



INGLESIDE PRECINCT

SUSTAINABILITY PEER REVIEW + STRATEGY ANALYSIS

PREPARED BY KINESIS FOR PITTWATER COUNCIL

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Note: This report is provided subject to some important assumptions and qualifications:

The results presented in this report are modelled estimates using mathematical calculations. The data, information and scenarios presented in this report have not been separately confirmed or verified. Accordingly, the results should be considered to be preliminary in nature and subject to such confirmation and verification.

Energy, water and greenhouse consumption estimates are based on local climate and utility data available to the consultant at the time of the report. These consumption demands are, where necessary, quantified in terms of primary energy and water consumptions using manufacturer's data and scientific principles.

Generic precinct-level cost estimates provided in this report are indicative only based on Kinesis's project experience and available data from published economic assessments. These have not been informed by specific building design or construction plans and should not be used for design and construct cost estimates.

The Kinesis software tool and results generated by it are not intended to be used as the sole or primary basis for making investment or financial decisions (including carbon credit trading decisions). Accordingly, the results set out in this report should not be relied on as the sole or primary source of information applicable to such decisions.

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EXECUTIVE SUMMARY

Kinesis were engaged by Pittwater Council to review the completed technical studies for the Ingleside Precinct and provide an independent peer review of the sustainability performance and outcomes for the precinct.

The purpose of this report is to examine alternate infrastructure options, strategies and compliance requirements, beyond traditional methods, that could improve the sustainability of the development. This report is prepared as a primer for discussion at a meeting to be held with Pittwater Council, Department of Planning and UrbanGrowth NSW.

KEY FINDINGS

The following documents were made available to Kinesis for review as part of this sustainability and infrastructure peer review process:

- Draft Infrastructure Delivery Plan by Cardno
- Land Capability, Salinity and Contamination Assessment by SMEC
- On Site Effluent Management Capability Report by SMEC
- Slope Risk Assessment Report by SMEC, and
- Transport and Traffic Assessment by AECOM
- Water Cycle Management and Flooding Assessment by Cardno

The purpose of these studies was to investigate the feasibility of development opportunity to release land in the Ingleside Precinct. It is reported that a business as usual approach to the delivery of infrastructure would come at a cost of \$24,000 per lot.

DELIVERING A SUSTAINABLE INGLESIDE

This report identifies that optimised infrastructure delivery and building design can deliver a largely self-sufficient precinct that meets the objectives for the precinct, optimises regional infrastructure investment and sets a new benchmark for sustainability in fringe residential planning and development.

To deliver on these outcomes, it is recommended that the project team for the Ingleside precinct pursue the following:

1. **Precinct scale recycled water¹.**
2. **BASIX Energy 60 (20 points above current compliance) delivered by building scale energy solutions.**

3. **Improved public and active transport links and design.**

4. **Investigate additional infrastructure solutions, including LED street lighting and planning for EVs.**

When compared to BASIX compliance, the combination of these strategies is expected to deliver:

- **35% reduction** in potable water demand.
- **40% reduction** in stationary greenhouse gas emissions
- **20% reduction** in peak electricity demand
- **100% reduction** in sewer loads generated by the precinct.
- Unlimited water for irrigation of public spaces, green corridors and school playgrounds and playing fields, ensuring improved public domain that is less reliant on rainfall and local climate conditions.
- In the absence of district recycled water, an average BASIX water outcome of 55 achieved via rainwater harvesting, would meet the environment flows and ground water targets agreed to by Council at the commencement of the project. While a BASIX water outcome of 60 is possible with significantly increased rain tank sizes, this outcome would realistically only be delivered with a recycled water solution.
- Save households approximately **\$800 a year** on their utility bills.

Four action areas were identified to deliver these outcomes at Ingleside.

GREEN STAR COMMUNITIES

Accreditation under the Green Star Communities rating tool is being targeted for Ingleside, aimed towards a Four Star (Australian Best Practice) Green Star rating. The combination of the above strategies will assist in the delivery of this rating across a number of targeted strategies, including:

- **Greenhouse Gas Strategy** – 2-3 points (out of a possible 6 points)
- **Peak Electricity Demand** – 2 points (out of a possible 2 points)
- **Integrated Water Cycle** – 3-5 points (out of a possible 7 points)

¹ Subject to further investigation of the water balance and commercial arrangements to be established.



TECHNICAL STUDY REVIEW

The Department of Planning & Environment in partnership with Pittwater Council and UrbanGrowth NSW is undertaking the precinct planning for the Ingleside Precinct. The planning investigations have been informed by a suite of technical studies. The following technical study documents were made available to Kinesis for review as part of this sustainability and infrastructure peer review process:

- Draft Infrastructure Delivery Plan by Cardno
- Land Capability, Salinity and Contamination Assessment by SMEC
- On Site Effluent Management Capability Report by SMEC
- Slope Risk Assessment Report by SMEC
- Transport and Traffic Assessment by AECOM
- Water Cycle Management and Flooding Assessment by Cardno

A summary and key take-outs from this review (as they relate to the scope of this report) are outlined below.

DRAFT INFRASTRUCTURE DELIVERY PLAN

The Draft Infrastructure Delivery Plan (IDP) summarised the estimated costs of bringing key infrastructure to Ingleside, particularly potable and waste water, electricity and telecommunications. Of the four sub-precincts, only North and South Ingleside were investigated as it is expected they'll be developed first as the housing density of Wirreanda Valley and Bayview Heights were considered too low to provide cost estimates at this point.

The probable costs for infrastructure delivery are summarised in Table 1. These are general costs, not the cost to Council.

Precinct	Potable Water (\$,000,000)	Wastewater (\$,000,000)	Electricity (\$,000,000)	Total (\$,000,000)
North Ingleside	16.3	12.4	14.4	43.1
South Ingleside	3.2	10.1	15.7	29
Total	19.5	22.5	30.1	72.1

Table 1 Summary of probable costs of infrastructure delivery for North and South Ingleside (Draft Infrastructure Delivery Plan, Cardno)

Alternative servicing, such as via district recycled water, was not precluded, but was considered unlikely to be viable, given the proximity to traditional services coupled with the fragmented land ownership. It was identified that alternative infrastructure could be further investigated as part of the development of the Precinct.

It should be noted that Ingleside was identified as part of the 2010/11 Metropolitan Development Program and is part of Sydney Water's Growth Servicing Plan. Under the Growth Service Plan, water and wastewater infrastructure is largely delivered and paid for by Sydney Water. The Growth Servicing Plan (2014 to 2019) states that Sydney Water has completed high level strategic planning for the area. Sydney Water will only commit to delivering the infrastructure if there is approved funding for the work.

Key take-out – With an estimated 3,000 dwellings destined for North and South Ingleside, water, sewer and electricity infrastructure delivery equates to roughly \$24,000 per dwelling. This cost should be considered alongside demand management or alternative infrastructure solutions for the precinct.

ON SITE EFFLUENT ASSESSMENT FOR SUBDIVISION

The On Site Effluent Assessment for Subdivision report examines the major and minor limitations to on-site treatment and disposal of sewage in Wirreanda Valley and Bayview Heights. These sub-precincts were identified in the Draft Infrastructure Delivery Plan as being infeasible for the delivery of traditional sewer infrastructure.

The report examines constraints including buffers from bores and water courses, physical characteristics of soil such as permeability and slope, and chemical characteristics of the soil such as phosphorous loading.

After applying all buffer constraints it was determined that 32% of the remaining site area has minor physical limitations with regard to slope and major chemical limitations with regard to phosphorous loading. This limits the possible use of conventional on-site effluent management systems.

Key take-out - Phosphorous is a major limiting factor to conventional on-site effluent management systems. Without traditional sewer infrastructure, new residential development at Wirreanda Valley and Bayview Heights would be required to install on-site effluent management systems that manage phosphorous levels. As a result, the opportunity for new residential development in Wirreanda and Bayview Heights is unlikely.

SLOPE RISK ASSESSMENT REPORT

The Slope Risk Assessment Report is concerned with the risk of events such as landslides within the precinct. Slope constraints pertaining to on site effluent treatment is explored in the On Site Effluent Management Capability Report (SMEC).

TRANSPORT AND TRAFFIC ASSESSMENT

The Transport and Traffic Assessment examines detailed transport modelling to determine the effects the Ingleside development will have on the transport network and offers recommendations. These recommendations are summarised in Table 2.

