<table>
<thead>
<tr>
<th>Location</th>
<th>Address</th>
<th>Phone</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auckland</td>
<td>18 Gabador Place, Mt Wellington</td>
<td>09 573 0690</td>
<td><a href="http://www.briangerrycivil.co.nz">www.briangerrycivil.co.nz</a></td>
</tr>
<tr>
<td>Hamilton</td>
<td>25 Vickery St, Te Rapa, Hamilton 3200</td>
<td>07 849 2879</td>
<td></td>
</tr>
<tr>
<td>Wellington</td>
<td>35 Takapu Road, Wellington 5028</td>
<td>04 232 9442</td>
<td></td>
</tr>
</tbody>
</table>
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Why Choose Brian Perry Civil?

Breadth of Capability

Brian Perry Civil is New Zealand’s leading foundation engineering contractor with a reputation for performance, innovation and quality in demanding and high risk jobs.

Our workforce is highly trained, committed and has a range of practical skills backed with experience.

A strong team of experienced professionals provide technical support and management skills.

Strong relationships with New Zealand’s leading geotechnical consultants adds to our technical capability.

Specialised plant provides versatility and we lead the industry with our range of cranes, piling equipment and marine plant.

We are committed to safe work places, employee health and protection of the environment. We are certified to the ISO 9001 quality standard.
Alternatives and Innovation

Our experienced and professional staff are always on the lookout for a better or smarter way of doing things.

We are regularly approached at the feasibility or design stages of a project to assist with technical solutions and innovative methods for demanding foundation applications.

Unrivalled Experience

Brian Perry Civil has been a significant player in the NZ piling market since 1973, with experience evolving from temporary shoring of deep pipeline excavations.

Piling applications include foundations and retention works for high rise buildings, heavy industrial plant, bridging and marine structures, pump stations and pipelines.

We have encountered a wide range of ground conditions ranging from deep alluvial gravels and silts to the complex geology of Auckland’s volcanic region.

We have worked throughout New Zealand and the South Pacific.
Performance

Strategic Alliance and Joint Venture

If we don’t have the experience in house, we team up with those who do.

Some of our most successful projects have been joint ventures with specialist overseas experts where we provide the local knowledge and resources.

Certainty of Delivery

Our design / build piling and foundation service including ground investigation, is offered in conjunction with specialist geotechnical and structural consultants.

We operate in a team environment, either as a team leader or team member.

We work successfully in any contractual arrangement, be it competitively bid, main contract, subcontract, negotiated, alliancing, design / build, guaranteed maximum price, fast track or turnkey.

Our success in competitive tendering demonstrates our cost effectiveness.

Track Record

Our track record in the construction industry for innovation, performance and certainty of delivery is unrivalled.

This has been recognised with the company receiving multiple New Zealand Contractors Federation awards over the years.

Ownership

Ownership by The Fletcher Construction Company Ltd provides additional certainty to performance through strength in resources, financial backing and management.
## Deep Foundation System Options

