CARDNO
QUEENSLAND
GEOTECHNICAL SERVICES CAPABILITY
Cardno has over 70 geotechnical professionals in Australia. In Queensland, our team consists of more than 25 specialist geotechnical engineers, geologists, geotechnicians and scientists that all provide services related to ground engineering. We work closely with all disciplines including the transport, structures, bridges, environmental services and GIS teams to deliver safe, practical and sustainable solutions. Our team is involved with projects for various clients and across a broad range of sectors from the feasibility stage, detailed assessment and design, right through to construction supervision and completion reporting.

Our geotechnical design capability is broad and includes shallow and deep foundation design, ground settlement analysis, slope risk assessments and remedial design, dam and levee engineering, pavement design, soft soils engineering and ground improvement, design of retaining structures, temporary support works and much more.

Our team is versatile and conduct a variety of site work such as inspections, geotechnical investigations, geological mapping, rail and road pavement assessments, monitoring and instrumentation, groundwater and hydrogeological assessments and construction support. We also supplement our site work by conducting soil and rock laboratory testing that we manage through our network of testing facilitates.

We support clients through the whole project life cycle with expertise in the following services.
1. Project Planning

Using desktop data, Cardno can optimise geotechnical investigations to show targeted, relevant information that provide value to the project. We work in partnership with our clients, employing our depth of knowledge across disciplines to develop fit-for-purpose project geotechnical plans. We utilise industry standard GIS systems which allows us to quickly and efficiently undertake desktop studies of existing sources of data. In addition to our GIS systems we are able to draw upon countless years of experience, as well as publicly available data sources to develop ground assumptions that are tested in the field investigation phase.

2. Investigation

Cardno is experienced in the full spectrum of geotechnical investigations across all sectors, markets and project scale. We have successfully undertaken investigations for buildings, transport and industrial infrastructure projects. The investigation services we offer include:

- Field supervision and logging of borehole drilling and test pitting
- Geotechnical logging of core
- Instrumentation and monitoring of ground movement, settlement gauges, piezometers and inclinometers
- CPTu and in-situ vane shear testing
- Geological and geomorphological mapping
- Seismic refraction surveys and interpretation
- Permeability and groundwater assessment

3. Assessment

Our geotechnical service professionals strive to provide clear and concise analysis of field investigation data to enable clients to understand the implications of the ground on their project and make informed choices. We can provide professional risk-based assessment, interpretation and reporting with respect to:

- Foundation investigations for structures
- Stability of natural, excavated or constructed slopes
- Consolidation and stability of embankments and associated remedial measures

In the course of our investigations we use a number of tools: stress measurement and monitoring cells, extensometers, piezometers, point load testers, mini beam testers, meyco penetrometers, rockbolt pull testing kit, rockbolt hole gauge, instrumentation data logger, cone penetrometers (CPT) and dynamic cone penetrometers (DCP).
4. Construction Phase

By engaging with clients throughout the project life cycle, Cardno is uniquely positioned to provide constructive-stage support and effective implementation of the project geotechnical plan.

Each member of our geotechnical team has industry experience and a deep understanding of construction phase constraints and requirements.

Cardno undertakes contractor support, client-side supervision and proof engineering of all geotechnical structures, excavations and support systems. We develop and implement quality assurance programs, testing and inspection plans, hold point approvals and practicable completion inspections.

5. Analysis and Design

Cardno’s commitment to delivering full life cycle value to clients continues with the analysis of field investigation data, either collected by us or supplied by the client, and the development of clear and concise geotechnical interpretations.

Our easy-to-interpret results are tailored to the project requirements, and employ cutting edge digital data visualisation to enable quick and instinctive access to the results.

Cardno designs ground stabilisation, support systems, underground and above-ground excavations, foundations and geotechnical structures for all markets and projects. We have particular expertise in pile design, slope risk assessments and remedial design, dam and levee engineering, pavement design, soft soils engineering and ground improvement, design of retaining structures and temporary support works.

We use sound engineering judgment and experience, our understanding of the full project life cycle, together with state-of-the-art modelling and analysis tools, to develop efficient and economical design solutions for our clients.