The recommendations for private vehicle travel focus on the proposed Mona Vale Road upgrade, delivered in two stages – Mona Vale Road East and Mona Vale Road West which are separated by section of completed upgrade works. The upgrades consist of widening to two lanes, increasing the speed limit to 80 km/hr from 70 km/hr and enhanced intersection design.

Adequate public transport is expected to be provided via bus services of which an increase is proposed. It is estimated that Mona Vale Rd will have a high frequency bus service by 2021. Key bus corridors identified by the Transport and



Traffic Assessment are Mona Vale Rd, Powderworks Rd, Lane Cove Rd, Cabbage Tree Rd (within the precinct itself) and Manor Rd. These roads will need to accommodate bus stop and have lane widths of at least 3.5 metres.

The active transport plan involves off-road share paths along all collector roads, shared paths along riparian corridors and a wide shoulder along Mona Vale Road. Precise details of cycling and pedestrian infrastructure have yet to be finalised and some are subject to feasibility studies.

The active transport plan consists of

- A separated shared path alongside Mona Vale Rd West from McCarrs Creek Rd to Powder Works Rd.
- A short separated shared path along Mona Vale Rd East from Ponderosa Pde to Foley St.
- A shared path along Powderworks Rd.
- A wide shoulder along Mona Vale Rd.
- A proposed multi-use path connecting Lane Cove Rd to Walana Cres.
- Opportunity to provide recreational paths along riparian corridors adjacent to Cicada Glen and Mullet Creeks.

All strategies outlined above will follow the standards laid out in the NSW Bicycle Guidelines 2005.

Parking and end-of-trip facilities were outside the scope of the AECOM report.

Mode	Infrastructure/Service Improvements	Responsibility
Active Travel	Utility path alongside Mona Vale Road	RMS
Active Travel	Off-road shared paths (collector roads)	Developer / Council
Active Travel	Off-road shared paths (green corridors)	Developer / Council
Public Transport	Bus priority treatment at Mona Vale Road intersections	RMS
Public Transport	Enhanced bus services along Mona Vale Road	TfNSW
Public Transport	Enhance local services through Ingleside	TfNSW
Public Transport	Improved stopping facilities along Mona Vale Road	RMS
Public Transport	New / upgraded bus stops on other local roads	Developer / Council
Private Car	Mona Vale Road Upgrade	RMS
Private Car	Intersection improvements at Powderworks Road / Garden Street	Developer / Council / RMS
Private Car	Intersection improvements at Mona Vale Road / Pittwater Road	RMS
Private Car	Provision of roundabouts within the Ingleside Precinct	Developer / Council

Table 2 Summary of infrastructure provision (AECOM, 2015)

Key take-out - The dominant mode of transport in the Pittwater LGA is by private vehicle and this is not expected to change dramatically for residents at Ingleside. The active transport plan focuses on connections with Terrey Hills and Mona Vale via cycling infrastructure along Mona Vale Rd. The fuel mix of private vehicle transport – petrol, diesel, ethanol, electric etc – was outside the scope of the transport and traffic assessment. Given the context of expected car use and ownership, and expected take-up of electric vehicles, planning for electric vehicles will form an important part of any transport and energy strategy for the precinct.

WATER CYCLE MANAGEMENT AND FLOODING ASSESSMENT

Cardno has completed water balance modelling for Ingleside precinct. In order to meet the targets for groundwater and environmental flows at a sub-catchment level, a range of mitigation measures have been established:

Rainwater Harvesting

- Lot scale reuse for residential/mixed use development for toilet flushing, laundry, hot water and external uses
- Reuse for commercial development (school and community centre) for toilet flushing and external uses
- The following tank sizes have been adopted:

Low Density	10kL/lot
Medium Density	6kL/lot
Mixed Use	6kL/lot
Environmental Living	12kL/lot
School	150kL/ha roof area
Community Centre	150kL/ha roof area

Bioretention

- 200sqm bioretention in Wirreanda Creek catchment
- 14,000sqm bioretention in Cicada Glen Creek catchment
- 25,000sqm bioretention in Narrabeen/Mullet Creek catchment
- All detention basins will act as retention ponds

Stormwater Harvesting will also be used for irrigation of sports field in Narrabeen/Mullet Creek catchment.

Key take-out - These mitigation measures contribute to the sustainability outcomes across the precinct. Based on the specifications above, Kinesis calculates that these measures are expected to approximately deliver:

- 20% reduction in precinct water consumption
- Estimated BASIX Water outcome of 55
- Approximately \$90 household saving in water utility costs per year



OPPORTUNITIES ANALYSIS

Drawing on the review of technical studies and the draft Precinct Structure Plan, Kinesis has identified that through optimised infrastructure delivery and building design, Ingleside can deliver a new benchmark in sustainable development that meets the objectives for the precinct, optimises regional infrastructure investment and provides the potential for increased yield.

Our approach to the review and analysis of opportunities integrates both the expected yield and development outcomes of the draft Ingleside Precinct Structure Plan (see Figure 1) with predictive analytics to help Pittwater Council understand the implications of growth years before development begins. In addition, the integration of demand forecasting across energy, water, sewer, peak demand, transport patterns and financial modelling provides a unique and joined-up approach to infrastructure delivery opportunities to help enable sustainable development at Ingleside.

Analysis was undertaken using PRECINX, a precinct model used for the analysis of carbon, water, infrastructure, affordability and transport. Developed in partnership with UrbanGrowth NSW, PRECINX integrates land use, development and master plan inputs with demographic, utility, transport and affordability models to both analyse the performance of precinct and model the impact of a comprehensive suite of strategies and interventions to improve the sustainability and infrastructure performance of new and existing development.

DRAFT STRUCTURE PLAN

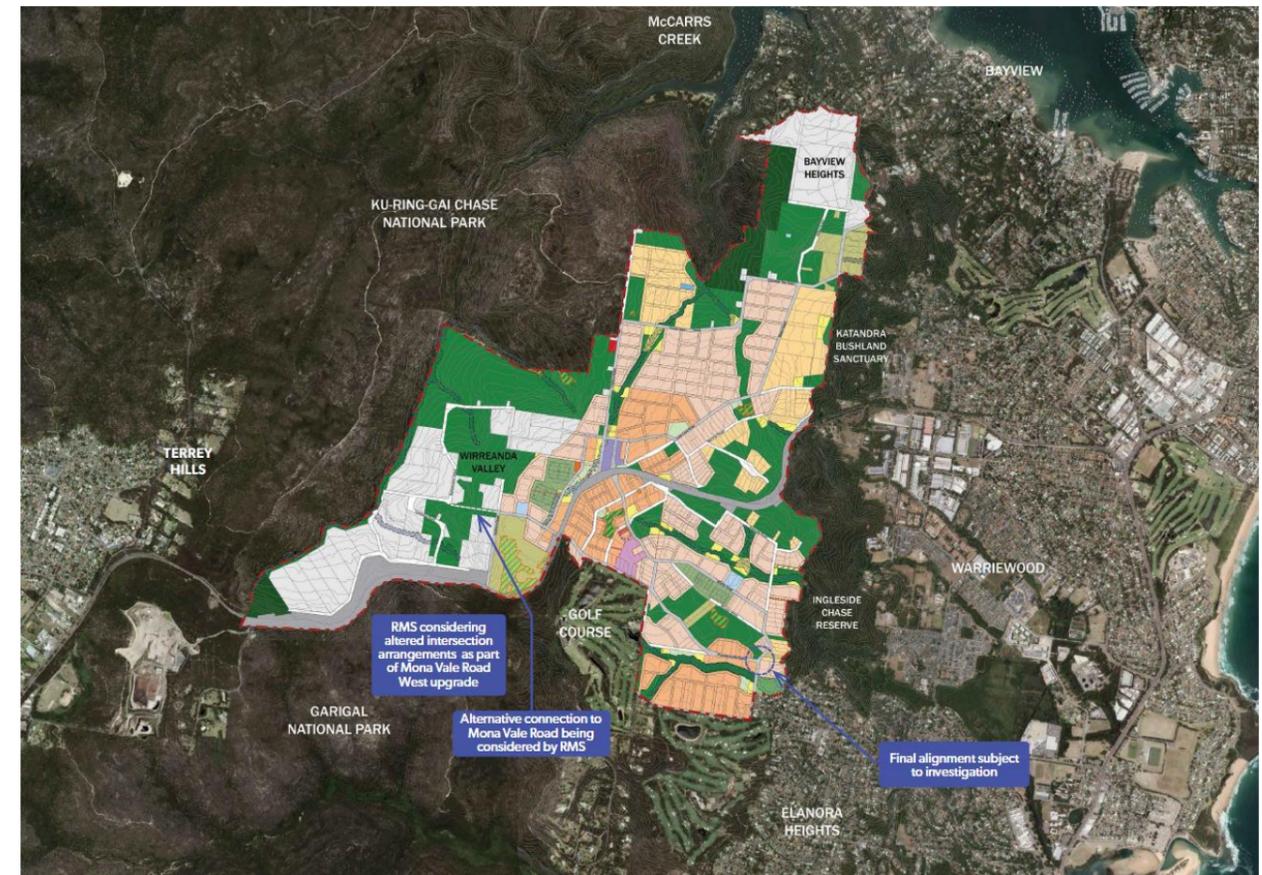


Figure 1 Draft Ingleside Precinct Structure Plan (24 November 2016)



