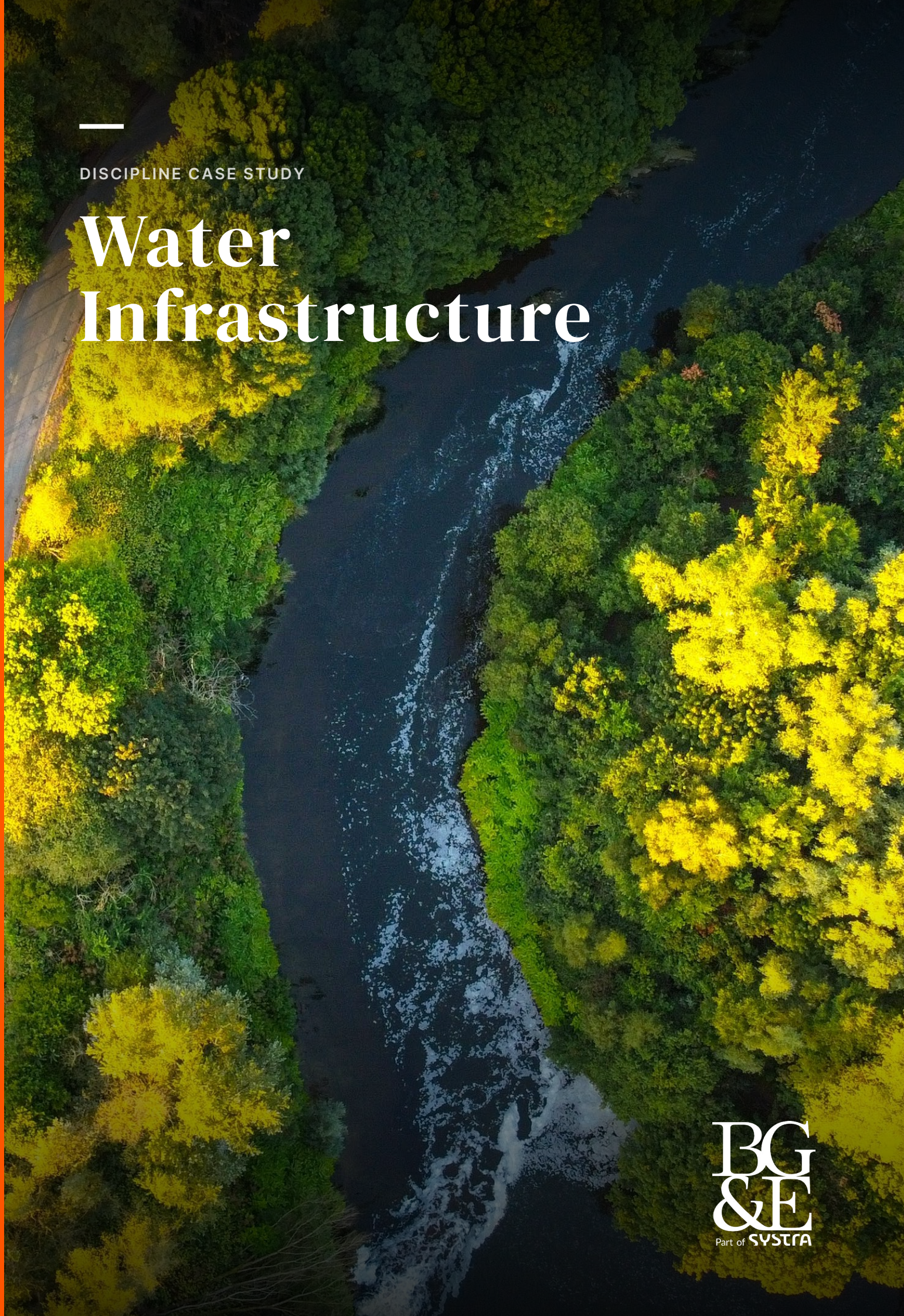
DISCIPLINE CASE STUDY

Water Infrastructure



BG&E
Part of SYSTRA

Huskisson Sewer Pumping Station 7

WASTEWATER PUMPING & CONVEYANCE

HUSKISSON, NSW, AUSTRALIA
CLIENT: SHOALHAVEN WATER

A review of the existing sewerage systems in Shoalhaven Council identified a need to upgrade the Huskisson/Vincentia Sewer Pumping Station (SPS) No. 7 rising main, gravity main and emergency storage in Montague Street, McNamara Street, and Berry Street, Vincentia.

