Cardno has extensive experience in the design of flexible and rigid pavements in accordance with VicRoads, Austroads and RMS Code of Practice. Many of our designs have been reviewed and approved by VicRoads’ Geopave technical group.

Cardno has developed an extensive portfolio of flexible pavement investigations and designs ranging from large scale residential subdivisions, to arterials and collectors for Councils and VicRoads to heavy duty freeway pavements.

We have also produced designs for concrete pavements, including heavy industrial pavements subjected to variably loaded vehicles, and understand the importance of having accurate vehicular load information when designing rigid pavements.

Cardno has also been involved in the investigation and rehabilitation of existing asphalt pavements at numerous locations within Melbourne and across Victoria. These projects generally involved Falling Weight Deflectometer (FWD) testing, an intrusive investigation of the existing pavement, in-situ and laboratory testing and then the design of the remediation options. The design options consider issues such as remaining design life, reuse of existing materials and the cost of remediation versus full reconstruction.

New Pavements
- Due diligence assessments for new developments
- Subgrade assessment including geotechnical drilling of boreholes
- Laboratory testing in NATA accredited soils laboratory
- Design of flexible and rigid pavements ranging from residential, to commercial and industrial, to ports and airports, to heavy duty arterials and freeways
- Pavement design optimization using CIRCLY and HIPAVE
- Construction advice, inspection and testing
- Large scale laboratory testing through Cardno’s Construction Sciences Division

Pavement Rehabilitation
- Pavement condition assessments including surface defects, intrusive investigations and pavement life assessments
- Falling Weight Deflectometer testing
- Back calculation of pavement layer strength using Rubicon and ELMOD
- Design of rehabilitation solutions including overlays, stabilization and full reconstruction
- Forensic pavement assessment for expert witness testimony
Geotechnical Investigation
> Geotechnical investigations for road associated infrastructure such as bridges, culverts, embankments, water storages and pipelines
> Specialist in-house NATA accredited soils laboratory
> Geotechnical analysis including foundation solutions, pile design, slope stability, seepage and settlement

Environmental Contamination and Acid Sulfate Soils
> Contaminated land, vapour, groundwater investigation and management
> Remediation of contamination
> Environmental remediation design, supervision and validation
> Hazardous material assessment and management

Traffic Management and Transport Planning
> Road safety audits
> Car park design & audits
> Traffic impact studies
> Site accessibility studies
> Traffic modelling and analysis
> Pedestrian access

Surveying
> Engineering surveying and dimensional control
> Geographic information systems and mapping
> Global positioning systems (GPS)
> Laser and high-definition scanning
> Computer-aided design and drafting (CADD)

Subsurface Utility Engineering
> Ground penetrating radar
> Pipe and cable location
> Vacuum excavation
> Pavement coring

Civil Engineering
> Civil design & commercial site works
> Feasibility investigations
> Survey services
> Land development
Key Projects

### Gunns Gully Road Overpass
Kalkallo, Victoria

Cardno was engaged to conduct a geotechnical investigation for the proposed Hume Highway Bridge overpass for Gunns Gully Road in Kalkallo. The overpass will provide access to the future Lockerbie housing estate that will be constructed to the east of the Hume Highway. The construction of the overpass includes a triple span bridge and associated access ramps. The spill through bridge abutments are to be supported on bored piers. A total of six access ramps each with a length in the order of 600m are to be built by importing fill to the site.

The investigations were conducted in accordance with VicRoads requirements which included conducting testpits at 100m intervals along the alignment of the embankments as well as boreholes at 7m intervals across the width of the piers and abutments. Geotechnical analysis included settlement and slope stability analysis for the embankments, rock socket analysis for the piles and mechanistic pavement analysis.

### Pavement Rehabilitation and Design – various roads within Mornington Peninsula and Yarra Ranges
Victoria

Cardno is prequalified with VicRoads in several categories under the geotechnical group including Advanced Pavement Design (ND1, ND2 & ND3), Intermediate Rehabilitation Design (RM1, RM2 & RM3), Field Investigation, and Laboratory Testing (PT1 & PT2) as well as Geotechnical Services (GT-DES, GT-GWH & GT-INV).

Under this prequalification Cardno has conducted a number of investigations for the rehabilitation of a number of sections of VicRoads roads within the Yarra Ranges and Mornington Peninsula.

The first phase of these investigations was to conduct a visual assessment as well as Falling Weight Deflectometer Testing to assess the existing condition of the roads. This testing was used to allow a preliminary assessment of the remaining design life of the pavements as well as to target an intrusive investigation.