SUSTAINABLE WATER INFRASTRUCTURE

ADDRESSING STORMWATER INFRASTRUCTURE

Water balance modelling by Cardno has outlined that targets for both groundwater and environmental flows at a sub-catchment level can be met through significant rainwater harvesting and reuse, bioretention and stormwater harvesting and reuse. These strategies provide water reductions across the precinct:

- 20% reduction in precinct water consumption
- Estimated BASIX Water outcome of 55
- Approximately \$90 household saving in water utility costs per year

While these significant mitigation measures meet the groundwater and environmental flow targets for the precinct, a precinct recycled water scheme (that incorporates sewer and stormwater collection and reuse) could contribute to or reduce the need for the mitigation measures outlined above. This is discussed further below.

ADDRESSING SEWER INFRASTRUCTURE

Wirreanda Valley and Bayview Heights sub-precincts were identified in the Draft Infrastructure Delivery Plan as being infeasible for the delivery of traditional sewer infrastructure. As a result, on-site effluent management systems were investigated for these sub-precincts. However, phosphorous is a major limiting factor to conventional on-site effluent management systems and without traditional sewer infrastructure, new residential development at Wirreanda Valley and Bayview Heights would be required to install non-traditional on-site effluent management systems that reduce phosphorous levels.

Non-Traditional On-site Effluent Management (Alternative Treatment Units)

The major constraints identified for on-site effluent management systems were nutrient loading of the soil and physical slope, depth and permeability of the sites. Both of these have the possibility to be overcome by Alternative Treatment Units (ATUs). Different from a traditional septic system, an ATU treats wastewater using a combination of biological treatment, membrane filters, chemical disinfectants and/or amended soils to lower the nutrient content to a level acceptable for areas with phosphorous constraints.

Through discussions with various providers, several ATUs are available which may be suitable for the development constraints outlined in the On Site Effluent Assessment for Subdivision technical report. These systems would:

- Require a minimum application area of 170 m², however an individual lot-by-lot assessment will be required to accurately determine the minimum application area at specific locations.
- Require regular maintenance and inspections.
- Possibly require chemical disinfectants such as chlorine or ozone, but no additional potable water for dilution. Further investigation may be required regarding the impact of disinfectants on local ecology.
- Require ATU agreements, which are hard to enforce and could place additional administrative demand on Council ensuring the agreements are enforced. This cost would need to be considered and addressed.

The ATU systems considered are not designed to handle pool and spa wastewater generated during times of heavy rains and maintenance which can be of significant volume. This wastewater would need to be removed by tanker to a

liquid waste facility at the pool owners' expense. This expense could drive non-compliance issues relating to inappropriate discharges to the land and would need to be managed via appropriate policy or development controls.

Based on a high-level review, an ATU of this type is expected to cost between \$17,000 to \$28,000 per lot and requirement ongoing maintenance costs of up to \$300 per year.

This cost is substantial and combined with the requirement that each lot be tested for physical feasibility makes it difficult for land owners to collectively enter a development agreement. Stormwater will need to be managed separately, with additional, dedicated land application areas.

Some concerns have been raised by the Ingleside Project Control Group in relation to the application of ATUs at Ingleside. These concerns would need to be considered alongside other alternatives to ensure sustainable outcomes are achieved:

- ATUs are not designed to remove some household chemicals and households would need to adopt practices to reduce these chemicals in the system. The presence of household chemicals can pose a risk to water quality of groundwater and surrounding waterways (Wirreanda Creek, along the western edge of Wirreanda Valley, is identified as pristine creek environment draining into McCarrs Creek and eventually The Pittwater waterway).
- Furthermore, some ATUs require chemical disinfectants such as chlorine, which could impact on the surrounding water quality of surrounding waterways, groundwater and harm local ecosystems.
- Concern is raised that the soil/geotechnical features of the area in addition to the number and proximity of ATUs may impact the ability of an area to absorb effluent. If these systems are used too closely together depending on soil/geotechnical features there is risk of effluent pollution to waterways and groundwater.
- Concern is raised regarding the regulatory and maintenance regime of these units to ensure the effluent from the system is of a quality for irrigation and will not pose pollution risks to groundwater and surrounding waterways.

Precinct Recycled Water

An alternative approach to address this constraint is recycled water, delivered at a precinct scale.

Rather than a lot by lot approach to infrastructure delivery, a precinct scale recycled water scheme would involve the commissioning of a third party provider to install a local water recycling centre. Each dwelling is connected to both potable and recycled water supply, and waste water collection. Waste water is diverted to the local water centre where it is treated to produce non-drinking grade water, which is then returned to dwellings for non-drinking purposes such as toilet flushing, laundry and irrigation. Recycled water can also be provided to non-residential customers for the same non-drinking purposes.

Precinct recycled water schemes typically operate at a scale of a minimum of 1,500 lots or greater. Given this, it is expected that a precinct recycled water scheme would not be feasible for the Wirreanda Valley and Bayview Heights sub-precincts only, but should be pursued for the Ingleside Precinct as a whole, delivering significant infrastructure and water reduction outcomes for the entire project.

Both public and private utilities can develop and manage the delivery of recycled water across Ingleside. However, without coordination with development and infrastructure delivery, a business as usual approach to water and sewer connection is expected and development within the Wirreanda Valley and Bayview Heights sub-precincts would be expected to require expensive on-site effluent management systems that address phosphorus constraints.



The delivery of recycled water at Ingleside would need to include the following considerations:

- **Space Requirements** – a recycled water scheme includes a recycled water plant and operations building and associated storage tanks².
- **Noise and Odour** – there are no expected issues meeting noise or odour buffer requirements. Recently approved recycled water schemes in Pitt Town and Lake Macquarie City Council meet noise and odour requirements set by each council and produce recycled water which meets the standards set by state and federal guidelines.
- **Stormwater Considerations** – a precinct recycled water scheme would need to address the management of stormwater across the precinct, such as incorporating the stormwater harvesting proposed for the irrigation of sports fields in the Narrabeen/Mullet Creek catchment or collecting additional residential rainwater. This could be incorporated into the performance requirements for any system in order to reduce the costs associated with these stormwater mitigation measures.
- **Cost and Connection Considerations** – while detailed costs have not been determined for Ingleside, the capital costs for precinct recycled water is estimated to be below the cost for an ATU (as outlined above). However, for the North and South Ingleside precincts, under the Sydney Water Growth Servicing Plan, water and wastewater infrastructure is largely delivered and paid for by Sydney Water. Cost and connection considerations would form part of the Request for Information (RFI) process outlined below and should be considered in this context.
- **Additional benefits to surrounding uses** – In the case of the Ingleside Precinct, neighbouring golf courses would benefit from the availability of recycled water, effectively reducing the need for any exported sewer, ensuring all wastewater is collected and used on-site.