The upgrades are necessary to allow for increased wastewater flows to ensure efficient operation and reduce the risk of wastewater overflows into the environment.

The scope entailed:

- Detailed design of approximately 780 metres of DN200 sewer rising main and approximately 240 metres of DN400 sewer gravity main.
- Provision of new emergency storage and a new sewer pumping station, including new pumps.
- Upgrade of the electrical and telemetry systems, including a new CT meter and outdoor electrical switchboard.

Winmalee Sewerage Treatment Plant Upgrade

WASTEWATER TREATMENT

BLUE MOUNTAINS, NSW, AUSTRALIA
CLIENT: SYDNEY WATER, STANTEC (FORMERLY CARDNO) & DOWNER

The Winmalee Sewage Treatment Plant (STP) was commissioned in the 1980s to meet the needs of a growing population in the Penrith area. In 2015, a Pollution Reduction Program was imposed that required Sydney Water to reduce the nutrient loads from the plant, necessitating the $60 million upgrade of the STP.

BG&E was the project's principal structural engineering resource responsible for the delivery of the concept and detailed structural design for all structures on the project, including:

- Inlet works.
- Membrane bioreactor tanks.
- Ancillary structures (inc. chemical storage, blower and switchrooms).

The project was an upgrade of an existing facility on a space-constrained site and required careful management of the civil and structural design as well as close coordination of the cross-discipline design to ensure there was no disturbance to ongoing operations during construction and commissioning.

Upon completion, the project has addressed reliability constraints, increased capacity for servicing the current and projected population beyond 2030, and ensured the plant meets new Environmental Protection Licence requirements.

Gordonbrook 150ML Offstream Storage

WATER CONTAINING STRUCTURES

GORDONBROOK, QLD, AUSTRALIA
CLIENT: SOUTH BURNETT REGIONAL COUNCIL

The Town of Kingaroy in South East Queensland was historically reticulated from two sources: 30% from the nearby Gordonbrook Dam and 70% from an offtake connected to the Boondooma-Tarong supply pipeline.

The South Burnett Regional Council secured funding for the detailed design of a proposed 150ML off-stream water storage to improve Kingaroy's water supplies by providing a raw water storage facility for inflows from the Ellwoods supply pipeline that can be drawn upon during maintenance of either the Boondooma-Tarong pipeline or the Ellwoods off-take pipeline.

BG&E was engaged to complete the detailed design of the 150ML off-stream water storage to improve Kingaroy's water supplies.

This project aims to provide the town of Kingaroy with water security, by converting Gordonbrook Dam from town water supply to irrigation use, which includes:

- Construction of a 150ML off-stream storage facility at the Kingaroy Water Treatment Plant.
- Upgrade of Gordonbrook Dam to government standards.
- The construction of the Wooroolin Water Reservoir.

Kenya Water Treatment Plant

WATER TREATMENT

CHINCHILLA, QLD, AUSTRALIA
CLIENT: LAING O'ROURKE & QUEENSLAND GAS COMPANY (QGC)

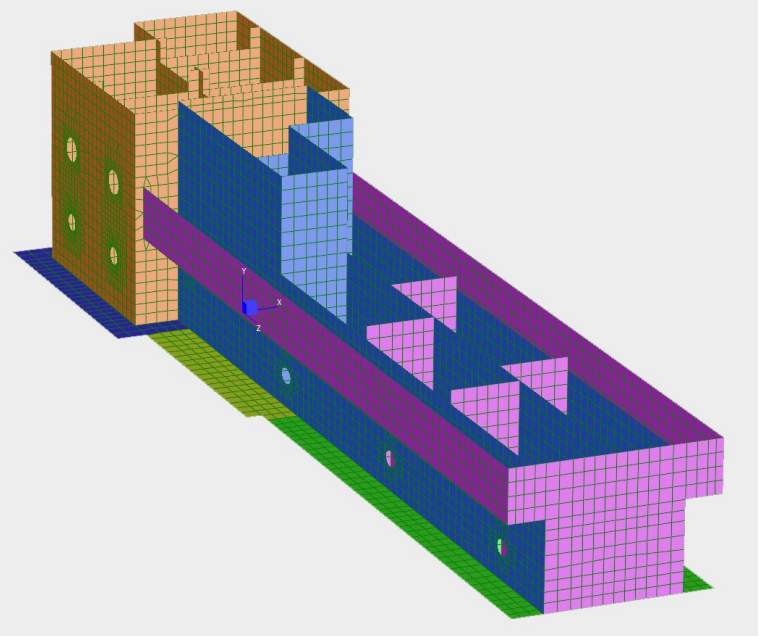
The Kenya Water Treatment Plant is a new water treatment plant constructed as a part of the Queensland Curtis LNG (QCLNG) project of QGC. The QCLNG project is the world's first to convert natural gas from coal seams into liquefied natural gas and began exporting in 2014.