The next phase of the assessment was to conduct pavement dippings at regular intervals supported by a suite of laboratory testing. This phase allowed an assessment of the suitability of the existing pavement materials for reuse as well as an assessment of the pavement subgrade.

The final phase of the assessment was to use the previously collected data to back calculate the strength parameters of the existing pavement and the prepare options for the rehabilitation of the pavements including asphalt overlays, in-situ stabilization and full-depth reconstruction.
Container Storage Facility
Laverton North, Victoria

The proposed container storage facility in Laverton North will be used for the storage of shipping containers stacked up to 7 high. It is proposed that the facility will utilize a crushed rock hard stand both to support the containers and also for the vehicular traffic. Traffic utilizing the facility will include a combination of semi trailers and B-doubles bringing in the containers at the entrance to the facility. A majority of the traffic within the facility will consist of large container forklifts. In order to appropriately design the hard stand it was necessary to design for both the traffic and also for bearing capacity beneath the containers.

The analysis software HIPAVE was used to assess the traffic loads in various configurations including with the forklifts travelling and also with the forklifts lifting at full height.

Residential Estate
Craigieburn, Victoria

Cardno has been involved in the ongoing development of a large residential subdivision in Craigieburn since 2003. As part of these works Cardno has conducted geotechnical investigation for the pavements as well as other infrastructure such as wetlands and bridges.

The pavement investigations have included investigations for new pavements ranging from lightly trafficked local access roads up to heavy duty arterials. These investigations included boreholes at regular spacings along the pavement alignments and a suite of laboratory testing.

In addition, the investigations have included assessments of existing local Council roads with regard to their suitability for upgrade for the new traffic. These investigations included pavement dippings, Falling Weight Deflectometer testing, laboratory testing and design of pavement overlays.
Key Projects

**Tug Facility**
Port Melbourne, Victoria

The facility at the Port of Melbourne is a facility near the mouth of the Yarra River for berthing of the tugs. The facility includes a pier as well as a number of maintenance and office facilities and access pavements. Cardno conducted the geotechnical investigations for the pier and for the access pavements.

Several different pavements were designed for the facility including a deep asphalt pavements, thin asphalt granular pavements, spray seal granular pavements and rigid pavements.

---

**Mt Ridley Road**
Craigieburn, Victoria

Cardno was engaged in undertaking a pavement investigation including a geotechnical investigation, a condition survey and deflection testing of the Mt Ridley Road, Craigieburn. The section length investigated was approximately 3km. The geotechnical investigation included the excavation on 22 testpits through the existing pavement.

Based on the results of the site observations, geotechnical and pavement deflection testing, pavement designs were provided including re-sheeting and totally new construction options utilising a deep strength asphalt pavement.

---

**Pavement Rehabilitation Project**
Bundoora, Victoria

Cardno was engaged to undertake a pavement investigation to determine the requirements for upgrading of several of the pavements for a private client in Bundoora. The investigations included pavement dippings, a condition survey and deflection testing of two roads within the site.

The two roads under investigation had a combined length of 900m. The geotechnical investigation included the excavation on 7 testpits through the existing pavement across the site.
Cardno’s pavement team acted as the lead for the pavement design of one of the shortlisted tenders for the Western Distributor. The Western Distributor project, now the West Gate Tunnel project, involves a number of different pavements including:

Upgrading of 6km of freeway pavements between the Western Ring Road and West Gate Bridge. These pavements had the requirement for reuse and recycling as much of the existing pavement as possible while also being subjected to extremely reactive soils and significant settlement of the existing road embankments. These pavements were typically deep asphalt pavements utilizing heavy duty asphalt and an OGA wearing course.

**Tunnel pavements:** These were designed as rigid CRCP pavements constructed on the tunnel backfill. Options were provided including either a SMAH wearing course or Low Noise Diamond Grinding of the concrete surface.

**Intersection pavements:** New pavements were required at each of the intersections for the entrance/entry ramps along the alignment. Designs were provided for reconstruction of these pavements but advice was also given for the rehabilitation of these pavements.

**Port pavement:** The port pavement was a very heavy duty pavement with the purpose of trafficking highly loaded vehicles around the perimeter of the port. This pavement was to be subjects to traffic in the order of 3 x 10^9 ESAs. Two solutions were provided including a deep asphalt pavement and a rigid pavement.
Cardno’s Commitment to Zero Harm

Safety is a core value at Cardno and our Zero Harm 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.

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).