Costs and Benefits of Climate Change Adaptation Options for Community Assets: Final report

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Author/s	Mitchell Perry Boris Lam Stephanie Doumtsis
Checked	Lili Pechey
Approved	Jim Binney

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Contact

Jim Binney
Director
Natural Capital Economics
jim.binney@nceconomics.com

Report Authors

Mitchell Perry, Boris Lam, Stephanie Doumtsis Lili Pechey, Jim Binney

EXECUTIVE SUMMARY

Background

Climate change is already impacting community assets and wellbeing across Victoria. This includes local government assets like buildings, roads, drainage, and natural assets as well as built assets in natural areas.

Understanding the impacts of climate change on community assets can be complicated. This can be due to the uncertain[1] nature of future climate variables and their impacts on climate hazards. Further uncertainty arises due to missing or inadequate data on existing assets or when there is a need to understand impacts on natural assets, like trees and parkland. These factors make it difficult for councils to quantify the negative impacts from climate change on assets and in turn to demonstrate the benefits of climate change adaptation options.

Being unable to demonstrate the benefits of adaptation makes it difficult for local government to identify, compare and implement economically viable adaptation options. It also makes it difficult to demonstrate value for money and to obtain funding from State and Federal Government for adaptation. These factors limit early intervention on climate change and limit the ability of local governments to perform their legal obligation to manage climate related risks[2] to community assets.

To better prepare for climate change, the Department of Environment, Land, Water and Planning (DELWP) has prepared six place-based Regional Adaptation Strategies (RAS). These five-year strategies are being developed to provide a long-term framework to enable adaptation across Victoria.

This project is a key deliverable under the RAS for Greater Melbourne Region and will assist the Greater Melbourne area by establishing a framework and data to demonstrate and determine the most the beneficial adaptation options for communities. The framework primarily focusses on adaptation to the climate hazards of inland flooding, coastal flooding, sustained higher temperatures, bushfires, heatwaves, droughts, and severe storms (i.e. a combination of both acute and chronic climate hazards).

This report and its associated primary output, the *Cost-Benefit Analysis Framework (the Framework)* can be used to drive future cost-benefit analysis (CBA) work. In doing so, it will assist councils in understanding the negative implications of climate change for their community, support evidence-based decision making and enable quicker action to build climate resilience.

Approach and Findings

This project involved several stages which were completed over 5 months and worked to inform the development of the Framework. The first stage of the project was to perform a desktop review of reports and data sources with relevance to the project. This review found that a range of data already exists in the public domain which could be used to assist councils in performing high-level cost-benefit analysis of adaptation options for community assets. However, use of such information would not be as reliable as council-specific data.

The next stage of the project involved sending a request to councils to collect and understand the data they hold on buildings, roads, drainage, and natural assets as well as their built assets in natural areas. This included data on the number, size, replacement cost and maintenance costs of assets This

[1] The uncertainty of future climate projections is driven by unknowns associated with the levels of future emissions, the natural variability of the climate and the climate response to changes.

[2] Under the Local Government Act 2020 and the Climate Change Act 2017, Local Governments have a legal responsibility to manage climate risks for community assets.

data was then used to build asset and cost profiles to provide a store of data for use in future analysis. Asset profiles are a summary of key information of each council's assets while cost profiles provide a summary of recent capital, operational and maintenance expenditure for each asset class for each council.

Based on this work, it was found that councils generally hold detailed data on built assets such as buildings, roads, and drainage and that a high proportion of these assets are captured in council spatial data (GIS). In contrast, councils have less detailed data regarding their natural assets and built assets in natural areas. Examination of publicly available spatial data sets is recommended as a means of collecting more data on these assets than was able to be provided by councils.

A survey was issued to council representatives to understand the quality of their asset data for the five asset categories. The survey was also used to investigate councils' understanding of climate risks relevant to their municipality, the extent that any adaptation actions have been planned or are currently being undertaken and councils' ability to effectively manage climate risks. It was found that while many councils are able to identify the climate hazards that are relevant to their community, there is significant variation in the level of preparation that councils have undertaken to make their assets more resilient to climate hazards. Based on survey responses and data collection, councils are generally more equipped to develop climate risk management plans for built infrastructure (such as buildings, roads, and drainage) because they have more high quality data on hand for these assets compared to natural assets and built assets in natural areas.

Three consultation sessions with participating councils were held by video-conference. The sessions were broken down by asset class with one session dedicated to each of: buildings (30 attendees from 14 councils), roads and drainage (37 attendees from 13 councils), and natural assets and built assets in natural areas (32 attendees from 32 councils). Councils were generally found to have adequate data on road and building assets, which can be used to help inform management and decision making in the face of climate change. However, data on drainage, natural (e.g. conservation reserves and park trees) and built assets in natural areas was generally regarded as not being sufficiently detailed to inform decision making at this stage. Refinement of all asset data to include attributes such as age, condition, life expectancy, maintenance cost and operational costs is viewed as vital by councils and will need to be completed to inform climate change adaption management decisions.

Gap Analysis

Based on the work completed across each stage of the project 3 key gaps in data and information which may limit the use of the CBA framework and the implementation of climate change adaptation options include:

- A lack of readily accessible information for councils to perform a quantitative risk assessment. In particular, most councils appear to be missing information on the likelihood of climate hazard events which will affect assets. This will limit councils' ability to implement the Framework and assess adaptation options.
- Incomplete data on natural assets. This includes basic data on the assets as well as data on asset values. A lack of data for these assets will limit the inclusion of benefits derived from protecting natural assets in the assessment of adaptation options. This gap may can be addressed in part through the use of publicly available spatial data sets (e.g. Data Vic or Vicmap).
- Councils' concerns about a lack of confidence in their internal capacity to manage and make decisions in the face of climate change.

Recommendations

Based on the findings across each stage of the project, a set of 8 recommendations are made with a view to enhancing the ability of councils to use the *Cost-benefit Analysis Framework*:

1. Test the Framework at the local scale (i.e. for a single council). This would provide the opportunity to test the method, develop further guidance and improve 'user-friendliness'.
2. Develop tools to assist councils in implementing the Framework.
3. Improve capacity to understand and assess climate risk through programs which are designed to improve councils' capacity to adapt to climate change over the long term.
4. Enhance and collate data on hazard likelihoods at the local scale to provide councils with the required inputs into quantitative risk assessment. This could include consideration of coincidence hazards.
5. Enhance council asset profiles developed as part of the project and underlying asset data.
6. Enhance council cost data
7. Enhance natural asset data.
8. Perform further work to understand the impact of climate change on natural assets and the benefits they provide.

CONTENTS

1 PROJECT OVERVIEW

Acknowledgement

This project has been overseen by a working group consisting of representatives from the Northern Alliance for Greenhouse Action (NAGA), the Eastern Alliance for Greenhouse Action (EAGA), the Western Alliance for Greenhouse Alliance (WAGA) and the South East Councils Climate Change Alliance (SECCCA), and the Department of Environment, Land, Water and Planning. Furthermore, the project has benefited from the participation of asset managers, sustainability officers and other staff within individual councils, who assisted with the provision of asset and cost data, and whose contributions helped to ground this project in reality.

1.1 Background and context

Climate change is already impacting community assets and wellbeing across Victoria. This includes local government assets like buildings, roads, drainage, and natural assets as well as built assets in natural areas.

Understanding the impacts of climate change on community assets can be complicated. This can be due to the uncertain[3] nature of future climate variables and their impacts on climate hazards. Further uncertainty arises due to missing or inadequate data on existing assets or when there is a need to understand impacts on natural assets, like trees and parkland. These factors make it difficult for councils to quantify the negative impacts from climate change on assets and in turn to demonstrate the benefits of climate change adaptation options.