The water treatment plant is required for the purification process of the water that is drawn up as part coal seam gas extraction process.

BG&E was appointed as sub consultant to Laing O'Rourke's in house design office to assist in structural design of several large reinforced concrete tanks that are to house the various water treatment processes.

Services delivered by BG&E included:

- Structural design of the primary precast water tank (FEA Model in Figure 1).
- Structural design and review of ancillary buildings.
- Development of sophisticated finite element models to allow the detailed investigation of the various temperature, shrinkage and loading conditions.



Northern Water Treatment Plant

WATER TREATMENT

WOLEEBEE, QLD, AUSTRALIA
CLIENT: LAING O'ROURKE & QUEENSLAND GAS COMPANY (QGC)

The Northern Water Treatment Plant is the largest of a trio of produced water treatment plants that treat saline water produced as part of the coal seam gas extraction process.

The plant has the capacity to purify 100,000 cubic metres of water per day which is then reused by the local communities and farmers.

BG&E provided:

- Primary reinforced concrete water tank structural design.
- Pipe rack steelwork and footing design.
- Ancillary building structural design and reviews.

In 2016, the QGC's water treatment plant at the northern gas fields was named Industrial Water Project of the Year at the annual Global Water Awards which recognise the most impressive technical or environmental achievement in the field of industrial water.

Harding River Water Treatment Plant

WATER TREATMENT

KARRATHA, WA, AUSTRALIA
CLIENT: DECIMIL

This project comprised the design and construction of a new water treatment building and processing equipment on the Harding River Dam, 30 kilometres east of Karratha.

BG&E provided civil and structural engineering design services and construction assistance for the new facility, including:

- Shop drawing reviews.
- Responding to contractor's queries through RFI Register.
- Site attendance.
- Confirmation of design intent.

The works included bulk earthworks and drainage on a moisture reactive site, process buildings, treatment structures, administration and workshops.

The structures included the clear water tank, the flocculator tank, the clarifier tank, the chemical storage building and the water treatment building. The design included tilt-up concrete walling in a remote, cyclone prone location.

Completed in 2003, this project enables the provision of potable water to the towns of Dampier, Karratha, Cape Lambert, Point Samson, Roeburn and the neighbouring regions.

Ellenbrook Tank

WATER CONTAINING STRUCTURES

ELLENBROOK, WA, AUSTRALIA
CLIENT: WATER CORPORATION WA

BG&E designed the Ellenbrook Water Tank, an 80-million-litre above-ground concrete drinking water storage tank, the largest built for the Water Corporation at its completion in 2018.

The tank ensures a reliable drinking water supply for Ellenbrook and the surrounding north eastern metropolitan corridor.

The tank, with an external diameter of over 91 metres and a height of approximately 13 metres, was constructed from prestressed concrete, featuring an in-situ post-tensioned base slab and precast wall panels.

A lightweight steel roof, supported by 13 internal precast columns, covers the structure.