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Bored Piles</th>
<th>CFA Bored Piles</th>
<th>Driven H Piles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pile drilled / soil removed and replaced with reinforced concrete</td>
<td>Auger drilled into ground and replaced with concrete as the auger is removed</td>
<td>Steel section driven into the ground</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Design</th>
<th>Bored Piles</th>
<th>CFA Bored Piles</th>
<th>Driven H Piles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect on adjacent ground</td>
<td>No displacement of the soil but the potential for relaxation / softening adjacent ground, dependant upon the soil and bore support used</td>
<td>Typically no displacement with good construction controls Localised densification of loose non-cohesive soils.</td>
<td>Small cross sectional area and hence minimal soil displacement or potential improvement</td>
</tr>
<tr>
<td>Typical size ranges</td>
<td>600–2500mm diameter</td>
<td>450 – 750 mm diameter</td>
<td>150 – 350 UCs, UBPs</td>
</tr>
<tr>
<td>Capacity</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>- Shaft friction</td>
<td>Very high with enlarged base</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>- Structural</td>
<td>Very high structural capacity and stiffness achievable</td>
<td>Cage insertion can limit tensile and flexural capacity at depth</td>
<td>Driving stresses often govern the steel section required</td>
</tr>
<tr>
<td>Durability</td>
<td>Conventional concrete in the ground design Permanent liner in highly aggressive conditions</td>
<td>Conventional concrete in the ground design</td>
<td>Sacrificial thickness of steel above low ground water level</td>
</tr>
<tr>
<td>Typical / Plant</td>
<td>Hydraulic or crane mounted piling rig, handling crane, casing, vibro with powerpack and / or drilling support fluid plant</td>
<td>Hydraulic piling rig, concrete pump and possible handling crane</td>
<td>Crane, vibro hammer or hydraulic hammer with powerpack or drop hammer and leaders or guide frame</td>
</tr>
<tr>
<td>Construction</td>
<td>Concrete, reinforcement cages and method dependant material</td>
<td>Concrete and reinforcement cages</td>
<td>Steel sections</td>
</tr>
<tr>
<td>Material to Plant</td>
<td>Casing and cage lay down area</td>
<td>Cage lay down area</td>
<td>H pile lay down area</td>
</tr>
<tr>
<td>Materials storage</td>
<td>Machine only unless driven casing</td>
<td>Machine only</td>
<td>Yes, if vibro used hammer used to obtain pile set</td>
</tr>
<tr>
<td>Noise</td>
<td>No, unless driven casing used</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Vibration</td>
<td>100% Nett volume</td>
<td>100% Nett volume</td>
<td>None</td>
</tr>
<tr>
<td>Spoil</td>
<td>Plunged columns can be placed into the top of the pile to structural positional tolerances</td>
<td>Fast installation process with real time monitoring systems for construction control and records</td>
<td>Full strength welded splice used at connections Pre-drilling can be used to overcome obstructions</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methodology</td>
<td>Driven Tubes Piles</td>
<td>Precast Concrete Piles</td>
<td>Vibroreplacement</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------</td>
<td>-----------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Effect on adjacent ground</td>
<td>Large displacement of plugged tubes resulting in densification of non-cohesive soils and enhanced capacity.</td>
<td>Large displacement resulting in densification of non-cohesive soils and enhanced capacity.</td>
<td>Large displacement with densification of non-cohesive soils surrounding the stone column which enhances the capacity.</td>
</tr>
<tr>
<td>Typical size ranges</td>
<td>350 – 750 mm diameter</td>
<td>250 – 600 mm square</td>
<td>600 – 1200 mm diameter</td>
</tr>
<tr>
<td>Capacity</td>
<td>- Shaft friction Medium</td>
<td>- End bearing Very high</td>
<td>- Structural Lifting, driving and jointing can limit capacity</td>
</tr>
<tr>
<td></td>
<td>- Structural Tubes can be reinforced concrete filled to enhance capacity</td>
<td>Conventional concrete in the ground design</td>
<td>Conventional concrete in the ground design</td>
</tr>
<tr>
<td>Durability</td>
<td>Sacrificial thickness of steel and internal reinforced concrete</td>
<td>Review potential corrosion at joints</td>
<td>Weathering / degradation of stone typically not an issue</td>
</tr>
<tr>
<td>Typical / Plant</td>
<td>Crane, vibro hammer or hydraulic hammer with powerpack or drop hammer, leaders or guide frame</td>
<td>Crane, hydraulic hammer with powerpack or drop hammer, leaders or guide frame</td>
<td>Crane, vibro probe with power pack, water pumps, compressor and front loader</td>
</tr>
<tr>
<td>Material to Plant</td>
<td>Steel tubes, reinforcement cages and concrete</td>
<td>Precast concrete piles unless manufactured on site</td>
<td>Stone stockpiles</td>
</tr>
<tr>
<td>Materials storage</td>
<td>Tube and cage lay down area</td>
<td>Precast pile lay down / curing area</td>
<td>Stone</td>
</tr>
<tr>
<td>Noise</td>
<td>Yes if top driven but limited if bottom driven</td>
<td>Yes</td>
<td>Machine only</td>
</tr>
<tr>
<td>Vibration</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Spoil</td>
<td>None, but ground heave possible</td>
<td>None, but ground heave possible</td>
<td>20% – 100% Nett volume</td>
</tr>
<tr>
<td>Other</td>
<td>Predrilling can be used to overcome obstructions Enlarged bases can be formed to enhance capacity</td>
<td>Variable pile founding depth can lead to high wastage levels and jointing expensive</td>
<td>Top feed “Wet” process requires water circulation system and settlement ponds to contain silts</td>
</tr>
</tbody>
</table>
Bored Piles

Application

Bored piles are non-displacement piles commonly used in high capacity applications.

