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Long-list of options for Gloucester Water Supply Scheme

Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Off-Stream Storage	• New off-stream storage • Pumping from river unavoidable even under less ideal circumstances as there is no existing off-stream storage • Raw water supplied from Barrington River and pumped to Gloucester WTP for treatment • Options for six sites investigated and two deemed feasible for storage above 250 ML – across the river from the WTP (Site 2) and east of Thunderbolts Way (Site 5) respectively	• Zoned embankment • Spillway • Transfer pumping infrastructure including pipelines from river offtake to storage site, and storage site to WTP	Designed to as required	• Approvals and permits – pipeline crossing across Gloucester River and rail track (Site 2) • Land acquisition for storage site • Potential for cultural heritage sites • Impact to environment including local ecology • Low resilience option with no additional supply sources • Community acceptance based on current socio-political sentiment towards dam projects • Impact from potential spillway or dam flows – on rail infrastructure due to close proximity to storage site (Site 2), or neighbouring cottages (Site 5) • Suitability of water quality as a result of impacts from Gloucester Landfill Facility on run-off and groundwater (Site 5)	• Rainfall dependent water source – extraction limited to favourable river flow conditions • Potential for long lead times on negotiations with Australian Rail Track Corporation for boring under rail track (Site 2) • Availability of fill materials • Large construction carbon footprint • Potential for complex geology resulting in increased CAPEX – fractured rock (Site 2) • Stratification from poor water quality • May require easements for sections of pipeline	• Flexibility in staging • Enhanced raw water quality management with availability of alternative water source when Barrington River conditions are unfavourable	$20.8M	$530K	Medium – some preliminary investigations and preliminary concept design completed, further investigation required into stakeholders, water quality and geological conditions
On-Stream Storage	• Construction of on-stream storage for additional Barrington River • Option considers either raising existing weir crest or creation of new weir for additional storage	• Foundation excavation and weir construction to required level	Requires further investigation	• Approvals and permits – environmental impacts to aquatic habitat and river • Low resilience option with no additional supply sources • Environmental impacts to aquatic and river ecology – disruption to fish passage, reduced biodiversity, increased erosion and sedimentation, decrease in water quality	• Rainfall dependent water source – extraction limited to favourable river flow conditions • Increased siltation upstream of weir	• Significantly less infrastructure required	Not assessed		Low – no investigations undertaken, requires investigation into feasibility of option based on river hydrology and environmental constraints

Stratford Mine Dam	• Potential new water source
	• Return Water Dam at the mine site holds approximately 1000 ML of water
	• Considered as an option in 2019-20 drought for discharging into Avon River and for dust suppression and stock watering
	• Water quality testing identified water suitable for drinking water with pH correction required
	• Option to either:
	  ○ Transfer directly to Gloucester WTP for treatment and distribution
	  ○ Utilise dam water to inject flow into Barrington River upstream of raw water
		• Acquisition of dam from Stratford Coal
		• Transfer pumping infrastructure including pipeline from mine dam to either Gloucester WTP or river discharge point (approximately 20 km)
		• Upgrade to treatment as required for additional treatment either at the WTP or before discharging to river based on further testing
			1000 ML but requires further investigation into source	• Approvals and permits – may require rigorous testing and investigation to confirm suitability for injecting directly into WTP or river
				• Replenishment of dam water – availability, duration, source
				• Aquatic ecology – impacts of dam water quality on receiving waterbody
				• Suitability of dam water for drinking water standards
				• Acquisition of dam – (coal mine near end of life)
				• Community acceptance based on current socio-political sentiment towards dam projects
					• Highly likely rainfall dependent water source – replenishment potentially dependent on rainfall
					• Stratification of stored water from poor water quality
					• May require easements for sections of pipeline
						• Enhanced raw water quality management with availability of alternative water source when Barrington River conditions are unfavourable
						• Low investment of CAPEX for significant storage and new water source
						• Consideration for emergency measure if unsuitable for permanent solution
							$19.1M for pipeline transfer	Not assessed	Low – requires feasibility investigations for conversion of dam to off-stream storage, water quality testing, water profiling for source of water through hydrological and geological investigations

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
	offtake point for increased extraction								
Desalination of River Water via Gloucester River	• Construction of a permanent packaged desalination plant • Proposed location adjacent to existing Gloucester WTP • Raw water intake via new offtake point from Gloucester River • Reject discharge to ocean towards Hallidays Point • Treated water pumped for distribution from desalination plant via Gloucester WTP	• Potential land acquisition near WTP • Packaged desalination plant including river water intake and pumping infrastructure, storage tanks for flow attenuation, screening and microfiltration units, reverse osmosis units, and treated water storage tanks • Brine pumping system and discharge line to ocean outfall (approximately 70 km)	Flexible to as required	• River not saline – unsuitable for desalination	N/A	N/A	Not assessed		Low – no planning investigations completed but constrained by river flow conditions and requires outfall pipeline to ocean
Desalination of Sea Water	• Construction of a permanent desalination plant near the coastline • Located adjacent to Hallidays Point STP • Raw water intake and reject discharge via ocean • Treated water pumped from coast to Gloucester network for distribution	• Desalination plant including sea water intake and pumping infrastructure, screening and microfiltration units, reverse osmosis units, brine pumping system and discharge line to ocean outfall, and storage tanks • Pipeline from desalination plant to Gloucester (approximately 70 km inland from coast depending on route) • Lift pump stations and balance tanks	Flexible to as required	• Approvals and permits – pipeline crossing across creeks and Avon River, and rail track • Aquatic ecology – impingement and entrainment • Aquatic ecology – reject discharge • Community acceptance	• Potential for long lead times on negotiations with Australian Rail Track Corporation for boring under rail track • Feasible but impractical option for inland community due to significant infrastructure required for small community • Large carbon footprint with high energy intensive operation of desalination plant and long pumping distance • High operation and maintenance costs for desalination plant and transfer pipeline • Requires upskilling and additional labour for plant operation • Long lead time from planning and construction to operation • May require easements for sections of pipeline	• Rainfall independent supply • Reliable source of supply • Potential for pumped hydropower • Proven technology • Operation flexible to demand	$90.5M	Not assessed	Low – not considered a practical water security solution as significant distance from the coast
Regional connection (pipeline from Manning via Krambach)	• Connection to Manning Water Supply scheme • Scheme connects via pipeline from Krambach • Gloucester is integrated into the Manning scheme, supplied from Bootawa WTP and Nabiac Borefield • Interconnection would allow Gloucester WTP to be decommissioned	• Approximately 38 km pipeline connecting Krambach and Gloucester • Lift pump stations and balance tanks • Chlorine booster station • Upgrades to network infrastructure in Manning scheme including trunk mains, pump stations, and Krambach reservoir	Entire township supplied from Manning, 2050 ADD 1.27 ML/d	• Approvals and permits – pipeline crossing across creeks and Avon River, and rail track • Increase in risk from impacts of natural disasters (such as bushfires leading to loss of power at pump stations) • Environmental impacts along pipeline construction corridor • Community acceptance for integrating Gloucester with Manning scheme	• Potential for long lead times on negotiations with Australian Rail Track Corporation for boring under rail track • Considerable carbon footprint with long pumping distance • Potentially rainfall dependent solution dependent on water security solution for Manning • Requires easements for sections of pipeline	• Decommission Gloucester WTP, which may either reduce or offset operational expenses for new pipeline • Potential for pumped hydropower • Reduced risk of water quality incidents as need for raw water extraction eliminated from Barrington River • Potential to connect new customers along pipeline route • Road widening along The Bucketts Way for pipe easement	$41.2M	$1.0M	Medium – preliminary investigations and concept design completed, requires investigation into environmental impacts, landowner consultation for easements, and community consultation for connecting schemes

