Greenhouse Gas Inventory Report - Statistics New Zealand (Agricultural production data)
Forestry		- MPI (2014, 2015) National Exotic Forest Description - Statistics New Zealand

[4] Due to the accounting method chosen for this report, all carbon stored in harvested trees, including in the wood products removed, below ground and in residues left on site, is assumed to result in an emission in the harvesting year.

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A data gap analysis was undertaken during the data collection stage of the project, and identified the following data gaps (see Table 2 below):

Table 2 Dunedin City Council Greenhouse Gas Inventory 2016- Data Gaps

Emissions Category		Data gap	Alternative Data sources
Stationary Energy		Dunedin specific biofuel (wood) consumption data Dunedin specific coal consumption data	Biofuel and coal consumption estimates provided in the Dunedin City Council Baseline Energy Study
Transportation		Dunedin Port bunker fuel data	None – no emissions were estimated
Waste	Solid Waste	Fairfield Landfill – historic and current waste volume data Historic waste volumes prior to 1991	DCC 2011 waste volume estimate for Fairfield landfill Estimated based on Dunedin population figures and average national waste generation per person
	Waste Water	Number of rural septic tanks in use in Dunedin	AECOM estimate (1% of DCC population using septic tanks)
Industrial		Significant industrial activity resulting in GHG emissions	Emissions were estimated based on national emissions data on a per capita basis
Agriculture		Dunedin specific agricultural production data for reporting period	Estimates based on NZ 2012 Agricultural Census data
Forestry		Dunedin specific forest harvest figures	Estimate based on standing forest volume in harvesting age and regional harvest data

A more detailed description of the assumptions and limitations associated with the carbon footprint calculations is provided in Appendix A – Assumptions, Limitations, Exclusions and Data Issues.

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3.0 CDP Reporting

To be completed in independent document. (Potentially remove this section or only outline the CDP reporting requirements and process.)

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4.0 Data Sources and References

DCC 2015 Dunedin City Council (2015), The Dunedin Energy Baseline Study, retrieved on June 2016 from: http://www.dunedin.govt.nz/__data/assets/pdf_file/0009/521838/Dunedin-Energy-Baseline-Study-2015-Final.pdf

IPCC 1996 Intergovernmental Panel on Climate Change (1996), *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*, Intergovernmental Panel on Climate Change

IPCC 2006 Intergovernmental Panel on Climate Change (2006), *Guidelines for National Greenhouse Gas Inventories*, Intergovernmental Panel on Climate Change

LRIS 2013 LRIS Portal (2013), *Land Cover Database – Version 4*, provided Dunedin City Council

MBIE 2016 Ministry for Business, Innovation and Employment (2016), Quarterly Electricity and Liquid Fuel Emissions Table, retrieved June 2016 from: http://www.mbie.govt.nz/info-services/sectors-industries/energy/energy-data-modelling/statistics/greenhouse-gas-emissions

MBIE 2015 Ministry for Business, Innovation and Employment (2015), *Energy in New Zealand 2015 – 2014 Calendar Year Edition*, Ministry for Business, Innovation and Employment

MfE 2016 Ministry for the Environment (2016), *New Zealand's Greenhouse Gas Inventory 1990-2014*, Ministry for the Environment

MPI, 2016 Ministry for Primary Industries (2016), National Exotic Forest Description as at 1 April 2015

StatsNZ 2016 NZ Statistics (2016), *2012 Agricultural Census tables; Livestock numbers by type and territorial authority*, retrieved June 2016 from: http://www.stats.govt.nz/browse_for_stats/industry_sectors/agriculture-horticulture-forestry/2012-agricultural-census-tables/livestock.aspx

StatsNZ 2015 NZ Statistics (2015), *Forestry Harvest Values by Regional Council: 2014 and 2015*, retrieved on June 2016 from: http://nzdotstat.stats.govt.nz/wbos/Index.aspx

StatsNZ 2016 NZ Statistics (2016), Population by territorial authority/area unit, retrieved July

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2016 from:
http://nzdotstat.stats.govt.nz/wbos/

WRI 2015 World Resources Institute (2015), *Global Protocol for Community-Scale Greenhouse Gas Emissions (GPC)*, World Resources Institute

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Appendix A

Assumptions, Limitations, Exclusions and Data Issues

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Appendix A Study Assumptions, Limitations, Exclusions and Data Issues

Sector/Category	Assumptions and Exclusions
Stationary energy emissions	
Residential, commercial and industrial stationary energy emissions	- Coal and biomass related emissions have been estimated using consumption information obtained from the Dunedin City energy baseline study. - Due to the lack of heavy industry within the Region, it was assumed that there are no emissions from industrial coal consumption. - Consumption of electricity data is based on total energy distributed to grid exit points within the Aurora network and total energy delivered to individual ICPs within the Dunedin City territorial boundary for the Powernet network. - Emission per user group (i.e. residential, commercial and industrial) was estimated based on national average energy use split between these groups as reported by MBIE (2015).
LPG	- All gas distributed in Dunedin is LPG. The majority of gas is distributed in 9kg and 45kg bottles, with one company operating a small pipeline network. - It was assumed that the distribution loss is insignificant; due to the limited extent of reticulated gas.
Electricity generation	- Emissions from electricity generation originating from within the Dunedin City area are included in the national emissions factor calculations. Emissions from renewable sources such as hydro electricity generation are assumed to be zero. - Generation for the region was supplied by Delta for the Aurora network. - Powernet has no generation sources within the Dunedin City territorial boundary. - National emission factor for electricity generation was estimated based on data published by MBIE in their quarterly electricity and liquid fuel emissions table (MBIE 2015). - Emissions associated with Transmission & Distribution Loss were estimated on the national average emissions factor provided by MfE (2016).
Industrial Emissions	- Not included in reporting boundary as it is assumed that there are no relevant emissions from stationary industrial energy generation occurring within DCC.
Fugitive Emissions	- Not included in the Inventory, as there is no production of oil or gas occurring within DCC.
Mobile emissions	
Road transport	- Total volume of fuel sold within Dunedin was provided by Dunedin City Council. - Fuel consumption figures (petrol diesel) also include fuel used for off-road transport and recreational water transport, as these are sold through the same network. Due to a lack of data these could not be reported separately. - Fuel sales reported by DCC were for the Otago region, DCC's proportion of sales was based on the rates share of fuel sales within the Otago region.
Rail transport	- Emissions from rail transport are estimated based on freight data provided for 2015 and the average EF for rail freight in New Zealand supplied by the Kiwi Rail Annual Report (2015). - Emissions estimates are based on length of rail network and average fuel consumption per tonne km and freight volume. - The rail network in the South Island is Diesel only. The emissions factor may therefore slightly underestimate the rail related emissions, as the national average emissions factor also includes electrified rail. - Diesel sold for rail transport within the Dunedin City area may already be counted under road transport. Due to lack of data it is not possible to estimate what portion of the rail related diesel use was purchased in- or outside the region. Estimating rail related emissions based on freight volume and the national emissions factor (and potentially double counting the emissions) represents a conservative estimate. Given the small size of the overall rail related emissions this was assumed to be the most appropriate approach.