Being unable to demonstrate the benefits of adaptation makes it difficult for local government to identify, compare and implement economically viable adaptation options. It also makes it difficult to demonstrate value for money and to obtain funding from State and Federal Government for adaptation. These factors limit early intervention on climate change and limit the ability of local governments to perform their legal obligation to manage climate related risks[4] to community assets.

A lack of quantitative data on the costs of climate change and the benefits of adaptation may also prevent some councils from understanding the need for climate change adaptation. As such, they are unlikely to put in place processes to collect the necessary data to perform analysis of adaptation options. This will make future analysis of adaptation options more difficult.

To better prepare for climate change, the Department of Environment, Land, Water and Planning (DELWP) has prepared six place-based Regional Adaptation Strategies (RAS). These five-year strategies are being developed to provide a long-term framework to enable adaptation across Victoria.

This project is a key deliverable under the RAS for Greater Melbourne Region and will assist the Greater Melbourne area by establishing a framework and data to demonstrate and determine the most the beneficial adaptation options for communities. The framework will focus primarily on adaptation to the climate hazards of inland flooding, coastal flooding, bushfires, heatwaves, droughts, and severe storms.

This report and its associated primary output, the *Cost-Benefit Analysis Framework (the Framework)* can be used to drive future cost-benefit analysis (CBA) work. In doing so, it will assist councils in

[3] The uncertainty of future climate projections is driven by unknowns associated with the levels of future emissions, the natural variability of the climate and the climate response to changes.

[4] Under the Local Government Act 2020 and the Climate Change Act 2017, Local Governments have a legal responsibility to manage climate risks for community assets.

understanding the negative implications of climate change for their community, support evidence-based decision making and enable quicker action to build climate resilience. The Framework also provides an incentive to councils to collect accurate data, including on the impacts of climate change, as it will assist in determining the benefits of adaption more accurately.

1.2 Aims and objectives

The purpose of this project is to assist councils across Greater Melbourne in developing a CBA framework for five major asset classes – buildings, roads, drainage, natural assets, and built assets in natural areas. This framework will allow councils to develop an understanding of how to conceptualise the costs of climate change on community assets and to begin taking steps towards adopting the most cost-effective adaptation measures.

Alongside developing the Framework, this project aims to:

- Identify sources of quantitative estimates of the monetary impacts of climate change on community assets and infrastructure owned and managed by all councils within the Greater Melbourne region.
- Consult with stakeholders to assess the extent and quality of existing data and information relevant to these assets and explore emerging trends and needs.
- Compile data from councils to characterise and profile each asset class and establish current and historical baseline costs for asset renewal for each council.
- Identify data and information gaps and develop a clear methodology for addressing gaps.
- Make recommendations for undertaking subsequent cost benefit modelling and prioritising key opportunities.

2 APPROACH

The following section details the approach used for each stage of the project, which was delivered over a five-month period, commencing in July 2021.

2.1 Desktop review

A desktop review of several reports and data sources with relevance to the project was undertaken. A full list of the reports and data reviewed is included in Table 1, with additional detail provided in the document references.

Table 1. Reports and data reviewed as part of the project desktop review

Title	Author
Asset Vulnerability Assessment[5]	South East Councils Climate Change Alliance
First Pass Climate Change Asset Vulnerability Assessment	City of Melbourne
Resilient Emergency Relief Centres	Eastern Alliance for Greenhouse Action
Exploratory Study: researching the costs of climate impacts on public and private buildings, energy supply systems and the urban forest	Eastern Alliance for Greenhouse Action
Urban Environmental-Economic Account for Melbourne	Department of Environment, Land, Water and Planning
Council annual reports[6]	Various Councils across greater Melbourne
Local Government Assets: Asset Management and Compliance	Victorian Auditor General's Office
Climate Measurement Standards Initiative	Climate-KIC Australia
Example council data[7]	Various – Councils of greater Melbourne
Local Government Victoria's (LGV) indicators relating to asset renewal and upgrades	Know Your Council
Rawlinsons' Construction Cost Guide 2020	Rawlinsons
Data Vic spatial data	Data Vic
Melbourne Water spatial layers	Melbourne Water

[5] The desktop review included a review of the input data collected for the Asset Vulnerability Assessment. Projects. Output data were not available during delivery of the current project.

[6] As part of the desktop review, a selection of annual reports from Councils across greater Melbourne were reviewed to understand existing data and reporting.

[7] As part of the project, a selection of existing Council data was provided to inform the data request by illustrating the type/format of data some councils hold.

The desktop review was undertaken to determine the applicability of existing data and information for use in future climate change adaption focused CBA. An understanding of existing data also informed the development of the CBA framework.

Most information and data was assessed for applicability using four criteria: scope, relevance, quality and coverage (see Table 2). For publicly available spatial data, the review focused on determining what asset information could be collected independently of councils.

Table 2. Criteria for assessing the applicability of existing data for use in climate change adaption CBA

Criteria	Key Question
Scope	Does this data cover all in-scope Council assets?
Relevance	Would the data assist in performing cost-benefit analysis associated climate change adaptation?
Quality	Would the data enable accurate quantification of the costs of climate change or benefits of adaption? E.g., Timeliness, Accuracy, Frequency
Coverage	Is the data of use to a broad range of councils?

The findings of the desktop review were compiled and presented to the project control group (PCG). Key findings from the desktop review are discussed in section 3.1 and the full presentation is provided in Attachment A.

IPWEA Practice Note 12.1 – Climate Change Impacts on the Useful Life of Infrastructure

A review was conducted on the IPWEA Practice Note 12.1 (IPWEA, 2020). This document can be considered as an introductory guide for asset managers to qualitatively understand climate change impacts and how to incorporate them into estimates of built asset useful life until 2100.[8] Practice Note 12.1 considers six climate change impacts:

- Increased temperatures and heatwaves,
- Increased rainfall and floods,
- Decreased rainfall and droughts,
- Sea level rise and saltwater intrusion,
- Increases in bushfire weather intensity, and
- Changes to high wind and cyclonic events.

Relevance to project

Adaptation measures are briefly described and there are three measures – 'Accommodate, Protect, and Retreat' recommended for each climate impact. For example, the 'Accommodate' recommendation for increased bushfire weather is for infrastructure to be constructed using fire resistant materials. The 'Protect' option suggests using firebreaks or covering fire sensitive material with fireproofing materials. The 'Retreat' option suggests evacuating moveable pieces of infrastructure in case of a fire.

The document also discusses where to find further information on climate impact modelling. This consists of data, reports, and climate models in the Australian context. An example is the Climate Change in Australia website and Report which has detailed information on climate model outputs in accessible graphical formats for a range of emissions scenarios and time periods.

The practice note includes a decision tree worksheet to help asset managers to identify which climate impacts councils' assets are exposed to. It can be used as a starting point for future impact analysis.

[8] It is to be used in conjunction with IPWEA Practice Note 12.

2.2 Data request

A data request was sent to 31 councils across greater Melbourne to collect data on council-owned building, roads, drainage, and natural assets as well as built assets in natural areas. The request was in the form of an MS Excel workbook with a sheet dedicated to each asset class. Additional sheets sought aggregate expenditure data on each asset class and provided basic instructions. An explanation about how to respond the data request was also provided in two webinars with council representatives.

The collected data was used to develop asset and cost profiles. These are further explained in sections 2.3 and 2.4 of this report. The data also informed the development of the CBA framework by providing an understanding of the amount and quality of data held by councils regarding their assets.

The data request is provided in Attachment B to this report. Key findings relating to the collected data are discussed in sections 3.2 and 3.3.

2.3 Development of asset profiles

The data collected from councils was used to develop asset profiles for each council. These profiles were created by summarising the asset data provided by each council into a single table to provide a holistic view of each council's assets and associated data. The individual asset profiles were incorporated into the completed data requests provided by each council to form a single source of information.