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Regional connection (water carting from Tea Gardens)	• Water carting from Tea Gardens approximately 120 km via road • Activated during times of emergency only, i.e., when river flow conditions are not ideal and dam storage level is low • Option was implemented previously in the 2019-20 drought	• No additional infrastructure required	Required yield as per circumstances and availability at Tea Gardens (2019-20 Level 4 restrictions 538 kL/d)	• Impact and / or delay of transport from unforeseen circumstances such as traffic accident, bushfire, etc. • Dependent on availability of water supply at Tea Garden bores • Potential for water contamination requiring additional disinfection • Freight availability for prolonged periods	• Short-term supply solution – impractical for prolonged periods, continuous operation of freight required with carting delivered over 24 hr period daily in 2019-20 drought for Level 4 restrictions • Greenhouse gas emissions from daily use of freight	• Some flexibility in scaling yield to as required • Cost-effective short term water security solution until long term solution implemented • Successfully implemented previously • Infrastructure for loading from Tea Gardens and unloading at Gloucester in place	Not assessed		High – based on investigations undertaken by Council in the recent droughts
Stormwater Harvesting	• Stormwater collection and transfer to Gloucester off-stream storage to supplement extraction of raw water from the Barrington River • Investigations completed identified Gloucester split across the north-to-south ridge through centre of township with multiple smaller catchments draining towards Barrington River • Investigations concluded sufficient yield to meet current demand in typical rainfall year, but reduces significantly in a low rainfall period • Investigation sampling undertaken following a rainfall event indicates relatively good quality stormwater with metals, nutrients and suspended solids falling within or below thresholds for acceptable stormwater pollutants – pathogens, viruses and hydrocarbons were however not tested	• Multiple collection basins for each catchment • New off-stream storage • Pumping and transfer infrastructure from each collection basin to new off-stream storage • Potentially upgrade of WTP dependent on stormwater quality	Investigation of 20ha catchment with 25% soil capacity found an approximate yield of 114 ML/yr in a typical rainfall year, and 30 ML/yr during lowest rainfall period	• Potentially poor water quality requiring a higher level of treatment • Multiple small catchments • Mosquito breeding at collection points and storage basins • Catchment is predominantly environmental conservation and low density residential with large lots, favourable for pervious ground profile	• Rainfall dependent water source • High operation and maintenance costs • Minimal growth in Gloucester for developer driven opportunities • Significant infrastructure required for collection of stormwater • Requires large storage to capture flows during wet weather • Requires reconfiguration of stormwater network to route stormwater to collection basins	• Utilisation of some existing stormwater network • Flow attenuation in low flow events • Reduced pollutants in natural waterways	$191.5M (based on capturing all local runoff with 8000 ML storage)	Not assessed	Low – preliminary investigations indicate potential for sufficient yield for material impact, but significant infrastructure required for a centralised harvesting scheme
Groundwater	• Considers potential for groundwater sources in or near Gloucester • Current water source for Gloucester, Barrington River, falls within the Gloucester Basin groundwater source as per the Water Sharing Plan for the Lower North Coast • 1999 PPK study did not identify any potential sites in the Gloucester area	If investigations deem option is feasible: • Borefield • Potentially new WTP depending on location • Groundwater transfer pipeline to Gloucester WTP or supply reservoir	Requires further investigation	• Approvals and permits • Availability of groundwater • Suitability of groundwater for potable water supply • Environmental impacts from extraction • Potentially poor water quality requiring a higher level of treatment	• No prospective sites have been identified for Gloucester region • Long lead time for new borefield from planning and construction to operation		Not assessed		Low – requires an updated investigation into availability of groundwater in region
Reticulated Recycled Water	• Dual reticulation network to supply both potable and recycled water for new development areas only • Recycled water could be utilised for outdoor uses, toilet flushing and laundry purposes (i.e., for hot water) offsetting potable	• Advanced water treatment process including membrane filtration • Transfer pumping infrastructure including pipelines to developments • Additional storage for recycled water storage	Approximately up to 478 kL/d by 2050 (up to 30% of current effluent used for irrigation in 2017-18, and 70% used in	• Insufficient recycled water demand due to low growth • Cross-contamination • Public health risk due to potential for misuse of recycled water by customer • Approvals and permits • Community acceptance	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Only suitable for new residential developments (not practical to retrofit existing	• Rainfall independent yield • Promotes community education and acceptance • Effluent management • Maintains aesthetic values during drought	$16,000 per dwelling including cost for treatment and distribution	Not assessed	Medium – not considered viable due to insufficient availability of effluent for recycled water use, both as a result of low