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Sector/Category	Assumptions and Exclusions
Water transport	- Emissions from international water transport (bunker fuels) were not included in the inventory, due to a lack of available data. - No fuel data for marine transport (e.g. bunker fuel) was available for the DCC Port. - Recreational marine transport including the Monarch Wildlife Cruises and Tours boats are assumed to be included in the diesel estimates for DCC (road transport).
Aviation	- Aviation data was provided by Dunedin Airport (via Air BP) and Z Energy, this is based on fuel sold/ pumped at airport. - It was assumed that planes are refilled before take-off. Fuel sales data therefore represents 50% of aviation related emissions, in line with the GPC framework.
Off-Road transport	- Off-road fuel consumption is assumed to be included in the data reported for road transport. Due to lack of specific data these could not be reported separately.
Waste	
Solid Waste Disposal	- Waste data is based on annual survey data (1991-present) for key landfills provided by Dunedin City Council. - Data gaps in reported waste volumes sent to landfill were estimated by applying the New Zealand national average waste generation per capita and using DCC specific population figures. - First Order Decay method requires estimates for waste sent to landfill for at least 50 years. Solid waste sent to landfill prior to the reporting period was estimated based on population estimates (StatsNZ 2016) and national average waste generation potential per person reported by MfE (2016). - DCC reported specific waste composition (SWAP) for the Green Island landfill. The Sawyers Bay and Fairfield landfill sites were assumed to have a similar waste composition as reported nationally (MfE, 2016). - Green Island landfill has installed a landfill gas recovery system in 2010. The Sawyers Bay landfills were assumed to not have any landfill gas recovery. The Fairfield landfill also collects landfill gas for flaring. - Fairfield waste volumes were estimated by DCC (2011). The current Landfill operator confirmed that the volumes were reasonable. However, the current operator was unsure about historic waste volumes as he had only recently taken over the operation of the landfill. - Fairfield waste first order decay emission model was based on the 2011 estimate and using the national average for waste composition. Due to a lack of data it was assumed that the waste volume has been constant since the opening of the landfill in 1973. This is likely to represent a conservative estimate of the overall emissions generated by the landfill. - Green Island landfill also accepts sewage sludge from the Green Island and Mosgiel waste water treatment plants. The sludge is digested and is considered to be stable. Although the sludge may still result in methane emissions when sent to landfill it was assumed that these would be minor and have not been estimated. - Sludge from the Tahuna waste water treatment plant is incinerated. The resulting ash is also landfilled but is assumed to be inert.
Biological Treatment (composting)	- No emissions from biological treatment have been estimated and are assumed to be insignificant.
Incineration	- 75% of the sludge generated at the Tahuna WWTP is incinerated. IPCC and GPC emissions calculations do not provide a formula for estimating CO_2 emissions from incineration of sludge, as these are biogenic. Due to a lack of actual emissions data, CO_2 emissions from the incineration have been estimated based on the average emissions per tonne of medical quarantine hazardous waste reported by MfE (2016). - No emissions from CH_4 and N_2O have been estimated for the incineration of sludge, similar to the National Inventory Report (MfE 2016). These are assumed to not occur or to be insignificant. - No emissions from open waste burning have been included. Any emissions are associated with rural and illegal burning of waste and have been omitted due to lack

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Sector/Category	Assumptions and Exclusions
	of available data.
Waste Water Treatment	- Emissions from waste water treatments are based on treatment methods employed by waste water treatment plants and New Zealand average waste generation potential per capita for DCC and townships within the DCC boundary population figures. - Sludge removed from waste water treatment plants was assumed to be sent to landfill. It was further assumed that this was already included in the total volume of waste sent to landfill. No additional calculations for emissions generated from sludge disposal were included. - Emissions from treatment of sludge, i.e. drying, were assumed to be included in the stationary energy use reported for the City. No additional calculations for sludge treatment processes were included. - It was assumed that 1 % of the DCC population used septic tanks for waste water treatment in rural areas. - Waste water treated at Middlemarch, Seacliff, Waikouaiti and Warrington waste water treatment plants is ultimately discharged to land. It was assumed that the discharge of treated waste water to land would not result in any significant emissions. As a result, no emissions were estimated for discharge of waste water to land.
Industrial Processes and Product use	
Industrial Processes	- No emissions from industrial processes have been included, due to lack of specific activity data. Only a small number of industries operate within DCC, for the purpose of this report it was assumed that their emissions are not significant on the overall scale.
Product Use incl. HFC, PCFs and SF_6	- Emissions for refrigerants, fire extinguishers, foam blowing, aerosols and metered dose inhalers, as well as SF6 in electrical equipment are estimated based on New Zealand average per capita emissions and DCC population figures.
Agriculture	
Agriculture	- Agricultural emissions are based on agricultural production data provided by Statistics New Zealand. - 2014-15 data for DCC is based on Stats NZ 2012 Census Livestock numbers by territorial authority. - Statistics NZ 2012 Census data reported pig numbers for Dunedin City is confidential. The Otago region overall recorded 11,000 pigs, with the majority recorded under Waitaki District (partially in Otago Region) and Clutha district. The unaccounted pig numbers were assumed to be spread across Central Otago, Queenstown-Lakes and Dunedin City. Pig numbers for DCC were assumed to be in the same range as those reported for Clutha.

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Forestry	
Forestry	- Carbon stored in exotic forests is based on data provided in the National Exotic Forest Description published by MPI (MPI 2016). - Due to insufficient data for land use changes, no emissions from land use change of cropland, wetlands, settlements and other land have been estimated. - Carbon sequestration for exotic forests include above ground, below ground, dead wood and litter. - Maturing native forests (i.e. Manuka and Kanuka), as well as grassland with woody biomass have been included as native forests. - Data for native forests is based on LCDB vol. 4 data. - Carbon sequestration rates for exotic forest are based on yield tables provided by MfE, assuming a 50/50 split between pre 1990 and post 1989 forests within DCC. - Sequestration rates for native forest were based on data provided in the 2006/07 Wellington Inventory (LCR 2008). Following advice from MfE, it was assumed that these were still applicable. - Emissions from forest harvesting activities are included in the Inventory as part of the LULUCF emissions. For the purpose of this report, it was assumed that all carbon stored in tree biomass (above and below ground as well as in dead wood and litter) become an emission in the year of the tree harvest.
Emission Factors	
Emission Factors – Mobile and Stationary Energy	- Emission factors used for the GHG emission calculations are based emission factors reported by MfE as part of the National Greenhouse Gas Inventory, MBIE quarterly energy statistics, etc. Detailed sources for each of the emissions factors used are provided in the Excel emissions calculations tables. - Advice received by MfE (for a previous report) supported the use of the most recently published emissions factors for all reporting years and emissions calculations. - The Global Warming Potential used to convert CH_4 and N_2O to CO_2e are based on the IPCC Fifths Assessment Report[5] for 100 year GWP including climate change feedbacks.

[5] https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (p. 714)

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Appendix B

GPC Summary Table

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AECOM

Dunedin City Council
20-Feb-2017

Dunedin City Council Climate Vulnerability and Risk Assessment Summary

Dunedin City Council Climate Vulnerability and Risk Assessment Summary

Client: Dunedin City Council

Co No.: N/A

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Date	20-Feb-2017
Prepared by	Kristina Healy
Reviewed by	James Hughes

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			Name/Position	Signature
0	12 Aug 16	Draft for review		
1	23 Sept 16	Updated draft		
2	26-Oct-16	Final report	Justine Bennett Associate Director	
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Executive Summary

Dunedin City Council (DCC) committed to the Compact of Mayors in December 2015. Dunedin is one of three cities within New Zealand, including Auckland and Wellington to pledge to the Compact of Mayors. The aim of the Compact is to reduce Greenhouse Gases (GHGs) and prepare for the impacts of climate change whilst tracking progress on a common platform against a magnitude of cities worldwide.

AECOM have been engaged to assist DCC in achieving compliance with the first and second year obligations of the Compact of Mayors. The obligations are:

a. Develop a community carbon footprint following the Global Protocol for Community Scale Greenhouse Gas Emissions (GPC) standard, including stationary energy, transport and waste related emissions

b. Develop GHG emission reduction targets for Dunedin City

c. Identify climate hazards and complete a climate change risk and vulnerability assessment

d. Report the results on either the CDP or carbon*n* platform

This report covers item c) above and involves identifying and summarising climate change risks.

This process was undertaken through a desk-top review of existing reports relating to climate impacts within the Dunedin area, as well as a focus workshop where identified risks were rated and prioritised.

The priority risks are summarised below, however with the caveat that a further work is required in a number of areas to further refine, and to involve more specific expertise.