They are mainly used where large vertical loads, seismic loads or bending moments must be carried by a single unit and/or when extremely tough (rock) and abrasive ground is prevalent.

The large diameters available combined with heavy steel reinforcing cages provide high structural strength. Larger capacity bored piles founded in rock can minimise settlement and often provide an economical solution over other pile types.

Bored piles can be installed with little or no vibration and with much lower noise levels than driven piles.

Bored pile types offered by Brian Perry Civil include:

- Concrete shafts
- Caissons
- Contiguous piles
- Secant piles
- Continuous Flight Auger piles (CFA)
- Screwed piles courtesy of Piletech

Shaft Support

Shaft support methods depend on ground conditions, the ground water regime and site environmental constraints, they include:

- Drilled, vibrated or screwed temporary casing
- Permanent casing
- Bentonite or Polymer fluids

Belling

Belling techniques in suitable ground can prove economical to take advantage of high end bearing resistance.

We have formed bells up to 3600mm in diameter with mechanical belling tools.

Grooving

Additional skin friction resistance in bored piles can be achieved by spiral grooving the socket length using a reaming tool.

Plunged Columns

Structural steel sections or precast concrete columns can be placed accurately into piles to facilitate superstructure construction.

Drill Rigs

Brian Perry Civil’s fleet includes:

- Hydraulic rotary drill rigs of differing sizes offering high production rates in the toughest of conditions including low headroom, high torque units.
- Crane mount drill rigs allowing the crane to be used in both piling and handling modes.

Tools and Attachments

Purpose-designed tooling for removing soil and rock, adapted for the toughest New Zealand conditions include:

- Drill buckets
- Soil and rock augers
- Core barrels
- Down-hole hammer drills
- Rock chisels
Waihi Shafts, Waihi – Two x 2.5m diameter x 85m deep shafts

Central Motorway Junction, Auckland – Installing retaining wall piles under viaduct
Continuous Flight Auger (CFA) Piles

For use as an alternative to cased bored piles up to 750mm diameter. Fast efficient method of construction in unstable soils.

Set up on a pile position and commence drilling

Drill to pre-determined pile of founding level

Pressurise concrete system and blow bung to commence concreting

Concrete pile to ground level / piling platform

Clean pile head and plunge reinforcement cage into fluid concrete
Piles excavated using Benonite / Polymer

For use in unstable soils where long casings would be necessary. Enable the construction of large diameter piles without permanent casing.

1. Set up on a pile position and install a short temporary casing
2. Excavate the pile bore to founding depth maintaining the support fluid level
3. Clean or exchange the support fluid and install the reinforcement cage
4. Place the high slump concrete using tremie methods
5. Remove the temporary casing
Bentonite Equipment
## Bored Pile Construction Methodology Options

<table>
<thead>
<tr>
<th>Bore state</th>
<th>Excavation</th>
<th>Bore support</th>
<th>Concrete placement</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable - dry</td>
<td>Auger</td>
<td>Short collar</td>
<td>Guided freefall</td>
<td>Camera inspection possible</td>
</tr>
<tr>
<td>Stable - wet</td>
<td>Auger / bucket</td>
<td>Short collar</td>
<td>Tremie pipe</td>
<td>Pumping from the pile bore can result in stability and concrete integrity problems.</td>
</tr>
<tr>
<td>Unstable - wet or dry</td>
<td>Auger / bucket / wet auger</td>
<td>Permanent</td>
<td>Tremie pipe</td>
<td>Installation of long casings can be problematic to install and remove (capability, noise, vibration).</td>
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<tr>
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<td>Auger / bucket / wet auger</td>
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<td>Cost of permanent casing is high but the integrity ensured. Care required removing long casings in difficult ground.</td>
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</tr>
</tbody>
</table>

### Construction Options

- **Auger / bucket**
- **Guided freefall**
- **Tremie pipe**
- **Bentonite**
- **Polymers**
- **CFA Auger Piling**
- **Spoil on the auger string**
- **Hollow stem auger**

### Standard Pile Diameters

- 450
- 600
- 750
- 900
- 1050
- 1200
- 1500
- 1800
- 2100
- 2400

### Comments

- Good control and monitoring of the process is required. Cage insertion into the concrete can restrict depth achievable.
Driven Piles

Application

Driven piles take many forms. Selection is determined by location and type of structure, column loads, ground conditions, environmental considerations and material durability.