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
	water demand for domestic uses • Upgrade of Gloucester STP will be required with advanced water treatment for effluent treated to unrestricted public access standards in accordance with the Australian Guidelines for Water Recycling		2019-20 drought)		properties), can be discriminatory • Partially rainfall dependent demand (outdoor use driven by day-to-day weather conditions) • Developer driven, beyond Council's influence for implementation • Increase in greenhouse gas emissions with increased level of treatment • High operation and maintenance costs with dual network				growth and existing user intake during drought period
Recycled Water for Restricted Use	• Existing effluent management consists of supplying restricted recycled water for pasture irrigation to a nearby property • Option considers expansion of existing scheme to new users • Investigations completed identified four potential agricultural users in near vicinity to STP • Two identified sites would require consideration for buffer zones due to close proximity to Gloucester River • No major infrastructure upgrades are required	• Expansion of recycled water distribution network to new users	Approximately up to 478 kL/d by 2050 (up to 30% of current effluent used for irrigation in 2017-18, and 70% used in 2019-20 drought)	• Insufficient recycled water demand for material impact on potable water demand • Users not guaranteed over longer term	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse during drought • Rainfall dependent demand • Requires buffer zones to reduce impact on waterways for sites located adjacent to Gloucester River	• Rainfall independent yield • Effluent management • No upgrades required to treatment • Increases reliability with increased number of users	Not assessed		Medium – effluent available for new users, but low impact in offsetting potable water demand
Recycled Water for Unrestricted Use	• Upgrade of Gloucester STP to Australian Guidelines for Water Recycling for unrestricted use for open space irrigation • Investigations completed identified given open spaces for irrigation including Gloucester Showground, Gloucester District Park, Billabong Native Park, Minimbah Native Garden and Gloucester Golf Course	• New RTP with membrane filtration, chlorination and treated water storage tanks • Transfer pumping infrastructure including pipelines • Storage and recycled water irrigation infrastructure at end user sites (if Council owned and operated)	Approximately up to 478 kL/d by 2050 (up to 30% of current effluent used for irrigation in 2017-18, and 70% used in 2019-20 drought)	• Existing uptake of potable water for sites negligible – insufficient for material impact on potable water demand • Approvals and permits • Community acceptance	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse during drought • Significant infrastructure required to maximise use • Rainfall dependent demand • Increase in operation and maintenance costs • Increase in greenhouse gas emissions with increased level of treatment	• Rainfall independent yield • Promotes community education and acceptance • Effluent management • Maintains aesthetic values during drought • Increases reliability with increased number of users	Not assessed		Medium – practical solution but low impact in offsetting potable water demand
Recycled Water for Environmental Flows	• Substitution of flows downstream of Barrington River offtake point for Gloucester WTP to enable greater extraction upstream • Replacement flows supplied from Gloucester STP • Replacement of flows to potentially enable increased extraction rates under normal conditions for storage in future off-stream storage dam • Further studies will be required to determine the limitations on increased extraction and to	• Upgrade of Gloucester STP to achieve water quality required to a level appropriate for the ecosystem of the Barrington River • Transfer pumping infrastructure including pipeline to river discharge • Construction of additional off-stream storage as per 'Off-Stream Storage' option	Approximately up to 478 kL/d by 2050 (up to 30% of current effluent used for irrigation in 2017-18, and 70% used in 2019-20 drought)	• Approvals and permits – specifically for land clearing adjacent to STP required for expansion • Community acceptance • Impact on river health and ecology from substitution flow • Impact on river health and ecology from increased offtake	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • May not improve yield / supply if river extraction limits are reached • Potential high increase in operation and maintenance costs with increased level of treatment • Requires additional off-stream storage to enable increased extraction	• Effluent management • May improve river flow • Adaptable to growth	Not assessed		Low – no feasibility investigations completed

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
	determine the required substitution water quality for maintaining a healthy river system				• Rainfall dependent water source for extraction • Supporting legislation not fully developed				
Purified Recycled Water	• Expansion of Gloucester STP to advanced level treatment for indirect purified recycled water use • Recycled water from STP redirected to future off-stream storage to mix with raw water extracted from Barrington River	• Upgrade of Gloucester STP to achieve advanced water quality including membrane filtration, reverse osmosis, UV advanced oxidation, and treated water storage tanks • Transfer pumping infrastructure including pipeline to off-stream storage • Construction of additional off-stream storage as per 'Off-Stream Storage' option	Approximately up to 478 kL/d by 2050 (up to 30% of current effluent used for irrigation in 2017-18, and 70% used in 2019-20 drought)	• Community acceptance • Failure at critical control points can result in severe public health consequences • Approvals and permits	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Supporting legislation not fully developed • Large carbon footprint with high energy intensive operation of recycled water plant • Significant increase in operation and maintenance costs	• Can be aligned with delivery of new WTP required within next 5 to 10 years • Effluent management • Rainfall independent yield • Increase in reliability of supply	Not assessed		Medium – advanced treatment technically viable, but option is long-term solution requiring significant engagement with community for acceptance

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Long-list of options for Bulahdelah Water Supply Scheme

Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Off-Stream Storage	• New off-stream storage • Pumping from river unavoidable even under less ideal circumstances as there is no existing off-stream storage • Raw water supplied from Crawford River and pumped to Bulahdelah WTP for treatment • Limited selection for storage site, ideally located close to raw water pump station	• Foundation excavation and storage construction – may potentially be a Turkey's Nest dam if site is located within a flood zone (specifically adjacent to existing raw water pumping station) • Transfer pumping infrastructure including pipelines from river offtake and to WTP	Designed to as required	• Approvals and permits • Highly likely land acquisition required for storage site • Potential for cultural heritage sites • Impact to environment including local ecology dependent on site • Low resilience option with no additional supply sources • Community acceptance based on current socio-political sentiment towards dam projects	• Rainfall dependent water source – extraction limited to favourable river flow conditions • Availability of fill materials • Large construction carbon footprint • Limited options for storage site • Potential for complex geology resulting in increased CAPEX • Stratification from poor water quality	• Flexibility in staging • Enhanced raw water quality management with availability of alternative water source when Crawford River conditions are unfavourable	$17.6M	Not assessed	Low – no preliminary planning completed, investigation required to determine geotechnical conditions, hydrological aspects, approvals, material availability, and environmental impacts
Additional On-Stream Storage	• Existing weir on the Crawford River provides 163 ML live storage, and a total storage of 228 ML including dead storage • Option considers either raising existing weir crest or creation of new weir for additional storage	• Foundation excavation and weir construction to required level	Requires further investigation	• Approvals and permits – environmental impacts to aquatic habitat and river • Low resilience option with no additional supply sources • Environmental impacts to aquatic and river ecology – disruption to fish passage, reduced biodiversity, increased erosion and sedimentation, decrease in water quality • Climate change impact – high confidence scenario predicted inundation of +0.84 m	• Rainfall dependent water source – extraction limited to favourable river flow conditions • Increased siltation upstream of weir	• Significantly less infrastructure required	Not assessed		Low – no investigations undertaken, requires investigation into feasibility of option based on river hydrology and environmental constraints
Desalination of River Water via Myall River	• Construction of a permanent packaged desalination plant • Proposed location adjacent to existing Bulahdelah raw water offtake point adjacent to confluence of Myall River and Crawford River • Raw water intake via existing offtake point at Myall River • Reject discharge to ocean towards Pacific Palms • Treated water pumped from desalination plant to Bulahdelah reservoirs for distribution	• Land acquisition near Bulahdelah WTP raw water offtake point • Packaged desalination plant including river water intake and pumping infrastructure, storage tanks for flow attenuation, screening and microfiltration units, reverse osmosis units, and treated water storage tanks • Brine pumping system and discharge line to ocean outfall (28 – 40 km depending on route) • Transfer pumping infrastructure from desalination plant to reservoir including (approximately 2.5 km)	Flexible to as required	• Approvals and permits – pipeline crossing across Myall River, extraction licence, ocean discharge • Aquatic ecology – impingement and entrainment • Aquatic ecology – reject discharge • Community acceptance – impact to local industries dependent on river water from increased extraction • Land acquisition for desalination plant	• Rainfall dependent water source – extraction based on river flow conditions • Large carbon footprint with high energy intensive operation of desalination plant and long pumping distance for outfall • High operation and maintenance costs for desalination plant and transfer pipeline • Construction through environmentally sensitive corridor for reject discharge pipeline (Wang Wauk State Forest) requiring underbore for significant lengths of pipe • Requires upskilling and additional labour for plant operation • Long lead time from planning and construction to operation • May require easements for sections of pipeline	• Easy integration into existing water supply system • Proven technology • Operation flexible to demand	$93.9	Not assessed	Low – no planning investigations completed but constrained by river flow conditions and requires outfall pipeline to ocean