Where possible, asset profiles presented data by asset type on:

- Number of assets (i.e. count)
- Size of assets (e.g. sqm)
- Replacement value of assets ($)
- Average annual maintenance cost of assets
- Proportion of asset data included in asset management systems
- Proportion of assets represented in a council's spatial data (e.g., Geographic Information System (GIS) layers)
- A rating, as provided by councils, on the quality of the asset data provided

Representative asset profiles were also developed for each of the Greenhouse Alliance areas. They present representative information, based on the data from the councils within each Alliance area. They were developed by analysing the data to determine the lowest, average, and highest values for asset-related variables.

By providing an overview of council assets and attributes, the individual asset profiles provide the data necessary to perform high level climate change adaptation CBA for each council. When aggregated, the individual council profiles could be used to perform a region wide CBA. The representative asset profiles supplement the individual asset profiles to provide representative data for use when an individual council's own data is unavailable or unreliable.

The representative asset profiles for each of the four Greenhouse Alliances are provided as Attachment C to this report. Key findings from the development of asset profiles are discussed in section 3.2

2.4 Development of cost profiles

The data collected from councils was also used to develop cost profiles for each council. The cost profiles were created by summarising the financial data provided by each council into a single table to sit alongside the asset profiles. Where possible, cost profiles presented data by asset class on:

- 3-year average annual capital expenditure
- 3-year average annual operational expenditure
- 3-year average annual maintenance expenditure
- 3-year average annual asset renewal expenditure

These averages represent the 'present-day' estimation of costs. Asset renewal expenditure was derived from capital expenditure based on proportions expressed in each council's annual report.

The cost profile data was used to develop a cost forecast using three annual growth scenarios (low, mid and high). The midpoint estimate of growth in expenditure for each council was aligned to expected growth in population in each LGA between 2018 and 2036 obtained from DEWLP (2019-a). The low and high scenarios reflect ±20% of this value. These forecasts represent the business-as-usual scenario for councils in term of expected expenditure, that is, without consideration of expenditure on adaptation options.

Recent council data on expenditure was collected but not able to be used to forecast future expenditure due to the 'lumpy' nature of the data. Furthermore, as is consistent with DEWLP (2019-b), a downward trend was identified in some cases, which may not be realistic over the long term. It is for these reasons that expenditure was forecast based on growth in population.

The relationship between population growth and asset expenditure growth is imperfect. However, population growth is a clear driver of demand for assets as well as council revenue through rateable assessments (DEWLP, 2019-b). Population growth may also impact proportionate spending, with councils with higher population growth rates likely to spend more on new assets than asset renewal by comparison to councils with slower population growth rates (VAGO, 2019). The VAGO note that population growth and service level data can be used to ensure capital planning decisions meet community need (VAGO, 2019).

The costs forecasts do not take account of future changes in expenditure due to future changes in the climate brought on by climate change. However, as the starting point is based on current expenditure, they take account of existing climate change impacts on expenditure. The ability to consider climate change in cost forecasts was limited by a lack of data on how climate change will alter expenditure over the long term. This lack of data on the impacts of climate change on expenditure was consistent with findings from the survey of councils. If and when data is available, it could be incorporated into cost forecasts.

Representative cost profiles and cost forecasts were also developed for each of the Greenhouse Alliances. Like the representative asset profiles, they present representative information, based on the data collected from the councils within each Alliance area. The growth scenarios are consistent across representative cost forecasts, and are based on the average rate of population growth expected between 2016 and 2056 in greater Melbourne.

By providing an overview of a council expenditure, the individual cost profiles provide data which can be used to inform a high-level climate change adaptation CBA. The cost forecasts provide insights into future expenditure under a business-as-usual scenario. The representative cost profiles and forecasts supplement this information by providing representative data for use when an individual council's own data is unavailable or unreliable. The cost forecasts can be amended to test alternative growth scenarios.

The representative cost profiles and cost forecasts for each of the four greenhouse alliances are provided in Attachment C to this report. Key findings from the development of cost profiles are discussed in section 3.3.

2.5 Survey

A survey was issued to council representatives to identify the quality of their asset data for five asset categories – buildings, roads, drainage, natural assets, and built assets in natural areas. Respondents were primarily asked about:

- The level of understanding that their council currently has about potential future climate impacts
- The area/number of assets captured spatially in a Geographic Information System (GIS)
- Whether councils were undertaking any works to make assets more resilient to climate change
- The extent that councils currently consider climate risks and have conducted risk assessments for the relevant assets
- Whether councils have sufficient internal capacity to manage climate risks to exposed assets
- The level of accuracy and quality at which asset data was recorded
- The scale at which maintenance costs were increasing because of climate change

These questions were used to investigate councils' understanding of climate risks relevant to their municipality, and the extent that any adaptation actions have been planned or are currently being undertaken. The full survey is contained in Attachment E, along with summarised responses (Attachment F). The key findings from the survey are discussed in section 3.4

2.6 Consultation

Three consultation sessions with participating councils were held by video-conference. The sessions were broken down by asset class with one session dedicated to each of:

- buildings
- roads and drainage
- natural assets and built assets in natural areas

The number of attendees and number of councils represented at each session is shown in Table 3.

Table 3. Consultation participation

	Buildings	Roads and drainage	Natural assets and built assets in natural areas
Number of councils represented	14	13	15
Number of attendees	30	37	32

Each session involved an overview of the project's aims and background, an overview of the CBA framework being developed, a high-level overview of the findings from the data collection process as well as the findings from the information collected through the survey.

Attendees were given the opportunity to participate in two group activities as part of the consultation sessions. These activities were conducted using the online whiteboard tool Mural. Using this tool, participants are able to share their thoughts and ideas on a shared, interactive whiteboard.

In each session, the first group activity provided participants an opportunity to state agreement or disagreement with the high-level findings to date and to rate the quality of Council data for the relevant asset to other data held by council. The second of the group activities provided attendees the opportunity to share key challenges they face when making asset management decisions in the context of climate change.

Key findings from the consultation sessions are discussed in section 3.5.

2.7 Gap analysis

As part of the project, a gap analysis was performed to identify information and data gaps that could limit the implementation of the CBA framework. This process began as part of the desktop review and continued across the other stages of the project. Gap analysis was conducted at a high level and based on broad findings across the project rather than being specific to individual councils. The findings from the gap analysis have been synthesised from across the project and are described in section 0.

3 KEY FINDINGS

The following section provides the key findings from each stage of the project.

3.1 Desktop review

The findings from the desktop review of reports and data are presented in Table 4. A traffic light system has been used to visually compare how well the reports and data meet each criterion. Green indicates when a criterion is met, amber indicates when a criterion is partially met, and red indicates when a report did not meet the criterion.

In summary, findings from the desktop review show that a range of data already exists which could be used as part of performing a high-level cost-benefit analysis of adaptation option for community assets. This data includes:

- Publicly available spatial data which could be used as part of understanding the exposure of some community assets. This data is available from Data Vic and Melbourne Water.
- High level asset information on community assets. This data is available from council annual reports, Auditor General reports and Local Government Victoria's (LGV) indicators relating to asset renewal and upgrades.
- Substitute information or data which could be used where specific data on community assets doesn't exist. This data is available from Rawlinson's, EAGA / SECCA studies, DEWLP's Urban Environmental-Economic Account for Melbourne. Using substitute information may limit the accuracy of CBA results.

Generally, the data reviewed was of an acceptable quality for use in high level CBA, with data on built assets being more readily available. To perform a CBA councils would still need to understand the likelihood and extent of climate hazards and the expected impact on (e.g. damage to) community assets.