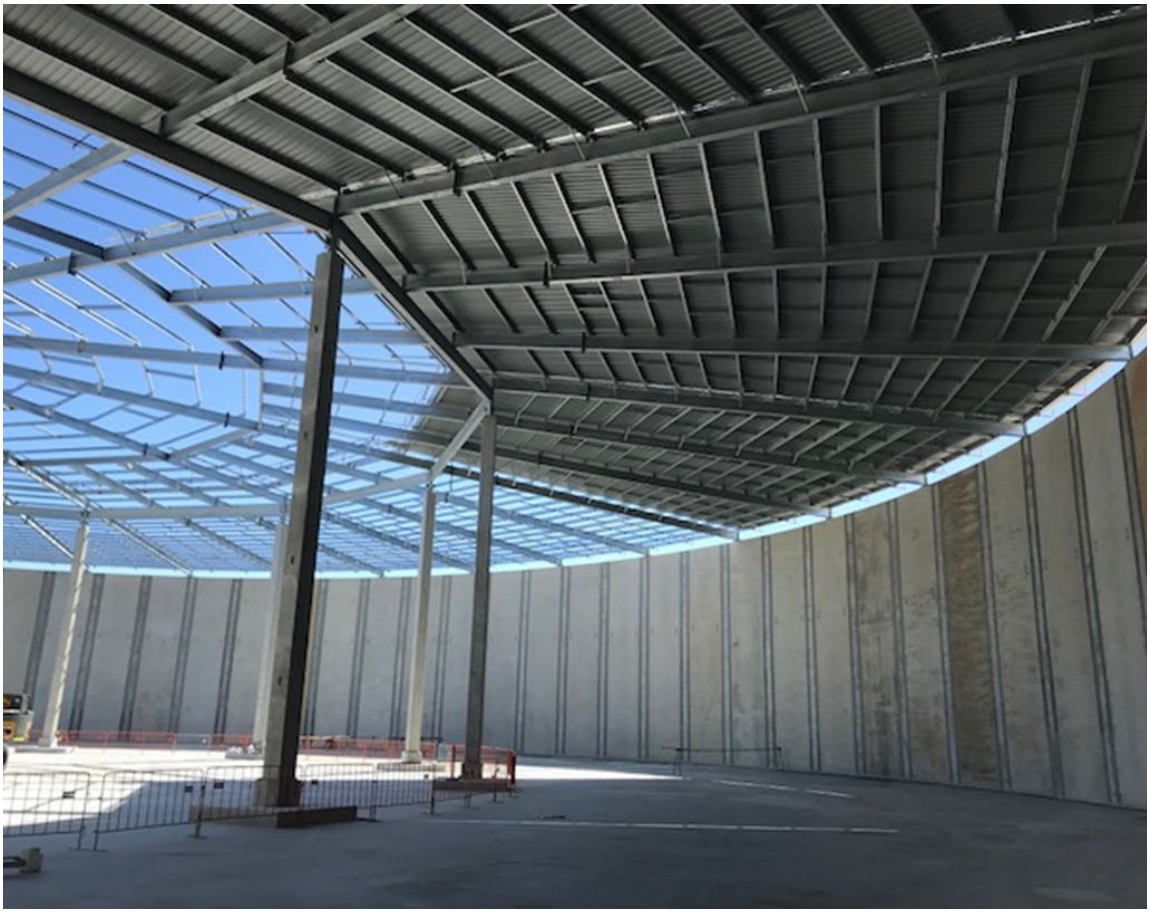
The base slab was constructed in a single 92 metre diameter pour, involving approximately 1,260 cubic metres of concrete placed over 11 hours. Early staging of the base slab post-tensioning enabled construction without thermal or shrinkage cracking.

The Ellenbrook Water Tank sets a new standard for large above-ground water storage with its efficient structural detailing, post-disaster functionality, and strict cracking limitations for 100-year unlined potable water containment.

Georgiou engaged BG&E for the detailed design of all concrete elements, including:

- A combined base slab and ring beam cast in-situ in a single 6750-square-metre pour with bi-directional post-tensioning tendons and no conventional reinforcement.
- Tank walls made of 80 precast, vertically tapered and pre-tensioned panels — including special panels for access manholes and post-tensioning anchorage pilasters. Panels were stitched in-situ, then circumferentially post-tensioned.
- An innovative wall-to-base slab detail to resist Importance Level 4 seismic actions.

Ellenbrook Tank — Ellenbrook, WA, Australia.



Roe Highway & Kalamunda Road Interchange

WATER PIPELINE CONVEYANCE

HIGH WYCOMBE, WA, AUSTRALIA
CLIENT: MAIN ROADS WA

Roe Highway is part of a key road corridor in Western Australia that links the Kwinana Freeway to the Great Northern Highway, providing access to the Kewdale, Hazelmere and Canning Vale industrial areas.

Prior to the construction of the interchange, Kalamunda Road was one of the last remaining signalised intersections on Roe Highway.

Completed in late 2021, this project involved the construction of a grade-separated interchange at the Roe Highway and Kalamunda Road intersection.