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Desalination of Sea Water	• Construction of a permanent desalination plant near the coastline • Located adjacent to proposed Pacific Palms STP • Raw water intake and reject discharge via ocean • Treated water pumped from coast to Bulahdelah network for distribution	• Land acquisition nearby coast • Desalination plant including sea water intake and pumping infrastructure, screening and microfiltration units, reverse osmosis units, brine pumping system and discharge line to ocean outfall, and storage tanks • Pipeline from desalination plant to Bulahdelah (28 – 40 km inland from coast depending on route) • Lift pump stations and balance tanks	Flexible to as required	• Approvals and permits • Aquatic ecology – impingement and entrainment • Aquatic ecology – reject discharge • Community acceptance • Land acquisition for desalination plant	• Construction through environmentally sensitive corridor (Wang Wauk State Forest) requiring underbore for significant lengths of pipe • Feasible but impractical option for inland community due to significant infrastructure required for small community • Large carbon footprint with high energy intensive operation of desalination plant and long pumping distance • High operation and maintenance costs for desalination plant and transfer pipeline • Requires upskilling and additional labour for plant operation • Long lead time from planning and construction to operation • May require easements for sections of pipeline	• Rainfall independent supply • Reliable source of supply • Proven technology • Operation flexible to demand	$93.5M	Not assessed	Low – not considered a practical water security solution as significant distance from the coast
Regional connection (pipeline from Manning via Smiths Lake)	• Connection to Manning Water Supply scheme • Scheme connects via pipeline from Smiths Lake • Bulahdelah is integrated into the Manning scheme, supplied from Bootawa WTP and Nabiac Borefield • Interconnection would allow Bulahdelah WTP to be decommissioned	• Approximately 35 km pipeline connecting Smiths Lake and Bulahdelah • Lift pump stations and balance tanks • Chlorine booster station • Potential upgrades to trunk mains in southern Manning scheme and / or Smiths Lake reservoir	Entire township supplied from Manning, 2050 ADD 0.49 ML/d	• Increase in risk from impacts of natural disasters (such as bushfires leading to loss of power at pump stations) • Environmental impacts along pipeline construction corridor • Community acceptance for integrating Bulahdelah with Manning scheme	• Construction through environmentally sensitive corridor (Wang Wauk State Forest) requiring underbore for significant lengths of pipe • Considerable carbon footprint with long pumping distance • Potentially rainfall dependent solution dependent on water security solution for Manning • May require easements for sections of pipeline	• Decommission Bulahdelah WTP, which may either reduce or offset operational expenses for new pipeline • Reduced risk of water quality incidents as need for raw water extraction eliminated from Crawford River • Potential to connect new customer along pipeline route such as Bungwahl	$59.0M	Not assessed	Low – no feasibility investigations completed, requires investigation of impact on network from increased demand in southern Manning
Regional connection (pipeline from Manning via Nabiac)	• Connection to Manning Water Supply scheme • Scheme connects via pipeline from Nabiac • Bulahdelah is integrated into the Manning scheme, supplied from Nabiac Borefield • Interconnection would allow Bulahdelah WTP to be decommissioned	• Approximately 50 km pipeline connecting Smiths Lake and Bulahdelah • Lift pump stations and balance tanks • Chlorine booster station • Potential upgrades Nabiac reservoir	Entire township supplied from Manning, 2050 ADD 0.49 ML/d	• Increase in risk from impacts of natural disasters (such as bushfires leading to loss of power at pump stations) • Community acceptance for integrating Bulahdelah with Manning scheme	• Considerable carbon footprint with long pumping distance • Reduces reliance on Nabiac borefield marginally for Manning water security, especially under drought conditions • May require easements for sections of pipeline	• Decommission Bulahdelah WTP, which may either reduce or offset operational expenses for new pipeline • Easy integration with Nabiac borefield due to low demand for Bulahdelah catchment • Less constrained construction corridor with wider road reserves and flatter terrain in comparison with Smiths Lake connection • Reduced risk of water quality incidents as need for raw water extraction eliminated from Crawford River • Potential to connect new customer along pipeline route such as Coolongolook	$34.1M	$394K	Medium – no feasibility investigations completed, requires investigation of impact on Manning Scheme but 2050 ADD is relatively low