Given the fragmentation of land ownership at Ingleside, coordination is required to enable a precinct level recycled water scheme in a timely manner and ensure new residential development is configured to connect to this system. Key next steps in the investigation include:

1. **Request for Information or Registration of Interest** for the provision of precinct scale recycled water from both public and private utilities. This process will test the market and provide clarity and confidence on the delivery of this system at Ingleside, early in the planning and development process. Any RFI should include key performance and delivery outcomes, including requirements for the Wirreanda Valley and Bayview Heights sub-precincts, water and sewer performance outcomes and any additional key outcomes sought such as stormwater considerations.
2. **Establish performance requirements for Ingleside** which facilitates the take-up of recycled water, such as higher BASIX targets (see High Performance Dwellings below). Through the delivery of recycled water, new dwellings at Ingleside would be expected to achieve BASIX Water 60 (20 points above current requirements).
3. **Establish a mechanism** to capture value for the implementation of the precinct recycled water scheme. This mechanism would collect funds or the third party operator to deliver the infrastructure to each lot when required.

² An example of a system sized to service 2,500 lots in Lake Macquarie can be viewed here: <http://www.lakemac.com.au/downloads/D35798997E50D1D22272928EA6AD450B95F4C408.pdf>

INGLESIDE RELEASE AREA AND NEIGHBOURING GOLF COURSES

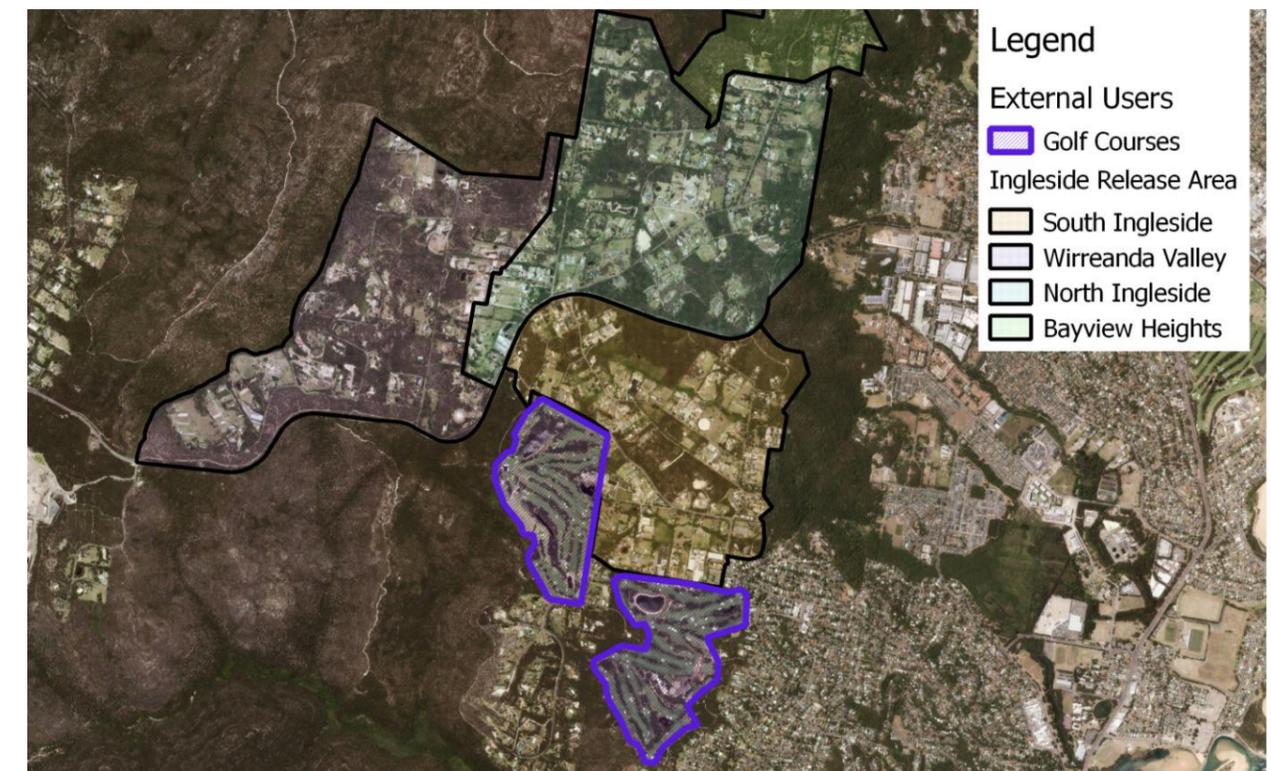


Figure 2 The two golf courses neighbouring the Ingleside Release area are total approximately 140 ha in area, with an estimated irrigation demand of 150 ML/yr

The value-add of Precinct Recycled Water:

Compared to a business as usual infrastructure approach, precinct recycled water would deliver significant environment and other benefits to the Ingleside Precinct:

- **44% reduction** in potable water demand for the precinct by using recycled water for non-drinking purposes such as toilet flushing, clothes washing and irrigation (nearly double the water reduction under the proposed rainwater/stormwater reuse strategies).
- **100% reduction** in sewer loads generated by the precinct.



- Enable all new dwellings to achieve a BASIX Water 60 (**20 points above current BASIX compliance** and 5 points higher than the proposed rainwater/stormwater reuse strategies).
- Provide additional water for irrigation of public spaces, green corridors and school playgrounds and playing fields, ensuring improved public domain that is less reliant on rainfall and local climate conditions.
- Displace the bore water demand currently used to irrigate the golf courses
- Allows for fragmented land ownership. Recycled water can be delivered in a scalable fashion i.e. infrastructure is delivered as and when required by individual lots or group of lots.

It should be noted that:

- If the recycled water system just collects wastewater, this will not address the stormwater issues on the site. As discussed above, a precinct recycled water scheme would need to address the management of stormwater across the precinct, such as incorporating the stormwater harvesting proposed for the irrigation of sports fields in the Narrabeen/Mullet Creek catchment or collecting additional residential rainwater.
- Ingleside was identified as part of the 2010/11 Metropolitan Development Program and is part of Sydney Water's Growth Servicing Plan. Under the Growth Service Plan, water and wastewater infrastructure is largely delivered and paid for by Sydney Water. The Growth Servicing Plan (2014 to 2019) states that Sydney Water has completed high level strategic planning for the area. Sydney Water will commit to delivering the infrastructure if there is approved funding for the work.



HIGH PERFORMANCE DWELLINGS

High performance dwellings can deliver more sustainable, resilient and affordable living at Ingleside.

Dwellings built in Ingleside will need to obtain a BASIX score of 40 on both greenhouse gas emissions and water consumption. If built under current BASIX targets the average dwelling at Ingleside is expected to:

- Consume **5.6 MWh** of electricity each year,
- Emit **6.5 tonnes** of CO2 each year,
- Consume **180 kL** of potable water each year, and
- Produce **140 kL** of sewer each year.

When compared to the Sydney Metropolitan average, a dwelling in Ingleside is expected to emit 20% less greenhouse gases and consume 37% less potable water.

Over the past few years, the average BASIX energy score has risen from 3 points above compliance to 5 points above, and as energy efficient technology continues to drop in price while electricity tariffs continue to rise, this trend is expected to continue. This suggests that current targets may not be driving energy efficiency in the residential sector and could be increased for Ingleside.

The popularity of solar PV is increasing throughout NSW, with more BASIX certificates including larger solar systems in recent years (Figure 4). Solar PV is also relatively popular in the Pittwater LGA with a penetration of about 5% and growing – one of the higher penetration rates across Sydney (Figure 5). Furthermore, the average size of PV systems installed in Pittwater is also growing (Figure 6), meaning residents of Pittwater are increasingly likely to take up solar PV, and install bigger systems in the coming years. Without any extra incentives it is then expected that Ingleside will see over 500 kW of solar PV installed, possibly rising to over 900 kW in the next 10 years.

Both of these trends indicate market capacity to deliver increased BASIX targets while ensuring that all dwellings are significantly more sustainable.

This report has already shown how residential dwellings can achieve a BASIX Water score of 60 through precinct recycled water. Similarly, new dwellings at Ingleside could be expected to achieve BASIX Energy score of up to 60 through the following readily available strategies. For the purposes of this report, Kinesis modelled the following strategies to achieve high performance energy outcomes for an average home in Ingleside:

- Average 7-star NatHERS thermal performance
- Efficient LED lighting in all dwellings
- Solar hot water in all dwellings
- Solar PV (average 1.5 kW per dwelling)

When compared to compliance (BASIX Energy 40) BASIX Energy target of 60 at Ingleside is expected to deliver approximately:

- **40% reduction** in stationary greenhouse gas emissions
- **20% reduction** in peak electricity demand
- Save households roughly **\$800 a year** on their energy bills.

