ARUP

Westmead South

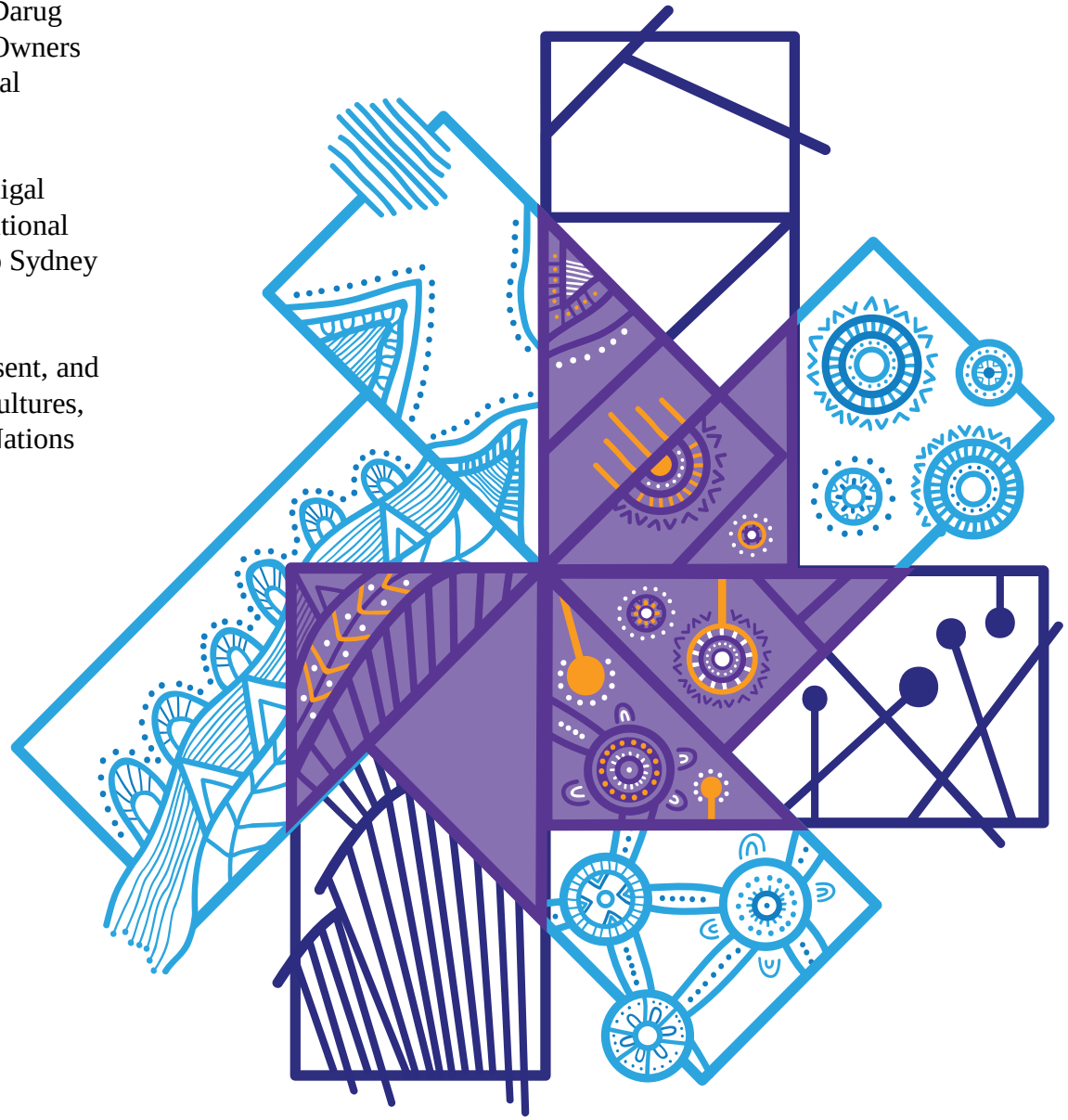
Resilience Plan

25/10/2023

Arup would like to acknowledge the Darug Nation and People as the Traditional Owners of the land on which Cumberland Local Government Area is situated.

We also wish to acknowledge the Gadigal people of the Eora Nation as the Traditional Owners of the land on which the Arup Sydney office is located.

We pay respect to Elders past and present, and recognise and celebrate the ongoing cultures, traditions and custodianship of First Nations peoples.



The artwork is *Shift to shape an even better world* by Gilimbaa Artist Tarni O'Shea.

Document Verification

Project title	Westmead South Masterplan ESD Consultancy
Document title	Resilience Plan
Job number	296694-00
Document ref	ESD-REP-02
File reference	ESD

Revision Draft 1	**Date** 22 Sep 2023	**Filename**	Westmead South – Resilience Plan_Draft for issue 20230921		
		Description	Draft Resilience Plan report for client review and comment		
			Prepared by	**Checked by**	**Approved by**
		Name	Aeeshah Mohammed, David Jewkes	Jo Walton-Hespe	Jo Walton-Hespe
		Signature			

Revision Draft 2	**Date** 06 Oct 2023	**Filename**	Westmead South – Resilience Plan_For issue 20231006		
		Description	Resilience Plan report for issue.		
			Prepared by	**Checked by**	**Approved by**
		Name	Aeeshah Mohammed, David Jewkes	Jo Walton-Hespe	Jo Walton-Hespe
		Signature			

Revision 1.0	**Date** 25 Oct 2023	**Filename**	Westmead South – Resilience Plan_v1.0		
		Description	Resilience Plan report for re-issue; updated per Cumberland City Council comments.		
			Prepared by	**Checked by**	**Approved by**
		Name	David Jewkes	Jo Walton-Hespe	Jo Walton-Hespe
		Signature			

ARUP

Executive Summary

Key impact areas:

The mid- to long-term climate profile for Westmead South indicates that extreme heat and intense rainfall present significant hazard to the precinct's infrastructure, buildings, and community for the 2050 and 2090 time-horizons. These hazards exhibit an increasing risk profile, above the baseline condition. The three most significant risk areas identified for the precinct are:

Extreme heat, **heatwaves**, and increased **Urban Heat Island (UHI) effect** pose an **extreme risk** to Westmead South and its communities, for the 2050 and 2090 horizons.

Extreme heat and its impact to indoor thermal comfort poses a **high risk**, for 2050 and 2090.

More intense rainfall events and impacts to civil drainage, including unmanaged overland flow paths, pose a **high risk** to community safety and physical assets, for 2050 and 2090.

Key adaptation opportunities:

A suite of adaptations are available to Westmead South to minimise or eliminate impacts to built form, environment, and community arising from climate hazards. These may be categorised into (1) precinct adaptations (2) building adaptations (3) and adaptive capacity:

Precinct adaptations:

- Urban planning and landscaping options to minimise UHI effect.
- Electricity supply redundancy / on-site renewable energy to minimise impact from heatwave-induced blackouts.
- Permeable paving to improve uptake in high intensity rainfall events.

Building adaptations:

- High solar reflectance index surfacing on roofs to mitigate UHI effect.
- Uplift in hydraulic drainage requirements for high intensity events.

Adaptive capacity:

- Digital alert system or boards for hazardous weather conditions, such as forecast heat waves, bushfire smoke, storm fronts, or systems failure.
- Outreach programmes to liaise with vulnerable communities on key hazards, such as building adaptive capacity to manage extreme heat.

In applying adaptations, Westmead South has opportunity to minimise its exposure to climate hazards and to realise secondary co-benefits to its community and environment. Adaptations can contribute to physical and social resilience and assist in delivery of other ESD outcomes such as decarbonisation and nature-positivity.

Interactive contents menu

Click images below to navigate

Part 1: Resilience Drivers

Part 2: Climate Context

Part 3: Climate Impact Assessment

Part 4: Resilience Planning

Appendix A - Impact Assessment Matrix

Appendix B - Flood Mapping Excerpts

Introduction

Purpose of this document

Climate hazards pose significant and increasing risk to Sydney's communities, infrastructure, and urban form, with the intensity and frequency of key hazard variables and indicators projected to uplift to 2100. Climate hazards act as a multiplier to the acute shocks and chronic stresses Sydney experiences, disproportionately impacting vulnerable communities. In response to this, various local, state, and federal policies and strategies have been developed driving improved climate resilience across the urban planning, infrastructure, and property sectors.

In this context, Arup has been commissioned by Cumberland City Council to develop this Resilience Plan to identify and assess potential climate impacts to Westmead South and to table adaptations to minimise or eliminate these impacts. The assessment considers impacts that may arise between current climate conditions and two time horizons – 2050 and 2090. For priority impact areas, strategies to minimise or eliminate are longlisted, capturing potential stakeholders to engage and milestones to monitor to assist in adaptation implementation.

It is intended that this Resilience Plan inform the Westmead South masterplan and DCP. Adaptation options that respond to priority impact areas are to be considered by the project team and priority adaptations carried forward for implementation. Some adaptation options tabled in this Plan are operational, intended to inform the Council's ongoing precinct management and community engagement programmes.