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Regional connection (pipeline from Tea Gardens)	• Connection to Tea Gardens Water Supply scheme • Scheme connects via pipeline from Tea Gardens • Bulahdelah is integrated into the Tea Gardens scheme, supplied from Tea Gardens Borefield • Interconnection would allow Bulahdelah WTP to be decommissioned	• Approximately 40 km pipeline connecting Tea Gardens and Bulahdelah • Lift pump stations and balance tanks • Chlorine booster station • Potential upgrade to Tea Gardens reservoir and / or network	Entire township supplied from Tea Gardens, 2050 ADD 0.49 ML/d	• Potentially insufficient availability of water from borefield – extraction limitations • Increase in risk from impacts of natural disasters (such as bushfires leading to loss of power at pump stations) • Community acceptance for integrating Bulahdelah with Tea Gardens scheme	• Considerable carbon footprint with long pumping distance • Some underbore required for pipeline	• Decommission Bulahdelah WTP, which may either reduce or offset operational expenses for new pipeline • Reduced risk of water quality incidents as need for raw water extraction eliminated from Crawford River • Potential to connect new customers along pipeline route such as North Arm Cove community	$23.6M	Not assessed	Low – no feasibility investigations completed, requires investigation of water security for Tea Gardens scheme with permanent additional demand from Bulahdelah
Regional connection (water carting from Tea Gardens)	• Water carting from Tea Gardens approximately 40 km via road • Activated during times of emergency only, i.e., when river flow conditions are not ideal	• Infrastructure for receiving and unloading tankers at Bulahdelah	Required yield as per circumstances and availability at Tea Gardens	• Impact and / or delay of transport from unforeseen circumstances such as traffic accident, bushfire, etc. • Dependent on availability of water supply at Tea Garden bores • Potential for water contamination requiring additional disinfection • Freight availability for prolonged periods	• Short-term supply solution • Greenhouse gas emissions from daily use of freight	• Some flexibility in scaling yield to as required • Cost-effective short term water security solution until long term solution implemented	Not assessed		High – based on past implementation at Gloucester and Stroud in the 2019-20 drought
Stormwater Harvesting	• Stormwater collection and transfer to Bulahdelah off-stream storage to supplement extraction of raw water from the Crawford River • Township of Bulahdelah bound by Myall River in the west, merging with Crawford River in the south, and highest elevation to east of town, falling towards the river. Existing stormwater infrastructure and topography indicate multiple small stormwater catchments that direct stormwater to the river via various routes.	• Multiple collection basins for each catchment • New off-stream storage • Pumping and transfer infrastructure from each collection basin to off-stream storage • Potentially upgrade of WTP dependent on stormwater quality	High level modelling indicates 1220 ML/yr across the entire catchment with assumed 31% imperviousness	• Potentially poor water quality requiring a higher level of treatment • Multiple small catchments • Impact on receiving waterbodies from reduced flows • Mosquito breeding at collection points and storage basins • Catchment is predominantly rural and village residential with large lots, favourable for pervious ground profile	• Rainfall dependent water source • High operation and maintenance costs • Minimal growth in Bulahdelah for developer driven opportunities • Significant infrastructure required for collection of stormwater • Potentially requires large storage to capture flows during wet weather • Requires reconfiguration of stormwater network to route stormwater to collection basins	• Utilisation of some existing stormwater network • Flow attenuation in low flow events • Reduced pollutants in natural waterways • Potential for localised opportunities	Not assessed		Low – very high-level investigation undertaken for stormwater yield
Groundwater	• Considers potential for groundwater sources in or near Bulahdelah • Known private bores in community • Sites identified in 1999 by PPK included drilling along the alluvial floodplain of the Myall River, upstream and downstream of Bulahdelah • Of the three sites investigated, one of the sites included three test bores drilled in National Park 9 km downstream of Bulahdelah on the eastern side of Myall River which produced	If investigations deem option is feasible: • Borefield • Groundwater transfer pipeline to Bulahdelah WTP	Study concluded potential potable supply yield of 3 to 8 ML/day	• Approvals and permits • Suitability of groundwater for potable water supply – impacts of farming and waste activities in the surrounding area • Environmental impacts from extraction, specifically on nearby wetlands • Potentially poor water quality requiring a higher level of treatment – high hardness and dissolved iron content identified in 1999 studies	• Long lead time for new borefield from planning and construction to operation • Construction through environmentally sensitive corridor, Myall Lake National Park • Highly likely rainfall dependent source – storage volumes uncertain as the bounds of fresh quality aquifer are unknown. Under non pumping conditions groundwater flows downvalley and towards Myall River. Recharge likely to be		Not assessed		Low – potential for groundwater identified, but studies are outdated and need to be reinvestigated to confirm source, yield, geotechnical conditions and hydrological aspects

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
	high yields from deeper fluviatile sand and gravel aquifers				from upstream alluvial areas and from direct rainfall recharge through permeable dune sand cover across area. • Potential for saltwater intrusion south and from tidal sections of river				
Reticulated Recycled Water	• Dual reticulation network to supply both potable and recycled water for new development areas only • Recycled water could be utilised for outdoor uses, toilet flushing and laundry purposes (i.e., for hot water) offsetting potable water demand for domestic uses • Upgrade of Bulahdelah STP will be required with advanced water treatment for effluent treated to unrestricted public access standards in accordance with the Australian Guidelines for Water Recycling	• Advanced water treatment process including membrane filtration • Transfer pumping infrastructure including pipelines to developments • Additional storage for recycled water storage	Approximately up to 326 kL/d by 2050 (up to 16% of current effluent used for golf course irrigation in 2017-18, and 95% used in 2019-20 drought)	• Insufficient recycled water demand due to low growth • Cross-contamination • Public health risk due to potential for misuse of recycled water by customer • Approvals and permits – specifically for land clearing adjacent to STP required for expansion • Community acceptance	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Only suitable for new residential developments (not practical to retrofit existing properties), can be discriminatory • Partially rainfall dependent demand (outdoor use driven by day-to-day weather conditions) • Developer driven, beyond Council's influence for implementation • Increase in greenhouse gas emissions with increased level of treatment • High operation and maintenance costs with dual network	• Rainfall independent yield • Promotes community education and acceptance • Effluent management • Maintains aesthetic values during drought	$16,000 per dwelling including cost for treatment and distribution	Not assessed	Medium – not considered viable due to insufficient availability of effluent for recycled water use, both as a result of low growth and existing user intake during drought period
Recycled Water for Restricted Use	• Existing effluent management consists of supplying restricted recycled water to Bulahdelah Golf Course • Option considers expansion of recycle water supply to new users for agricultural purposes with multiple farms and agricultural properties surrounding the township of Bulahdelah • No major infrastructure upgrades are required	• Expansion of recycled water distribution network to new users	Approximately up to 326 kL/d by 2050 (up to 16% of current effluent used for golf course irrigation in 2017-18, and 95% used in 2019-20 drought)	• Insufficient recycled water demand due to low growth • Users not guaranteed over longer term	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse during drought • May require long pipelines for single users • Rainfall dependent demand	• Rainfall independent yield • Effluent management • No upgrades required to treatment • Increases reliability with increased number of users	Not assessed		Medium – effluent available for new users, but insufficient availability during drought period based on existing user intake
Recycled Water for Unrestricted Use	• Upgrade of Bulahdelah STP to Australian Guidelines for Water Recycling for unrestricted use for open space irrigation • Open spaces for irrigation may include Bulahdelah Showground and Jack Ireland Sports Complex	• New RTP with membrane filtration, chlorination and treated water storage tanks • Transfer pumping infrastructure including pipelines • Storage and recycled water irrigation infrastructure at end user sites (if Council owned and operated)	Approximately up to 326 kL/d by 2050 (up to 16% of current effluent used for golf course irrigation in 2017-18, and 95% used in 2019-20 drought)	• Existing uptake of potable water for sites negligible – insufficient for material impact on potable water demand • Approvals and permits – specifically for land clearing adjacent to STP required for expansion • Community acceptance	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse during drought • Significant infrastructure required to maximise use • Rainfall dependent demand • Increase in operation and maintenance costs • Increase in greenhouse gas emissions with increased level of treatment	• Rainfall independent yield • Promotes community education and acceptance • Effluent management • Maintains aesthetic values during drought	Not assessed		Medium – practical solution but low impact in offsetting potable water demand
Recycled Water for	• Substitution of flows downstream of Crawford River offtake point	• Upgrade of Bulahdelah STP to achieve water quality required to a level	Approximately up to 326 kL/d by 2050 (up to	• Approvals and permits – specifically for land clearing	• Insufficient availability of recycled water whilst	• Effluent management • May improve river flow • Adaptable to growth	Not assessed		Low – no feasibility