Table ES1 – Summary table of priority risks

Risk Categories	Priority Risks
Cropping and horticulture	- Further detailed work required
Pastoral agriculture	- Further detailed work required
Forestry	- Increase in pests, fungal diseases and weed growth as a result of higher temperatures
	- Increased fire risk as a result of higher temperatures and increased incidence of drought.
Human health and vulnerable populations	- Summer heat related deaths likely to increase (very low current rates)
	- Increase intensity and frequency of food and water borne diseases and insect borne
	- Increase in size and extent of flood plains around urban streams and plains – in particular: Lindsay Creek, Water of Leith (incl Dunedin North), Kaikorai Stm, Taieri Stm (Mosgiel, Airport) – with potential to affect people, property and infrastructure.
	- Increased coastal erosion and associated costs for protection of the coastline (particularly around South Dunedin coastline and Blueskin Bay).
	- Low lying coastal communities affected by increasing groundwater levels (South Dunedin, Lower Taieri and Dunedin Airport, Waikouaiti)
	- In South Dunedin there are significant vulnerabilities: 8 rest homes, 18 education facilities (early childhood through to high school), Edgar Centre, Marne St. Hospital, and number of churches are at risk.

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Risk Categories	Priority Risks
Energy Resources	- Further detailed work required
Water Resources	- The increase in groundwater levels in areas where geology (e.g. sandy soils) is more susceptible to liquefaction increases the likelihood of liquefaction occurring.
	- Increase of salt water intrusion to groundwater or potable water supplies of low lying coastal areas (Lower Taieri and Dunedin Airport)
	- Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (Mosgiel)
	- Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (Brighton, Waldronville, Waitati, Waikouaiti, Warrington, Karitane).
	- Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (South Dunedin)
	- Increase risk of groundwater contamination from onsite wastewater treatment systems (e.g. Harwood and Long Beach) with rising groundwater levels.
Critical infrastructure and facilities	- Increased risk of flooding to property and infrastructure in priority catchments: (Stormwater and wastewater systems struggle with increased rainfall intensity).
	- Dunedin Airport (Taieri Plain) is low lying and lies adjacent to the Taieri Stream River which will become more tidal, threatening flooding and salinity
	- State Highway 1 and other harbour side roads (including Portsmouth Dr, Aramoana Rd, Portobello Rd), impacted by flooding, storm surge, and king tides.
	- Sections of rail line where it is adjacent to the coast will be impacted by storm surges, king tides and flooding. Including sections of main trunk, and rail line to Port Chalmers.
	- Light industry located in low lying and reclaimed areas affected by flooding more frequently (South Dunedin - including Harbourside)
Ecosystems	- Change to phenology (seasonal activities) such as flowering, breeding, growth and migration
	- Fragmented, small areas of conservation in and around Dunedin City will exacerbate climate change impacts due to constrained migration links
	- Ocean acidification and warmer waters will decrease plankton productivity and diversity
	- Cool-water fish recruitment will decrease
	- Landward migration of coastal ecosystems will change coastal fisheries, and inshore sub-tidal breeding and nursery areas. Freshwater ecosystems will also be affected by encroaching salt water intrusion.
	- Loss of wetlands.

As mentioned, the above risks were prioritised during a single workshop with DCC staff. The likelihood and consequence of each risk was evaluated subjectively by workshop participants – with varying degrees of confidence being expressed in relation to the ability to apply these ratings. Given the high-level nature of this particular study (as part of the Compact of Mayors) , this is deemed to be appropriate at this stage, however further assessment will be required in a number of areas.

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In terms of the Compact of Mayors requirements, this initial summary risk assessment should provide the level of detail necessary for compliance and also provide a platform for further detailed work going forward.

It is recommended that DCC consider more detailed work which refines the risk assessment and utilises knowledge from appropriate sector specialists to better understand the nature of the risks posed and, then to develop more specific adaptation options.

In regard to adaptation, a number of options are currently being considered by DCC, particularly in relation to:

- Dunedin South, and the current and future risk regarding sea level rise and inland flooding.
- Coastal erosion along the South Dunedin coastline (e.g. St Clair and St Kilda).

DCC has commissioned a number of studies and reports which address these risks, and they are continuing to investigate options with community.

It is noted that DCC will need to consider both the type of adaptation option, and also the timing of implementation. That is, should initiatives be implemented now, or revisited at a future date when more information is available, and what are the risks in delaying implementation.

The following are summarised as key next steps:

- Potential broader discussion around an appropriate risk framework to utilise for both climate risk and natural hazard risk management. It is important that the framework and criteria used are mutually agreed across Council departments. This may, for example, involve a common high level framework, with specific consequence / likelihood tables for different applications.
- Further analysis and prioritisation of those climate risks which require more specialist input.
- Development of adaptation options, where possible, for the priority risks.

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1.0 Introduction

1.1 Background

Dunedin City Council (DCC) committed to the Compact of Mayors in December 2015. Dunedin is one of three cities within New Zealand, including Auckland and Wellington to pledge to the Compact of Mayors. The aim of the Compact is to reduce Greenhouse Gases (GHGs) and prepare for the impacts of climate change whilst tracking progress on a common platform against a magnitude of cities worldwide.

AECOM have been engaged to assist DCC in achieving compliance with the first and second year obligations of the Compact of Mayors. The obligations are:

a. Develop a community carbon footprint following the Global Protocol for Community Scale Greenhouse Gas Emissions (GPC) standard, including stationary energy, transport and waste related emissions

b. Develop GHG emission reduction targets for Dunedin City

c. Identify climate hazards and complete a climate change risk and vulnerability assessment

d. Report the results on either the CDP or carbon*n* platform

This report covers Item c) above, the climate risk and vulnerability assessment.

1.2 Scope and Approach for Climate Change Compliance Review

This report summarises:

- Key climate hazards, projections and available data on these (including spatial data),
- A range of 'risk' areas and risk descriptors,
- High level consequence and likelihood descriptors for use within a risk assessment,
- An initial 'first cut' risk assessment based on available data – developed through a workshop with DCC staff.

The approach used to compile this report involved reviewing and summarising a range of existing reports, studies and maps. Risks were identified based on best practice approaches as referenced within the report. The following diagram summarises the steps undertaken:

Figure 1 Study approach

1.3 Previous Studies and Report References

Dunedin City faces significant risks with respect to climate change, in particular those relating to sea level rise and rainfall (resulting in flooding). A number of recent studies and reports have been prepared, as well as modelling of sea level rise scenarios and development of a range of adaptation options. The reports were reviewed and these assisted in identifying the relevant climate hazards and informed the risk assessment.

As part of the review of existing reports/studies the draft Dunedin Second Generation District Plan (2GP) policy and maps were considered. 2GP includes maps of natural hazards (overlays), and aims to reduce the effects of natural hazards through rules according to the type of natural hazard, the risk it poses and the sensitivity of the activity proposed (2GP Section C, Chapter 11). The sensitive activities

were reviewed and were included where relevant within the Risk Areas defined in Table 2 and the risk assessment approach outlined in Section 5.0.

Other key reports referenced are summarised below:

Ministry for the Environment (2016). *Climate Change Projections for New Zealand: Atmosphere Projections Based on Simulations from the IPCC Fifth Assessment*. Wellington: Ministry for the Environment.