Table 4. Desktop review findings based on an assessment of data suitability for supporting climate change adaptation CBA

Report	**Organisation**	**Scope** *Does this data cover council assets that are in scope?*	**Relevance** *Could the data assist in performing CBA associated climate change adaptation?*	**Quality** *Could the data enable accurate quantification of the costs of climate change or benefits of adaptation? Timeliness, Accuracy, Frequency*	**Coverage** *Is the data of use to a broad range of councils?*
Asset Vulnerability Assessment	SECCCA	Yes - Buildings, roads, drainage, natural assets.	Highly relevant - The data is expected to be highly relevant.	High quality - The data is expected to be of a high quality coming directly from councils.	Medium coverage - The data focus on specific councils but could be applied to like councils across the region.
First Pass Climate Change Asset Vulnerability Assessment	City of Melbourne	Yes - Buildings, roads, drainage, natural assets, built assets in natural areas.	Highly relevant - The data describes asset vulnerability under different climate change scenarios. - The data provides a ranking of varying levels of asset vulnerability. - The data explores asset vulnerability for assets within each category.	High quality - The data is expected to be of a high quality coming directly from City of Melbourne.	Medium coverage - The data collected focuses on City of Melbourne. The climate information could be relevant across councils. The asset information could be relevant for like councils.
Resilient Emergency Relief Centres	EAGA	Yes - Buildings.	Somewhat relevant - The data describes asset vulnerability and exposure for different climate or weather risks. - The data does not describe asset vulnerability based on distinct climate impacts.	Medium quality - The data describes replacement cost for some assets only. - The data describes adaptation costs and timeline but does so at a high level.	Medium coverage -The data is likely to be relevant to a wide range of councils, but adaptation costs are specific to building assets.

Report	Organisation	Scope	Relevance	Quality	Coverage
Exploratory Study: researching the costs of climate impacts on public and private buildings, energy supply systems and the urban forest.	EAGA	Yes - Buildings, trees.	Less relevant - The data describes asset exposure at an aggregate level and does not provide disaggregated data.	Low quality - Data is available on urban forest benefits but is provided at a high level with little detail.	Medium coverage. - The data describes exposures and damages on a high level, making it hard to disaggregate to an individual council basis.
Urban Environmental-Economic Account for Melbourne	DEWLP	Yes - Natural assets.	Somewhat relevant. - The data does not provide information on asset exposure, but mostly describes how to understand and capture enviro-economic impacts. - It provides information relevant to valuing the benefits of natural assets.	Medium quality - The data provides unit rates that can be used in quantifying ecosystem benefits. - Benefit transfer techniques rely on information from locations outside of Melbourne which impacts accuracy - Accuracy, frequency, timeliness varies across the referenced material.	High coverage - The unit rates could be used by all councils across Greater Melbourne to inform a CBA.
Climate Measurement Standards Initiative	Climate-KIC	Yes - Buildings, roads, drainage, natural assets, built assets in natural areas.	Somewhat relevant - The report provides data on how the projected future climate will impact climate hazards across Australia for multiple climate scenarios and time frames.	High quality - The climate scenario data is based on best available science and is expected to be updated regularly.	Medium coverage - Data is relevant across all councils but not specific to greater Melbourne.

Report	Organisation	Scope	Relevance	Quality	Coverage
Example council data	Councils	Yes - Buildings, roads, drainage.	Highly relevant - The data provides replacement costs for assets. - The data does not describe in detail the assets which are exposed, to what extent they are exposed, and what hazards they are exposed to.	High quality - The data is expected to be of a high quality coming directly from Council.	Medium coverage - Data is specific to one council but could be applied to like councils across the region.
Local Government Victoria's (LGV) indicators relating to asset renewal and upgrades	LGV	Yes - Roads, aggregate capital works.	Somewhat relevant - The cost and condition of road information is useful in understanding replacement costs. - This data does not assist in understanding exposure to climate change risks. - The capital works data is useful in understanding how costs are changing as a result of climate change. However, asset specific information would enable more accurate estimates of benefits of climate change adaptation.	High quality - The data is collected on an annual basis and is specific to each council.	High coverage - Each council is required to provide this information.
Local Government Assets: Asset Management and Compliance (Auditor General reports)	Auditor General	Yes - Buildings, roads, drainage, parks, other infrastructure.	Somewhat relevant - The high-level data on what proportion each asset class represents of the total value across councils will provide usable assumptions to break down high level financial information from councils when more detailed data does not exist.	Medium quality - The data is presented at a high level. - The data/findings are not expected to be updated to reflect new information.	Medium coverage - This study provides high level information on council data practises relevant to all councils. However, findings are based on a small sample size of councils. A larger sample size would improve its applicability to other councils.

Report	Organisation	Scope	Relevance	Quality	Coverage
Council annual reports	Councils	Yes (varies by council) - Roads, drainage, parks, reserves, trees, built assets in natural areas.	Somewhat relevant - This information may enable a high-level summary of each council's assets.	Medium quality - The data is reported on an annual basis and is specific to each council. Date of data collection is not specified and may vary by council.	Medium coverage - Data is not available for all councils. - Data could be transferable between like councils.
Rawlinson's Construction Cost Guide 2020	Rawlinson	Yes - Buildings, roads, drainage, built assets in natural areas.	Somewhat relevant - This information will enable replacement cost values to be determined for a range of built assets when council specific information is unavailable.	High quality - This data is refreshed annually and specific to the region.	High coverage - This information could be used by all councils.

Findings from the review of spatial data are presented in Table 5. Findings identify the assets for which publicly available spatial data exists and for which there are gaps. Such publicly available data could be used to supplement existing council data when performing a climate change adaptation CBA or to expand CBA to include non-council owned assets, which would be likely to provide a more complete picture of the costs and benefits of adaptation. The completeness of each spatial data set has not been verified.

Table 5. Findings from desktop review of publicly available spatial data

Council assets for which publicly available spatial data exists	Other assets for which publicly available spatial data exists	Observed gaps in publicly available spatial data
• Buildings (unidentified polygons and points for 'key features") • Roads • Drainage (pits and pipes) • Natural assets (Public land parcels and marine assets)	• Schools (points only) • Railway infrastructure • Freight networks • Airports and runways • Powerlines • Other waterway infrastructure (Melbourne Water) • LGA boundaries	• Data on built assets in natural areas and trees • Detailed asset information (e.g., what type of building?) • Exposure to climate hazards • Economic/financial data to determine consequences • Spatial data sets are unlikely to cover 100% of each asset class

Key point

Findings from the desktop review show that a range of data already exists which could be used, in addition to councils' specific data, to inform a high-level cost-benefit analysis of adaptation option for community assets.

3.2 Data request and the development of asset profiles

Councils were asked to provide data on their building, road, drainage and natural assets as well as built assets in natural areas. Examples of assets in each category are shown in Table 6.

Table 6. Examples of asset categories

Buildings	Roads	Drainage	Natural assets	Built assets in natural categories
• Commercial • Industrial • Community • Residential • Aquatic centres	• Sealed roads • Unsealed roads • Footpaths • Bridges • Kerbs	• Pipes • Pits	• Rivers • Coasts • Waterbodies and wetlands • Open spaces (parks, gardens, reserves, sports grounds, recreational areas) • Trees	• Park assets • Outdoor furniture • Playground equipment • Open space furniture • Lighting • BBQ facilities • Bike racks

A summary of the findings from the development of the asset profiles is contained in Table 7. The data below is presented in three broad categories – buildings, roads and drainage, natural assets and built assets in natural areas. Further detail about the findings for each asset category are contained below.

Table 7. Findings from the development of asset profiles

Asset category	Summary of findings	Significance for the CBA framework
Buildings	Councils have: • detailed and accurate GIS information on their building assets. • accurate financial information on building assets.	Existing data on buildings: • is ready to be used in asset management decisions including those associated with climate change. • is ready to be used to estimate the consequences of climate change and benefits of adaptation.
Roads and drainage	Councils have: • detailed and accurate GIS information on road and drainage assets. • irregular and variable financial information on their road and drainage assets.	Existing data on roads and buildings: • is ready to be used in asset management decisions including those associated with climate change. • may not be sufficient for all councils to estimate the financial consequences of climate change and to estimate the benefits of adaptation. Some councils may need to rely on high level assumptions or to gather sufficient information for use in the CBA framework.
Natural assets and built assets in natural areas	Councils have: • less detailed data on these asset classes compared to built infrastructure. • readily available data for trees, parks and reserves compared to waterbodies, wetlands, and coastal areas. • irregular and variable financial information for this asset class, with maintenance information being more readily available compared to replacement costs.	Existing data on natural assets and built assets in natural areas: • is less ready to be used in asset management decisions compared to built infrastructure. • is ready to be used for assessing climate impacts and adaptation for trees, parks, and reserves as there is relatively more information for these categories. • is not sufficient for all councils to estimate the financial consequences of climate change and to estimate the benefits of adaptation. Councils may need guidance from the CBA framework to fill gaps in the area including determining replacement values for such assets.