AVERAGE BASIX ENERGY POINTS ABOVE COMPLIANCE SINCE 2007

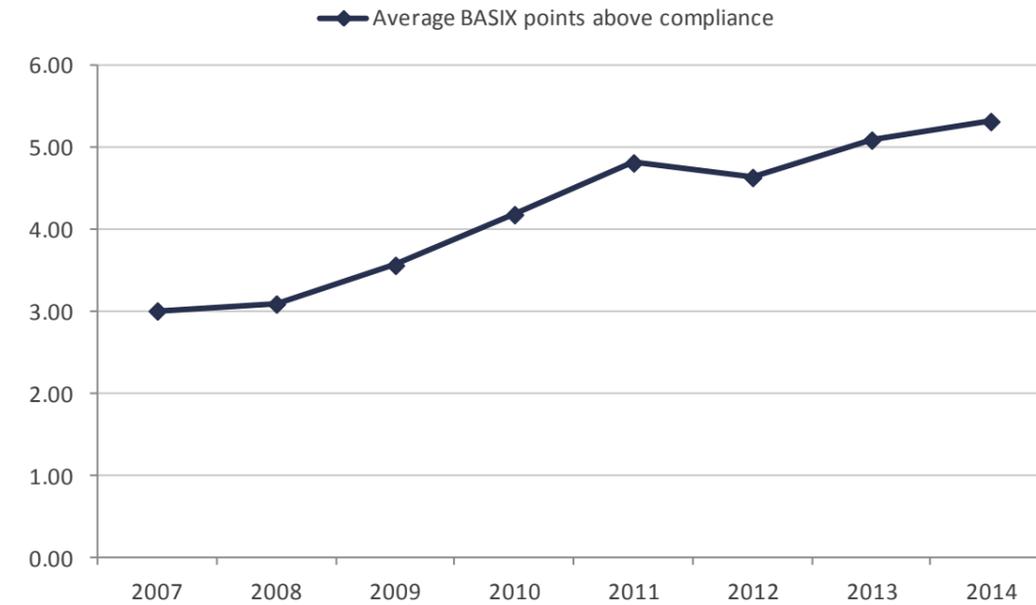


Figure 3 The average number of BASIX points above compliance achieved throughout NSW since 2007.

SOLAR INSTALLATIONS LISTED ON BASIX CERTIFICATES

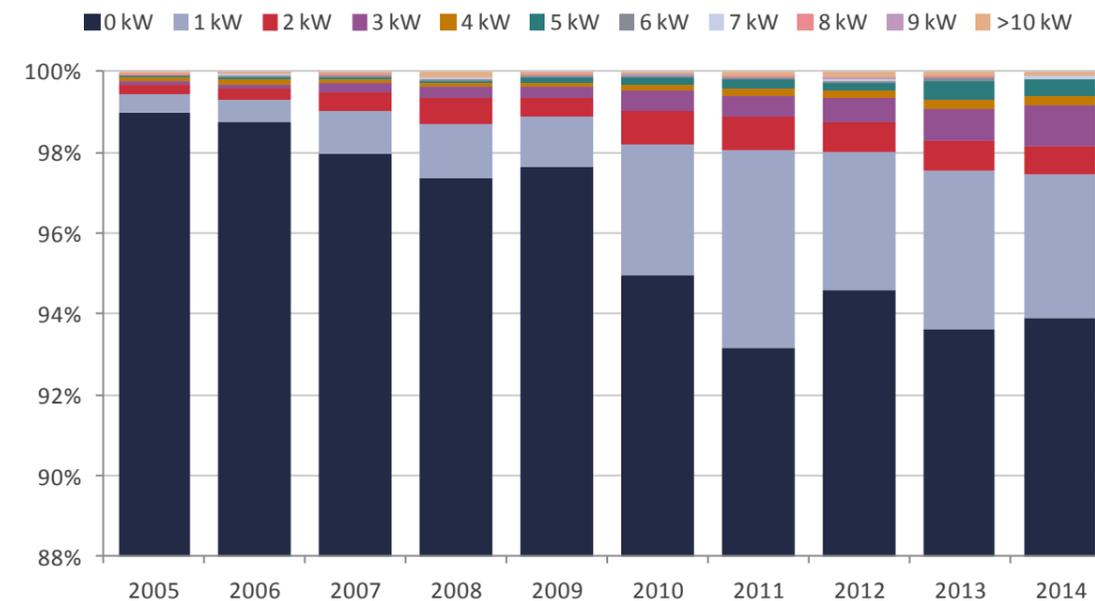


Figure 4 The proportion of different size solar PV installations listed on BASIX Certificates in NSW since 2005.



Precinct Energy Solutions

Given the development density of Ingleside, precinct scale trigeneration and cogeneration was explored but is not recommended given both the significant thermal losses and variable thermal demands of the residential development.

Recent developments of the density and scale of Ingleside, however, are exploring the opportunities presented by a precinct-scale micro grid that is used to facilitate the distribution of electricity across a precinct. A micro-grid would reduce the dependence on the central grid and facilitate increased take-up of both solar PV and battery storage technology to deliver low carbon and smarter infrastructure outcomes, as well as better manage the increase and electricity demand of electric vehicles.

Under the NSW State Government’s solar feed in tariff, households receive 6c/kWh for any electricity they export to the grid. This is far below the amount households pay for electricity (approximately 25c per kWh). A micro-grid sees a third party manage the distribution of power generated by Solar PV within the precinct, meaning electricity can be wheeled between dwellings and the full value realised. Battery storage can also be used to better manage local electricity generation to reduce peak demand and connection requirements to the main grid. Whilst a micro-grid will maintain connection to the larger electricity grid it can generally isolate itself from the main grid during power outages and continue to deliver power, increasing the resilience of the Ingleside Precinct.

The analysis for improved building energy performance was done agnostic of the way energy services are delivered, i.e. building by building or precinct solutions (or combinations of both). Micro-grid opportunities could be included as part of the recycled water RFI process.

Establishing Higher BASIX Targets for Ingleside

Detailed studies and cost-benefit analysis has been undertaken by the NSW Department of Planning as part of the BASIX Target Review which proposed, for most developments, a 5 to 10 point increase in BASIX Water and Energy targets. The City of Sydney also conducted a study on BASIX Energy Targets for multi-unit dwellings proposed a 20 to 25 point increase in BASIX Energy targets. For Ingleside, high level analysis suggests a marginal capital cost of approximately **\$5,000 to \$8,000 per dwelling** to deliver BASIX Energy 60 (20 points higher than current compliance).

Additional building upgrades to achieve BASIX Energy and Water outcomes outlined in this report should be further investigated and costed in order to support appropriate targets for new dwellings at Ingleside. Given the importance of recycled water in delivering significantly higher BASIX Water outcomes, this investigation should be linked to the delivery of water infrastructure across the precinct.