Westmead South

Part 1: Resilience drivers

Resilience drivers

Key definitions

Adaptation: The process of adjustment to actual or expected climate and its effects. *IPCC*

City resilience: The capacity of individuals, communities, businesses, and systems within a city to survive, adapt and thrive no matter what kinds of chronic stresses and acute shocks they experience. *Resilient Sydney Strategy*

Climate hazards: The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources. *IPCC*

Exposure: [The] presence of people, livelihoods, species or ecosystems, environmental functions, services, resources, infrastructure, or economic, social or cultural assets in places and settings that could be affected [by climate hazards]. *ISO 14091*

Impacts: The consequences of realized risks on natural and human systems, where risks result from the interactions of climate-related hazards..., exposure, and vulnerability. *IPCC*

Shocks: Sudden short-term events that threaten a city e.g., major storms, floods, bushfires, heatwaves, disease outbreaks, terrorism, and cyber-attacks. *Resilient Sydney Strategy*

Stresses: [Chronic weakening of] the fabric of a city on a day-to-day or cyclical basis [e.g.,] homelessness and housing affordability, lack of access to public transportation systems, family violence, climate change, structural inequity, and chronic food or water shortages. *Resilient Sydney Strategy*

Vulnerability: [The] probability that an asset will fail given a climate impact. *TfNSW*

Resilience drivers

Local, state & national drivers

The table below summarises some strategic and legislative context, relevant to Westmead South, that drives improved resilience to climate shocks and stresses in infrastructure and the urban built form:

Scale	Driver	Description	Link
Local & regional	Cumberland City Council's **Environmental Management Framework** (2019)	"[Summarises] Council's plans, strategies and policies to provide guidance and inform decision-making" on current and emerging environmental issues. Notes the "compound effects of climate change-related events, such as bushfires and the urban heat island effect; and increasing air pollution across Sydney, which could exacerbate respiratory problems". Identifies climate change adaptation as a key initiative for the Council in responding to energy demand, urban heat stress and biodiversity loss issues.	*Link*
	WSROC's **Turn Down the Heat Strategy and Action Plan** (2018) and initiatives	Comprehensive initiative focused on reducing urban heat and its associated risks by implementing measures such as urban greening, sustainable design, and community engagement.	*Link*
	WSROC's **Future Proofing Residential Development in Western Sydney** (2022)	Focuses on integrating climate change considerations such as extreme weather environments and rising temperatures into the planning and design of residential areas, enhancing climate resilience in communities.	*Link*
	City of Sydney **Resilient Sydney Strategy** (2018)	See page 10 below.	*Link*

Resilience drivers

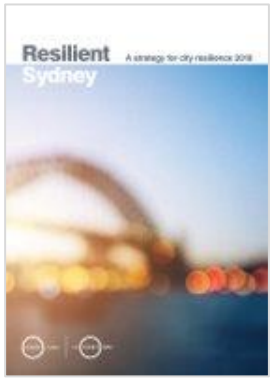
Local, state & national drivers

Scale	Driver	Description	Link
State	**NSW Climate Change Policy Framework** (2016)	Policy driving climate change resilience by: • Reducing risks and damage to public and private assets • Reducing climate change impacts on health and wellbeing • Managing impacts on resources, ecosystems and communities.	*Link*
	NSW Climate Change Adaptation Strategy (2023)	Key decision-making principles and objectives for adaptation.	*Link*
	Transport for NSW Climate Risk Assessment Guidelines (2021)	Guiding TfNSW, teams, partners, contractors, and stakeholders with advice and requirements on conducting a climate risk assessments.	*Link*
	GANSW **Connecting with Country Framework** (2023)	Framework for collaboration and embedment of Aboriginal knowledge, perspectives and heritage in design and planning, including on climate resilience and adaptation.	*Link*
National & international	**National Climate Resilience and Adaptation Strategy 2021 – 2025** (2021)	Comprehensive plan focused on climate resilience and adaption to protect communities, ecosystems and industries from the rising effects of climate change.	*Link*
	PCA and GBCA's **Every Building Counts** (2023) policy recommendations	Policy recommendations for a roadmap to a greener, healthier, and more equitable built environment.	*Link*
	World Economic Forum **Global Risks Report** (2023)	Snapshot of risk perception, highlighting failure to mitigate climate change and to adapt to climate change as priority risks globally.	*Link*
	Resilient Cities Network	Network of 100 cities sharing resources on resilience and adaptive capacity in city communities, urban planning, and built forms.	*Link*

Resilience drivers

Summary of *Resilient Sydney Strategy*

The City of Sydney's ***Resilient Sydney Strategy*** (2018) outlines a comprehensive plan designed to enhance the city's ability to withstand and adapt to the various shocks and stresses listed below. This strategy is essential for precinct and local planning as it provides a framework for building a more resilient and sustainable city by identifying vulnerabilities, setting resilience goals, and guiding policies and initiatives to make Sydney more adaptable and responsive to changing conditions and future uncertainties. The excerpts below highlight how the *Strategy* addresses climate resilience, and the key challenges, outcomes, and actions in adapting to climate shocks and stresses.



Acute shocks and chronic stresses

In identifying and prioritising climate impacts to a community, it is important to consider how climate hazards may exacerbate ongoing or recurrent shocks and stresses to the community, its infrastructure, and its environment. Urban communities may experience a variety of shocks and stresses, arising from internal triggers (e.g., inequality or asset failure) and external pressures (e.g., natural disasters). Climate hazards have the potential to interact with and compound these shocks and stresses, increasing the frequency or severity of their negative impacts. The *Resilient Sydney Strategy* outlines 16 shocks and stresses relevant to cities. The graphic below highlights nine of these that have significant potential to be compounded by climate hazards:

Major acute shocks

Extreme weather	Infrastructure failure	Financial institution failure	Water crisis
Digital network failure	Terror attack	Disease pandemic	Cyber-attack

Chronic stresses

Health services demand	Homelessness and housing affordability	Social cohesion	Employment diversity
Inequity	Chronic illness	Lack of access to public transport	Drug and alcohol abuse

Resilience drivers

Summary of *Resilient Sydney Strategy*

A key resilience goal nominated by the *Resilient Sydney Strategy* is 'Direction 2: Live with our climate'. This is a useful exemplar for climate resilience and adaptation for master planning in Australia, noting key action areas to drive resilience, informed by community and stakeholder engagement conducted by the City of Sydney. The graphic below extracts key points from 'Direction 2: Live with our climate':

Direction 2: Live with our climate - *We adapt to sustain our quality of life and our environment*

Challenge
Pressure on our health, environment, economy

Outcomes
Access to **clean air, water, natural environments and adaptive technology** for climate comfort and safety, health and city connections

Driven by key community & stakeholder engagement findings:

- [Inaction] in reducing carbon emissions and **adapting to our changing climate**.
- [No] broad understanding of our **community preparedness** for shocks.

Solutions tabled:

- Centralised renewable energy
- Changes to building codes and regulations
- City greening
- More diverse & varied essential services provision
- Data sharing, communication and collaboration to plan for disruption

Flagship Action:
9. Policy and action to cool homes and streets[1]

Supporting Actions:
10. Develop investment in resilient buildings, assets, precincts and cities.
11. Enable affordable access to renewable and resilient energy.

Aligned Actions:
12. Adopt urban resilience in research and teaching curricula
13. Measure metropolitan carbon emissions and report progress
14. Support a more flexible and resilient water cycle.
15. Reduce reliance on liquid fuel.

[1]Cool Suburbs - Turn down the heat target: 2°C reduction in heat in urban areas.

Excerpt from City of Sydney *Resilient Sydney Strategy* (2018)

Westmead South

Part 2: Climate context

Climate context

Project context and boundary

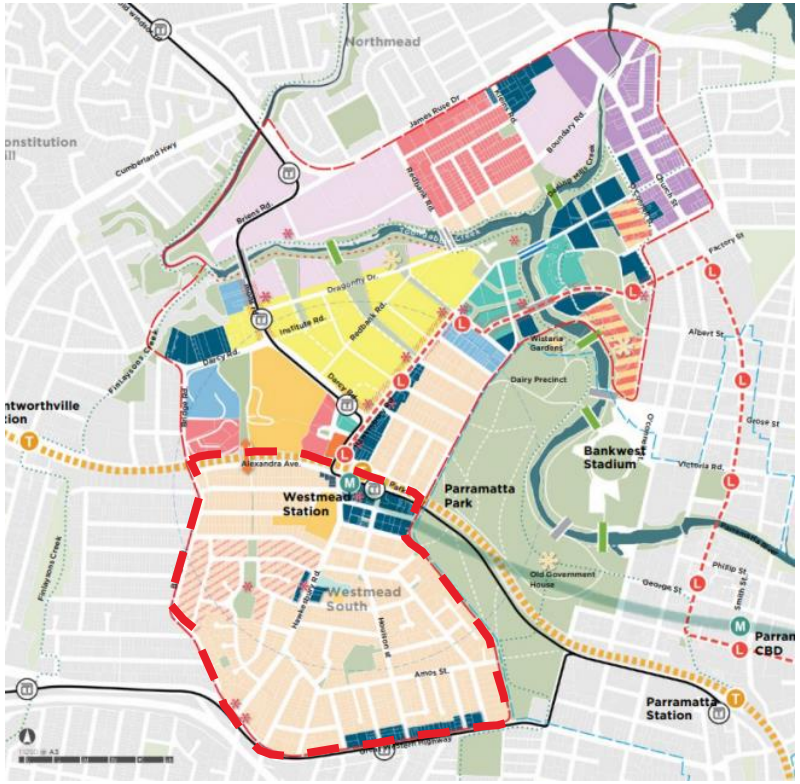
Westmead South is a key centre of Cumberland City, located in the southern portion of the Westmead Precinct, 1.7km from the Parramatta Business District. It is bound to the north by a railway corridor, south by the Great Western Highway, east by the Mays Hill Precinct (Parramatta Park), and west by Bridge Road.