Brian Perry Civil has experience in all forms including:

Displacement Piles
- Timber piles
- Steel H piles
- Precast concrete piles
- Steel tubes – top and bottom driven
- Raked or vertical

Driven cast-in-place piles
- Vibroset piles

Sheet Piles
- For marine and land-based retaining structures

Piling Hammers

Our extensive piling hammer range includes:

Impact hammers
Used to fully drive or finish displacement piles in a range of conditions and to drive sheet piles in hard ground.

We offer accelerated hydraulic hammers with the advantages of high capacity, production and efficiency plus a range of traditional drop hammers.

Vibro hammers
Used to advance displacement piles (steel tubes and H sections) in good ground and to drive and withdraw steel casings and sheet piles.

We offer modern hydraulic and electric units with variable frequency to minimise noise and vibration in built-up areas.
Vibro Hammer Selection

Amplitude

Amplitude is a function of the eccentric moment of the hammer divided by the suspended mass (hammer plus pile).

For the pile to penetrate the ground, the vibro hammer must create sufficient amplitude to exceed the elastic range of the soil.

Generally the more cohesive the soil the greater the amplitude required to achieve penetration.

A pile in granular soil is easier to drive than one in clay because typically the adhesion on the pile to the soil is less.

As a rule of thumb use:
- 4mm – minimum for non-cohesive soils
- 6mm – for average soils
- 8–10mm – for highly cohesive soils

Frequency

The higher the frequency the lower the vibration effects on the surrounding structures but the lower the productive capacity of the hammer.

1600 rpm is considered to be a good compromise. Variable frequency units allow the frequency to be adjusted to minimise noise and vibration in built-up areas.

Power

The available power places limits on what eccentric moment can be driven at the desired frequency.

If the power is too low the vibro hammer will not be able to overcome the skin friction between the soil and the pile and the pile will no longer move.
Bottom-driven steel tubes

For use when ground conditions are suited to driven piles but noise is a concern. Thinner section casing can be used because of lower driving stresses than for top-driven tubes.

- Pitch steel tube and form driving plug with drop hammer
- Drive tube with Internal Drop Hammer (maintaining plug)
- Perform Pile Set / PDA to confirm pile capacity is achieved
- Place reinforcement cage inside casing
- Pour concrete
Vibro-set Piles

For use as an alternative to precast piles or bored piles in soft grounds. Economic when vibrating a tube is faster than drilling and casing.

1. Pitch steel tube with sacrificial shoe
2. Vibrate tube to depth (displacing soil)
3. Place reinforcement cage inside casing
4. Pour Concrete
5. Remove casing with Vibro
Middleton Road, Wellington – Stabilisation using Sheet Piles

Rewa Bridge, Fiji – Bottom driven steel tubes up to 50m long
Fergusson Wharf, Auckland – Raking H Piles to support crane rails

Huntly Power Station Cooling Tower, Huntly – Pre Drilled H Piles
Pile Testing

Application

Pile testing is an important technique to provide assurance of pile capacity and integrity. It is especially important for cases when:

- Loads are large or critical
- Ground conditions are marginal or difficult to assess

Structural codes now provide an economic incentive to prove the capacity of piles by allowing a lower design safety factor.

Pile testing offered by Brian Perry Civil include:

Pile Load Testing
- Calculations using the Hiley formula
- PDA (Pile Driving Analyser), a proprietary dynamic testing system, including Grlweap wave analysis software
- Traditional static load testing using kentledge or reaction anchors
- Osterberg cell

Pile Integrity Testing
- Cross Hole Sonic Logging (CSL)
- Pile Echo tester (PET)

Hiley Formula
The Hiley formula assumes the energy of the falling hammer during pile driving is proportional to the energy resisted by the pile. It was intended to be applied to cohesionless, well drained soils or rock.