SOLAR PV PENETRATION ACROSS SYDNEY

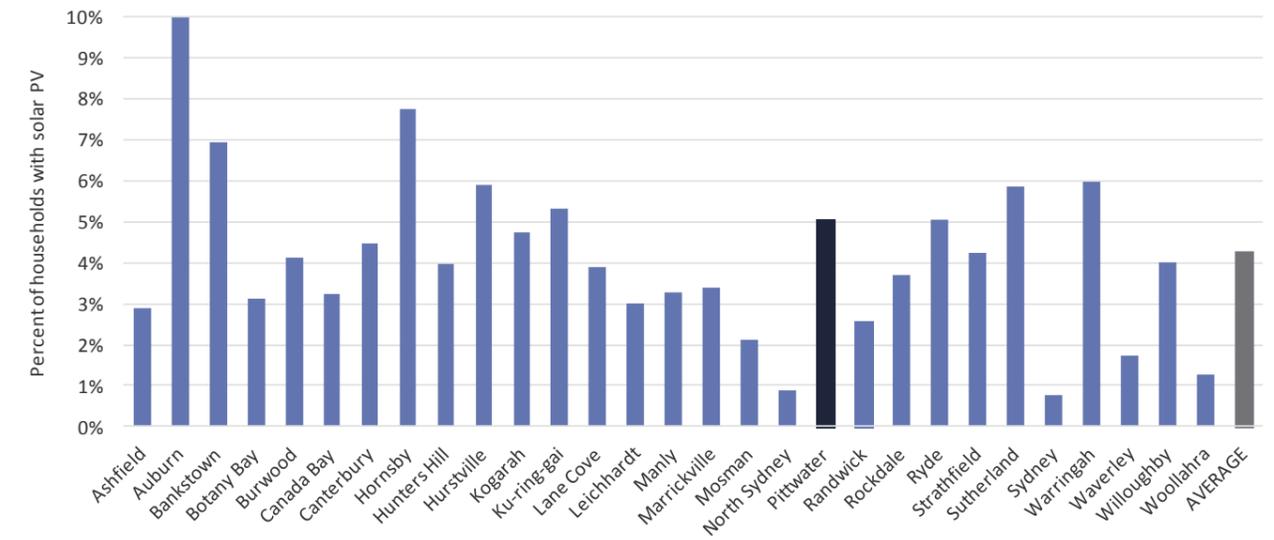


Figure 5 Solar PV penetration across the Sydney Metropolitan area

AVERAGE SOLAR PV SYSTEM SIZE IN PITTWATER LGA

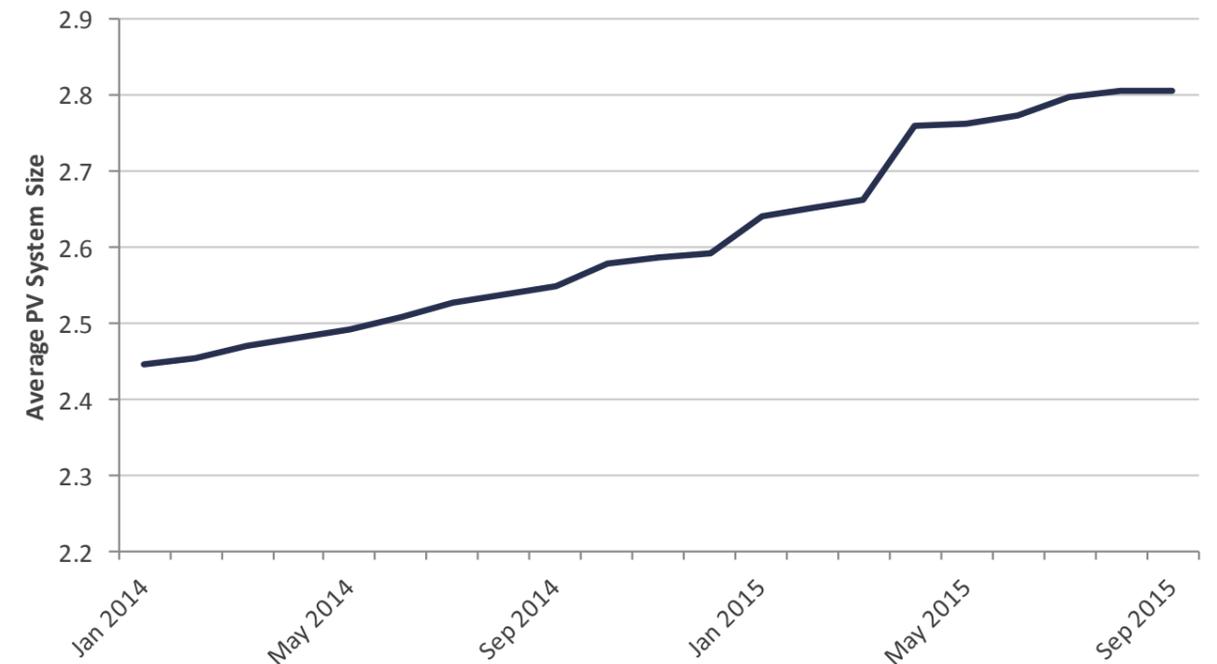


Figure 6 Average Solar PV size in the Pittwater LGA.



EFFICIENT PUBLIC INFRASTRUCTURE – LED STREET LIGHTING

As the development of the Ingleside Precincts will require extensive new walkways, cycleways and roadways, all of which need to be lit, there is an opportunity to extend the developments' sustainability goals to this electricity end-use.

It is estimated that Ingleside will require approximately 1,000 MWh of electricity each year to light its public domain with standard street lights. Following a successful trial of LED street lights by Ausgrid which concluded in 2013, there is the opportunity of employing this more efficient technology. It is estimated that LED street lighting could reduce street lighting electricity demand by almost 50% and the Precinct's green house gas emissions by a further 2% beyond the strategies outlined earlier in this report.

PLANNING FOR ELECTRIC VEHICLES

As the private vehicle is and will remain the dominant mode of transport for residents local to Ingleside, it is expected that electric vehicles will be introduced to the precinct as market availability increases.

Achieving progressive take up of electric vehicles will require considerable planning and preparation. New infrastructure, including re-charge stations must be built and measures must be taken to ensure that the electricity grid can support increased demand. Planning controls should be prepared for this eventuality by ensuring the necessary infrastructure amendments can be readily made when required.

In comparison to the average petrol vehicle, an electric vehicle achieves a 60% reduction in per km greenhouse gas emissions and (based on current electricity retail tariffs) 80% reduction in per km fuel costs.

Based on conservative estimates from the 2008 Garnaut Review, by 2031, approximately 13% of all vehicles are expected to be electric. The introduction of and adoption of electric vehicles represents a significant challenge to how energy is delivered for private vehicles. Planning for this growth will future proof the Ingleside development and ensure the infrastructure is available to leverage this emerging technology. For example, assuming a largely off-peak charging profile, electric vehicles at Ingleside will add significant electricity demand to the network.

The use of electric vehicles could reduce a household's green house gas emissions by up to 35% and save households over \$6,000 per year.

The infrastructure requirements for electric vehicles vary so appropriate actions should be explored with advice from a number of providers. Generally, electric vehicles will charge on a regular 10Amp circuit, however a 15Amp circuit provides faster and more stable charging and is preferable. The circuit, regardless of whether it is 10Amp or 15Amp, should be a dedicated circuit to ensure that the circuit does not become overloaded.



Figure 7 LED street light trial. Photo: Ausgrid, <https://www.flickr.com/photos/ausgridphotos/8745398245>



Figure 8 Public EV charging in Toronto, Canada. Photo: Wikimedia, https://commons.wikimedia.org/wiki/File:Ride_and_Drive.jpg



PUBLIC AND ACTIVE TRANSPORT LINKS

The current average Pittwater resident drives approximately 21.5 km per day, approximately 10% higher than the Sydney Metropolitan Average car use, and over 75% of all trips are made by car. While this mode split is not expected to change dramatically at Ingleside, reductions in car use can be achieved through improved links to both public and active transport.

The main connection to public transport is along Mona Vale Road, providing residents with connections to Mona Vale Town Centre and the planned BRT. However, given the scale of Ingleside, not all residents will be within walking distance of public transport stops along Mona Vale Road. To facilitate resident connection to this public transport, it is recommended that a 'Park and Ride' facility is incorporated in the precinct for use by local residents.

In addition, opportunities exist to encourage residents to use more sustainable modes. The Pittwater LGA already sees high cycling use. Figure 6 shows the cycling heat map for the Ingleside region, highlighting cycling use along major corridors and the lack of cycling along Mona Vale Road. There is a particular opportunity to connect Terrey Hills and Mona Vale via cycling infrastructure along Mona Vale Rd, providing residents with connections to Mona Vale town centre, the commonly cycled Forrest Way and Ku-ring-gai National Park. The Transport and Traffic Assessment Report supports these opportunities:

- Mona Vale Road represents a good opportunity to connect two major leisure routes for Pittwater cyclists and allow access to popular cycling routes in Ku-ring-gai National Park.
- Existing plans for Mona Vale Road upgrade highlight it as an opportunity to include dedicated, separated cycleway with minimal to no disruption.
- Mona Vale Road represents a good opportunity to connect the Wirreanda Valley and North/South Ingleside precincts to the BRT for cycle and public transport commutes, as well as common cycle routes along Forest Way and to service the new Northern Beaches Hospital.

