Figure8. The limited rank hydrophilic sedge and grass patches within the central valley bottom wetland provide suitable roosting and foraging habitat for African Grass Owls. The high levels of human disturbances on the site including hunting with dogs; severely restricts the likelihood of any nests and limits potential roosting suitability. The annual burning of the site restricts the vegetative cover along the valley bottom wetland. Off-road bikes, quads and vehicle tracks transverse the entire site as well as helicopter training and landing on the site and open areas to the south of the site adjacent to the Waterval cemetery.

African Grass Owls are found exclusively in rank grass, typically, although not only, at fair altitudes. Grass Owls are secretive and nomadic breeding in permanent and seasonal vleis, which it vacates while hunting or post-breeding, although it will breed in any area of long grass and it is not necessarily associated with wetlands. It marshlands it is usually outnumbered by the more common Marsh Owl (*Asio capensis*) 10:1 (Tarboton *et al.* 1987). Grass Owls nest on the ground within a system of tunnels constructed in mostly tall grass; peak-breeding activity (February-April) tends to coincide with maximum grass cover (Steyn 1982). Grass Owls specialise in large rodent prey, particularly *Otomys* vlei rats, although a wide range of rodent prey species, including *Rhabdomys*, *Praomys*, *Mus*, and *Suncus,* are taken (Earle 1978). Some local and nomadic movements in response to fluctuating food supplies, fire and the availability of suitable habitat can be expected (Steyn 1982). The ecological requirements of this species make it susceptible to many land-use changes impacting contemporary South Africa.

The Grass Owl appears to have undergone local population reductions because of habitat loss and fragmentation resulting from several factors. Agricultural transformation and intensive grazing have diminished its scarce and specialised habitats. Intense use of the grasslands in Gauteng and frequent burning (e.g. Ranger 1965), typically in densely settled areas, reduces rank cover for this species. It does not seem to adapt to transformation of its preferred rank grassland habitat into short grasslands, crop or grazing land. Its habit of nesting on the ground may make it susceptible to disturbances by people and livestock. The possibility that excessive accumulations of pesticide residues depress reproductive outputs should not be ignored (Brookes 1984).

Limited suitable roosting and foraging habitat exists within the small patches of rank hygrophilous and hydrophilic sedges and grasses within the central valley bottom wetland.. Due to current high levels of human disturbances (frequent cutting and harvesting of thatch, illegal hunting activities) on the site and surrounding areas limit the likelihood of successful nesting activities. It does not seem to adapt to transformation of its preferred rank grassland habitat into short grasslands, crop or grazing land. Its habit of nesting on the ground may make it susceptible to disturbances by people and livestock as well as dogs. No African Grass Owls or Marsh Owls were flushed during the current field survey. African Grass Owls have been flushed from the central valley bottom and seepage areas to the north of the site along the Jukskei River in 2006.

4.4 MAMMALS

No small mammal trappings were conducted due to time constraints and the limitations that the results from single night or brief field surveys would pose. The brief fieldwork was augmented with previous surveys in similar habitats as well as published data. Mammal species recorded within the study area as well as those that may occur within the study area, on the basis of available distribution records and known habitat requirements are included in the Table4 below. The majority of larger mammal species are likely to have been eradicated or have moved away from the area, as a result of previous agricultural activities, hunting and poaching as well as severe habitat alteration and degradation. Common Duiker, Mountain Reedbuck, Aardvark, Porcupine, Blacked-Back Jackal have however been recorded from the site and surrounding grasslands situated to the north, south and east of the site and could possibly occur or utilise the site for limited foraging purposes Low larger mammal species diversity is expected on the site due to high levels of human activities (poaching and hunting) as well as extensive habitat transformation and degradation on and surrounding the site.