The method is widely considered to be one of the better formulae of its type but comparisons indicate significant differences are possible from the results of a static load test.

The low cost and ease of application means that the load capacity of all piles can be assessed. Ideally the results should be calibrated against PDA or static load test.

PDA (Pile Driving Analyser)
The PDA method is becoming increasingly popular due to its low cost and rapid results.

It derives pile resistance from hammer energy but takes better account of elastic compression effects, shaft friction and associated damping.

Comparisons with static load tests indicate significant improvement in accuracy compared to the Hiley Formula.
Static Load Testing

Static load testing involves the direct measurement of pile head displacement in response to a physically applied test load. It remains the most accurate method of determining long term load capacity of a pile.

Static load testing also allows the most complete assessment of load versus settlement characteristics, in particular time-related effects.

Testing may be carried out for the following load configurations:

- Compression
- Lateral
- Tension (uplift)

The load is most commonly applied via a jack acting against a dead weight (kentledge) or a reaction beam restrained by an anchorage system.

Osterberg Cell

The Osterberg Cell is a hydraulically-driven, high capacity, sacrificial loading device installed into the pile during construction.

This negates the need for overhead structural beams and tie-down piles required for a static load test.

The cell works in two directions, upward against side shear and downward against end bearing thus allowing these parameters to be accurately and separately determined.

Cross-hole Sonic Logging (CSL)

This determines the quality of the concrete of deep foundations. PVC or steel tubes are installed within the pile during construction.

During the test a transmitter is lowered down one of the tubes and sends a high frequency signal to a receiver inserted in another tube.

Transmitter and receiver move down each pair of tubes scanning the entire length of shaft. Software analyses the results to produce an image of the shaft showing imperfections.

Pile Echo Tester (PET)

The top of the pile is tapped with a lightweight plastic hammer and the reflected sonic wave is recorded by a computer to determine both length and continuity of the pile. The method has limitations and must be used carefully.

Pile Integrity Testing

There are a number of systems available to test and evaluate the soundness of the constructed shaft.

Avalon Drive, Hamilton – 710 diameter tubes PDA testing, results and analysis
Pressure Grouting

Application

Pressure grouting is a widely used technique to:

- Seal cavities in retaining and cut-off walls
- Increase ground resistance in anchor and tie-back systems
- Improve pile performance

Ground Anchors Grouting

The capacity of ground anchorage systems is determined by the size of tendon, surrounding ground conditions and grouting technique. The grouting techniques include:

- Tremie grouting
  - Rock and stiff ground
  - Resistance to withdrawal dependent on side shear at ground / ground interface

- Injection grouting
  - Course granular materials and fissured rock
  - Effective diameter is increased by injecting the grout into the pores and natural fractures of the ground.

- Post grouting
  - Cohesive or Cohesionless soil
  - Grout pipes are installed in the bond length
  - High pressure grouting compacts the surrounding soil increasing the anchorage capacity.

Tube à Manchette Grouting

This technique has been used by Brian Perry Civil to arrest settlement of sinking piles and heavy foundations in situations where ground has behaved unexpectedly.

It has been used successfully in a number of bridge applications where settlement was becoming critical.

The technique involves enhancing ground at various points immediately adjacent to the pile by controlled grouting using the tube à manchettes.

This can be applied to existing piles to improve performance or during the design of piles to optimise performance.

Design of the tube and grout pressures are critical. The procedure requires repeated application over many days to continually improve the ground conditions to their optimum parameters.
Tauranga Harbour Link – Bored pile base grouted using Tube manchettes
Ground Improvement

Application

Brian Perry Civil’s ground improvement techniques can be used under a variety of structures to:

• Increase ground bearing capacity
• Control settlement
• Reduce lateral earth pressures
• Avoid liquefaction
• Accelerate consolidation
• Improve slope stability

Brian Perry Civil has experience in techniques including:

• Vibrocompaction (wet or dry)
• Vibroreplacement
• Dynamic compaction
• Vertical wick drains
• Lime cement columns
• Grouting

Cohesionless Soils

The engineering properties of a granular soil (compressibility, shear strength, and permeability) are all dependent on the state of compaction or relative density of the soil.