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Environmental Flows	for Bulahdelah WTP to enable greater extraction upstream • Replacement flows supplied from Bulahdelah STP • Replacement of flows to potentially enable increased extraction rates under normal conditions for storage in future off-stream storage dam • Further studies will be required to determine the limitations on increased extraction and to determine the required substitution water quality for maintaining a healthy river system	appropriate for the ecosystem of the Crawford River • Transfer pumping infrastructure including pipeline to river discharge • Construction of additional off-stream storage as per 'Off-Stream Storage' option	16% of current effluent used for golf course irrigation in 2017-18, and 95% used in 2019-20 drought)	adjacent to STP required for expansion • Community acceptance • Impact on river health and ecology from substitution flow • Impact on river health and ecology from increased offtake	maintaining current level of effluent reuse • May not improve yield / supply if river extraction limits are reached • Potential high increase in operation and maintenance costs with increased level of treatment • Requires additional off-stream storage to enable increased extraction • Rainfall dependent water source for extraction • Supporting legislation not fully developed				investigations completed
Purified Recycled Water	• Expansion of Bulahdelah STP to advanced level treatment for indirect purified recycled water use • Recycled water from STP redirected to future off-stream storage to mix with raw water extracted from Crawford River	• Upgrade of Bulahdelah STP to achieve advanced water quality including membrane filtration, reverse osmosis, UV advanced oxidation, and treated water storage tanks • Transfer pumping infrastructure including pipeline to off-stream storage • Construction of additional off-stream storage as per 'Off-Stream Storage' option	Approximately up to 326 kL/d by 2050 (up to 16% of current effluent used for golf course irrigation in 2017-18, and 95% used in 2019-20 drought)	• Community acceptance • Failure at critical control points can result in severe public health consequences • Approvals and permits – for purified recycled water plant, land clearing adjacent to STP required for expansion	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Supporting legislation not fully developed • Large carbon footprint with high energy intensive operation of recycled water plant • Significant increase in operation and maintenance costs	• Effluent management • Rainfall independent yield • Increase in reliability of supply	Not assessed		Medium – advanced treatment technically viable, but option is long-term solution requiring significant engagement with community for acceptance

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Long-list of options for Stroud Water Supply Scheme

Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Off-Stream Storage	• New additional off-stream storage dams adjacent to existing 50 ML dam at WTP site • Based on 2009 concept design by NSW Dams & Civil • Raw water supplied from Karuah River transported to existing sedimentation system • Overflow from existing dam to new dams through interconnected dam system	• 2 x in-ground storage dams • Valve pit arrangement or small pump station for each dam • Upgrade of DN150 transfer pipe from river pump station to DN200	Designed for 2 x 50 ML dam, equating to total additional 100 ML, but can be re-designed to as required	• Approvals and permits – environmental impacts not assessed • Potential for severe consequences with dam failure • Compliance with current legislation • Low resilience option with no additional supply sources	• Rainfall dependent water source – extraction limited to favourable river flow conditions Stratification from poor water quality • No allowance for staging – shared dam wall	• Land owned by Council • Operational flexibility with integration with existing dam system	$9.4M	$21K	High – option developed to concept design stage by Dams & Civil in 2009
Additional On-Stream Storage	• Existing natural weir on the Karuah River provides 17 ML storage • Option considers raising the weir crest for additional storage	• Foundation excavation and weir construction to required level • Modifications to fish passage structures	Requires further investigation	• Approvals and permits – environmental impacts to aquatic habitat and river • Low resilience option with no additional supply sources • Aquatic ecology – disruption to fish passage, reduced biodiversity • River ecology – impact on riparian vegetation with likely increased inundation resulting in increased erosion and sedimentation, decrease in water quality •	• Rainfall dependent water source – extraction limited to favourable river flow conditions • Increased siltation upstream of weir	• Visual amenity creation such as wetlands		Not assessed	Low – no investigations undertaken but has considerable potential for environmental impacts
Duralie Mine Dam	• Potential new water source • Option to either: ○ Transfer directly to Stroud WTP for treatment and distribution ○ Utilise dam water to inject flow into Karuah River upstream of raw water offtake point for increased extraction	• Acquisition of dam from Duralie Coal • Transfer pumping infrastructure including pipeline from mine dam to either Stroud WTP or river discharge point (approximately 17 km) • Upgrade to treatment as required for additional treatment either at the WTP or before discharging to river based on further testing	Requires further investigation	• Approvals and permits – requires rigorous testing and investigation to confirm suitability for injecting directly into WTP or river • Replenishment of dam water – availability, duration, source • Aquatic ecology – impacts of dam water quality on receiving waterbody • Suitability of dam water for drinking water standards • Acquisition of dam – mine may be planned for continued operations for a long-term • Community acceptance based on current socio-political sentiment towards dam projects	• Highly likely rainfall dependent water source – replenishment potentially dependent on rainfall • Stratification of stored water from poor water quality • May require easements for sections of pipeline	• Enhanced raw water quality management with availability of alternative water source when Karuah River conditions are unfavourable • Low investment of CAPEX for significant storage and new water source • Consideration for emergency measure if unsuitable for permanent solution	$9.7M for pipeline transfer	Not assessed	Low – no investigations undertaken, requires investigation into feasibility for conversion of dam to off-stream storage, water quality testing, water profiling for source of water through hydrological and geological investigations
Desalination of River Water via Karuah River	• Construction of a permanent packaged desalination plant • Proposed location adjacent to existing Stroud WTP • Raw water intake via existing offtake point • Reject discharge to ocean towards Pacific Palms • Treated water pumped for distribution from desalination plant via Stroud WTP	• Potential land acquisition near WTP • Packaged desalination plant including river water intake and pumping infrastructure, storage tanks for flow attenuation, screening and microfiltration units, reverse osmosis units,	Flexible to as required	• Approvals and permits – extraction licence, ocean discharge • Aquatic ecology – impingement and entrainment • Aquatic ecology – reject discharge • Community acceptance – impact to local industries dependent on river water from increased extraction	• Rainfall dependent water source – extraction based on river flow conditions • Large carbon footprint with high energy intensive operation of desalination plant and long pumping distance for outfall • High operation and maintenance costs for	• Easy integration into existing water supply system • Proven technology • Operation flexible to demand		Not assessed	Low – no planning investigations completed but constrained by river flow conditions and requires outfall pipeline to ocean