The Westmead Precinct is in the Central River City, one of Greater Sydney's three cities. It is poised to transform, with significant infrastructure investment including a future Metro station at Westmead, Parramatta Light Rail, rapid growth in health, education and innovation, and potential connection of the North-West T-way with the Liverpool-Parramatta T-way via Westmead South.

The precinct is expected to provide residents increased employment, services and recreation opportunities within 30 minutes. As a gateway to Westmead Precinct, the study area is well placed to provide specialised retail and commercial uses and diverse housing opportunities.

Westmead South context map

Wider Westmead Precinct



Climate context

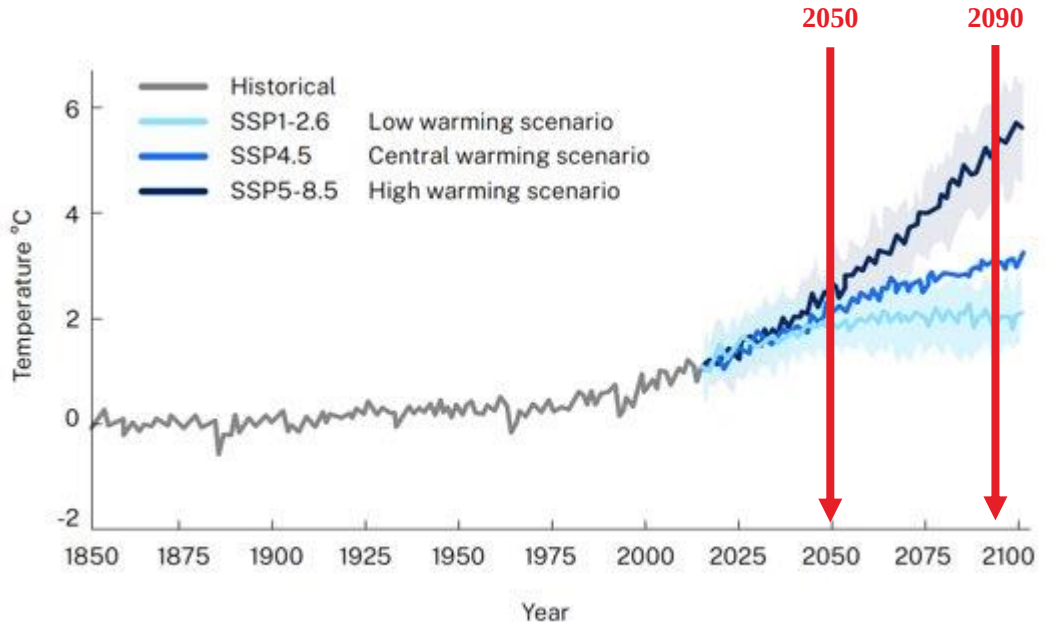
Emissions scenario & timescales

Emissions scenario:
The IPCC publishes four greenhouse gas concentration trajectories, or Representative Concentration Pathways (RCPs), for use in climate modelling and research:

- **RCP 8.5** – very high emissions scenario: Little global action taken to reduce emissions.
- **RCP 4.5 and 6.0** – intermediate emissions scenarios: Strong global action taken to reduce emissions towards end of century.
- **RCP 2.6** – stringent emissions mitigation scenario: Ambitious and immediate global action.

Of these, RCP 8.5 has been adopted for this Resilience Plan. This emissions scenario offers a conservative approach for climate impact assessment; it also most closely aligns with the global current trajectory of observed anthropogenic emissions and surface warming. It also aligns with NSW and Australian government guidance on climate risk assessment and adaptation.

Timescales:
In climate impact assessment and adaptation planning it is important to select an appropriate timescale (a time interval over which climate projections are considered with reference a project, asset, or system design life). To capture near- and far-term climate impacts, this Resilience Plan utilises **2050** and **2090** timescales, against an historical baseline.



Source: NSW climate change adaptation strategy

Climate context

Climate projections

The table below outlines the climate projections for Westmead South, for 2050 and 2090, against the baseline historical condition. Projections for 2030 and 2070 are also given, for the variables: annual mean rainfall, severe fire danger days. Projections are taken from the NSW Government's *NSW and Australian Regional Climate Modelling* (NARCliM) and CSIRO's *Climate Change in Australia* for the East Coast Cluster (South); baseline climatic data has been taken from BoM (Parramatta North - Masons Drive):

Climate variable		Indictor	Baseline	RCP8.5 Climate Projections			
				2030	2050	2070	2090
Primary	**Temperature**	Annual mean max	23.3°C	23.9°C	25.1°C	25.3°C	27.1°C
		Days > 35°C per annum	10.9 days	14.3 days	19.1 days	19.8 days	34.1 days
	Precipitation	Annual mean rainfall	975.2mm	+1.87%	N/A	+10.18%	N/A
		Rainfall intensity	197mm	+10.1%	+10.7%	+17.2%	+25.0%
	Humidity	Mean annual, at max temperature	55%	-0.58%	-0.91%	-1.4%	-1.4%
Secondary	**Drought**	Frequency (droughts / 20-years)	1.3	1.9	2.0	2.0	2.0
		Duration (months / drought)	22 months	31 months	31 months	35 months	39 months
	Evapotranspiration		1400 to 1600	+4.1%	+7.2%	+10.5%	+14.3%
	Bushfire	Severe fire danger days (FFDI >50 / yr)	1.1 days	1.2 to 1.5 days	N/A	N/A	1.5 to 1.6 days

Climate context

Climate hazards

The table below gives an indication on the broad swathe of climate hazards that may increasingly impact communities and built forms in Australia towards 2090. The six hazards highlighted have been considered in the climate impact assessment for Westmead South:

Climate hazard			
	Bushfire weather & longer bushfire seasons		Landslide, erosion, subsidence
	Bushfire smoke & air quality impacts		Drought & water scarcity
	High wind events		Storms & hail
	Extreme heat & heatwaves		Lightning
	Rainfall & flooding (pluvial & fluvial)		Duststorms
	Coastal inundation & storm surge		Multi-hazard events

Climate context

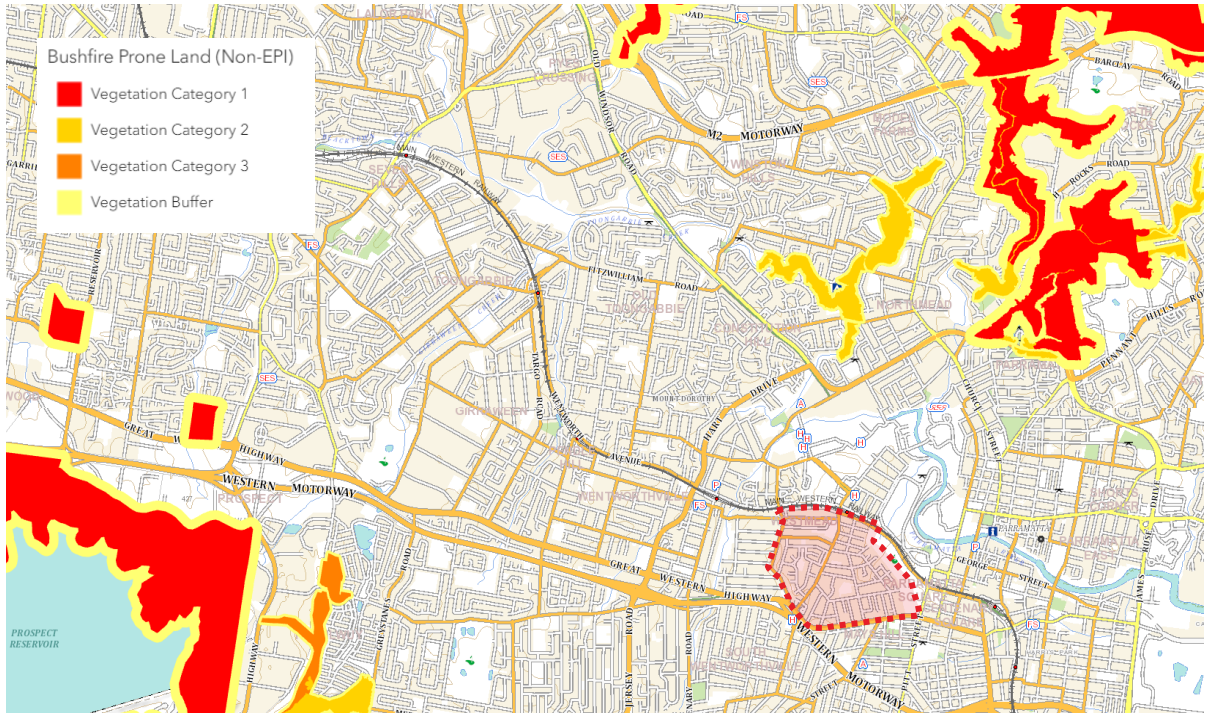
Climate hazards: Bushfires & air quality

- Greater Sydney is exposed to **recurrent bushfire smoke events**, impacting air quality and effecting community health and wellbeing.
- Severe bushfire weather days are projected to **increase in frequency to 2090**, with resultant uplift in bushfire smoke events.
- The site does not include bushfire prone land.