Software Capability

- gINT
- HoleBASE
- pLog
- Geostudio (Slope/w, Seep/W, Sigma/W)
- Wallap
- Surpac
- Rocscience (RS3, Dips, Slide, RocSupport, Unwedge, RocData, Phase 2, RocFall, CPillar, RSPile)
- Allpile
- Lpile
- GRLWeap
- geotech
- CPT analysis
- Galena
- Circly
- Strater
- ArcGIS
- AutoCAD
- MapInfo
- Plaxis 2D/3D
- Drains
- Hecras
- Eonfusion
- Rorb Infoworks
- DeepExCav
- MAP3D 3D finite element analyses
Legacy Way is a 4.6km twin 12.4m diameter road tunnel with approximately 3km of surface connections to facilitate entering and exiting the tunnels.

The new roadway bypasses the Brisbane CBD to the west and connects the Western Freeway at Toowong with the Inner City Bypass at Kelvin Grove. Cardno, together with GHD and URS, formed the Design Alliance responsible for all design work throughout the project.

As part of the Design Alliance, Cardno is involved in the design of various cut and cover structures, tunnel portals, anchored bored pile retaining walls, soil nail walls, cut slopes and fill embankments. In addition, Cardno is also involved in the Moggill Road – Western Freeway upgrade involving various fill embankments and bridge abutments. Cardno’s role extends into the construction phase with several geotechnical engineers being part of the Construction Design Support Team responsible for the construction supervision.

Cardno are also heavily involved in the detailed geotechnical investigation for the project, providing deep drilling supervision, laboratory testing services, in-situ parameters for design and advice on excavatability, strength of materials, and settlement potential.
Mackay Ring Road

The Mackay Ring Road Stage 1 project consists of road construction from Stockroute Road roundabout to Bald Hill Road. Cardno are involved in the design of 52 crane and piling pads on the project, designed in accordance with BRE470. Cardno's involvement also includes ground certification for abutment structures and various temporary works packages.

Pacific Motorway Upgrade – Woolgoolga to Ballina (Portion B & C)

Portion B of the Woolgoolga to Ballina project involves the upgrade of a 29.8km section of existing highway to a four-lane dual carriageway. Cardno was the design lead for Section B3, which is 15km in length and includes a grade separate interchange, construction under live traffic, large earthworks cutting (approx. 1Mcu.m) and two rural bus stops/tumaround areas with car parking.

Cardno completed the bridge foundation geotechnical design for the 27 bridges (including 10 twin bridges) to be designed by the Arup Cardno joint venture. The bridge foundations consisted of a combination of bored piles socketed into rock, driven steel tubes and pad footings. Cardno was also responsible for the preparation of specifications for additional geotechnical investigations to be undertaken for the purpose of the detailed design.

Ipswich Motorway Upgrade – Rocklea to Darra (Stage 1)

Package 1 (Granard Road to Oxley Road) of these works is a Design & Construct (D&C) project in western Brisbane that is approximately three kilometres in length, crossing Oxley Creek plus a number of other tributaries of the Brisbane River.

This section of the Ipswich Motorway is particularly significant as it services major freight and industrial hubs including the Acacia Ridge Terminal (Queensland’s largest inter-modal terminal facility), Archerfield Airport, South East Queensland produce markets at Rocklea, and a large number of industrial/commercial operators in the predominantly industrial area.

Cardno, part of a design joint venture, is delivering all of the engineering and environmental services for the D&C project. Cardno’s geotechnical team acted as the independent verifier for the geotechnical and pavement packages.

Mt Cotton Road Upgrade (Stage 2)

Cardno was the lead designer for documentation of a Wide Centre Line Treatment to Mount Cotton Road between chainage 0.00 – 2.95km and 4.90 – 9.00km. This project covered safety improvement works at Mount Cotton Road (111) – Woodlands Drive to Mount View Road (Ch. 0.00-2.95km and 4.90-9.00km) including WCL treatment, shoulder widening, line marking, signage, intersection upgrades, drainage upgrades, review sight distance, review PUP and other related infrastructure and preparation of contract documents.