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
		and treated water storage tanks • Brine pumping system and discharge line to ocean outfall (50 – 80 km depending on route)		• Land acquisition for desalination plant	desalination plant and transfer pipeline • Construction through environmentally sensitive corridor for reject discharge pipeline (Wang Wauk State Forest and Myall River State Forest) • Requires upskilling and additional labour for plant operation • Long lead time from planning and construction to operation • May require easements for sections of pipeline				
Desalination of Sea Water	• Construction of a permanent desalination plant near the coastline • Located adjacent to proposed Pacific Palms STP • Raw water intake and reject discharge via ocean • Treated water pumped from coast to Stroud network for distribution	• Land acquisition nearby coast • Desalination plant including sea water intake and pumping infrastructure, screening and microfiltration units, reverse osmosis units, brine pumping system and discharge line to ocean outfall, and storage tanks • Pipeline from desalination plant to Stroud (50 – 80 km inland from coast depending on route) • Lift pump stations and balance tanks	Flexible to as required	• Approvals and permits • Aquatic ecology – impingement and entrainment • Aquatic ecology – reject discharge • Community acceptance • Land acquisition for desalination plant	• Construction through environmentally sensitive corridor (Wang Wauk State Forest and Myall River State Forest) • Feasible but impractical option for inland community due to significant infrastructure required for small community • Large carbon footprint with high energy intensive operation of desalination plant and long pumping distance • High operation and maintenance costs for desalination plant and transfer pipeline • Requires upskilling and additional labour for plant operation • Long lead time from planning and construction to operation • May require easements for sections of pipeline	• Rainfall independent supply • Reliable source of supply • Proven technology • Operation flexible to demand • Can be extension of Bulahdelah Desalination option	$78.5M	Not assessed	Low – not considered a practical water security solution as significant distance from the coast
Regional connection (pipeline from Hunter via Dungog)	• Water sharing between Stroud Water Supply Scheme and adjacent LGA, Hunter Water • Activated during times of emergency only and not for daily operation • Scheme connects to Dungog via pipeline • Further investigation required to determine feasibility of option along with consultation with Dungog Shire Council	• Approximately 24 km pipeline from Dungog to Stroud • Lift pump stations and balance tanks • Chlorine booster station • Modifications to Stroud Road reservoir for flexibility to pump both to Stroud Road and Stroud water supply zones	Further investigation required into availability but required yield as per circumstances (2050 ADD 0.38 ML/d)	• Requires partnership with another regional Council • Dependent on water security at Dungog, especially under drought conditions • Increase in risk from impacts of natural disasters (such as bushfires leading to loss of power at pump stations) • No control over asset or quality of water • Environmental impacts along pipeline construction corridor • Community acceptance for sharing between communities	• Considerable carbon footprint with long pumping distance • Potentially rainfall dependent solution unless Dungog in the future is supplied from Belmont desalination plant • Potential for shared operation and maintenance expenses with Dungog Shire Council for collection and / or treatment of water • May require easements for sections of pipeline	• Potential to connect new customer along pipeline route • Potentially increased social and economic benefits as a result of partnership	$16.2M	$163K	Low – no investigations undertaken; engagement required to determine viability of option

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Regional connection (water carting from Tea Gardens)	• Water carting from Tea Gardens approximately 60 km via road • Activated during times of emergency only, i.e., when river flow conditions are not ideal and dam storage level is low • Option was implemented previously in the 2019-20 drought	• No additional infrastructure required	Required yield as per circumstances and availability at Tea Gardens (2050 ADD 0.38 ML/d)	• Impact and / or delay of transport from unforeseen circumstances such as traffic accident, bushfire, etc. • Dependent on availability of water supply at Tea Garden bores • Potential for water contamination requiring additional disinfection • Freight availability for prolonged periods	• Short-term supply solution – impractical for prolonged periods • Greenhouse gas emissions from daily use of freight	• Some flexibility in scaling yield to as required • Cost-effective short term water security solution until long term solution implemented • Successfully implemented previously • Infrastructure for loading from Tea Gardens and unloading at Stroud in place		Not assessed	High – based on investigations undertaken by Council in the recent droughts
Regional connection (water carting from Gloucester)	• Water carting from Gloucester via Stratford Mine Dam • Activated during times of emergency only, i.e., when river flow conditions are not ideal and dam storage level is low • Depending on quality of water, option considered for either: ○ dust suppression, roads maintenance and construction activities; or ○ supplementing flow for potable water by carting to Stroud STP for treatment and distribution	• Upgrade to treatment as required for additional treatment either at the WTP or before discharging to river based on further testing	Required yield as per circumstances and availability at Stratford Dam	• Approvals and permits – requires rigorous testing and investigation to confirm suitability for injecting directly into WTP or for non-potable use • Impact and / or delay of transport from unforeseen circumstances such as traffic accident, bushfire, etc. • Dependent on availability of water availability at Stratford Dam • Suitability of dam water quality for purpose • Freight availability for prolonged periods	• Short-term supply solution – impractical for prolonged periods • Greenhouse gas emissions from daily use of freight	• Some flexibility in scaling yield to as required • Cost-effective emergency measure • Shorter distance in comparison with Tea Gardens		Not assessed	Low – requires further investigation into Stratford Mine Dam as per Gloucester "Stratford Mine Dam" option
Stormwater Harvesting	• Stormwater collection and transfer to Stroud off-stream storage to supplement extraction of raw water from the Karuah River • Township of Stroud bound by Karuah River on the western side and highest elevation to east of town, falling towards the river. Existing stormwater infrastructure and topography indicate multiple small stormwater catchments that direct stormwater to the river via various routes.	• Multiple collection basins for each catchment • Pumping and transfer infrastructure from each collection basin to current off-stream storage (may require additional off-stream storage to be constructed to store stormwater when available) • Potentially upgrade of WTP dependent on stormwater quality	High level modelling indicates 909 ML/yr across the entire catchment with assumed 29% imperviousness	• Potentially poor water quality requiring a higher level of treatment • Multiple small catchments • Mosquito breeding at collection points and storage basins • Catchment is predominantly rural and village residential with large lots, favourable for pervious ground profile	• Rainfall dependent water source • High operation and maintenance costs • Minimal growth in Stroud for developer driven opportunities • Significant infrastructure required for collection of stormwater • Potentially requires large storage to capture flows during wet weather • Requires reconfiguration of stormwater network to route stormwater to collection basins	• Utilisation of some existing stormwater network • Flow attenuation in low flow events • Reduced pollutants in natural waterways • Potential for localised opportunities		Not assessed	Low – very high-level investigation undertaken for stormwater yield, but requires either or both of significant storage and collection basins
Groundwater	• Considers potential for groundwater sources in or near Stroud • Current water source for Stroud, Karuah River, falls within the Gloucester Basin groundwater source as per the Water Sharing Plan for the Lower North Coast • 1999 PPK study did not identify any potential sites in the Stroud area	If investigations deem option is feasible: • Borefield • Potentially new WTP depending on location • Groundwater transfer pipeline to Stroud WTP or supply reservoir	Requires further investigation	• Approvals and permits • Availability of groundwater • Suitability of groundwater for potable water supply • Environmental impacts from extraction • Potentially poor water quality requiring a higher level of treatment	• No prospective sites have been identified for Stroud region • Long lead time for new borefield from planning and construction to operation			Not assessed	Low – requires an updated investigation into availability of groundwater in region