While no bushfire prone land is identified at Westmead South, prone land exists north at Parramatta Lake and west at Prospect Reservoir. More broadly, Sydney Basin is bound by bushfire prone land, rendering bushfire smoke a significant, ongoing hazard. Smoke conditions impact comfort and health, with particulates able to enter through building façade and mechanical systems. Poor air quality disproportionately impacts vulnerable groups such as the elderly and those with respiratory conditions. It can also damage mechanical systems and increase the frequency of false fire alarms.

Bushfire weather frequency is projected to increase in Sydney, lifting from 1.1 to 1.5 days of severe fire danger p.a. between the current and future 2090 condition.

Recent hazardous bushfire smoke events include the 2019-2020 summer, when 33 days of hazardous air quality were recorded in greater Sydney.



Source: NSW Planning Portal Spatial Viewer

Indicator	Baseline	2030	2050	2070	2090
Severe fire danger days p.a.	1.1 days	1.2 to 1.5 days	N/A	N/A	1.5 to 1.6 days

Climate context

Climate hazards: Extreme heat & heatwaves

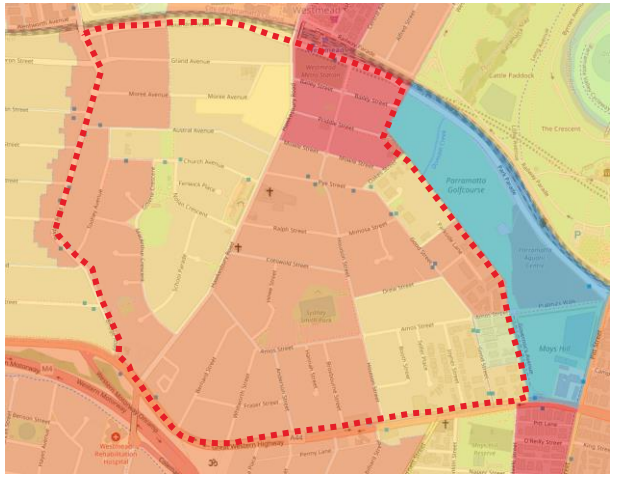
- Westmead South is currently exposed to **urban heat island effect**.
- Extreme heat conditions are projected to increase, with an **additional 23 days p.a. above 35°C** at Westmead South by 2090, above the current average of 10.9 days.
- Extreme heat disproportionately impacts vulnerable groups and poses significant risk to urban and built infrastructure systems.

Average annual, mean min., and mean max. temperatures are projected to increase across Australia's East Coast to 2090, with an uplift in average mean max. at Westmead South of +1.8°C by 2050 and +3.8°C by 2090. Summers are projected to become increasingly hot, with an additional 23 days annually exceeding 35°C; this presents a tripling of hot days per annum, above the baseline condition.

Urban heat island (UHI) mapping (top right) illustrates that Westmead South is currently exposed to +3 to +6 °C variance in surface temperature against a non-urban, vegetated reference. Heat vulnerability index (HVI) mapping (lower right) indicates the area's communities experience varying vulnerability to heat, quantified across heat exposure, sensitivity, and adaptive capacity. Increase in average and max. temperatures to 2090 indicates that UHI effect increasingly impact Westmead South's vulnerable communities.

Indicator	Baseline	2030	2050	2070	2090
Annual mean max	23.3°C	23.9°C	25.1°C	25.3°C	27.1°C
Days > 35°C p.a.	10.9 days	14.3 days	19.1 days	19.8 days	34.1 days

Source: NSW Urban Heat Island to Modified Mesh Block 2016, SEED Map, NSW Dept. Planning and Environment 2019



Source: NSW Heat Vulnerability Index to ABS Statistical Area Level 1 2016, SEED Map, NSW Dept. Planning and Environment 2019

Climate context

Climate hazards: Rainfall & flooding

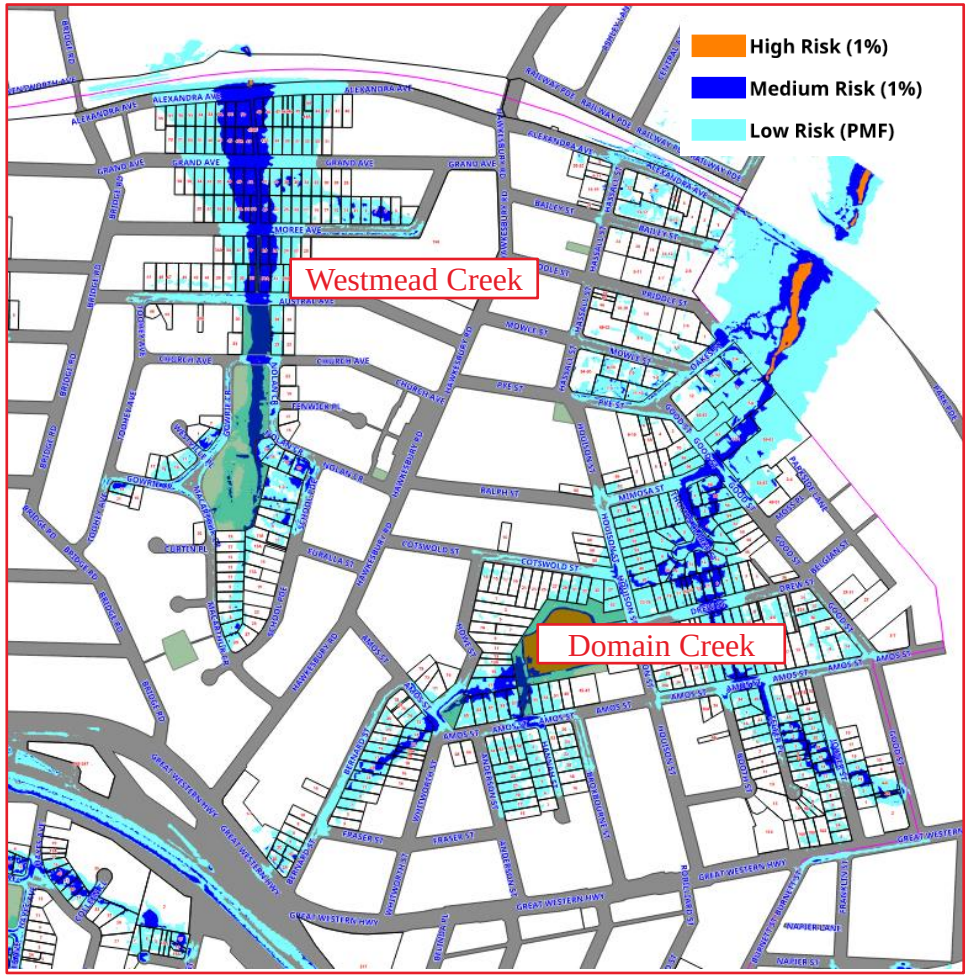
- Westmead South has **existing overland flow and inundation** areas.
- **Rainfall intensity projected to increase** +10% by 2050, +25% by 2090.
- **Uplift in flood depth and extent** has been modelled for +10%, +30% changes in rainfall intensity.
- Urban form, hardscaping, and landscaping are relevant local factors.

Westmead Creek and Domain Creek catchments comprise most of Westmead South's area, feeding north to Parramatta River. In the 100-year ARI event, depths >1m are exhibited at Sydney Smith Park (Domain Creek), and depths >0.5m at Alexandra Ave., Grand Ave., and Moree Ave. (Westmead Creek). Flooding extent typically varies depending on the presence of impermeable surfaces, location of waterways, direction of underground and surface flows, and vegetation.

Rainfall events in the Sydney basin are projected to become more intense, likely leading to an increase in flash flooding in urban areas. In the Parramatta area, rainfall intensity is projected to increase by +10.7% by 2050, and +25.0% by 2090, above current climate conditions, during intense rainfall events. Average annual rainfall is also projected to increase for the 2050 and 2090 conditions.

The figure to the right illustrates flood risk level for Westmead South, for its existing condition. In **Appendix B: Flood mapping excerpts**, change in overland flow paths and flood extents for +10% and +30% intensity conditions (above 1% AEP) are illustrated. Collectively, this indicates that overland flow paths and inundation will continue to pose a risk to Westmead South into the future, with increase in rainfall intensity likely exacerbating flood hazard levels for the community and the urban form.

Source: Cumberland City Council *Map 4 - Flood Risk Precincts Map*, 2021



Climate context

Climate hazards: Drought & water scarcity

- Greater Sydney is projected to experience **more droughts**, and droughts of **longer duration** toward 2090.
- Evapotranspiration is projected to increase, impacting landscaping and natural environments.

Increased drought frequency (+0.7 months / 20-year period) and drought intensity (+17 months / drought) in the Sydney Basin by 2090 is likely to result in more frequent and prolonged water restrictions. This may be accompanied by increased social and regulatory expectation for water efficiency and circularity.

Increase in evapotranspiration is unlikely to directly impact residents and businesses in Westmead South. However, it may impact landscaping and the water table, with increased water loss annually and flow on impacts to urban amenity, natural systems, and soil stability.