Cardno was awarded the next stage of the upgrade of Mt Cotton Road. The scope involved the detailed design for widening 7km of Mt Cotton Road between the suburbs of Mount Cotton, Carbrook and Sheldon in the Redlands Region of Brisbane. The project includes two sections of the road widening to achieve safety improvements and involved the pavement design, P90 estimate and preparation of tender documentation for the Mount Cotton Road wide centreline treatment project.
The geotechnical services team is an industry leader, and backed by our construction materials testing team — the largest of its kind in Australia. We have delivered the following projects in recent years:

**Landslip Remediation for Scenic Rim Regional Council**

Cardno are currently finalising the remediation design of 35 landslip sites within the Scenic Rim area which are funded through the Natural Disaster Relief and Recovery Arrangements (NDRRA) works. The work involves site inspections of all the landslip sites, development of a remediation solution, scoping and procurement of further investigations as required, documentation of the proposed solution and preparation of tender documents. Cardno also assisted with the geotechnical investigation, hydraulic analysis and survey of the landslip sites.

**Maleny Kenilworth Road**

Cardno completed the design of remedial works on failed cut slopes and embankments at approximately 10 sections of the Maleny-Kenilworth Road where storms in 2010/2011 caused loss of road formation due to slope failure. In many places, the failures were located in old in-filled valleys where the filling comprised uncompacted earthworks. Drainage deficiencies had a large part to play at the sites. Remediation techniques varied and included reconstructing the slopes in rockfill, micropile retention systems, gabion retaining walls, earthworks re-profiling or road realignment.

**Dalrymple Bay Dams**

Cardno was engaged by Dalrymple Bay Coal Terminal to undertake the detailed design of the Rail Loop Dam and the raising of Quarry Dam. Both dams serve as detention of runoff from the coal terminal.

Rail Loop Dam is located within an existing rail loop. The dam embankment is approximately 9m high. The dam footprint contains two existing dams; Domestic Dam and Rail Receival Dam.

The existing Quarry Dam was built circa 1992 and consisted of a narrow clay core with miscellaneous fill shoulders. The existing dam is known to leak. The proposed works involved raising the dam crest by 5m and a reduction in the dam leakage.

Cardno’s geotechnical and dam engineers were responsible for the geotechnical investigation of dam area, review and back analysis of the existing Quarry Dam to simulate measured leakage, seepage and stability modelling of the proposed dam structures, assessment of site materials for use in dam embankments, preparation of project specifications, in particular earth fill material required for the dam structure, construction supervision and materials testing and assistance with regulatory approvals.
Gladstone Area Water Board (GAWB) Offline Storage

The GAWB Offline Storage structure is a 20m high earthfill dam structure with concrete lined spillway capable of supplying raw water to Gladstone town water and industrial customers for a period of two weeks in the event of a failure of critical infrastructure at Awoonga Dam; the normal raw water source.

Cardno were the primary engineers responsible for the entire life-cycle of the project from the investigation stage (including geotechnical and borrow material investigation), concept development, preliminary design, detailed design and documentation and construction supervision. In particular, Cardno’s geotechnical team were responsible for seepage and stability modelling of the dam structure, slope stability analysis of rock cuttings at the spillway, preparation of project specifications and construction inspections.

Gold Coast Rapid Transit

The 13km light rail corridor connects Gold Coast University Hospital (GCUH) and Griffith University with Broadbeach via Southport and Surfers Paradise.

Cardno provided geotechnical support services for temporary work certification of bored pile and driven pile inspections for various bridges, viaducts and structures. Cardno also provided construction material testing services and trench inspections for various sections of the project. In addition, Cardno was involved in the design of various permanent and temporary structures.

Port of Airlie Development

Since project initiation, Cardno provided a range of services including geotechnical investigation, acid sulfate soils investigation, soil contamination investigation, and civil and structural design for the Port of Airlie Marina Development, Airlie Beach. The project comprised 17ha of reclamation, 1.25km of sheet pile revetment, 1.5km of rock revetment, and involved over 1 million m³ of excavation by both dredge and conventional equipment.