High relative density leads to increased bearing pressures, low total and differential settlements, and high resistance to liquefaction in seismic regions.

Vibrocompaction

Vibrocompaction uses the action of a special vibrator (usually accompanied by water jetting), to densify cohesionless soil particles.

Dynamic Compaction

This method of ground improvement uses a heavy weight (5 to 20 tonne) repeatedly dropped in free fall from 2m to 30m on to the ground to be compacted.

The shock waves and high ground stresses produced by impact result in:

• compression of air voids in the soil
• partial liquefaction and creation of drainage paths
• generation of excess water pressures which cause consolidation of fine grained soils

The method is well suited to compaction of near surface soils with large air voids such as refuse dumps or poorly filled ground.

Guide to Vibrocompaction and Vibroreplacement potential based upon soil particle size.
Vibrocompaction Process

Vibration and air / water jets directed downwards at the tip facilitate probe penetration. Jets turned off as required depth of compaction is reached.

Side and upper jets are switched on to promote the flow of material towards the probe and commence compaction. The probe is lifted once the predetermined criterion is achieved.

The probe is raised in 0.5m increments over the full depth to be treated. The compaction causes localised craters so the working platform needs re-levelling.

Pegasus Town, Christchurch – Vibrocompaction for liquification and lateral spreading control
Cohesive to Cohesionless Soils

Vibroreplacement / Stone Columns (wet or dry)
In this process soil improvement of sensitive soft clays, sands and silts is achieved by reinforcing weak soils with densely compacted granular columns.

A vibrator is used to penetrate and displace the soil and to compact the clean inert stone in stages to form a dense column.

Jetting water is often used to assist the penetration of the vibro head.

The surrounding soil confines the granular columns and allows the columns to develop a higher bearing pressure, this is relative to the surrounding ground.

The stone columns and the surrounding soils form an integrated system with low compressibility and improved bearing capacity.

Cohesive Soils

Dewatering using Wick Drains
Wick drains are used to improve the rate of consolidation of low permeability soils by reducing the length of drainage paths within the soil.

Prefabricated wicks are inserted vertically into the ground by a purpose-built rig. Pattern and depth are determined by the consolidation properties of the soil and the desired time for consolidation to occur.

Soil Mixing
Soft clays and silts can be stabilised by mixing the clay with unslaked lime or other cement materials. The resulting stabilised soil has the consistency of stiff to hard clay with lower compressibility and higher permeability than the unstabilised soil.

The net effect is a reduction in total and differential settlements under structural loads and an increase in the rate of this settlement because the increased permeability allows the columns to act as drains and dissipate pore water pressures.
Vibroreplacement Process

Probe penetrates weak soils under action of vibration and jetting which forms a hole to design depth.

After being held at depth for a short time, the probe is withdrawn and a charge of stone is placed into the hole.

The probe is reintroduced into the hole, the stone is forced out into the ground and compacted.

By adding successive charges of stone and compacting each one, a column of dense stone is built up to ground level.

Centreport, Wellington - Stone columns for lateral spreading
Mokai Geothermal Station, Taupo
- Stone Column foundations

Kings Wharf, Fiji - Jet grouting and barrettes for wharf rehabilitation
Delivered in conjunction with the Fletcher Construction South Pacific Division

The Gate, Auckland
- Dynamic compaction to consolidate landfill
Pegasus Town, Christchurch – Vibrocompaction for liquifaction and lateral spreading control

Northern Busway, Auckland – Wick drains for embankment construction

Wairere Drive, Hamilton – Wick drains for gully infill
Brian Perry Civil is an experienced and capable marine contractor with a history of performance on a multitude of challenging and high risk projects.

Our capability includes:

**Driven and bored piles for:**
- Bridges
- Wharves and jetties
- Berths
- Marinas
- Navigational structures
- Ground retention and reclamation
- Temporary and permanent staging
- Ocean outfall staging

**Sheet Piles for:**
- Permanent works
- Cofferdams
- Temporary staging
- Ground retention

**Reclamation and dredging using:**
- Reclaimed fill
- Mudcrete
- Rock bund retaining walls

**Drilled and socketed precast piles for:**
- Wharf construction
- Bridge abutments

**Marine Plant**
Brian Perry Civil has an up-to-date fleet of marine equipment including a range of pontoons, barges and work boats.