Indicator	Baseline	2030	2050	2070	2090
Frequency (droughts / 20-years)	1.3	1.9	2.0	2.0	2.0
Duration (months / drought)	22 months	31 months	31 months	35 months	39 months
Evapo-transpiration	1400 to 1600	+4.1%	+7.2%	+10.5%	+14.3%

Climate hazards: Storms, hail & extreme wind

- Continued exposure to storms, hail and extreme wind, but a slight decline in frequency of East Coast Lows projected by 2090.
- Changes to surface winds are projected to be minor. Projected changes in extreme winds are not conclusive.

Climate projections suggest that the frequency of East Coast Lows (ECLs) impacting South-East Australia will decrease toward the end of the century. ECLs are typically associated with storm systems. This is distinct from rainfall intensity, however, with rainfall intensity during high rainfall events projected to increase.

Seasonal surface wind speeds are projected to change only a small degree in the near- and far-term. Projections for extreme wind conditions – winds that are disruptive or damaging – are not conclusive.

ARUP

Westmead South

Part 3: Climate impact assessment

ARUP

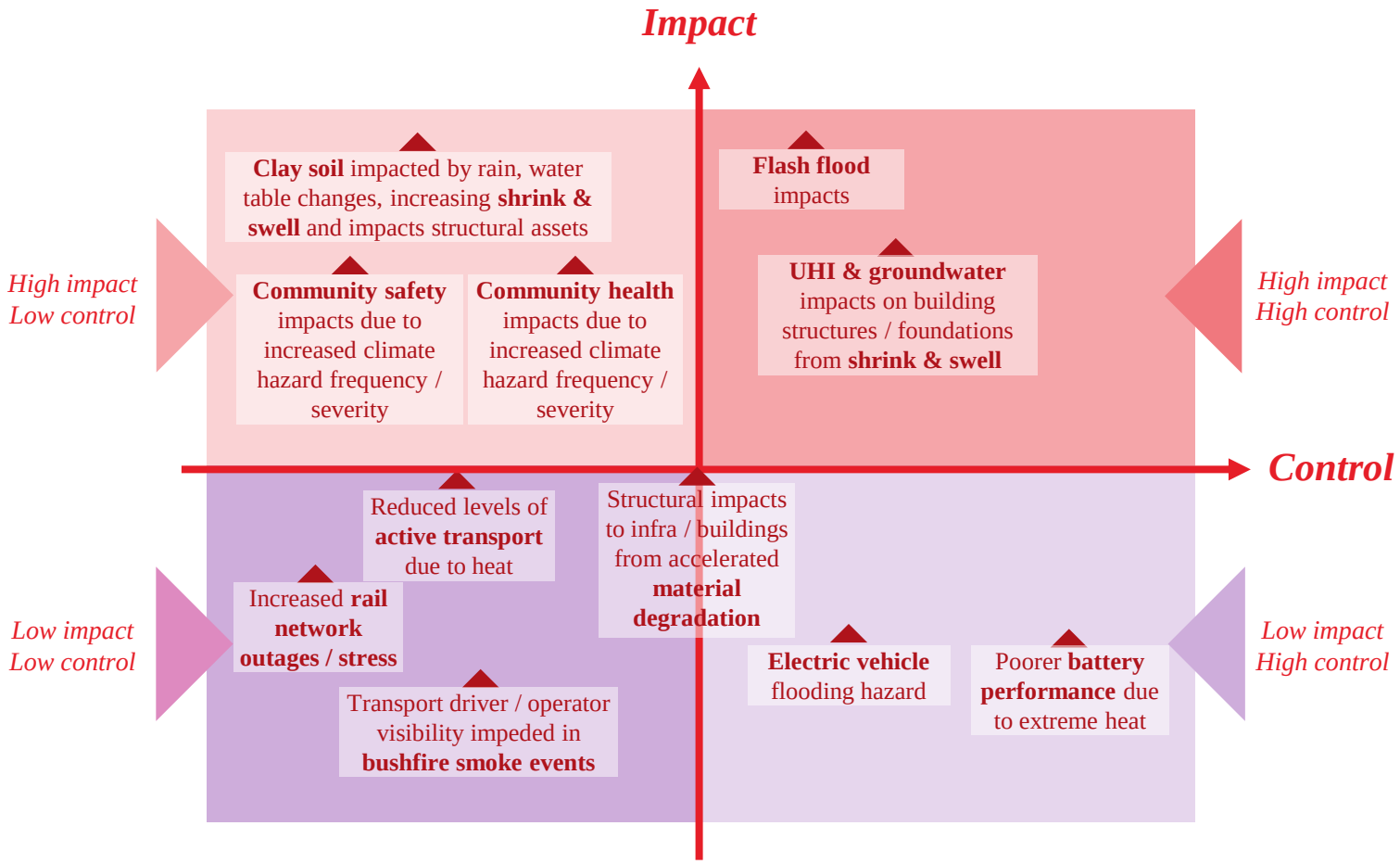
Climate impact assessment

Impact areas & workshop output

Climate impact areas were identified and workshopped with the core project team on 31/08/2023, categorised on a matrix of impact severity and impact controllability (see right). This initial set of impacts is not exhaustive. Primary impact areas identified by participants were:

- **Community health and safety** impacts from broad climate hazards
- **Civil and structural** impacts from UHI effect, flooding, and soil movement
- **Transport network** impacts from bushfire smoke
- **Urban amenity and active transport** impacts from extreme heat
- **Battery and EV** impacts from flooding and extreme heat

Following the workshop, additional impact areas have been identified and assessed, applying the AS5334:2013 risk matrix to allocate hazard categories, impact statements, likelihoods (L) and consequences (C), and qualitative risk levels to each impact area. See **Appendix A: Impact Assessment Matrix** for the full list of impact areas and assessment results.



Climate impact assessment

Key findings

- **Extreme heat**, **heatwaves**, and increased **UHI effect** pose an **extreme risk** to Westmead South and its communities, for the 2050 and 2090 horizons.
- **Extreme heat** and its impact to indoor thermal comfort poses a **high risk**, for 2050 and 2090.
- **More intense rainfall events** and impacts to civil drainage, including unmanaged overland flow paths, pose a **high risk** to community safety and physical assets, for 2050 and 2090.

The climate impact profile for Westmead South, for 2050 and 2090, indicates that extreme heat and intense rainfall will present the most significant hazard to the precinct's buildings, infrastructure, urban form, and community. These hazard categories pose an increasing risk profile between the baseline, historical condition and the future time horizons considered.

- See **Appendix A: Impact Assessment Matrix** for the full results.

Note: for some impact items, the qualitative impact level is consistent between the baseline and 2050 and / or 2090 horizons. This does not necessarily indicate that impact level is unchanged, but that the magnitude of change between time horizons is not significant enough to trigger an uplift in rating.

ARUP

Westmead South

Part 4: Resilience planning

Resilience planning

Adaptation

At a precinct level, adaptation to climate impacts can be broadly grouped into 3 types: (1) precinct adaptations (2) building adaptations and (3) adaptive capacity. The table below outlines adaptation options available for the Westmead South Masterplan, broken down by adaptation type and by climate hazard:

	Precinct adaptations	Building adaptations	Adaptive capacity
Bushfire & air quality **Low** to **Medium** impact level	-	▪ HVAC space provision, in critical buildings, for retrofit of high-grade filtration systems.	▪ Digital alert system or alert boards for hazardous weather conditions, including poor air quality alerts.
Extreme heat **Medium** to **Extreme** impact level	▪ Maximise street planting and urban greening to mitigate UHI effect. ▪ Electricity redundancy / on-site renewable energy generation to mitigate risk of heat wave-induced blackouts. ▪ High solar reflectance index surfacing to mitigate UHI effect (roads, carparks). ▪ Dedicated public spaces that are thermally comfortable and open during heat waves.	▪ High solar reflectance index surfacing to mitigate UHI effect (roofing). ▪ Site setback or % allocation to greening / rain gardens. ▪ Size all HVAC systems for 2030 or 2050 climate design conditions. ▪ Size all HVAC rooms to allow for increased plant size after 2050. ▪ Uptake of passive design, e.g., through min. Green Star Buildings, Green Star Homes ratings, or PassivHaus principles. ▪ Outdoor thermal comfort through landscaping, awnings, glare reduction.	▪ Digital alert system or alert boards for hazardous weather conditions, including forecast heat waves. ▪ Develop / onboard community outreach programme to liaise with vulnerable communities about heat management risks and strategies. ▪ Develop / onboard local / regional emergency heat management plan.

Resilience planning

Adaptation

	Precinct adaptations	Building adaptations	Adaptive capacity
Rainfall & flooding **Medium** to **High** impact level	▪ Permeable paving to improve water uptake. ▪ Uplift in civil drainage requirements to account for uplift in rainfall intensity, per ARR Guidelines. ▪ WSUD principles to manage overland flow paths and pollutant runoff. ▪ Undertake / update precinct flood mapping, including for proposed masterplan, and for uplift in rainfall intensities.	▪ Uplift in hydraulic drainage requirements to account for uplift in rainfall intensity, per ARR Guidelines. ▪ Curb-side WSUD applications. ▪ On-site detention basins for lots close to overland flow routs. ▪ Freeboard against selected AEP + rainfall intensity uplift, e.g., 200mm above 1%AEP + 19.7% intensity. ▪ Bunding or elevation of all critical electrical equipment.	▪ Develop / onboard local / regional flood management plan.
Drought & water scarcity **Low** to **Medium** impact level	▪ Recycled water / purple pipe network, or provision for connection to future regional purple pipe network. ▪ Selection of drought tolerant / native vegetation, considering 2050 and 2090 climates when selecting native species.	▪ On-site rainwater harvesting, connecting to non-potable water demands. ▪ Grey water capture and reuse. ▪ Highest efficiency water fixtures, and waterless fixtures where possible.	▪ Community outreach / education on minimising water usage.