Dunedin City Council (2011). *Climate Change Predictions Policy 2011, Corporate Policy – Sustainability Advisor Approval Date: 6 September 2011*. Retrieved from the Dunedin City Council website: http://www.dunedin.govt.nz/__data/assets/pdf_file/0008/225908/Climate-Change-Predictions-Policy-2011.pdf

Fitzharris, B. (2010). *Climate Change Impacts on Dunedin*. Retrieved from Dunedin City Council website: https://www.dunedin.govt.nz/__data/assets/pdf_file/0006/109779/MCA-Climate-Change-Report.pdf

Goldsmith, M. & Hornblow, S. (2016). *The Natural Hazards of South Dunedin*. Retrieved from the Otago Regional Council website: http://www.orc.govt.nz/PageFiles/1404/July%202016/The%20Natural%20Hazards%20of%20South%20Dunedin%20report%20-%20July%202016.pdf

Goldsmith, M., Sims, A. (2014). *Coastal hazards of the Dunedin City District, Review of Dunedin City District Plan – Natural Hazards*. Retrieved from Otago Regional Council website: http://www.orc.govt.nz/Documents/Publications/Natural%20Hazards/2014/Dunedin%20City%20Coastal%20Communities%20-%20Hazard%20Summary.pdf

Goldsmith, M., Payan, J.L., Melrose, R., Williams, J. (2015). *Flood hazard on the Taieri Plain, Review of Dunedin City District Plan: Natural hazards. First revision: August 2015*. Retrieved from Otago Regional Council website: http://www.orc.govt.nz/Documents/Publications/Natural%20Hazards/2015/Flood%20hazard%20on%20the%20Taieri%20Plain%20Revision%20One%20WEB.pdf

Goldsmith, M., Williams, J., Payan, J.-L., & Stocker, H. (2014). *Flood Hazard of Dunedin's urban streams, Review of Dunedin City District Plan: Natural Hazards*. Retrieved from the Otago Regional Council website: http://www.orc.govt.nz/Documents/Publications/Natural%20Hazards/2014/Dunedin%20City%20urban%20streams%20flood%20hazard.pdf

McClone, M. and Walker, S. (2011). *Potential effects of climate change on New Zealand's terrestrial biodiversity and policy recommendations for mitigation, adaptation and research*. Science for Conservation 312. Wellington: Department of Conservation. Retrieved from Department of Conservation website: http://www.doc.govt.nz/Documents/science-and-technical/sfc312entire.pdf

MWH. (2011). *Methodology for Determining Minimum Floor Levels 2011*. Prepared for Dunedin City Council. Retrieved from Dunedin City Council website: https://dcc.squiz.co.nz/__data/assets/pdf_file/0004/295465/MWH-Methodology-for-Determining-Minimum-Floor-Levels-2011.pdf

Parliamentary Commissioner for the Environment (PCE) (2015). P*reparing New Zealand for rising seas: Certainty and Uncertainty*. Retrieved from the Parliamentary Commission website: http://www.pce.parliament.nz/media/1380/preparing-nz-for-rising-seas-web-small.pdf

2.0 Identified Climate Hazards and Variables

Table 1 provides a summary of Dunedin climate variables and projections based on the reference material listed in Section 1. Many of these predictions are sourced from New Zealand Government guidance to 2040 and 2090. This includes updated guidance from MfE (2016).

It is noted that in 2011 DCC updated their climate change projections based on current projections and models by IPCC, MfE, NIWA and the Fitzharris study. These are, however, outdated in many cases, and Table 1 below supersedes these.

Table 1 Dunedin City climate variables and projections

Climate Variable	Direction of Change	Magnitude of Change	Spatial and Seasonal Variation
Atmospheric circulation	Continued variability but air masses will gradually become warmer	Less frequent fine weather spells (>4days). More frequent rain (~3 hours associated with southerly and south westerly winds) and heavy rainfall events (increase of subtropical depressions). Unchanged showery weather	Eastward moving troughs and fronts to cross region on 6-7 day intervals. Anticyclone centres located to the north of the region.
Mean temperature	Continued increase	2040 increase by 0.7 – 1.1 °C (MfE, 2016) 2090 increase by 0.7 – 3.1 °C (MfE, 2016)	Consistent seasonal increase with little spatial variation across the City
Annual rainfall	MfE (2016) indicates an increase in rainfall across all seasons.	Between 3% and 4% to 2040 and 3% and 10% to 2090. The increase varies depending on the model used and the season (MfE, 2016).	Rainfall increase inland and southern areas of City, north of Waitati drier.
Sunshine	Predicted to be small increases in solar radiation for the Dunedin area (MfE, 2016)	Minor for Dunedin.	Not modelled.
Growing degree days[1]	Potential significant increases.	Dependent on temperature increases. Example for 3 °C increase.	Annual growing degree days increases: Taieri Plains from 600 to 1110. Musselburgh from 670 to 1200. F2 Hill Climate from 370 to 800.
Extreme temperature	General increase	Increase in number of days over 25 °C from around 18 presently to approximately 23 (by 2040) and between 21 and 42 by 2090, depending on the model used, and season (MfE, 2016)	

[1] A heating index used in predicting plant/ crop growth

Climate Variable	Direction of Change	Magnitude of Change	Spatial and Seasonal Variation
Extreme rainfall	Expected increase in both mean rainfall and extreme rainfall.	Worst case scenario rainfall intensities (for design storms) would increase by about 20% by 2090.	
Drought	Magnitude and frequency expected to increase (due to increase evapotranspiration).	MfE (2016) estimates an increase in 'potential evapotranspiration deficit (PED)' of between 50 and 100mm by 2090.	Inland and southern areas of DC increase in evaporation offset by small increases in rainfall. Urban DC slight increase and coastal areas and north Waitati expected to increase.
Average and strong winds	International studies suggest increase in frequency but little NZ information.	Strength of westerly wind belt will increase incidence of gales over DC.	No information
Snow	Current events lasting several days pose greatest risk to everyday life and infrastructure. Expected to become less common, as temperatures increase.	Rare after 2040, Snow line to rise by 120m by 2040 and 270m by 2090.	Taieri River and Deep Stream (DC water supply) water balance to change with less snow storage.
Sea level rise	Will rise but upper bound difficult to predict given variability of values provided by different models.	For planning and risk assessment purposes – coastal areas should assume minimum 0.8m increase by 2090 and up to 1.6m (current DCC guidance).*	Use of sea level rise predictions will depend on type, lifecycle and adaptability of infrastructure and investments.
Waves and storm surges		From ORC (2014) a 1:500 ARI storm surge event would result in a level of between 1.9 and 2.2m relative to mean sea level.	Combination of higher global sea level, storm surge, El Nino during negative IPO and king tide could result in sea water levels over 3m above current MSOL.

**Note the draft (as of Feb 2017) Coastal Hazards and Climate Guidance (MfE) suggests a 2040 value of between 0.2 and 0.3m, and a 2090 value of between 0.4 and 0.9m. This variance relates to the range of possible SLR scenarios. Moreover, for planning purposes, the guidance recommends, for a 100 year planning horizon (2120 approx), to use a SLR value of 1m. It is noted that this value is recommended for existing coastal developments. For greenfield developments or new infrastructure in the coastal zone, the guidance recommends testing be undertaken based on a SLR value of 1.9m. The guidance also emphasises the need to approach planning from a risk-based perspective, and to consider adaptive pathways to manage changing risk over time.*

3.0 Risk areas (vulnerabilities)

Below we identify key risk areas (vulnerabilities). Selected climate hazards as identified in Table 1 are assessed in relation to these risk areas to identify potential effects, both positive and negative. The climate hazards identified are driven and influenced by the meteorological conditions including atmospheric circulation; hydrological processes; and the geographical setting and land development practices in Dunedin. It follows that the defined risk areas are not all affected by all of the identified climate hazards. The risk areas are listed in Table 2 with descriptors and examples provided. These have been sourced from both Fitzharris (2010) and the Dunedin 2GP plan.