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
Reticulated Recycled Water	• Dual reticulation network to supply both potable and recycled water for new development areas only • Recycled water could be utilised for outdoor uses, toilet flushing and laundry purposes (i.e., for hot water) offsetting potable water demand for domestic uses • Upgrade of Stroud STP will be required with advanced water treatment for effluent treated to unrestricted public access standards in accordance with the Australian Guidelines for Water Recycling	• Advanced water treatment process including membrane filtration • Transfer pumping infrastructure including pipelines to developments • Additional storage for recycled water storage	Approximately up to 12 kL/d by 2050 (up to 90% of current effluent used for pasture irrigation in 2017-18, and 100% used in 2019-20 drought)	• Insufficient recycled water demand due to low growth • Cross-contamination • Public health risk due to potential for misuse of recycled water by customer • Approvals and permits – specifically for land clearing adjacent to STP required for expansion • Community acceptance	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Only suitable for new residential developments (not practical to retrofit existing properties), can be discriminatory • Partially rainfall dependent demand (outdoor use driven by day-to-day weather conditions) • Developer driven, beyond Council's influence for implementation • Increase in greenhouse gas emissions with increased level of treatment • High operation and maintenance costs with dual network	• Rainfall independent yield • Promotes community education and acceptance • Effluent management • Maintains aesthetic values during drought	16,000 per dwelling including cost for treatment and distribution	Not assessed	Medium – not considered viable due to insufficient availability of effluent for recycled water use
Recycled Water for Restricted Use	• Existing effluent management consists of supplying recycled water for dairy cattle grazing to single user • Option considers expansion of recycle water supply to new users for agricultural purposes • No major infrastructure upgrades are required	• Expansion of recycled water distribution network to new users	Approximately up to 12 kL/d by 2050 (up to 90% of current effluent used for pasture irrigation in 2017-18, and 100% used in 2019-20 drought)	• Insufficient recycled water demand due to low growth • Users not guaranteed over longer term	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • May require long pipelines for single users • Rainfall dependent demand	• Rainfall independent yield • Effluent management • No upgrades required to treatment • Increases reliability with increased number of users		Not assessed	Medium – not considered viable due to insufficient availability of effluent for recycled water use due to existing user intake
Recycled Water for Unrestricted Use	• Upgrade of Stroud STP to Australian Guidelines for Water Recycling for unrestricted use for open space irrigation • Open spaces for irrigation may include Stroud Showground and Stroud Public School	• New RTP with membrane filtration, chlorination and treated water storage tanks • Transfer pumping infrastructure including pipelines • Storage and recycled water irrigation infrastructure at end user sites (if Council owned and operated)	Approximately up to 12 kL/d by 2050 (up to 90% of current effluent used for pasture irrigation in 2017-18, and 100% used in 2019-20 drought)	• Existing uptake of potable water for sites negligible – insufficient for material impact on potable water demand • Approvals and permits – specifically for land clearing adjacent to STP required for expansion • Community acceptance	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Significant infrastructure required to maximise use • Rainfall dependent demand • Increase in operation and maintenance costs • Increase in greenhouse gas emissions with increased level of treatment	• Rainfall independent yield • Promotes community education and acceptance • Effluent management • Maintains aesthetic values during drought • Increases reliability with increased number of users		Not assessed	Medium – not considered viable due to insufficient availability of effluent for recycled water use due to existing user intake
Recycled Water for Environmental Flows	• Substitution of flows downstream of Karuah River offtake point for Stroud WTP to enable greater extraction upstream • Replacement flows supplied from Stroud STP • Replacement of flows to potentially enable increased extraction rates under normal conditions for storage in future off-stream storage dam • Further studies will be required to determine the limitations on	• Upgrade of Stroud STP to achieve water quality required to a level appropriate for the ecosystem of the Karuah River • Transfer pumping infrastructure including pipeline to river discharge • Construction of additional off-stream storage as per 'Off-Stream Storage' option	Approximately up to 12 kL/d by 2050 (up to 90% of current effluent used for pasture irrigation in 2017-18, and 100% used in 2019-20 drought)	• Approvals and permits – specifically for land clearing adjacent to STP required for expansion, pipeline Mill Creek crossing for STP to river discharge • Community acceptance • Impact on river health and ecology from substitution flow • Impact on river health and ecology from increased offtake	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • May not improve yield / supply if river extraction limits are reached • Potential high increase in operation and maintenance costs with increased level of treatment • Requires additional off-stream storage to enable increased extraction	• Effluent management • May improve river flow • Adaptable to growth		Not assessed	Low – no feasibility investigations completed

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Option	Description	Key Infrastructure	Additional Yield	Risks	Issues	Opportunities	CAPEX	OPEX	Level of Confidence
	increased extraction and to determine the required substitution water quality for maintaining a healthy river system				• Rainfall dependent water source for extraction • Supporting legislation not fully developed				
Purified Recycled Water	• Expansion of Stroud STP to advanced level treatment for indirect purified recycled water use • Recycled water from STP redirected to future off-stream storage to mix with raw water extracted from Karuah River	• Upgrade of Stroud STP to achieve advanced water quality including membrane filtration, reverse osmosis, UV advanced oxidation, and treated water storage tanks • Transfer pumping infrastructure including pipeline to off-stream storage • Construction of additional off-stream storage as per 'Off-Stream Storage' option	Approximately up to 12 kL/d by 2050 (up to 90% of current effluent used for pasture irrigation in 2017-18, and 100% used in 2019-20 drought)	• Community acceptance • Failure at critical control points can result in severe public health consequences • Approvals and permits – for purified recycled water plant, land clearing adjacent to STP required for expansion, pipeline Mill Creek crossing for STP to WTP	• Insufficient availability of recycled water whilst maintaining current level of effluent reuse • Supporting legislation not fully developed • Large carbon footprint with high energy intensive operation of recycled water plant • Significant increase in operation and maintenance costs	• Effluent management • Rainfall independent yield • Increase in reliability of supply		Not assessed	Medium – advanced treatment technically viable, but insufficient availability of effluent for recycled water use due to existing user intake