Resilience planning

Adaptation

	Precinct adaptations	Building adaptations	Adaptive capacity
Storms, hail & extreme wind Low to Medium impact level	▪ Wind modelling of building massing to minimise street-level disruptive winds. ▪ Public spaces to include landscaping elements (vegetation, walling) that offer respite to prevailing wind conditions.	▪ Gutter guards to minimise hail impacts to drainage. ▪ Avoid planting of species likely to result in overhang / dead-drop over roofs.	▪ Digital alert system or alert boards for hazardous weather conditions, including incoming storm or hail systems. This could be tied to BoM alerts and / or built into public art systems (e.g., a visual barometer display and information panel).
Combined impacts Low to Medium impact level	▪ Precinct level strategy to maximise renewable energy generation and reduce reliance on grid. ▪ Geotechnical assessment of site to assess presence of reactive soils. ▪ Coordinate with major infrastructure providers (Sydney Metro, Sydney Water) to coordinate emergency management, resource redundancy, service downtime for typical shocks and stresses, etc.	▪ In case of reactive soils, require that developments liaise with durability / materials experts to manage exposure, e.g., through high SCM concrete mix, higher assumed groundwater table, etc.	▪ Free, periodic active transport workshops to improve resilience to transport network outages, e.g., free bike maintenance or bike training sessions. ▪ Community outreach / education on improving adaptive capacity to network-level outages, e.g., information on local areas of respite in case of heat waves and blackouts.

ARUP

Resilience planning

Adaptation implementation

To assist in adaptation selection and implementation for Westmead South, the following recommendations are made:

1. **Confirm adaptation priorities** based on:
    i. Impact level (i.e., climate impacts within the impact assessment that are high or extreme).
    ii. Capacity to be implemented precinct-wide, for maximum efficiency and benefit.
2. **Review and note additional co-benefits** (i.e., secondary positive effects) that adaptations may deliver, to inform business case. E.g.:
    i. Capacity to support other masterplan objectives around nature, the local economy, or social objectives.
    ii. Capacity to improve management of key transition risks.
3. **Nominate owners for priority adaptations** to assist in tracking adaptation and risk ownership.
4. **Utilise stakeholder engagement** to workshop adaptations and opportunities to build adaptive capacity, possibly engaging community members, local businesses, local interest groups, utility providers.

Resilience planning

Next-steps & ongoing monitoring

Adapting for future climate impacts has inherent uncertainty, with varying degrees of confidence within climate projections and intersection with local factors. Ongoing monitoring of impact areas and adaptations is critical to driving resilience. The graphic to the right outlines milestone actions to assist in this:

3-month milestone

- Ensure that agreed adaptations are included in master plan design, where possible.
- Track feasibility & progress of adaptations, noting barriers to implementation (legislative, design, engineering, cost, stakeholder).
- **Responsible parties:** Design team, council

12-month milestone

- Ensure that resilience assessment and planning informs Westmead South DCP, where relevant, including adaptations and future operational / community initiatives.
- Confirm ongoing suitability of this Resilience Plan's impact assessment results & adaptations, recording new impact areas & potential adaptations for masterplanning or future works programs.
- Conduct review of any new local, state or national strategies or policies on resilience, identifying new learnings, initiatives or requirements applicable to Westmead South.
- **Responsible parties:** Design team, council (strategic planning role / sustainability and climate role)

Ongoing review

- Establish a review timeframe and nominate a responsible authority within Council to undertake a review of risks, risk ratings and adaptations.
- Track and document climate hazards events (flooding, heat waves) impacting the Westmead South area, including downtime for critical infrastructure and vulnerable populations.
- **Responsible parties:** Council, possibly including strategic planning role or a sustainability and climate role. This role may be temporary in the short-term, or a dedicated responsibility for a strategic planner or sustainability and climate sub-team. This would create efficiencies in monitoring & delivering climate resilience outcomes in tandem with decarbonisation outcomes, as the council works towards alignment with NSW state government net zero targets.

ARUP

Westmead South

Appendix A: Impact assessment matrix

Impact assessment matrix

Results

#	Impact statement	Direct / indirect	Baseline			2050			2090		
			L	C	Level	L	C	Level	L	C	Level
Bushfire & air quality											
B1	More frequent bushfire smoke events **impacting visibility** across precinct, reducing transport network reliability and safety.	Direct	Unlikely	Minor	Low	Unlikely	Minor	Low	Possible	Minor	Low
B2	More frequent bushfire smoke events posing **health and wellbeing** risk to community, notably vulnerable groups and people with respiratory conditions.	Direct	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.	Likely	Mode-rate	Med.
B3	More frequent bushfire smoke events impacting precinct **outdoor amenity and indoor comfort**, e.g., outdoor activity impacts, nuisance false fire alarms.	Direct	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.	Likely	Mode-rate	Med.
Extreme heat & heatwaves											
H1	More frequent & severe heat events posing **health and wellbeing** risk to community, notably vulnerable groups such as the elderly.	Direct	Likely	Major	High	Almost certain	Major	Extreme	Almost certain	Major	Extreme
H2	Increase in average & extreme heat conditions impacting **active transport** network and patronage, increasing reliance on public and private modes.	Direct	Likely	Minor	Med.	Almost certain	Minor	Med.	Almost certain	Minor	Med.
H3	More frequent & severe heat events damaging **landscaping and outdoor amenity and comfort**.	Direct	Unlikely	Mode-rate	Med.	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.
H4	More frequent & severe heat events impacting **indoor thermal comfort**, exceeding passive design systems, heat rejection, ventilation.	Direct	Likely	Mode-rate	Med.	Almost certain	Mode-rate	High	Almost certain	Mode-rate	High
H5	More frequent & severe extreme heat events impacting **electrical asset** efficiency and function, e.g., batteries, EV chargers, rooftop PV, substations.	Direct	Unlikely	Mode-rate	Med.	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.
H6	Increase in average & extreme heat conditions exacerbating existing **UHI effect**, impacting community health and wellbeing, notably vulnerable groups.	Direct	Likely	Major	High	Almost certain	Major	Extreme	Almost certain	Major	Extreme

Impact assessment matrix

Results

#	Impact statement	Direct / indirect	Baseline			2050			2090		
			L	C	Level	L	C	Level	L	C	Level
Rainfall & flooding											
R1	Increase in rainfall intensity **overwhelming civil drainage** and urban form, resulting in flash flooding and unmanaged overland flows, posing safety risk to community and physical risk to civil assets.	Direct	Unlikely	Major	Med.	Possible	Major	High	Possible	Major	High
R2	Increase in rainfall intensity **overwhelming hydraulic drainage**, resulting in unmanaged overflow, posing safety risk to critical building assets, e.g., substations, EV charging, batteries, pollutant control.	Direct	Unlikely	Mode-rate	Med.	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.
R3	Increase in rainfall intensity **overwhelming civil drainage** and urban form, increasing pollutant runoff to sensitive environmental receivers.	Direct	Unlikely	Mode-rate	Med.	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.
R4	Increase in short-term, localised flooding to arterial roads impeding safe **access and egress** by community & critical services, e.g., emergency services.	Direct & indirect	Rare	Major	Med.	Unlikely	Major	Med.	Unlikely	Major	Med.
Drought & water scarcity											
D1	Increase in drought frequency & duration regionally **restricting potable water supply** to community and infrastructure.	Indirect	Unlikely	Mode-rate	Med.	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.
D2	Increase in drought frequency & duration impacting **landscaping and amenity**.	Direct	Unlikely	Minor	Low	Possible	Minor	Low	Possible	Minor	Low

Impact assessment matrix

Results

#	Impact statement	Direct / indirect	Baseline			2050			2090		
			L	C	Level	L	C	Level	L	C	Level
Storms, hail & extreme wind											
S1	Prevailing wind conditions & storm fronts **disrupting outdoor comfort and amenity**, exacerbated by urban form, e.g., wind tunnelling.	Direct	Unlikely	Minor	Low	Possible *	Minor	Low*	Possible *	Minor	Low*
S2	Hail, wind & storm debris **blocking drainage**, resulting in unmanaged building overflow from hydraulic drains and unmanaged overland flows from civil drains.	Direct	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.	Possible	Mode-rate	Med.
Combined impacts											
X1	Combination of more intense rainfall events, more frequent and prolonged drought, and more frequent extreme heat events, **increasing soil shrink & swell** in reactive soils and damaging civil and structural elements, e.g., slabs, underground pipes, embankments, retaining walls.	Direct	TBC**	Mode-rate to major	TBC**	TBC**	Mode-rate to major	TBC**	TBC**	Mode-rate to major	TBC**
X2	More frequent extreme heat events, coupled with more intense rainfall events, **accelerating material degradation** of exposed elements, e.g., façade systems, road surfacing, adhesives.	Direct	Unlikely	Minor	Low	Unlikely	Minor	Low	Unlikely	Minor	Low
X3	Increased frequency & intensity of climate hazard events that result in **transport network outages** and resultant impacts to community.	Indirect	Mode-rate	Mode-rate	Med.	Likely	Mode-rate	Med.	Likely	Mode-rate	Med.