Table 2 Descriptions and examples of each risk area

Risk Area	Description and Examples
Cropping and horticulture	Includes all types of cropping (e.g. wheat, maize, oats) and horticulture (e.g. fruit and vegetable growing).
Pastoral agriculture	General pastoral agriculture including beef and sheep farming, and dairy.
Forestry	Indigenous and exotic forests, particularly commercial plantations of exotic soft wood species (e.g. pinus radiata and eucalyptus).
Human health and vulnerable populations	Encompasses all potential effects and risks to public health, community, culture, and specifically includes vulnerable populations and facilities where vulnerable populations may be located e.g. schools, aged care facilities, hospitals
Energy resources	This refers to the raw resource and demand for the resource – not supporting infrastructure (e.g. generation plants, transmission, substations).
Water resources	This refers to the raw resource and demand for the resource – not supporting infrastructure (e.g. pumps, pipes and treatment).
Critical infrastructure and facilities	All urban and rural infrastructure associated with utilities (energy, transport, wastewater, water supply, stormwater, telecommunications), community centres, marae, airport, emergency control/ operations centres (e.g. police, fire, ambulance, search and rescue), welfare agencies (e.g. Salvation Army, Child Youth and Family), key civil contractor depots (e.g. Fulton Hogan, City Care Limited), service stations and bulk fuel storage (Fryatt Street Oil Wharf and storage terminals e.g. Parry Street).
Natural Ecosystems	In relation to flora and fauna, habitat spread and availability, and biodiversity of terrestrial freshwater aquatic and marine ecosystems. Includes effects on fisheries due to changes in the marine ecosystems.

4.0 Risk Identification

The *primary* climate variables and identified hazards associated with those variables are described in subsequent sections for each risk area as defined in Table 2. Climate variables have been grouped as follows for ease of presentation:

i. Temperature: includes average temperature, extreme temperatures, growing degree days, snow fall, atmospheric CO_2 increase

ii. Rainfall: average rainfall, extreme rainfall events (intensity), seasonal and regional variation, runoff (including snow melt), hydrology

iii. Sea level rise and coastal hazards: rise of mean high water spring level, storm surges, king tides, resulting effects on groundwater (driver for higher groundwater and change in salinity)

It is noted that wind projections for NZ have low to moderate confidence in model outputs and projected changes. Generally it is expected that the westerly wind flow across NZ will increase and is linked to temperature increases. By 2090 there are projected seasonal variations in westerlies, winter westerlies increase and summer and autumn westerlies decrease (NIWA Climate Change Scenarios for New Zealand, https://www.niwa.co.nz/our-science/climate/information-and-resources/clivar/scenarios). For Dunedin City there is little information available, and therefore these have not been included below.

It is also noted that the risk areas and risks identified below are a 'first-cut' assessment based on the information made available, and given the constraints of the project. A more comprehensive assessment should be done at a later stage, focussing on specific areas as deemed appropriate.

4.1 Temperature-related risks

As stated in Table 1, average temperature is expected to rise under all climate change scenarios. Incidents of extreme high temperatures (>25 °C) are expected to increase in occurrence. With increasing temperature comes an increase in growing degree days. As a result of increasing temperature, the snow line is projected to rise in elevation, thus affecting the seasonal snow storage and influencing runoff which is captured under rainfall (Section 4.2).

The following Table 3 summarises key risks as they relate to temperature increase across Dunedin. The risks are sourced (summarised) from the references listed in Section 1.3.

Table 3 Risks associated with predicted temperature changes across Dunedin City.

Risk Area	Discussion
Impact on cropping and horticulture	**Positive Effects** • Reduced frost risk and increased yield. • Increase in number of growing degree days thus changing the range of crops that are viable in region e.g. maize, stone fruits and viticulture.
	Negative Effects • Warmer temperature results in higher CO_2 which slightly reduces evapotranspiration. • Uncertainty of impact on pests, crop diseases and weed growth (although likely to increase in problems).
Agriculture e.g. pastoral farming	**Positive** • Results in longer growing season, higher CO_2 and reduced frost results in increased pasture production in the short term (<2040) in southern areas of Dunedin. • Less winter feed required. • Increase in suitable land (above 400m elevation) for intensive pastoral farming, approximately 100,000 ha by 2040 and further 200,000 ha by 2090. However would need to be balanced by climate impacts on water availability. • Decrease cold stress on animals (particularly lamb mortality rates). • Reduction in rabbit populations due to biological control agents (myxomatosis and rabbit haemorrhagic disease).
	Negative • Longer term decline in pasture production (2090) particularly in northern areas of Dunedin (2040). • Increase incidence and distribution of pests, disease and weeds. • Increase risk of heat stress on animals.
Forestry	**Positive** • Increased growing season, productivity and suitable forestry land (above 500m elevation) e.g. estimated additional 50,000 ha by 2040 and 200,000 ha by 2090. • Elevated CO_2 enhancing growth rates and wood density.
	Negative • Increase in pests and fungal disease. • Increase risk of fire.
Human health and vulnerable populations	**Positive** • Winter peak deaths in vulnerable populations will decrease. • Improved internal residential home climates leading to reduced incidence of respiratory illnesses.
	Negative • Summer heat related deaths likely to increase (very low current rates). • Increase intensity and frequency of water and food borne diseases.
Energy Resources	**Positive** • Less demand for winter heating in homes.
	Negative • Increased summer energy demand for air conditioning.
Water Resources	**Positive** • No positive effects noted due to changes in temperature.

Risk Area	Discussion
	Negative • Increase temperature can lead to increase in algal blooms and changes to water quality, along with impacts on fish species and microbial contamination. • Increase demand for irrigation due to longer growing season, particularly for north of Waitati which experiences an increase in droughts and reduced rainfall.
Ecosystems (terrestrial, marine and freshwater)	**Positive** • Short term ability of ecosystems to adapt to climate variability. • Increase in warm-water fish recruitment[2] and growth rates.
	Negative • Increase biotic spread of exotic weeds and invertebrates with warmer climate. • Short term threat of land use intensification, irrigation, carbon neutral energy development (e.g. wind and hydro) and carbon sequestration greater risk to biodiversity than climatic changes as these will happen faster than changes on ecosystems. • Loss of biodiversity and reduced or increased geographic range limits thus impacting competition and species interaction. • Change to phenology (seasonal activities) such as flowering, breeding, growth and migration. • Fragmented, small areas of conservation in and around Dunedin City will exacerbate climate change impacts due to constrained migration links. • Ocean acidification and warmer waters will decrease plankton productivity and diversity. • Cool-water fish recruitment will decrease.

[2] Recruitment in fisheries refers to the age and size of a fish at which can be caught and counted in nets.

4.2 Rainfall-related risks

Rainfall averages are not expected to change significantly but there remains uncertainty due to the level of variation across climate models. The local variability of rainfall across the region is expected to increase with rainfall increasing inland and in southern areas of City, with north of Waitati projected to being drier. The projected seasonal variation of 5% wetter in winter/spring in coastal areas and 5% drier in summer/autumn by 2040, and by 15% by 2090. In areas where rainfall is expected to decrease the fire risk will likely increase with increasing temperatures. Currently flooding in many areas is contained by natural land forms (e.g. higher terrain). However the reach of flood waters, particularly along estuary and river networks, and areas susceptible to surface flooding is predicted to increase due to the combination of rising water tables (as a result of sea level rise) and rainfall intensity.

Table 4 summarises key risks as they relate to rainfall changes across Dunedin city. The risks are sourced (summarised) from the references listed in Section 1.3.

Table 4 Key risk areas from changes to rainfall patterns and intensity.

Risk Area	Discussion
Impact on cropping and horticulture	**Positive Effects** • No significant average rainfall change but increase in temperature provides good conditions for growth and productivity.
	Negative Effects • Greater reliance on water storage for dry summers • Less rainfall projected around Waikouaiti affecting irrigation supply. • Increase risk from fire.
Agriculture e.g. pastoral farming	**Positive** • No significant average rainfall change but increase in temperature provides good conditions for growth and productivity.
	Negative • Northern coastal areas decline in pasture productivity due to increased drought frequency. • Associated increased demand on irrigation and water tables. • Increased risk of water catchment (agricultural/ pastoral) run-off pollution and contamination.
Forestry	**Positive** • No positive effects noted due to changes in rainfall.
	Negative • Increase in rainfall intensity will increase soil erosion problems and therefore water quality issues in the receiving environmental (sediment and herbicide usage). • Waikouaiti area tree growth reduced due to reduced rainfall and increased fire risk.
Human health and vulnerable populations	**Positive** • No positive effects noted due to changes in rainfall.
	Negative • Increase intensity and frequency of food and water borne diseases. • Increase in size and extent of flood plains around urban streams and plains, namely Lindsay Creek, Water of Leith, Kaikorai Stream, Taieri Plains, Waikouaiti and Karitane.
Water resources	**Positive** • Annual flow from larger rivers and streams will increase (increased water resource). • Groundwater resources will have increased recharge over winter but less over summer.