Jack-up barge: ‘Tuapapa’
- Size: 24m x 18m
- Operating Weight: 419 tonnes
- Maximum crane capacity: 100 tonnes
- Maximum working water depth: 18m

Allows work to continue unrestricted by tide levels and sea conditions.

Jack up Barge: ‘Kaupapa’
- Size: 25 x 9.5
- Operating Weight: 314 tonnes
Rewa Bridge, Fiji – Delivered in conjunction with Fletcher’s South Pacific Division.

Upper Harbour Bridge, Auckland

Kauri Point Wharf, Auckland
Ground Retention

Application

Brian Perry Civil offers a selection of retaining walls for a wide range of applications.

The wall type selected depends on the ground conditions, the standard of finish and the level of water tightness required.

Retaining wall methods include:

- Gravity structures – crib / gabion / reinforced earth
- Soldier piles in timber, steel or precast concrete
- Contiguous bored pile wall with shotcrete arch
- Slurry / Soilmix walls
- Sheet pile walls
- Secant pile walls
- Diaphragm walls
- Permanent or temporary ground anchors

Soho Square, Auckland – Basement excavation support using contiguous bored piles, soldier piles, temporary anchors and soil nails
Permanent or Temporary Ground Anchors

A number of different anchorage systems are available which may be categorized as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Ground Conditions</th>
<th>Durability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Soil</td>
<td>Rock</td>
</tr>
<tr>
<td>Bored (Bar or strand)</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td>Driven (Bar or strand)</td>
<td>✔ ✔</td>
<td>✗</td>
</tr>
<tr>
<td>Screwed (Tube or bar)</td>
<td>✔ ✔</td>
<td>✔</td>
</tr>
</tbody>
</table>

Anchors are generally tensioned against a waler system. Passive anchors and soil nails can also be used.

Petone, Wellington – Passive anchor and soil nails for cutting stabilization
# Deep Foundation System Options

<table>
<thead>
<tr>
<th>Construction</th>
<th>Methodology</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soldier Pile Wall</strong></td>
<td>Constructed using piles timber infill panels (timber, steel or concrete)</td>
<td>Good temporary performance due to replacement with CB slurry but some seepages</td>
</tr>
<tr>
<td><strong>Contiguous Bored Pile Wall</strong></td>
<td>Series of bored piles installed relatively close together with shotcrete arches</td>
<td>Ground supported with stiffness dependant on steel section. Precast panels can increase stiffness.</td>
</tr>
<tr>
<td><strong>Soilmix / Slurry Wall</strong></td>
<td>Steel or precast concrete elements placed in fluid soilmix / slurry</td>
<td>Ground supported with stiffness dependant on steel section. Precast panels can increase stiffness.</td>
</tr>
</tbody>
</table>