*Likelihood of disruptive winds arising at Westmead South will depend in part on urban form and building massing, and massing with reference to prevailing wind directions.

**Soil shrink and swell risk, and impact of climate variables, will directly depend on the presence & distribution of reactive soils within the precinct. It is recommended that soil test results be confirmed / tests undertaken to inform exposure assessment.

ARUP

Westmead South

Appendix B: Flood mapping excerpts

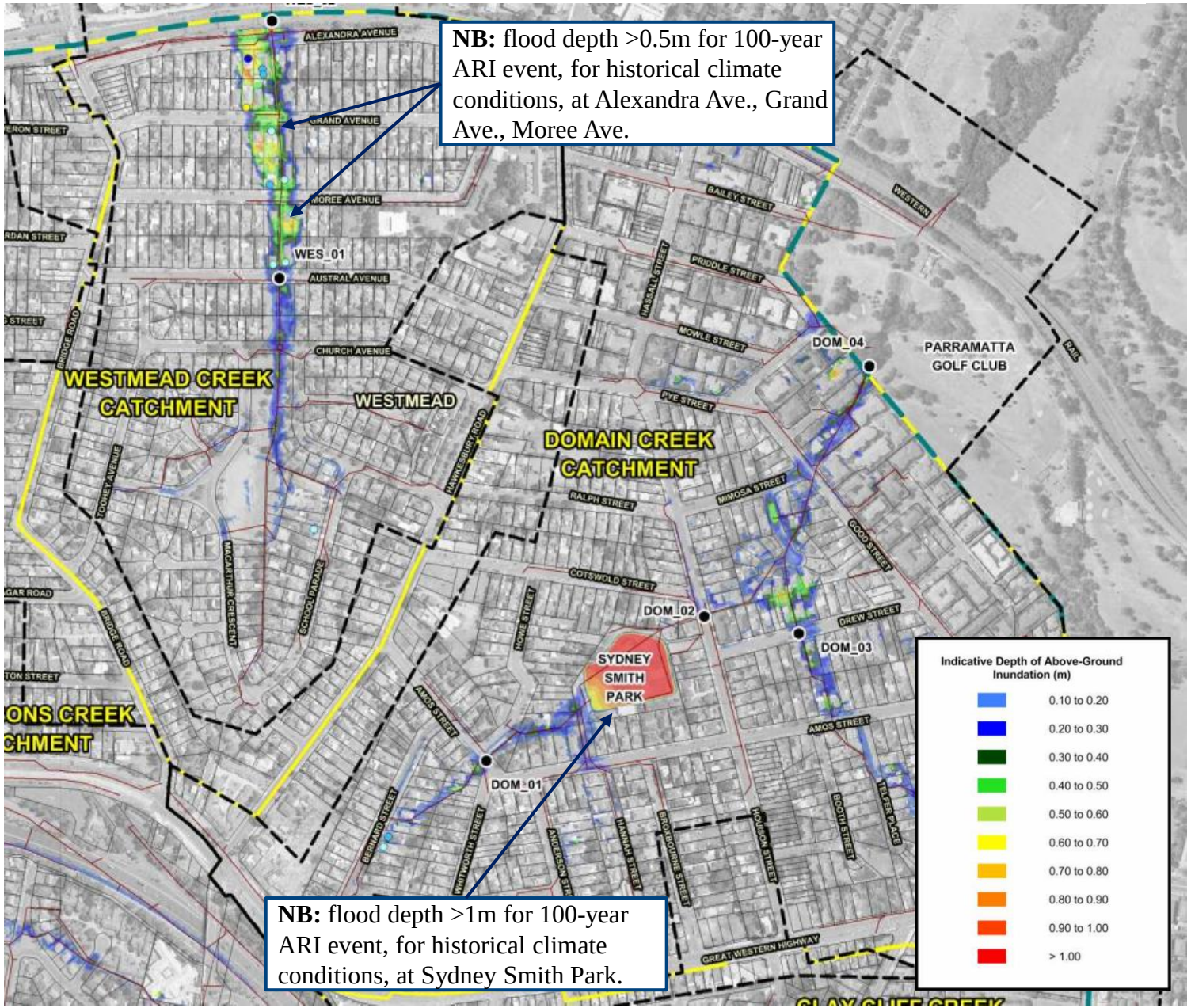
Climate context

Climate hazards: Rainfall & flooding

100-year ARI event for historical climate conditions

Source: *Holroyd City LGA Overland Flood Study*, figure 6.5, sheet 4 of 11: *TUFLOW model results 100-year ARI*

Indicator	Base-line	2030	2050	2070	2090
Annual mean rainfall	975.2mm	+1.87%	N/A	+10.18%	N/A
Rainfall intensity	197mm	+10.1%	+10.7%	+17.2%	+25.0%



Climate context

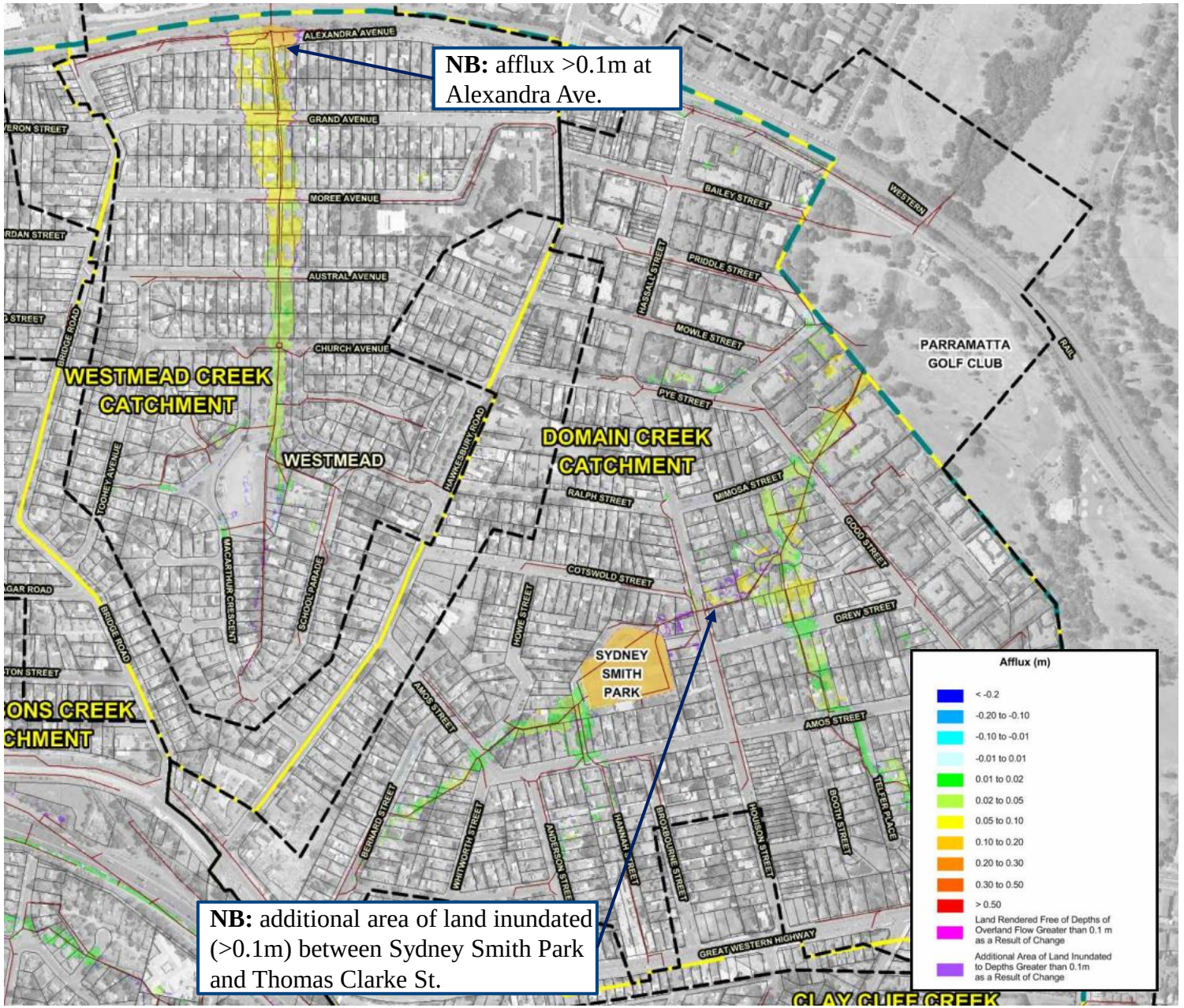
Climate hazards: Rainfall & flooding

Afflux for +10% rainfall intensity over the 100-year ARI event. Afflux is increase in water level resulting from a change in conditions.

Source: *Holroyd City LGA Overland Flood Study*, figure 6.12, sheet 4 of 11: *Sensitivity of flood behaviour to 10% increase in rainfall intensity 100-year ARI*

Note: Australian Rainfall & Runoff (ARR) Guidelines recommend considering +19.7% rainfall intensity for the RCP 8.5 future climate condition, for year 2090.