Risk Area	Discussion
	Negative • Significant change to the seasonal distribution of runoff – winter will be wetter, summer will be drier. Storage for irrigation and security of supply will be required. • Increased erosion due to rainfall intensity increases. • The increase in groundwater levels in areas where geology (e.g. sandy soils) is more susceptible to liquefaction increases the likelihood of liquefaction occurring.
Critical infrastructure and facilities	**Positive** • No positive effects noted due to changes in rainfall.
	Negative • Flooding (in general) is exacerbated by short duration intense rainfall and likely sea level rise. • Increase flood threats to Outram, Mosgiel, Dunedin Airport, Dunedin North, Waitati and Karitane. • Light industry located in low lying and reclaimed areas affected by flooding more frequently e.g. South Dunedin. • Stormwater and wastewater systems struggle with increased rainfall intensity, areas prone to flooding and flooding frequency. • State Highway 1 and other harbour side roads (approximately 70km worth (Fitzharris, 2010) impacted by flooding • Dunedin Airport (Taieri Plain) is low lying and lies adjacent to the Taieri River which will become more tidal, threatening flooding and salinity.

4.3 Sea Level Rise and Coastal Risks

Sea level expected to rise and increased effects from storm surges and king tides. Reclamation of Otago Harbour has resulted in some areas of South Dunedin being only 0.5m above sea level (Goldsmith & Hornblow, 2016). While generally Dunedin is well protected by natural land forms (southern dunes) and engineered sea walls the high groundwater table will be pushed higher by sea level rise, resulting in increased surface flooding and salt water intrusion into groundwater and other freshwater resources.

Appendix A provides a list of coastal areas, as defined in the ORC Coastal Hazards report (Goldsmith & Sims, 2014) and the Methodology for Determining Minimum Floor Levels (MWH, 2011) which indicates which areas are exposed to specific climate change coastal risks (e.g. sea level rise, storm surge, coastal erosion). The level of impact and assessment of risk (including vulnerability) is provided in the reference report and the summary provided is used to identify specific high and medium risk areas.

Table 5 summarises key risks (including those in Appendix A) as they relate to sea level rise, storm surge and tidal impacts across Dunedin. The risks are sourced (summarised) from the references listed in Section 1.3.

Table 5 Sea level rise, storm surges and king tide impacts on identified risk areas.

Risk Area	Discussion
Impact on cropping and horticulture	**Positive Effects** • No positive effects noted due to sea level rise.
	Negative Effects • Salt water intrusion to groundwater affecting lowland crops/ horticulture –in Taieri Plains • Salt water intrusion to groundwater affecting lowland crops/ horticulture – esp in Waikouaiti • Increasing salinity further upstream in the Taieri River and other tidally influenced stream/ estuaries.
Agriculture e.g. pastoral farming	**Positive** • No positive effects noted due to sea level rise.
	Negative • Lowland pasture affected by increased salinity in rivers, streams, groundwater – eg Taieri Plains and Waikouaiti. • Lowland pasture exposed to increased sea water inundation as a result of sea level rise and in particular storm surge and increased wave action. • Lowland coastal pasture exposed to erosion where natural dune systems or engineered protection measures are not present or compromised.
Human health and vulnerable populations	**Positive** • No positive effects noted due to sea level rise.
	Negative • Increased flood plain size, frequency and number of affected properties and infrastructure. • Increased coastal erosion and associated costs for protection of the coastline (particularly Blueskin Bay, Harwood, Warrington, Brighton, Taieri Mouth Road and Karitane). • Low lying coastal communities affected by increasing groundwater levels include Lower Taieri and Dunedin Airport, Brighton, Waldronville, South Dunedin, Waitati, Warrington, Karitane Long Beach, Purakaunui, Harwood and Waikouaiti. • In South Dunedin (greatest risk of flooding) 8 rest homes, 18 education facilities (early childhood through to high school), Edgar Centre, Marne St. Hospital, and a number of churches are at risk.
Water resources	**Positive** • No positive effects noted due to sea level rise.
	Negative • Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (Lower Taieri and Dunedin Airport, Brighton, Waldronville, South Dunedin, Waitati, Warrington, Karitane and Waikouaiti). • Increase risk of groundwater contamination from onsite wastewater treatment systems (e.g. Harwood and Long Beach) with rising groundwater levels.
Critical infrastructure and facilities	**Positive** • No positive effects noted due to sea level rise.

Risk Area	Discussion
	Negative • Salinity effects on building foundations if groundwater composition changes. • Increase in saline spikes (due to storm surges and king tides) at the Tahuna Station sewerage treatment and saltwater intrusion (corrosion of pipes and equipment). • Main trunk rail line (approximately 10km worth (Fitzharris, 2010)) where it is adjacent to the coast will be impacted by storm surges, king tides and flooding. • State Highway 1 and other harbour side roads (approximately 70km worth (Fitzharris, 2010) impacted by flooding, storm surge, and king tides. • Dunedin Airport (Taieri Plain) lies adjacent to the Owhiro Stream which will become more tidal, threatening flooding and salinity. • Onsite wastewater disposal systems affected by rising groundwater in settlements of Long Beach and Harwood.
Ecosystems (terrestrial, marine and freshwater)	**Positive** • No positive effects noted due to sea level rise.
	Negative • Landward migration of coastal ecosystems will change coastal fisheries, and inshore sub-tidal breeding and nursery areas. Freshwater ecosystems will also be affected by encroaching salt water intrusion. • Loss of wetlands.

5.0 Risk Assessment Approach

Tables 4 to 6 identify known negative and positive risks associated with climate change projections for the Dunedin city region. In completing the risk assessment for these potential climate change impacts reference has been made to the Australian and New Zealand Standards AS/NZ ISO 31000:2009[3] and Australian Standard AS 5334-2013[4]. Both these standards utilise a 'likelihood and consequence' approach to risk assessment.

Table 6 provides generic likelihood ratings for recurrent risks and long term risks occurring. Table 7 contains suggested generic consequence criteria and levels. These levels represent the potential consequences of climate risks in relation to service delivery, asset and infrastructure integrity and economic impact.

Table 8 presents the proposed risk rating which combines likelihood and consequences levels.

Note: it is acknowledged that Tables 6, 7 and 8 are not consistent with those used within DCC's 2GP document. This was discussed with DCC staff, and agreed that further discussion would be required in this regard, and that the proposed tables were appropriate for this study.

[3] AS/NZS ISO 31000:2009 Risk Management – Principles and guidelines
[4] AS 5334-2013 Climate Change adaption for settlements and infrastructure – A risk based approach

Table 6 Risk assessment likelihood level definitions (Source: Table C1, AS 58334-2013 Climate Change adaptation for settlements and infrastructure – a risk based approach)

Level	Level descriptor	Description	Recurrent of event risks	Long term risks
5	**Almost Certain**	Could occur several times per year	Has happened several times in the past year and each of the previous 5 years *OR* could occur several times per year.	Has a greater than 90% chance of occurring in the identified time period if the risk is not mitigated.
4	**Likely**	May arise about once per year	Has happened at least once in the past year and in each of the previous 5 years *OR* may arise about once per year.	Has a 60–90% chance of occurring in the identified time period if the risk is not mitigated.
3	**Possible**	May arise once in 10 years	Has happened during the past 5 years but not in every year *OR* may arise once in 25 years.	Has a 40–60% chance of occurring in the identified time period if the risk is not mitigated.
2	**Unlikely**	May arise once in 10 years to 25 years	May have occurred once in the last 5 years *OR* may arise once in 25 to 50 years.	Has a 10–30% chance of occurring in the future if the risk is not mitigated.
1	**Rare**	Unlikely during the next 25 years	Has not occurred in the past 5 years *OR* unlikely during the next 50 years	May occur in exceptional circumstances, i.e. less than 10% chance of occurring in the identified time period if the risk is not mitigated.