BG&E was engaged by Main Roads WA to design the relocation of Water Corporation's major trunk and distribution mains affected by the works. The project required the relocation of five separate water mains and their associated complex multi-valve arrangement which included Pressure Reducing Valve (PRV) arrangement installations. Due to the importance of the PRV's, they were designed to be above ground installations, housed in a specialised and secured Water Corporation managed building.

This project also included the detailed design and management of significant potential electrical fault touch voltages due to the close proximity of the Western Power's transmission towers that were previously constructed without a continuous earth/fault wire.

As lead consultant, BG&E, worked closely with the overall project team, including specialist Water Corporation accredited Earth Potential Rise (EPR) electrical consultants, to determine agreed safe voltage mitigation measures to be implemented on the steel pipelines during construction and for Water Corporation's permanent arrangements.

The water pipeline length and sizes consisted of three sizes of mild steel cement lined (MSCL) pipe:

- 900 metres of 1400 diameter.
- 1250 metres of 600 diameter.
- 400 metres of 300 diameter.

Roe Highway & Kalamunda Roat Interchange — High Wycombe, WA, Australia.

Mandurah Traffic Bridge Duplication

WATER PIPELINE CONVEYANCE

MANDURAH, WA, AUSTRALIA
CLIENT: MAIN ROADS WA

The Mandurah Estuary Bridge Duplication project involved the replacement of the existing timber bridge structure on Pinjarra Road near the Mandurah CBD in Western Australia.

To accommodate the new bridge structure, BG&E was engaged to relocate the water distribution main from the existing timber bridge.

The project included detailed design for two stages to suit the new bridge construction:

- Stage 1 — consisted of 200 metres of DN450 PE water distribution main, including valving and the installation a magnetic flow meter in a permanent bespoke underground concrete enclosure.
- Stage 2 — consisted of 250 metres of twin DN630 PE water distribution mains, horizontally directional drilled at depth under the Mandurah estuary seabed.

Stage 2 required complex valving and bypass arrangements on each side of the estuary crossing to enable the Water Corporation to switch between the two pipe lines for future redundancy should a pipe failure occur under the seabed.

The project was completed in 2018.

METRONET — Thornlie to Cockburn Rail Upgrade

WATER, SEWER & MAIN DRAINAGE RELOCATIONS

PERTH, WA, AUSTRALIA
CLIENT: NEWEST — NEWEST ALLIANCE

The METRONET program represents Perth's largest ever public transport investment, adding approximately 72 kilometres of new lines and 23 stations to the suburban network to increase capacity.

The Thornlie-Cockburn Link will be Perth's inaugural east-west crossline, enhancing travel flexibility and improving public transport access to the city's southeastern suburbs.

BG&E's scope included designing and documenting the relocation of Local Government Authority's (LGA) and Water Corporation's water distribution and reticulation mains, gravity sewer network, main drainage networks and Jandakot Airport's critical sewer pressure main — all impacted by the rail infrastructure upgrade and duplication within the existing rail corridor.

The pipeline relocations included the design documentation of significant microtunnelled concrete pipe crossings under operating freeways, passenger and freight rail networks to facilitate the installation of new carrier pipework to be installed within the sleeves.

BG&E's experience on the METRONET project highlights our expertise in designing Water Corporation distribution and reticulation mains within complex rail and urban environments while coordinating with major infrastructure projects. We excel in understanding the design, constructability, and maintenance of Water Corporation assets in close proximity to Western Power's high voltage transmission lines and the PTA's electrified rail environments.

The project ran from 2019 through to 2024 and comprised the following relocations:

WATER RETICULATION — RAIL CORRIDOR CROSSING

Leeming Road Crossing

Design of new microtunnelled sleeve and new pipeline across the rail corridor to replace existing water pipeline.

Clifton Road Crossing

Design of new microtunnelled sleeve and new pipeline across the rail corridor to replace existing water pipeline.

Ranford Road

Design of new sleeved rail corridor crossing within new bridge structure, including specialised bespoke details to address the differing bridge and water main movements across the bridge movement joints.

McLean Road Crossing

Design of new multi-staged sleeve across the rail corridor to enable the installation of the final Water Corporation new water pipeline across the rail corridor.

METRONET — Thornlie to Cockburn Rail Upgrade — Perth, WA, Australia.

METRONET — Thornlie to Cockburn Rail Upgrade — Perth, WA, Australia.