The development includes a 240 berth marina, passenger ferry terminal, hotel, residential component and retail precinct. Cardno were responsible for planning and managing the investigation in a soft marine environment and assigning the appropriate laboratory testing for derivation of appropriate geotechnical design parameters for settlement analysis.

FSNON Wharf

As part of the Facilities to Support Naval Operations in the North (FSNON) project at HMAS Coonawarra, Darwin for the Australian Defence Force, Cardno were commissioned to undertake geotechnical investigation and design of the FSNON wharf and hardstand. The geotechnical investigation involves both onshore and offshore drilling. The geotechnical design involved various elements including slope stability of the proposed hardstand, settlement analysis, wharf pile design, and sheet pile revetment wall design.

Tiger Brennan Drive Duplication (TBD)

The Tiger Brennan Drive duplication project extends from Woolner Road near Darwin CBD to Berrimah Road and is intended to ease traffic congestion for vehicles travelling between Darwin and Palmerston. The project was jointly funded by the Australian and Northern Territory Governments under the Nation Building 2 Program. The project involved the widening of about 9km of existing carriageway, rehabilitation of the existing pavement and a new bridge at Hidden Valley Road.
As part of the project, Cardno’s geotechnical engineers scoped and coordinated the geotechnical investigation and Falling Weight Deflectometer (FWD) testing, calculated design traffic volumes (ESA’s) for the project and undertook pavement design of the widened highway in accordance with Austroads and DoT standards. Cardno also undertook an analysis of FWD data and the design of pavement rehabilitation of the existing road.

Business Cases and Planning Studies
Cardno has been involved in various business cases and planning studies, most notably the Brisbane Road, Ipswich Planning Study and the Moggill Pocket Arterial Corridor. Cardno’s geotechnical engineers were responsible for the desktop investigations of the various options and providing recommendations on the most suitable route from a geotechnical perspective.

City of Gold Coast Review of Pavement Design Standards
In 2016 the City of Gold Coast (CoGC) City Planning initiated a review of their Land development guidelines (LDG). Cardno was commissioned to benchmark CoGC’s pavement design standards released as part of the City Plan against other Councils in South East Queensland. Based on the review, CoGC deemed the City Plan to be ‘anti-competitive’ and costlier in comparison to other local jurisdictions, largely due to the significantly higher design traffic values adopted in the City Plan.

In 2017, CoGC resolved to revert back to the pavement design standards from the previous LDG (Gold Coast Planning Scheme version 1.1 (2005) – Land development guidelines). To achieve this, Cardno were engaged to provide assistance in developing the pavement design standards, based on the previous LDG, suitable for the current draft LDG.
About Cardno
Cardno is a professional infrastructure and environmental services company, with expertise in the development and improvement of physical and social infrastructure for communities around the world. Cardno's team includes leading professionals who plan, design, manage and deliver sustainable projects and community programs. Cardno is an international company listed on the Australian Securities Exchange [ASX:CDD].

Health and Safety
Cardno’s “Zero Harm – Every Job, Every Day” safety program fosters an environment of clear accountability, shared responsibility, risk awareness and effective communication. Our program underpins all operations and is responsive to the needs of our clients. We are focussed on continually improving our safety culture and the management systems that reinforce our commitment to zero harm. Cardno operates an occupational health and safety management system that has been certified to AS4801 and OHSAS18001.

Quality Assurance
Cardno has developed and maintains a third party certified quality management system (QMS), which is certified to ISO9001. The QMS is applied all projects to achieve quality and consistency throughout the length of the project. Through managing efficient quality practises we demonstrate our commitment to providing excellence in service delivery, through maintaining various document management, audit and continuous improvement processes.

Environmental Management System
Cardno operates an Environmental Management System which complies with the requirements of ISO 14001:2004 for the provision of professional and management consultancy services. This certification covers investigation, environmental testing, research, planning, design, management and implementation services for a broad range of physical infrastructure and environmental projects.