Table 7 Description of consequence for the risk assessment (Source: New Zealand Climate Change Office (NZCCO). 2004. Coastal Hazards and Climate Change. A Guidance Manual for Local Government in New Zealand. 1st edition. 2nd edition revised by Ramsay, D, and Bell , R. (NIWA)).

Level	Consequence Level	Description
5	**Catastrophic**	• Huge financial losses involving many people and/or corporations and/or local government • Large long-term loss of critical services / infrastructure / facilities • Permanent loss of many homes; large-scale loss of employment • Complete or near-complete loss of an important natural env. • Loss of life or serious injury
4	**Major**	• Major financial losses for many individuals and/or a few businesses • Some long-term impacts on critical services / infrastructure • Some homes permanently lost • Major degradation of an important natural environment • Serious injury
3	**Moderate**	• High financial losses, probably for multiple owners • Disruption of critical services / infrastructure / facilities for several days; people displaced from their homes for several weeks; major impacts on valued natural environment
2	**Minor**	• Moderate financial losses for small number of owners; disruption of services / infrastructure / facilities for a day or two; moderate distress to some individuals; some impacts on significant natural environment
1	**Insignificant**	• Minimal financial losses; short-term inconvenience

Table 8 Risk rating matrix

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain	L	M	H	E	E
Likely	L	M	M	H	E
Possible	L	L	M	H	E
Unlikely	L	L	M	M	H
Rare	L	L	L	M	M

E = Extreme risks demand urgent attention at the most senior level and cannot be simply accepted as a part of routine operations without executive sanction.

H = High risks are the most severe that can be accepted as a part of routine operations without executive sanction but they will be the responsibility of the most senior operational management and reported upon at the executive level. These high risks will be subject to ongoing research and planning.

M = Medium risks can be expected to form part of routine operations but they will be explicitly assigned to relevant managers for action, incorporated into design standards and maintenance of assets, maintained under review and reported upon at senior management level.

L = Low risks will be maintained under review but it is expected that existing controls will be sufficient and no further action will be required to treat them unless they become more severe.

6.0 Summary of priority risks

A workshop was held with a range of DCC staff on 18 September 2016. The purpose of this workshop was to evaluate the range of risks identified, and provide an initial 'first-cut' risk rating to aid in prioritisation. Attendees at the workshop were from a range of Council departments including: risk management, policy and planning, transportation, infrastructure, and parks.

The sections below summarises the key risks discussed and considered to be priorities across each of the categories.

Risks were given a 'subjective' rating of likelihood and consequence based on expected climate impacts in 2090. Where there was significant uncertainty around the likelihood component, these were ranked as 'possible' (3).

6.1 Cropping and horticulture

Given the lack of specific sector knowledge within the workshop attendees, no ratings were given to risks associated with climate impacts on cropping and horticulture. These include risks such as potential for increased incidence of pests and diseases, reduced evapotranspiration, reduced water availability etc. Further assessment is required in this regard.

6.2 Pastoral agriculture

Similar to above, there was little specific agricultural expertise within the workshop. A number of risks were thought to be of higher priority, however the group overall felt that it would be unwise to elevate certain risks without further investigation and detailed work with experts. Broadly speaking, the following risks were deemed important: those associated with future declines in productivity, increases in drought and associated water demand, increased groundwater salinity affecting lowland pastures (Taieri and Waikouaiti), increased risk of inundation and erosion from coastal effects in lowland areas, potential for heat stress on animals.

All of the above were thought to be at least 'possible' (refer Table 6) and the consequences 'moderate' to 'major' (Table 7). This results in a 'medium' to 'high' risk level for all of these risks.

6.3 Forestry

While there was limited *specific* expertise within the group regarding forestry, members of the Parks department were present and offered some useful assessment of the risks identified. The following were thought to be of higher priority.

Risk Categories	Potential risk implication	Risk to 2090			COMMENT
		C	L	Risk	
Forestry	- Increase in pests, fungal diseases and weed growth as a result of higher temperatures	5*	3	H	Requires further research
	- Increased fire risk as a result of higher temperatures and increased incidence of drought.	4	4	H	

** Further research required due to uncertainty around likelihood of occurrence. However, high consequence of associated with this risk.*

6.4 Human health and vulnerable populations

There was a reasonable level of awareness among the attendees in regard to some areas/communities which may be more vulnerable to certain climate impacts – particularly those relating to flooding and coastal effects. These risks are summarised below, however it is acknowledged that further, more detailed work would be required.

Risk Categories	Potential risk implication	Risk to 2090			COMMENT
		C	L	Risk	
Human health and vulnerable populations	- Summer heat related deaths likely to increase (very low current rates)	4	3	H	Requires further research
	- Increase intensity and frequency of food and water borne diseases and insect borne	5*	2	H	Requires further research
	- Increase in size and extent of flood plains around urban streams and plains – in particular: Lindsay Creek, Water of Leith (incl Dunedin North), Kaikorai Stm, Taieri Stm (Mosgiel, Airport) – with potential to affect people, property and infrastructure.	4	4	H	Note Lindsay Creek catchment contains 3 schools, a hospital and a rest home. Kaikorai catchment contains industrial areas and a secondary school.
	- Increased coastal erosion and associated costs for protection of the coastline (particularly around South Dunedin coastline and Blueskin Bay).	4	4	H	
	- Low lying coastal communities affected by increasing groundwater levels (South Dunedin, Lower Taieri and Dunedin Airport, Waikouaiti)	4	4	H	Requires further evaluation
	- In South Dunedin there are significant vulnerabilities: 8 rest homes, 18 education facilities (early childhood through to high school), Edgar Centre, Marne St. Hospital, and number of churches are at risk.	5	4	E	South Dunedin is a priority area.

** Further research required due to uncertainty around likelihood of occurrence. However, high consequence of associated with this risk.*

6.5 Energy resources

Only one risk was identified in this section – relating to increased summer energy demand for cooling. This was not considered to be a priority risk by the group.

6.6 Water resources

There was reasonable understanding of the risks posed to water resources and those deemed to be priority risks are summarised below.

Risk Categories	Potential risk implication	Risk to 2090			COMMENT
		C	L	Risk	
Water Resources	- The increase in groundwater levels in areas where geology (e.g. sandy soils) is more susceptible to liquefaction increases the likelihood of liquefaction occurring.	4*	3	H	Further research required.
	- Increase of salt water intrusion to groundwater or potable water supplies of low lying coastal areas (Lower Taieri and Dunedin Airport)	5	4	E	
	- Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (Mosgiel)	5	4	E	Note bores at Mosgiel contribute approx 30% to total city supply and are therefore considered a priority.
	- Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (Brighton, Waldronville, Waitati, Waikouaiti, Warrington, Karitane).	4*	3	M	Likely impact of this is on salination of ground potentially impacting on community crops and gardens etc. Few bore supplies are in these areas.
	- Increase of salt water intrusion to groundwater and potable water supplies of low lying coastal areas (South Dunedin)	3	5	H	Likely impact of this is on salination of ground potentially impacting on community crops and gardens etc. Few bore supplies are in these areas.
	- Increase risk of groundwater contamination from onsite wastewater treatment systems (e.g. Harwood and Long Beach) with rising groundwater levels.	4*	3	H	Further research required due to uncertainty around likelihood of occurrence.

** Further research required due to uncertainty around likelihood of occurrence. However, high consequence of associated with this risk.*

6.7 Critical infrastructure and facilities

There was good understanding of the risks posed to critical infrastructure and facilities - including water supply, wastewater, and roading assets. The following table summarises those deemed to be the first-cut priority risks.