WATER DISTRIBUTION — RAIL CORRIDOR CROSSING

Ranford Road

Design and documentation of new microtunnelled sleeve and new DN600 diameter steel pipeline under the rail corridor crossing to replace the existing crossing. Works undertaken with uninterrupted operations of the existing freight rail over the pipeline.

Incorporated two separate sections of relocations in the pipe design — with one section addressing the rail corridor crossing and the second section required to facilitate the installation of large retaining walls associated with the new Ranford Road bridge and roadworks.

MAIN DRAINAGE

Hughes Street Main Drain (Water Corporation)

Design and documentation of the HughesStreet main drain network relocation affected by the proposed rail corridor works, including a new compensating basin and main pipe drainage with bespoke custom pits for the 200 metre siphonic main drain rail crossing to suit Water Corporation's specific maintenance requirements.

Coordination between design teams and stakeholders, including Water Corporation, ARC (Freight) Rail, Public Transport Authority, City of Gosnells and City of Canning, was essential due to the complexity of the combined gravity and hydraulic main drainage network that provides the flood protection to the overall precinct.

The design addressed the continuous operation of the existing ARC freight rail and constant flows within main drainage network — which required extensive interface with all stakeholders and the development of temporary works planning/documentation.

This project also incorporated the detailed design of a custom inlet headwall structure to the Water Corporation's specific requirements with cleanable safety screens and landings.

Amherst Street Main Drain (Water Corporation)

Designed the relocation of existing twin 1350 millimetre diameter main drainage pipe culverts under part of the rail corridor to a new continuous main drainage line under the track crossings over the full rail corridor extents.

With assistance from the Water Corporation's precinct drainage modelling team, the stormwater flows across the rail corridor were reduced to enable the use of a single 900 millimetre diameter pipe in lieu of the existing twin 1350 millimetre pipes.

The design documented the re-use the one of the existing 1350 millimetre diameter pipes as a sleeve for the new 900 millimetre diameter steel drainage pipe across the corridor. The section of the new 900 millimetre diameter steel pipeline beyond the existing 1350 millimetre diameter pipes was designed to be fully concrete encased across the rail corridor.

This crossing anticipated and factored into design, the ground movements between existing 1350 millimetre diameter pipe sleeve and the new concrete-encased pipe crossing to ensure no detrimental effect on the rail tracks or the new 900 millimetre diameter steel pipe within the rail corridor.

METRONET — Thornlie to Cockburn Rail Upgrade — Perth, WA, Australia.

METRONET — Thornlie to Cockburn Rail Upgrade — Perth, WA, Australia.

Cameron Street & Elliot Road Main

Drainage (City of Gosnells-LGA)
Designed the relocation of existing triple 1050 millimetre diameter drainage pipe culverts under the rail tracks to a new continuous main drainage system, spanning the entire corridor. This has required designing multiple rail crossings to suit constructability and to delineate the main drainage networks between the City of Gosnells, PTA, and ARC (Freight) Rail.

The design incorporated new microtunnelled twin 1200 millimetre diameter pipes under the rail corridor, with the works undertaken with uninterrupted operations of the existing freight rail over the new microtunnelled pipes.

In addition, the design documented the re-use the one of the existing 1050 millimetre diameter pipes as a sleeve for the new 700 millimetre diameter concrete drainage pipe across the corridor.

The detailed design incorporated a large custom basin headwall/outlet structure with cleanable safety screens and landings, capable of peak flows in excess of four cubic metres per second.

Greenway Avenue Main Drainage (City of Gosnells-LGA)

Designed the extension of existing twin 1050 millimetre diameter drainage pipe culverts under the existing freight rail tracks to new continuous main drainage pipes over the full rail corridor extents. This required the removal of the existing twin pipe headwalls within the rail corridor and continuing the twin 1050 millimetre diameter pipes to either side of the rail corridor to new custom City of Gosnells pits within their private lot drainage easements outside of the rail corridor.

This arrangement was developed to ensure that the City of Gosnells does not require access into the ARC (Freight) Rail or PTA electrified rail corridors for any regular maintenance works on their main drainage network.

At BG&E, we are united by a common purpose — we believe that truly great engineering takes curiosity, bravery and trust, and is the key to creating extraordinary built environments.

Our team of more than 800 highly skilled people, in offices across Australia, New Zealand, Singapore, the United Kingdom and Middle East, design and deliver engineering solutions for clients in the Property, Transport, Ports and Marine, Water, Defence, Energy and Resources sectors.

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