The active transport plan outlined in the Transport and Traffic Assessment will provide residents with better options to walk or cycle where possible, especially for small trips. However, some key gaps identified in the Transport and Traffic Assessment include:

- Providing intersection designs without consideration for active transport modes, particularly cycling movements
- Not containing explicit details regarding bicycle path and shared path design, particularly at connections and intersections
- Not suggesting processes to encourage local large employers and destinations in to install end-of-trip facilities and/or bicycle parking.

The Ingleside land release represents a unique opportunity to deliver world-class cycling and pedestrian infrastructure that ensure:

- Separated bicycle or shared paths where possible,
- Intersections where all vehicle, bicycle and pedestrian conflict points meet close to right angles
- Large (roughly one car length) setbacks where turning vehicles meet cyclists
- Consistent and clear design to avoid confusion from cyclists and motorists
- Bicycle parking at important destinations and high frequency bus stops to encourage multi-mode trips for longer distances

INGLESIDE CYCLING DEMAND

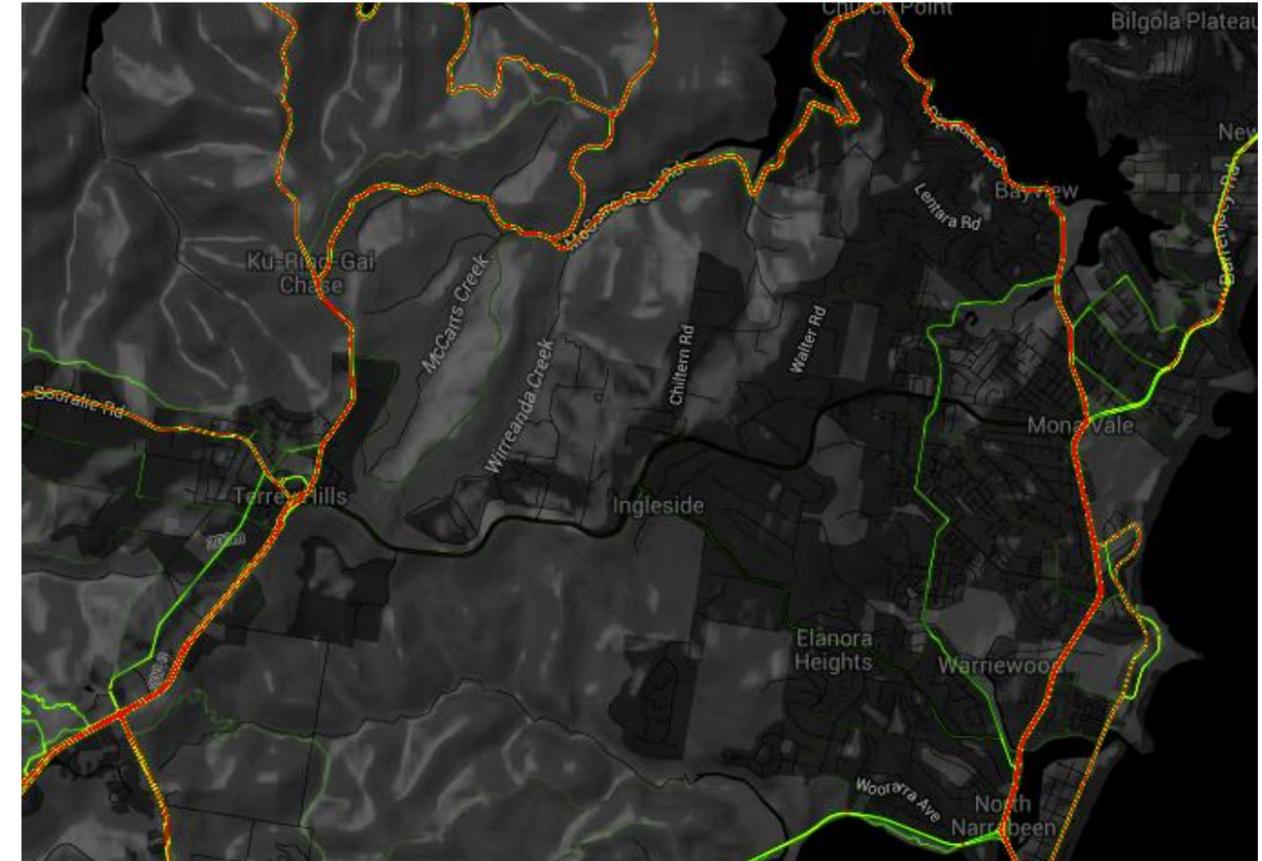


Figure 9 Cycling heat map of Strava users (labs.strava.com). Red shows roads of high use, green shows roads of low use.

Coordination and facilitation of active transport links

In order to enable world class cycling and pedestrian links within and adjacent to the Ingleside precinct, it is recommended that Pittwater Council facilitate:

- Holistic transport planning and design that includes not only Pittwater council, the RMS and TfNSW but also large local employers, schools and important destinations, such as the Northern Beaches Hospital.
- Planning controls to incentivise bicycle parking, end-of-trip facilities and public transport use.



LINK TO PITTWATER 2025

Pittwater 2025 outlines the community strategic plan and vision for Pittwater. Pittwater 2025 is part of an Integrated Planning & Reporting Framework which aims to integrate and streamline our statutory planning and reporting; strengthen our strategic focus and ensure accountability and responsiveness to our community. Pittwater 2025 is a 12 year community plan outlining the community's aspirations and desires to shape Pittwater's future.

Sustainability is a key driving principle to Pittwater 2025:

"The key message from the community over the last few years has been the need to address issues in a sustainable manner. The demand for both Council and the community to embrace sustainability is likely to increase, given the rapidly changing context in which we live. Climate change, rising sea levels, technological advances and population increases are all sustainability issues. Pittwater residents are fortunate to be in a position to provide leadership for action and change for sustainability at the local level. To do this, we need to become informed and involved – as individuals, families and businesses by adopting more sustainable practices and reducing our ecological footprint. The path towards sustainability is a journey as well as a destination – a process of continuous learning, improvement and reflection on our real needs for individual and community wellbeing, while ensuring the preservation and healthy functioning of the natural world."

As the major development site for the Pittwater Local Government Area, the Ingleside Precinct provides a unique opportunity to deliver on this vision under the following themes and indicators outlined in Pittwater 2025:

Traffic and Transport Strategy

- Increase in satisfaction of pedestrian and cyclist infrastructure through improved cycling links in and around the development area.

Beach & Coastal Management Strategy

- Increase in satisfaction of cleanliness of beaches and waterways through improved stormwater management and reduced pollution to downstream waterways delivered through the proposed rainwater and stormwater reuse strategies or, alternatively, through precinct recycled water.

Catchment Management Biodiversity

- Decrease per capita water consumption by 35% compared to a BASIX compliant development.
- Increase in the satisfaction of creek systems through improved stormwater management delivered through the proposed rainwater and stormwater reuse strategies or, alternatively, through precinct recycled water.
- Increase in sustainable water management practices through precinct recycled water, reducing water consumption and sewer loads.





GREEN STAR COMMUNITIES

Accreditation under the Green Star Communities rating tool is being targeted for Ingleside, aimed towards a Four Star (Australian Best Practice) Green Star rating. The combination of the opportunities and strategies identified above will assist in the delivery of this rating across a number of targeted strategies.

Green Star Communities requires the establishment of a Reference Case development which is calculated based on:

- The local conditions of the standard energy and water supply available to the site;
- Construction of all non-residential buildings to achieve minimal compliance with the NCC Section J DTS provisions;
- Construction of all residential buildings to achieve a minimum NatHERS Star rating requirement as specified in section J0.2a of the NCC;

PRECINX establishes and calculates a transparent Reference Case for Ingleside which meets this criteria to allow comparison for performance based analysis across the following key credits areas. Initial credit points have been analysed for the credit areas under Version 1.0 of Green Star Communities based on the delivery of the opportunities outlined in the previous section of the report:

- **Greenhouse Gas Strategy** – 2 points (out of a possible 6 points). Alternatively, mandating solar PV on residential dwellings and installing LED street lights could achieve 3 points via the prescriptive pathway.
- **Peak Electricity Demand** – 2 points (out of a possible 2 points)
- **Integrated Water Cycle (Performance Pathway)** – 3 points (out of a possible 7 points) are available under the performance pathway for this credit, reflecting the potential 35% reduction in potable water consumption. This assumes that the minimum stormwater requirements in this credit have been met.