Buildings

Buildings data is generally of high quality, with detailed information recorded by councils within Asset Management Systems (AMS) and GIS. All councils who responded provided detailed data on buildings with the majority of councils reporting that 90-100% of assets were recorded in AMS and GIS. In the majority of cases this included data on asset type, count, footprint size, replacement cost. Some councils were unable to provide annual maintenance cost or annual maintenance cost disaggregated by assets. To fill these gaps, standardised assumptions based on publicly available data and other council information could be used.

Roads

Councils provided detailed data on roads. This included size information, however, across councils, different units of measurement were provided making comparisons difficult (e.g. sqm vs km). One area of data which was limited was replacement value information and annual maintenance. Data for this category was initially requested for sealed and unsealed roads, but councils often provided more detail and included information for other assets such as kerbs and footpaths.

Lack of financial information for NAGA, WAGA and SECCCA councils is a consistent gap which is believed to be attributed to the inability to disaggregate high level data. Annual maintenance data from SECCCA councils for this category was also limited. Most EAGA councils were able to provide cost data.

Drainage

Councils provided detailed data on drainage associated with pipes and pits. They also provided further information about other drainage structures as well as assets associated with Water Sensitive Urban Design (WSUD). Data on annual maintenance cost is limited with some councils unable to report this information at all or by asset type. Some councils reported their maintenance and operating costs for drainage assets in conjunction with their road assets, making it difficult to disaggregate. In contrast to the two built assets above, data on drainage assets was less complete.

Natural assets

Not all councils are responsible for managing all of the natural assets specified in Table 6 and therefore many councils were not able to provide information. For those that could, natural assets had the least detail of all asset types. Of the data provided, trees, parks, and open spaces are generally better reported compared to rivers, coasts, and waterbodies.

Councils were generally able to provide detailed information about asset area, but not about replacement values and maintenance costs.

Some councils report data for natural assets and built assets in natural areas under the same category - *Assets under open spaces* – which makes disaggregation difficult Consequently, there is insufficient data to form a range of estimated values that councils could use in a CBA. NAGA councils reported the most comprehensive information for this asset category relative to the other alliances.

Built assets in natural areas

The data on built assets in natural areas was limited with most councils not providing detailed data. Some examples of built assets in natural areas include outdoor furniture, playground equipment, barbecue facilities and lighting. These issues are particularly pronounced for those councils that report assets under this class together with natural assets. Even for those councils that provided data for built assets in natural areas, few were able to provide detailed information on asset size and maintenance costs. Under this category, park assets generally had the most detailed information.

This gap currently prevents robust inclusion of this asset category in a CBA. However, GIS coverage suggests that spatial analysis may be an efficient approach to gathering more comprehensive information.

Summary

Generally, the data provided by councils is of good quality and can be captured in a high-level cost-benefit analysis of adaptation measures. The available information provided by councils was for buildings, roads, drainage, and natural assets. This information contained data on the number of assets under each category and their asset size (where available). Councils also provided some

additional miscellaneous information.[9] A high-level summary of the assets reported by each council is provided in Table 8.

Table 8. High level summary of councils' assets

Council name	Buildings (sqm)	Roads (km)	Drainage pipes (km)	Drainage Pits (count)	Natural assets (Y/N)	Built asset in NA (Count)
Banyule City Council	86,286	5,303,694 *	802	35,038	Y	Y
City of Bayside	351 ^	2,487	411	14,853	N	N
City of Boroondara	130,350	569	789	41,292	Y	N
City of Brimbank	na	na	na	n/a	na	na
Cardinia Shire	97,208	9,925,284 *	912	32,910	Y	N
City of Casey	na	1,800	2,488	96,947	Y	Y
City of Greater Dandenong	na	690	1,016	40,197	Y	N
City of Darebin	106,900	4,103,797 *	683	25,000	Y	N
City of Frankston	125,534	706	950	40,717	Y	Y
City of Glen Eira	228 ^	1,321	602	25,203	N	N
City of Hobson Bay	94,998	7,365,438 *	549	21,222	Y	Y
City of Hume	354,274	16,325,568 *	1,910	68,460	Y	Y
City of Kingston	56 ^	617	836	31,785	Y	N
City of Knox	102,873	5,357,609 *	39,485 ^	38,808	Y	N
City of Manningham	63,222	615	1,028	47,012	N	N
City of Maribyrnong	80,259	346	360	14,179	Y	Y
City of Maroondah	na	486	791	31,144	N	N
City of Melbourne	279 ^	4,267,502*	299,954 ^	14,286	Y	Y
City of Melton	96,653	2,905	1,483	51,345	Y	Y
City of Monash	560	768	1,152	46,144	Y	Y
City of Moonee Valley	90,821	30,727,547 *	521	24,804	Y	Y

[9] This included data such as LGA boundaries, schools, railway infrastructure, freight networks, airports and runways, powerlines, and other waterway infrastructure.

Council name	Buildings (sqm)	Roads (km)	Drainage pipes (km)	Drainage Pits (count)	Natural assets (Y/N)	Built asset in NA (Count)
City of Moreland	115,796	10,425,697 *	561	22,802	Y	Y
Mornington Peninsula Shire	na	1,712	1,250	142,182	Y	Y
Nillumbik Shire	50,915	800	398	19,195	Y	N
City of Port Phillip	66,463	265	236	11,344	Y	Y
City of Stonnington	133 ^	330	375	18,457	Y	Y
City of Whitehorse	187,749	9,130,080*	860	37,900	Y	Y
City of Whittlesea	90,779	13,908,551 *	1,895	73,532	Y	Y
City of Wyndham	175 ^	4,262	74529 ^	71,804	Y	Y
City of Yarra	52,550	1,970	215	11,847	Y	Y
Yarra Ranges Shire	183,646	4,767	824	32,461	Y	Y
Bass	45,166	2,200	na	17,617	N	Y

Note: The ^ symbol indicates that the data is recorded as a count. The * symbol indicates that the data is recorded as sqm. City of Brimbank did not provide data for this review.

Data was missing for natural assets with some councils not reporting on their tree assets. Further, detailed asset information was not provided as in the case of buildings where some councils provided data on unidentified polygons and points, and so there were instances where the building type was not identified. Exposure information to climate hazards was also missing.

Key point

Information for built structures such as buildings, roads, and drainage generally have good coverage with a high proportion of assets captured under AMS and GIS.

In contrast, natural assets and built assets in natural areas are the two categories with the most data gaps. Spatial analysis is recommended to gather more information about these asset categories. Exposure information to climate hazards was also not identified.

3.3 Data request and the development of cost profiles

Due to lumpy and in some cases limited data, trend analysis of recent capital, operational and maintenance expenditure was ineffective for forecasting future costs of councils. As an alternative, three growth scenarios low, medium, and high were used to demonstrate how council expenditure may change over time. These growth scenarios were based on population growth and provide an indicative range for expenditure under the business-as-usual scenario (i.e. no adaptation).

Further, most councils reported operations and maintenance expenditures combined. Separating these costs would allow greater understanding of the impact of climate hazards on expenditure trends.

Many councils only reported expenditure on natural assets and built assets in natural areas in total, with few reporting expenditure separately. Because cost data was inconsistently provided, expenditure for natural asset and built assets in natural areas was combined.