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<tr>
<th>Construction</th>
<th>Establishment</th>
<th>Materials to site</th>
<th>Work face access</th>
<th>Noise</th>
<th>Vibration</th>
<th>Spoil</th>
<th>Wall Movement</th>
<th>Watertightness</th>
<th>Connections</th>
<th>Durability</th>
<th>Load Capacity</th>
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<tr>
<td><strong>Soldier Pile Wall</strong></td>
<td>50–60T self erecting hydraulic drilling rigs and handling crane</td>
<td>Concrete, reinforcement cages, steel or precast concrete panels</td>
<td>Plant &amp; Materials delivery</td>
<td>Yes, if driven sections</td>
<td>Yes, if driven sections</td>
<td>Dependant on installation method</td>
<td>Ground unsupported allowing relaxation prior to concrete</td>
<td>Permeable with no groundwater control below excavation. Seepages long term</td>
<td>Numerous connection options dependant on materials used</td>
<td>Conventional concrete in the ground design or sacrificial steel thickness given long term seepage potential</td>
<td>Capacity can be enhanced by increasing the length of piles.</td>
</tr>
<tr>
<td><strong>Contiguous Bored Pile Wall</strong></td>
<td>50–60T self erecting hydraulic drilling rigs, handling crane and concrete pumps</td>
<td>Concrete, reinforcement cages</td>
<td>Plant &amp; Materials delivery</td>
<td>No</td>
<td>No</td>
<td>100% nett volume</td>
<td>Ground unsupported allowing relaxation prior to concrete</td>
<td>Permeable until shotcrete in place with no groundwater control below. Seepages long term</td>
<td>Drilled and grouted bars in to piles, shear and bending capacity possible</td>
<td>Conventional concrete in ground design</td>
<td>Capacity can be enhanced by increasing the length of some piles.</td>
</tr>
<tr>
<td><strong>Soilmix / Slurry Wall</strong></td>
<td>50T crane + grab / CSM, handling crane / grout plant with screw feed silos, high pressure pumps</td>
<td>Cement, bentonite, steel or precast concrete panels</td>
<td>Plant, materials and pipeline delivery of slurry</td>
<td>Machine only</td>
<td>No</td>
<td>30%–80% Nett volume</td>
<td>Ground supported with stiffness dependant on steel section. Precast panels can increase stiffness.</td>
<td></td>
<td>Welded to steel sections, shear &amp; bending capacity possible.</td>
<td>Sacrificial thickness of steel and internal lining wall for long-term ground water seepage</td>
<td>Capacity limited by penetration of steel beams</td>
</tr>
<tr>
<td>Methodology</td>
<td>Sheet Pile Wall</td>
<td>Secant Pile Wall</td>
<td>Diaphragm Wall</td>
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<tr>
<td>Clutched sheet piles driven into position.</td>
<td>A series of piles installed so that they overlap to form a wall.</td>
<td>A series of interlocking reinforced concrete panels.</td>
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**Cut off Walls**

**Application**

Brian Perry Civil offers a range of cut-off walls to suit particular civil engineering applications.

These applications include:
- Impervious walls for dams
- Water control barriers
- Cut-off walls for landfills and hazardous waste containments

**Slurry Cut off Walls**

**Bentonite Cement**

These are formed by using a specially formulated mix of cementitious and bentonite based materials together with proprietary additives.

This provides a plastic structure that offers extremely low permeability with a degree of flexibility which is important in areas prone to earthquake.

**Soil Bentonite**

Where ground water control is important but with higher permeabilities are allowed, soil bentonite slurry can be utilised

**Geomembrane Walls**

For prevention of gas migration, particularly above the ground water table, a secondary barrier is sometimes placed in the slurry wall.

This typically comprises a HDPE liner, which for shallow walls is lowered horizontally into the liquid slurry trench as either a continuous sheet or roll, or vertically with interlocking panels for deeper walls.

To complete the composite wall, the self hardening bentonite / cement slurry encapsulates the flexible liner.
Arapuni Dam, Waikato - Overlapping piles to 85m depths in conjunction with Trevi SpA
Brian Perry Civil owns a wide range of modern plant appropriate to NZ conditions.

Plant is maintained in our own well-equipped workshops and we are always looking to upgrade or reinvest in new plant to keep abreast of the latest technologies.

Piling Cranes
We have an extensive range of modern, heavy duty, high line pull, tracked cranes from 30 to 250 tonnes capacity with a spread of leaders and attachments.

Operators undergo comprehensive and continuing training on new and existing crane equipment.

Piling Hammers
Our modern piling hammer range includes hydraulic impact hammers and variable frequency hydraulic and electric vibro hammers.

Drill Rigs
We operate a range of sophisticated hydraulic drill rigs, well proven in NZ’s toughest conditions and offering superior production rates in a multitude of applications and conditions.

Rig weight ranges from 30 to 70 tonnes with drilling diameters up to 3m and depths to 80m.

Low headroom rigs are available capable for drilling 1.2m diameter to 24m depth.

Crane mount rotary rigs with drilling diameters up to 2.5m and depths to 58m deliver reliable production and provide the flexibility to allow the crane fleet to be used in both piling and handling modes.

Boring Tools and Attachments
- Drill buckets
- Soil and rock augers
- Core barrels
- Down-hole hammer drills
- Rock chisels
- Benoto buckets
- Diaphragm wall grabs

Bentonite Equipment
- Mixers
- Sanders
- Pumps
- Test equipment