Risk Categories	Potential risk implication	Risk to 2090			COMMENT
		C	L	Risk	
Critical infrastructure and facilities.	- Increased risk of flooding to property and infrastructure in priority catchments: refer Section 6.4. (Stormwater and wastewater systems struggle with increased rainfall intensity).	4	4	H	
	- Dunedin Airport (Taieri Plain) is low lying and lies adjacent to the Taieri Stream River which will become more tidal, threatening flooding and salinity	4	5	E	Dunedin Airport is low lying and is a critical regional facility that may require further assessment in the future.
	- State Highway 1 and other harbour side roads (including Portsmouth Dr, Aramoana Rd, Portobello Rd), impacted by flooding, storm surge, and king tides.	3	5	H	
	- Sections of rail line where it is adjacent to the coast will be impacted by storm surges, king tides and flooding. Including sections of main trunk, and rail line to Port Chalmers.	3	4	H	
	- Light industry located in low lying and reclaimed areas affected by flooding more frequently (South Dunedin - including Harbourside)	4	4	H	

6.8 Ecosystems

Risks to ecosystems were discussed in detail during the workshop, with particular input from those staff from the Parks department. The following were considered to be priority risks worthy of further investigation.

Risk Categories	Potential risk implication	Risk to 2090			COMMENT
		C	L	Risk	
Ecosystems	- Change to phenology (seasonal activities) such as flowering, breeding, growth and migration	4*	3	H	Further research required due to uncertainty around likelihood of occurrence.
	- Fragmented, small areas of conservation in and around Dunedin City will exacerbate climate change impacts due to constrained migration links	4*	3	H	Further research required due to uncertainty around likelihood of occurrence.
	- Ocean acidification and warmer waters will decrease plankton productivity and diversity	4*	3	H	Further research required due to uncertainty around likelihood of occurrence.
	- Cool-water fish recruitment will decrease	5*	3	E	Further research required due to uncertainty around likelihood of occurrence.
	- Landward migration of coastal ecosystems will change coastal fisheries, and inshore sub-tidal breeding and nursery areas. Freshwater ecosystems will also be affected by encroaching salt water intrusion.	4*	3	H	Further research required due to uncertainty around likelihood of occurrence.
	- Loss of wetlands.	5*	3	E	Further research required due to uncertainty around likelihood of occurrence.

** Further research required due to uncertainty around likelihood of occurrence. However, high consequence of associated with this risk.*

7.0 Summary discussion and next steps

As a result of the workshop a number of priority climate risks have been identified across the various risk areas. The likelihood and consequence of each risk was evaluated subjectively by workshop participants – with varying degrees of confidence being expressed in relation to the ability to apply these ratings.

Of particular note are those risks which have more than one 'likelihood' component associated with it. For example, the likelihood of sea level rise causing increased ground water salinity which in turn may impact on ecosystems or horticulture. These chains of impacts are inherently difficult to assess precisely, however are, nonetheless, important to identify and assess.

Conversely, those risks which are a *direct* risk from, say, sea level rise or flooding, are less problematic to assess and as such there is more perceived certainty and confidence in applying risk ratings.

As a result of the above, and where significant uncertainty remains around the 'likelihood' component, those risks with a particularly high consequence have also been flagged for further research.

In terms of the Compact of Mayors requirements, this initial summary risk assessment should provide the level of detail necessary for compliance and also provide direction for further detailed work going forward.

It is recommended that DCC consider more detailed work which refines the risk assessment and utilises knowledge from appropriate sector specialists to better understand the nature of the risks posed and, then to develop more specific adaptation options.

In regards to adaptation, a number of options are currently being considered by DCC, particularly in relation to:

- Dunedin South, and the current and future risk regarding sea level rise and inland flooding.
- Coastal erosion along the South Dunedin coastline (e.g. St Clair and St Kilda).

DCC has commissioned a number of studies and reports which address these risks, and are continuing to investigate options with community.

It is noted that in DCC will need to consider both the type of adaptation option, and also the timing of implementation. That is, should initiatives be implemented now, or revisited at a future date when more information is available, and what are the risks in delaying implementation.

The following are summarised as key next steps:

- Potential broader discussion around an appropriate risk framework to utilise for both climate risk and natural hazard risk management. It is important that the framework and criteria used are mutually agreed across Council departments. This may, for example, involve a common high level framework, with specific consequence/likelihood tables for different applications.
- Further analysis and prioritisation of those climate risks which require more specialist input.
- Development of adaptation options, where possible, for the priority risks.

Appendix A

Summary of coastal hazards

Coastal hazards

As summarised from ORC Coastal Hazards and MWH Methodology to Determine Minimum Floor Levels.

Sea Level Rise in 2040 and 2090 – the hazard associated with an increase in MHWS by 0.3m (2040) to up to 1.6m (2090)

Land Instability Hazard –land instability as a result of other hazards (e.g. flooding) and includes slips, subsidence, and liquefaction

Erosion Hazard – includes physical erosion of land on the coast

Storm Surge Hazard

Flooding Hazards – related specifically to surface runoff and groundwater level increases

Population Vulnerability – measured by the extent of development at risk, exposure of critical infrastructure at risk, area demography, population permanency and density

Coastal Area	Sea Level Rise	Land Instability Hazard	Erosion Hazard	Storm Surge	Flooding	Population Vulnerability
Brighton and Ocean View	✓	✓	✓	✓	✓	Low
Waldronville and Westwood	✓	✓		✓	✓	Low
South Dunedin and Upper Otago Harbour	✓	✓		✓	✓	High
Ocean Grove	✓	✓		✓	✓	Low
Otago Peninsula South Coast (Smaill's Beach to Victory Beach)			✓	✓		Low
Mid Otago Harbour (St Leonards to Deborah Bay and Macandrew Bay to Lower Portobello	✓			✓	✓	Medium
Harwood, Otakou, TeRauone	✓	✓	✓	✓		Low
Aramoana and Te Ngaru		✓	✓	✓	✓	Low
Heyward Point to Long Beach	✓	✓	✓	✓	✓	Low

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Coastal Area	Sea Level Rise	Land Instability Hazard	Erosion Hazard	Storm Surge	Flooding	Population Vulnerability
Purakaunui	✓			✓	✓	Low
Waitati	✓	✓		✓	✓	Medium
Warrington and Evansdale	✓	✓	✓	✓	✓	Low
Karitane		✓	✓	✓	✓	Low
Waikouaiti		✓	✓	✓	✓	Low
Pleasant River Mouth		✓	✓	✓	✓	Low

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Appendix B

Workshop attendees

Appendix B Workshop attendees

The following DCC staff attended the workshop held on 27 September 2016.

- Charlotte Flaherty
- Mick Ball
- Mitchell Turner
- Ashley Reid
- Sarah Valk
- Andrew Slater
- Hamish Orbell
- Jessie Wu

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Minute Extract Council 28 March 2017

A report from Community and Planning provided an update on work to ensure Dunedin would meet its requirements for participating in the Compact of Mayors. Work had been completed on the city-wide Greenhouse Gas Emissions Inventory (Attachment A) and the Climate Hazards and Risks Assessment (Attachment B), and both were ready to be submitted to meet compliance.

The Senior Policy Analyst and Mr Maurice Marquardt from AECOM New Zealand Ltd, the author of one of the attached reports, responded to questions from Councillors and commented on the reports.

Moved (Cr Aaron Hawkins/Cr Kate Wilson):

That the Council:

a) **Approves** the Greenhouse Gas Inventory Report and Risks Assessment Report for submission to the Compact of Mayors.

Division

The Council voted by division.

For: Crs David Benson-Pope, Rachel Elder, Christine Garey, Doug Hall, Aaron Hawkins, Marie Laufiso, Damian Newell, Jim O'Malley, Chris Staynes, Conrad Stedman, Kate Wilson and Mayor Dave Cull (12).

Against: Crs Mike Lord, Lee Vandervis and Andrew Whiley (3).

The division was declared CARRIED by 12 votes to 3

Motion carried (CNL/2017/001)