There were also a few councils that did not provide data in the format requested. This made it difficult to compare the data with that of other councils. In these instances, data was reorganised into a common format.

As discussed in 2.4, the 3-year average capital, operation, and maintenance expenditure was presented for councils to provide an indicative estimate for present day costs. Capital costs for building assets were the highest among all five asset categories. Operational and maintenance costs for natural assets were the highest relative to the other asset categories. In contrast, drainage assets had the lowest capital and operational costs.

It is difficult to draw any meaningful conclusions from variations in expenditure across asset classes across councils. To do this would require a more detailed analysis of asset expenditure, where factors such as the number of assets of each council, asset age and asset condition are considered. Expenditure data is not intended to be used to guide adaptation priorities. Instead, it can be used as an input into a high level CBA to understand the benefit adaptation options may have if they can reduce capital, operational or maintenance expenditure.

Key point

Future council expenditure was forecast based on population growth rather than recent expenditure trends. The financial data collected was of insufficient detail to inform an understanding of how climate change is impacting costs.

In general, it was observed the natural assets had the highest operational and maintenance expenditure across asset classes. This is notable given through the development of asset profiles, data on natural assets was found to be less complete than data on built assets. Improving natural asset data is expected to assist councils in understanding future costs associated with natural asset.

3.4 Survey

The survey results are summarised in this section.

Asset management processes

50% of councils do not combine their climate change management plans and their asset management plans. This suggests that there is more opportunity to incorporate climate risks into asset management plans to ensure long-term risks are understood and mainstreamed into asset management.

When asked about their asset management processes (such as asset acquisition, maintenance, renewal, and disposal), most councils reported that they "moderately consider" climate risks. There were also several councils reporting some uncertainty regarding whether they currently considered climate risks as a part of these processes. Further, 78% of councils reported that climate change objectives are not explicitly reported in asset management reporting processes. This points towards a lack of an overarching climate change strategy for most respondents.

Climate change risk management

Approximately 80% of respondents reported that their councils were currently undertaking public works programs to make their assets more resilient to climate change. Some examples of these actions include:

- Raising seawall height along the foreshore to reduce coastal flooding due to sea level rise

- Improving stormwater harvesting procedures, adopting an integrated water management plan, and conducting a flood modelling study to inform future flood scenarios

Councils also reported taking climate mitigation actions. This included installing energy efficient apparatus in buildings and incorporating more electric vehicles as part of the councils' fleet.

Among the six climate risks considered, the two hazards for which most councils had completed a risk assessment against their assets were inland flooding and storms. 87% of respondents did not conduct a risk assessment against coastal flooding, due to most councils not having a coastal area. Approximately 50% of councils reported conducting risk assessments against bushfires, heatwaves, and droughts.

Around 40% of respondents believe that they have sufficient internal capacity to understand the risks presented by climate change to council assets. A lower proportion believed that they have sufficient internal capacity to assess and manage these risks. 25-30% of councils expressed having little to no confidence when it comes to assessing and managing climate change risks, which respondents consider to be partly driven by existing budgetary limitations in building capacity for such tasks.

Asset data quality

Councils were asked about the quality of their data. All councils reported that they record asset information for buildings, roads, and drainage. This data is generally considered to be of high quality with more than 75% of assets (on average) from these three categories being captured in GIS.

There is also some variability within the natural asset category as assets such as lakes, wetlands, and coastal areas are not recorded to the same extent as trees, parks, and reserves. Most councils reported not capturing these assets or being unsure about their status. This could be because few councils have natural assets such as lakes of coastal areas. Overall, this is consistent with the independent review of data conducted as part of this study. This finding is corroborated by the desktop review of data. Given the importance of natural assets to community amenity, and ultimately service delivery by councils, this asset class warrants further attention going forward.

Impact of climate change on operations and maintenance costs

Councils were asked about the impact of climate change on operations and maintenance costs to understand the extent to which it is already influencing expenditure. 41% of respondents believed that climate change was a driver of increasing asset maintenance costs, with 9% believing that costs are independent of climate change and the remaining 50% being uncertain about whether climate change has this impact.

The top three climate events that were identified as influencing costs were storms, heatwaves, and inland flooding. Coastal flooding events were considered less relevant as most surveyed councils do not have coastal areas.

Key point

While many councils are able to identify the climate hazards that are relevant to their community, there is significant variation in the level of preparation that councils have undergone to make their assets more resilient to climate hazards.

Councils are generally more equipped to develop climate risk management plans for built infrastructure such as buildings, roads, and drainage as these assets are of a high data quality compared to natural assets and built assets in natural areas.

3.5 Consultation

The responses from the three consultation sessions are included in Appendix A. A brief summary is provided below.

Table 9. Summary of findings from consultations

	Buildings asset workshop	Roads and drainage asset workshop	Natural assets and built assets in natural areas workshop
Group activity 1 *How would you rate the quality of your asset data relative to other asset data at your council?*	Buildings: 6 / 10	Roads: 9 / 10 Drainage: 6 / 10	Natural assets and built assets in natural areas: 7 / 10
Group Activity 2 *What are the key challenges associated with making asset management decisions in the face of climate change?*	Having localized data on climate change hazards Understanding the vulnerability of assets and lifecycle costs (maintenance and replacement) Internal capacity and knowledge of climate adaptation options and funding	Data availability to measure hazards Knowledge of risks under a range of climate scenarios Developing a holistic and long-term adaptation approach Funding and governance regimes	Time Funding Data on the lifecycle costs and value of assets Internal resources and knowledge to assess and evaluate assets Having a transparent understanding of roles and responsibilities

Summary of workshop findings

Councils were generally described having adequate data on road and building assets, which can be used to help inform management and decision making in the face of climate change. However, data on drainage, natural (e.g. conservation reserves and park trees) and built assets in natural areas was described as not being sufficiently detailed to inform decision making at this stage. Refinement of all asset data to include attributes such as age, condition, life expectancy, maintenance cost and operational costs is viewed as vital by councils and should be completed before developing climate change adaption management decisions.

The main challenges impacting councils' ability to make asset management decisions in the face of climate change include:

- Data quality and availability
- Internal knowledge of climate hazards and asset vulnerability to climate hazards
- Knowledge of costs associated with adaptation and funding

The ratings provided by councils on the quality of a specific asset data relative to other councils' data appear somewhat inconsistent with other finding of this project. For example, natural assets and built assets in natural areas data received a higher rating than buildings and drainage data. This question may have been too broad to illicit appropriate responses. Responses to this question may also highlight that asset managers do not have a strong understanding of other asset data sets across the council.

3.6 Gap analysis

Based on the work completed across each stage of the project, the key gaps in data and information which may limit the use of the CBA framework and the implementation of climate change adaptation options include:

- **Data on natural assets.** As part of the project, most councils were able to provide detailed data on most built assets suitable for CBA analysis. This included data on buildings, roads and drainage.

They provided less detailed data on natural assets. Incomplete data on natural assets is identified as a key gap.

A lack of data on the value of natural assets is not unique to councils in greater Melbourne. To address this gap, it is common to use the benefit transfer method by which a value is inferred based on evidence from a different area. However, application of this method requires basic information on the underlying asset at least.

A lack of data on natural assets limits the inclusion of benefits derived from protecting natural assets in the assessment of adaptation options. It will also make performing a risk assessment against climate hazard for natural assets more difficult, likely leading to a qualitative assessment of consequences only. Data on natural assets can be found in publicly available spatial data sets (e.g. DataVic or Vicmap). This data can be used supplement data held by councils on natural assets and address this data gap. Further analysis of publicly available spatial data sets is required to understand how comprehensively publicly available data addresses this gap.