Indicator	Base-line	2030	2050	2070	2090
Annual mean rainfall	975.2mm	+1.87%	N/A	+10.18%	N/A
Rainfall intensity	197mm	+10.1%	+10.7%	+17.2%	+25.0%



Climate context

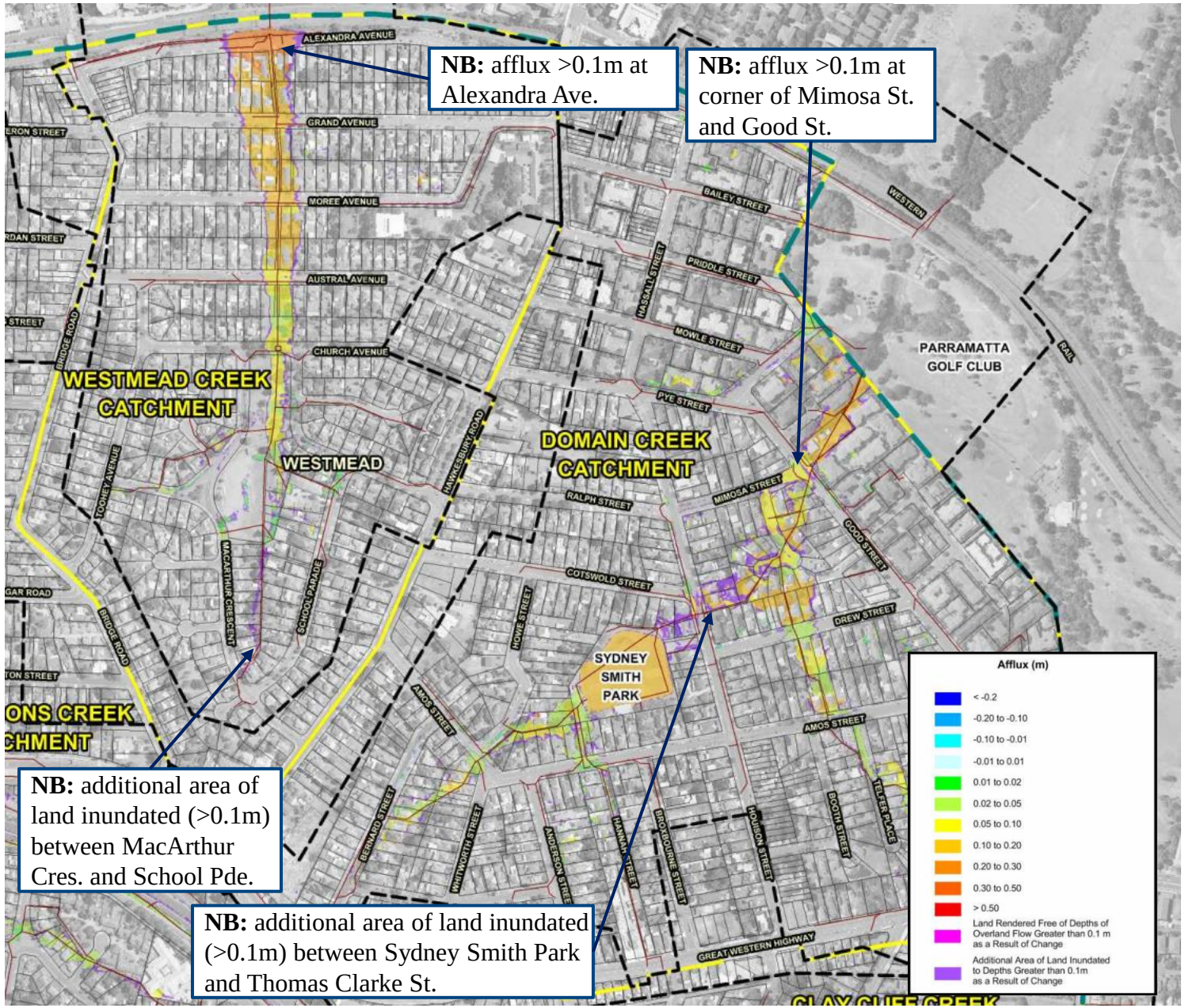
Climate hazards: Rainfall & flooding

Afflux for +30% rainfall intensity over the 100-year ARI event. Afflux is increase in water level resulting from a change in conditions.

Source: *Holroyd City LGA Overland Flood Study*, figure 6.12, sheet 4 of 11: *Sensitivity of flood behaviour to 30% increase in rainfall intensity 100-year ARI*

Note: Australian Rainfall & Runoff (ARR) Guidelines recommend considering +19.7% rainfall intensity for the RCP 8.5 future climate condition, for year 2090.

Indicator	Base-line	2030	2050	2070	2090
Annual mean rainfall	975.2mm	+1.87%	N/A	+10.18%	N/A
Rainfall intensity	197mm	+10.1%	+10.7%	+17.2%	+25.0%



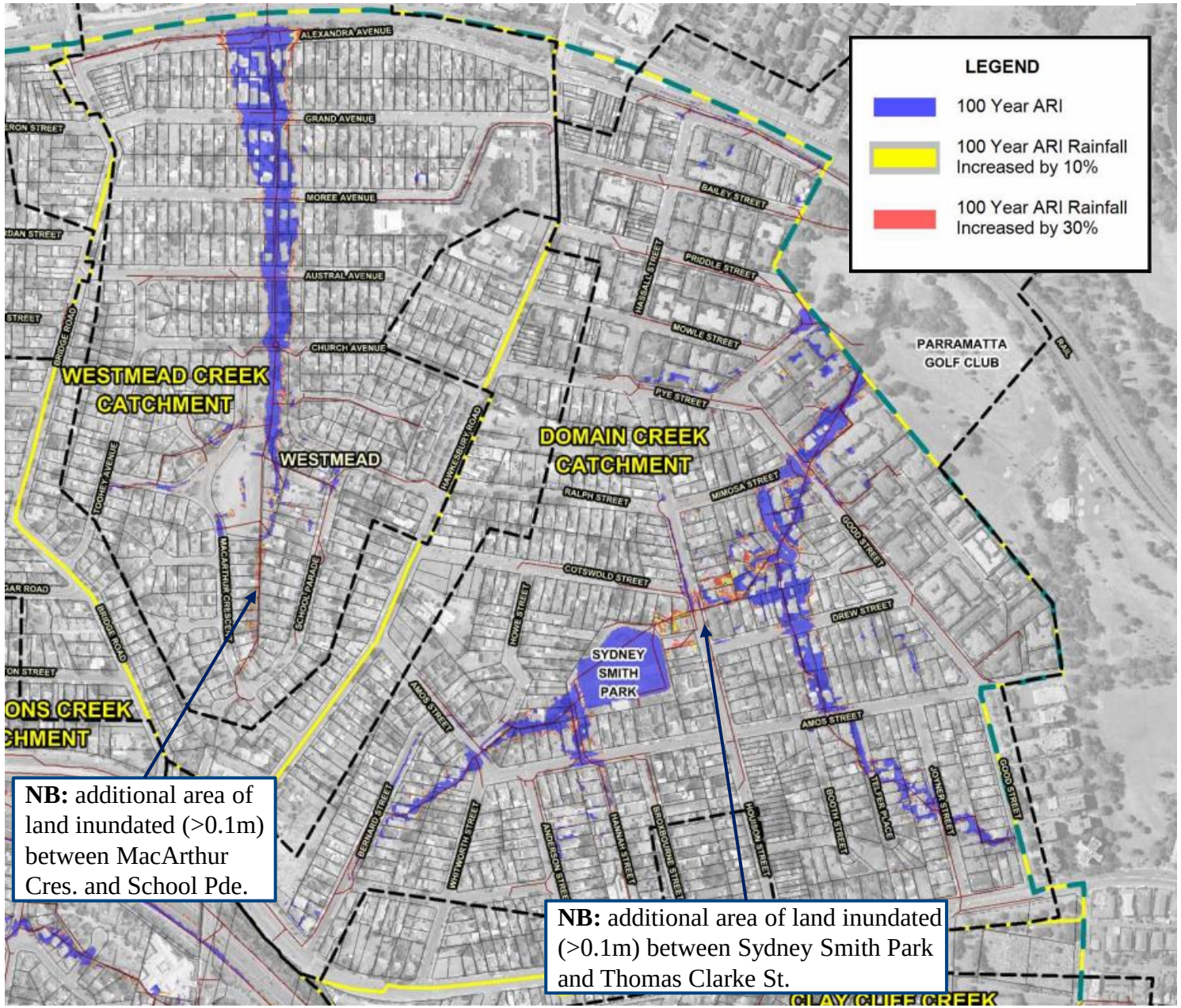
Climate context

Climate hazards: Rainfall & flooding

Change in flood extent for +10% and +30% rainfall intensity over the 100-year ARI event.

Source: *Holroyd City LGA Overland Flood Study*, figure 6.14, sheet 4 of 11: *Impact of Increased Rainfall Intensities on Extent of Flooding – 100-year ARI*

Indicator	Base-line	2030	2050	2070	2090
Annual mean rainfall	975.2mm	+1.87%	N/A	+10.18%	N/A
Rainfall intensity	197mm	+10.1%	+10.7%	+17.2%	+25.0%



ARUP