Alternatively, the Prescriptive Pathway can be pursued. This approach achieves 3 points out of an available 5 points as outlined below:

1. Irrigation for public open space and public realm is sourced from non-potable water sources (**not achieved** - stormwater harvesting is available for sports fields but all other public places will source potable water).
 2. All buildings in the project site have access to alternative water sources (**achieved**)
 3. 75% of the total annual stormwater runoff is evaporation or retained within the project site (**achieved**)
 4. Post-development peak 1 year Average Recurrence Interval (ARI) event discharge from the project does not exceed pre-development ARI (**not achieved** - peak flow is +/-5% of predevelopment condition)
 5. Receiving water quality is protected (**achieved**)
- The installation of recycled water (as outlined in this report) coupled with the proposed stormwater management could achieve 4 points via the prescriptive pathway as other public spaces will be watered by recycled water.

These credit points should be incorporated into the broader Green Star Communities review being undertaken by Pittwater Council. Further analysis and documentation of these credits can be incorporated once the delivery of these opportunities and strategies is further defined and agreed by Pittwater Council and key stakeholders.

Green Star Communities v1

Submission Guidelines





SUMMARY OF OPPORTUNITIES ANALYSIS

Recommendations	Detail	Potential Benefits	Potential Implementation Mechanism	Next Steps
Sustainable Water Infrastructure	<ul style="list-style-type: none"> Delivered by public or private utility. Local water recycling centre. Recycled water used in dwellings for toilet flushing, irrigation and laundry. Recycled water used for non-residential irrigation. Additional recycled water used on adjacent golf courses for irrigation. 	<ul style="list-style-type: none"> 35% reduction in potable water demand 100% reduction in sewer loads. Enable all new dwellings to achieve an outcome equivalent to BASIX Water 60 (20 points above current BASIX compliance). Improved and resilient public domain 	<ul style="list-style-type: none"> Collaborate with public private integrated utility and public domain management plan. Establish mechanism for value capture for recycled water infrastructure. 	<ul style="list-style-type: none"> Continue investigation by: <ul style="list-style-type: none"> Establish performance standards for precinct recycled water network. Engage Cardno to model the implication of the integration of precinct recycled water with stormwater management and model if excess water available Establish value capture mechanism. Request for Information for precinct recycled water network. As required assess costs associated with the project on a comparative scale, including Sydney water infrastructure that would still be required for potable water, what is the additional cost of the remainder of the precinct
High Performance Dwellings	<p>Higher BASIX Outcomes:</p> <ul style="list-style-type: none"> 60 for Energy 60 for Water* <p>*Note – as the stormwater requirement are expected to deliver a BASIX Water outcome of 55, no additional targets for water should be pursued.</p>	<ul style="list-style-type: none"> 40% less CO2 emissions 20% lower peak electricity demand 35% reduction in potable water demand \$800 electricity bill savings 	<ul style="list-style-type: none"> NSW Department of Planning BASIX. If higher BASIX targets are not achieved, the development should focus on requiring a minimum of 2 kW of solar PV and a minimum of 7-star NatHERS on all dwellings. 	<ul style="list-style-type: none"> Prepare cost-benefit analysis for building upgrades Meet with Department of Planning regarding BASIX targets
Active Transport Links	<ul style="list-style-type: none"> Explicit guidelines for shared and bicycle paths and intersections. Planning controls encourage end of trip facilities and bicycle parking. 	<ul style="list-style-type: none"> Improved active transport links. Reduced car dependence. Improved mode choice and connections. 	<ul style="list-style-type: none"> Mona Vale Rd upgrade. Coordination with Northern Beaches Hospital, RMS and TfNSW. LEP/DCP for end of trip facilities. 	<ul style="list-style-type: none"> Meet with Northern Beaches Hospital, RMS and TfNSW. Establish mechanism to encourage end of trip facilities in major trip generating developments.



Recommendations	Detail	Potential Benefits	Potential Implementation Mechanism	Next Steps
LED Street lights	<ul style="list-style-type: none"> Install efficient LED street lights 	<ul style="list-style-type: none"> Reduce street lighting electricity demand by almost 50% Reduce precinct emissions a further 2% beyond other strategies 	<ul style="list-style-type: none"> Ausgrid installation 	<ul style="list-style-type: none"> Request LED street lighting from Ausgrid
Planning for Electric Vehicles	<ul style="list-style-type: none"> Provide for future of Electric Vehicles 	<ul style="list-style-type: none"> Reduce total emissions by up to 35% Save households roughly \$6,000 per year 	<ul style="list-style-type: none"> Ensure electricity infrastructure to public parking is capable of providing for EV charging stations 	<ul style="list-style-type: none"> Obtain advice on EV charging requirements from EV providers Review of development controls to accommodate electric vehicles by providing adequate charge points in on and off-street parking areas.



KEY ASSUMPTIONS

Metropolitan Sydney average benchmarks

Electricity	2,132 kWh per person/year
Gas	3,888 MJ per person/year
Water	237.8 L per person/day
Transport	19.98 km per person/day

Tariffs and rates

Household cost savings outlined in this report are based on current tariffs outlined below:

Residential Water	Rate	Unit
Mains tariff	2.232	\$/kL
Recycled water tariff	2.068	\$/kL
Service charge per dwelling	765	\$/yr
Recycled water service charge	0	\$/yr
Residential Grid Electricity	Rate	Unit
Applied tariff	0.2514	\$/kWh
Solar feed-in tariff	0.06	\$/kWh
Service charge per dwelling	289.16	\$/yr
Residential Gas	Rate	Unit
Gas (first 3,775 MJ per qtr/remaining)	0.040964/0.023452	\$/MJ
Service charge per dwelling	207	\$/yr
Residential Transport	Rate	Unit
Fuel	1.50	\$/L
Annual capital costs (devaluation)	6,642	\$/yr
Annual registration/insurance	2,172	\$/yr

KEY DATA SOURCES

All results contained in this report are derived from PRECINX, a strategic infrastructure and urban design tool, used in the analysis of key performance metrics of precincts, integrating land use and development inputs with demographic, utility, transport and affordability models. PRECINX draws on local climate, land use and tariff data, and available utility, government, public and private sector datasets to calculate to performance of proposed developments, precincts, corridors and regions.

Important datasets used in PRECINX include:

- ACADS-BSG Australian Climatic Data (Reference Meteorological Year, RMY) for hourly temperature, insulation and humidity.
- Bureau of Meteorology local rainfall and evaporation data
 - Data is from the representative weather station for the local climate zone
 - The RMY (Representative Meteorological Year) is synthesized from a composite of 12 typical meteorological months that best represent the historic average of the specified location using post-1986 data in addition to the earlier weather data for each of the 69 climate zones in Australia.
- Department of the Environment (Ongoing) National Greenhouse Accounts Factors
- Sydney Water Best Practice Guidelines for water conservation in commercial office buildings and shopping centres (2007) and Best Practice Guidelines for holistic open space turf management (2011)
- National Water Commission, 2011, National performance report 2009-2010: urban water utilities, National Water Commission, Canberra
- NSW Department of Planning (Ongoing) BASIX Report Data.
- Department of Resources, Energy and Tourism, 2010, Energy in Australia – 2010, ABARE, Canberra
- Energy Use in the Australian Residential Sector, 1986 – 2020, Australian Government Department of the Environment, Water, Heritage and the Arts (DEHWA), 2008.
- National Construction Code (2010) Section J - Energy Efficiency Requirements
- Transport Data Centre (2006) The Development of a Sydney VKT Regression Model
- Department of Infrastructure and Transport, 2011, Road vehicle kilometres travelled: estimations from state and territory fuel sales, Australian Government, Canberra
- ABS (2010) 'Household Expenditure Survey, Australia: Summary of Results', catalogue number 65300DO001_200910, Australian Bureau of Statistics, Canberra.
- Kinesis (Ongoing) Water and energy end use data derived from first principle analysis of a range of metered residential and non-residential building types (ongoing, sourced from anonymised CCAP datasets from thousands of buildings, suburbs and cities across Australia), see: www.kinesis.org/ccap-asset and www.kinesis.org/ccap-city.