- **Internal capacity of councils.** As part of the project, councils were asked about their internal capacity to assess and manage climate change risks and the challenges of making decisions in the face of climate change. Responses indicated that councils have a mixed degree of confidence in their internal capacity (both resourcing and technical skill) and their own data for this purpose. Capacity to perform the necessary work has therefore been identified as a key gap. The Framework should assist councils in understanding what is achievable with their existing data. As such, it will help to partly address this gap[10]
- **Data to inform a quantitative risk assessment.** To implement the Framework and assess adaptation options against a specific climate hazard, councils will need to undertake a climate hazard risk assessment. A risk assessment can be qualitative, quantitative or a mixture of both, however, a completely quantitative risk assessment will support the most complete implementation of the framework.

  To perform a quantitative risk assessment requires an understanding of the likelihood of hazard events (i.e. what is the probability that a given event will occur in a given year) and their consequences (i.e. what is the direct, indirect tangible impact and the intangible impact from the event). Currently, councils do not have readily accessible information to enable a completely quantitative risk assessment[11]. In particular, most councils appear to be missing information on the likelihood of climate hazard events which will affect their areas under climate change. The Victorian Climate Projection 2019 provides information which can assist councils in understanding how the frequency of some climate hazard events will change, but it is not complete across all hazards, and in some cases, it requires incorporation into modelling to understand its downstream impacts (e.g. how rainfall will impact flooding).

[10] SECCCA's Asset Vulnerability Assessment will provide tools and guidelines to assist councils and as such help to address this gap (D La Fontaine, personal communication, 25 October 2021)

[11] Work to fill this data gap is currently underway as part of SECCCA's Asset Vulnerability Assessment (D La Fontaine, personal communication, 25 October 2021)

4 RECOMMENDATIONS

Based on the findings across each stage of the project, the following recommendations are made with a view to enhancing the ability of councils to use the *Cost-benefit Analysis Framework*:

1. **Test the Framework at the local scale.** The Framework can be used to consider a range of climate hazards and the benefits of adaptation options at a local or regional scale. In the first instance, it is recommended the Framework is trialled at a local scale (i.e. for a single council) This would provide the opportunity to test the method and to develop further guidance (e.g., examples of the steps and outputs) which could improve the 'user-friendliness' of the Framework.

   Testing the method with a single council will also provide the opportunity to resolve any implementation issues, which may be much more difficult to resolve when more data and stakeholders are involved such as with a region wide assessment. Therefore, this recommendation is also aimed at improving the readiness of the Framework and quality of outputs from a region wide assessment.

   Through the data and information they provided, some councils demonstrated a high degree of preparedness for undertaking a CBA of adaptation options. Given this, it is recommended that the Framework is tested with these councils.

2. **Develop tools to assist in the implementation of the Framework.** The information and data collected as part of the project could be used to develop a set of spreadsheet tools to assist councils to implement the Framework. Based the project findings, tools which could provide significant value to councils are:

   - Consequence tools – Used to inform the risk assessment, this type of tools could assist councils estimate the value of damages to each type of assets from specific climate hazards.
   - Cost-benefit analysis tool – A CBA tool could be designed to assist councils input collected data into a discounted cash flow model to generate decision criteria.

3. **Improve capacity to understand and assess climate risk.** Feedback received during the consultation and the online survey indicated that many councils do not have sufficient internal capacity to assess and manage climate change risk. As such, it is recommended that a range of programs and initiatives (potentially via the Greenhouse Alliances), which are designed to improve councils' capacity over the long-term to adapt to climate change, are implemented. The inclusion of a range of stakeholders (e.g. Engineers Australia, IPWEA, Victorian Local Governance Association) in these programs is expected to be important for capacity building[12]. A potential starting point might be a series of webinars. Topics for these webinars could include:

   - The fundamental aspects of performing a risk assessment.
   - Mainstreaming climate risk (including improving asset resilience) into asset management. This may include discussions with councils around existing council policies to identify how they can better incorporate climate risk.

   As an example of capacity building programs, WAGA, with the support of the other Greenhouse Alliances, is currently developing a broad program of assistance for councils to improve their capacity to understand, assess and address climate risk called 'Victorian Climate Resilient Councils' (VCRC) (F Macdonald, personal communication, 26 October 2021).

[12] As part of the Asset Vulnerability Assessment, SECCCA have developed a communications plan and identified a range of stakeholders important for capacity building (D La Fontaine, personal communication, 25 October 2021).

4. **Enhance and collate data on hazard likelihoods.** As identified in the gap analysis, councils do not have ready-to-use information on the likelihood of all climate hazards at the local scale[13]. The Victorian Climate Projection 2019 provide some information which can assist councils as do other resources like the Victoria's Climate Futures Tool and the Climate Change in Australia website. It is recommended that a set of local hazard resources be developed for councils which can be used as direct inputs into a risk assessment, and which would assist with performing quantitative risk assessments (e.g. developing estimates of likelihood for different hazards for councils). In addition, consideration should be given to developing coincidence hazards/risks (i.e. when two hazards and / or risks occur at the same time). Such work may be best undertaken by State Government, given there are likely to be similarities across the greater Melbourne region.

5. **Enhance council asset profiles.** It is recommended that asset profiles prepared as part of this project be further refined prior to undertaking future assessment of adaptation options. The asset data provided as part of this project was highly valuable for understanding asset data held by councils. However, due to the volume of data provided, there was limited opportunity to verify its accuracy when developing asset profiles. Further refining this data will improve the accuracy of any CBA results (of both localised and region wide CBAs) as councils will be able to more readily identify which assets are exposed to hazards, the consequences of exposure and benefits of adaptation.

   Effort to improve council asset data is already underway. The 'How Well Are We Adapting' program is specifically designed to help councils improve their data and measure their responses to climate change impacts. The program will be incorporated into the more general VCRC program mentioned in recommendation 3 (F Macdonald, personal communication, 26 October 2021).

6. **Enhance council cost data.** As part of this project, councils had difficultly disaggregating financial data, including by asset class. It is recommended that councils take steps to improve data collection to improve this. This will improve councils' ability to understand the impact climate change is having on asset costs and improve their ability to develop robust future cost forecasts.

7. **Enhance natural asset data.** A key finding from this project is that councils have limited data about their natural assets relative to other asset types. There is generally greater data about trees, parks and open spaces, but this is primarily related to asset area, not maintenance and replacement costs. Natural assets play an important role in mitigating the effects of climate change (e.g. by lowering temperatures) and can also be vulnerable to climate change (e.g. the effects of extreme heat, sustained higher temperatures and lack of rainfall on sporting fields). It is therefore important that councils have sufficient data to be able to make informed decisions about managing these assets.

   Basic data which present a complete picture of natural assets within an LGA and their extent is the most critical natural asset data to performing CBA of climate change adaptation. This should be the primary focus of addressing this recommendation. Collecting further data on the characteristics (e.g. species of tree) or value (e.g. the value of the benefits natural assets provide to society) of natural assets is also useful as it assists with accurately estimating consequences of climate change and benefits of adaptation. However, if this information is not available, it can be replaced with publicly available data (e.g. academic studies). Therefore, it is less critical to enabling CBA work.

8. **Further work to understand the impact of climate change on natural assets and the benefits they provide**. In addition to enhancing natural asset data, there is a need to better understand the impacts of climate change on natural assets and the benefits natural assets provide communities.

[13] Work to fill this data gap is currently underway as part of SECCCA's Asset Vulnerability Assessment through the development of a toolkit for councils (D La Fontaine, personal communication, 25 October 2021)

To address this gap, we recommend further work is undertaking to understand these aspects. This may include scientific research to understand impacts of changes in climate on natural assets or economic studies to understand the value of the benefits they provide.

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APPENDIX A – CONSULTATION

The responses from the three consultation sessions are summarised in this section.

Buildings asset workshop

Findings from group activity 1

The first group activity was conducted using an online whiteboard and gave participants the opportunity to state agreement with the high-level findings of the project and to rate the quality of building asset data. The questions posed to participants were:

- Do you agree that high quality building data exists?
- Do you agree that existing building data is ready to be used in asset management decisions?
- How would you rate building data relative to other asset data at your council?

The majority of councils agree that existing building asset data is of high quality and is available for council use. However, some councils noted that there are differences in the quality of building asset data between recently redeveloped and existing assets, with redeveloped assets having higher quality data compared to existing assets. The majority of councils who were consulted believe that their building data is ready to be used in asset management decisions. However, they acknowledged that further refinement of built asset data would support more accurate decisions. Further, there was a small group of councils who did not believe their building data is adequate or reliable to inform decision making for their region.

The quality of councils' building data relative to other asset data held was given an average rating of approximately six out of 10, by participants. Building data was considered to be less comprehensive and/or of a lower quality than road data. Participants suggested this may be because building data is relatively more complex and includes older assets or assets that are replaced less frequently.

Findings from group activity 2

The second group activity was conducted using an online whiteboard and gave participants the opportunity to share their thoughts about the key challenges associated with making asset management decisions in the face of climate change.

Key challenges associated with making building asset management decisions in the face of climate change include:

- Having localized data on climate change threats
- Understanding the vulnerability of assets and lifecycle costs (maintenance and replacement)
- Internal capacity and knowledge of climate adaptation options and funding

Participants highlighted that there is uncertainty regarding climate hazard information, which, in certain regions, prevents on-ground management. Increasing councils' internal expertise and knowledge around climate change as well as the certainty and limitations of climate data is considered imperative to building technical capacity and for 'kick-starting' adaptation decisions. Further, having localized data on climate change hazards and evidence of the risks they pose to building assets is required to undertake vulnerability assessments, which are vital for informing costings and support decision making. Additionally, councils believe that developing internal technical capacity would provide them with the knowledge and evidence they need to communicate the importance of adaptation to the state government.

The majority of councils believe that understanding the lifecycle costs of assets and benefits associated with different adaptation approaches would help inform decisions. One suggestion from

the consultation was to develop a matrix of building classes and adaptation options, which could be used to guide climate change adaptation. Further, understanding the costs associated with maintaining building assets is considered vital to helping justify the costs associated with adaptation and leverage further funding.

Roads and drainage asset workshop

Findings from group activity 1

The first group activity was conducted using an online whiteboard and gave participants the opportunity to state agreement with the high the level findings of the project and to rate the quality of their road and drainage asset data. The questions posed to participants were:

- Do you agree that high quality road and drainage data exists?
- Do you agree that existing road and drainage data is ready to be used in asset management decisions?
- How would you rate road and drainage data relative to other asset data at your council?

The majority of councils who were consulted believe that their existing road data is of high quality, mature and ready to inform asset management decisions. However, drainage asset data is considered to be of a lower quality and not currently capable of supporting asset management decisions (e.g. age and condition data tend to be incomplete). Because drainage data tends to comprise sub-surface assets, therefore requiring CCTV technology to attain the data.

The quality of councils' road data relative to other asset data has been given an average rating of approximately nine out of 10 and drainage data has been given an average rating of approximately six out of 10, by participating councils.

Findings from group activity 2

The second group activity was conducted using an online whiteboard and gave participants the opportunity to share their thoughts about the key challenges associated with making asset management decisions in the face of climate change.

Key challenges associated with making road and drainage asset management decisions in the face of climate change are considered to include:

- Data availability to measure hazards
- Knowledge of risks under a range of climate scenarios
- Developing a holistic and long-term adaptation approach
- Funding and governance regimes

Having localized climate data to measure the hazards and risks posed to road and draining assets is important for understanding the vulnerability of assets and to inform priority areas for adaptive management. Further, council participants highlighted that a long-term holistic approach needs to be taken into consideration when developing management decisions for road and drainage assets, not the current ad hoc approaches which tend not to be effective. This includes understanding the risks climate change poses on road and drainage asset as well as the potential impacts to economic security, access and transport.

Ideally, decision making would approach climate change asset management through a holistic lens which would consider elements of engineering, climate hazards, adaptation, vulnerability, resilience, social science and economics to develop appropriate decisions. Participants noted that in some situations (e.g. to manage regional flooding), councils' decisions about drainage assets need to be made in conjunction with Melbourne Water, which can further influence the range of asset data that needs to be taken into consideration.

Natural assets and built assets in natural areas workshop

Findings from group activity 1

The first group activity was conducted using an online whiteboard and gave participants the opportunity to state agreement with the high the level findings of the project and to rate the quality of their data on natural assets and built assets in natural area. The questions posed to participants were:

- Is the existing data on natural assets (including open space) adequate for informed decision making?
- Is the existing data on built assets in natural areas adequate for informed decision making?
- How would you rate the data on natural assets and built assets in natural area to other asset data at your council?

In general, the majority of councils have adequate asset and maintenance information on park and street trees, bushland areas and playgrounds, which can be, but is not always, used in decision making. The quality of this data varies between council regions with some regions having more refined and meaningful data compared to other councils.

The majority of councils do not have sufficient data on conservation areas and reserve trees to inform decision making or management.

In relation to built assets in natural areas, there is currently good data on built asset structures; however, the data is not always detailed enough to inform decision making. For example, there is limited information on the maintenance and renewal costs, age, condition, lifespan and operational costs of built assets to guide management.

Developing a detailed database of natural and built assets is viewed as necessary to have the required information to inform holistic decision making about climate change adaptation and resilience.

The quality of councils' natural and built assets in natural areas data relative to other asset data held, has been given an average rating of approximately seven out of 10, by the councils. Based on comments from the consultation, natural and built asset data is high level and a lower quality compared to road data, which are more refined and considered to have a quality rating of nine out of 10.

Findings from group activity 2

The second group activity was conducted using an online whiteboard and gave participants the opportunity to share their thoughts about the key challenges associated with making asset management decisions in the face of climate change.

Key challenges associated with making natural and built asset management decisions in the face of climate change include:

- Time
- Funding
- Data on the lifecycle costs and value of assets
- Internal resources and knowledge to assess and evaluate assets
- Having a transparent understanding of roles and responsibilities

Through consultation, participants highlighted that rate-capping and funding are key factors preventing councils from preparing and adapting their region to climate change. Developing more comprehensive data and knowledge of lifecycle costs is required to convince decision makers to fund adaptation activities for natural and built assets for climate change, as well as secure funds for the maintenance of these assets. Another key challenge impacting decision making is councils'

understanding of the potential impact of climate change to assets in their region and determining when assets need to be managed through a climate change lens versus a business-as-usual management approach. Developing councils' internal capacity and knowledge of natural and built assets vulnerability and resilience is required to develop effective and sustainable management decisions.

Summary of workshop findings

Councils were generally described having adequate data on road and building assets, which can be used to help inform management and decision making in the face of climate change. However, data on drainage, natural (e.g. conservation reserves and park trees) and built assets in natural areas was described as not being sufficiently detailed to inform decision making at this stage. Refinement of all asset data to include attributes such as age, condition, life expectancy, maintenance cost and operational costs is viewed as vital by councils and should be completed before developing climate change adaption management decisions.

The main challenges impacting councils' ability to make asset management decisions in the face of climate change include:

- Data quality and availability
- Internal knowledge of climate hazards and asset vulnerability to climate hazards
- Knowledge of costs associated with adaptation and funding

The ratings provided by councils to rate the quality of specific asset data relative to other councils data appear somewhat inconsistent with other finding of this project. For example, natural assets and built assets in natural areas data received a higher rating for its quality than buildings and drainage data. This question may have been too broad to illicit appropriate responses. Responses to this question may also highlight that asset managers do not have a strong understanding of other asset data sets across the council.

LIST OF ATTACHMENTS

The following is a list of attachments which were also developed as part of this project:

A. Presentation of findings of desktop review (PowerPoint)
B. Data request (Excel)
C. Asset and cost profiles and cost forecast
D. CBA framework
E. Survey questions
F. Survey results