The vagrants living on the site and associated hunting and poaching limits the suitability of the site for larger mammal species. High levels of hunting have been recorded from thee site with the use of dogs and wire snares as well as several empty shotgun and rifle cartridges. Several dog tracks were observed along the informal roads that bisect the site as well as a feral cat within the central valley bottom wetland. The collection or harvesting of wood (stumps) and rock material as well as the frequent burning of the vegetation reduces available refuge habitat an exposes remaining smaller terrestrial mammals to increased predation levels. The use of wire snares for high intensity poaching activities will significantly affect remaining smaller mammal species such as rabbits and mongooses. Secondary access roads and vehicles (motor cars, motor cycles, quad bikes) which transverse the site and bisect the drainage line increase access to the site as well as potential road fatalities. Major road networks (N1 and M39) with high vehicular traffic increase the risk of road fatalities (hedgehogs, hares) of mammals. Smaller mammal species are extremely vulnerable to feral cats and dogs.

The Yellow and Slender mongooses were observed on the site and prey on the smaller rodents, birds, reptiles and amphibians on the site. They have a precarious existence due to encroaching residential and commercial developments and surrounding road networks as well as illegal hunting with dogs and wire snares. Limited animal burrows (Yellow Mongooses, Highveld Gerbil, Multimmamate Mouse) and African Molerat were observed around the sandy sections of the grasslands on the southern and northern portions of the site. No major indigenous woodlands occur on the site hence the lack of certain arboreal mammal species (such as lesser bushbabies, tree rats and woodland dormice) on the site. The scattered low-lying granite outcrops and rock sheets provide favourable habitat for rupicolous mammal species such as the Eastern Elephant Shrew and Rock Dormouse. No evidence of Rock Hyrax was observed on the site.

Figure9. Smaller mammal species recorded on the site and adjacent Glen Austin AH included A: The rupicolous Eastern Rock Elephant Shrew (*Elephantulus myurus*); B: Yellow Mongoose (*Cynictis penicillata*); **C:** Four-Striped Mouse (*Rhabdomys pumilio*) and **D:** Scrub Hare (*Lepus sextalis*)[δ]

[δ] photographs courtesy of Prof. G.D. Engelbrecht University of Limpopo

The site was also surveyed for the following wetland associated mammals:

Figure10. The latrine of a Cape Clawless Otter was observed on the northern banks of the Modderfonteinspruit to the southeast of the site as well as along the Jukskei River during previous surveys.

Cape Clawless Otters (*Aonyx capensis*)

The latrine of a Cape Clawless Otter was observed on the northern banks of the Modderfontein Spruit. The permanent dams with dense reed invaded margins offers suitable refuge habitat for remaining Cape Clawless Otters. Suitable foraging areas occur along the dams on the Modderfonteinspruit as well as Jukskei River. The wetland habitats on the site are isolated from surrounding suitable habitat to the north-east by large areas of transformed old agricultural lands as well as the Gautrain alignment and Allandale and Alsation roads or “high risk” areas for Otters. The surrounding dams contain suitable prey items including crabs, frogs, fish and other aquatic life. The presence of several hunting dogs and wire snares on and around the site and neighbouring properties is an immediate threat to remaining Cape Clawless Otters.

Spotted-necked Otter (*Lutra maculicollis*)

Spotted-necked otters are adapted ideally to an aquatic life and are confined to the larger river systems, dams, lakes and swamps which have extensive areas of open water. No suitable habitat occurs for this species on the actual site or surrounding area.

Water or Marsh Mongoose (*Atilax paludinosus*)

The scats of Water/ Marsh Mongoose were observed around the dense reed beds along the Jukskwei tributary. The dams along the Jukskei and Moddefonteinspruit provide favourable foraging areas for the Marsh Mongooses. Prey items include frogs, fish and other aquatic life. The high human presence as well as several dogs and wire snares on and around the site and neighbouring properties is an immediate threat to remaining Marsh Mongooses.

Rough-haired Golden Mole (*Chrysopalax villosus*)

Limited suitable habitat occurs on the site in the form of the shallow sandy soils within the hydrophilic grass/sedge seepage wetlands along the central valley bottom wetland. The majority of areas surrounding the dams are situated on a hard plinthic B horizon or ferricrete layer which restricts burrowing activities.

African Marsh Rat or Water Rat (*Dasymys incomtus*)

Limited suitable habitat occurs along the reed beds around permanent dams as well as among the semi-aquatic grasses of the seepage wetlands as well as in the dense hydrophilic grasses along the Jukskei River to the north of the site.

Angoni Vlei Rat (*Otomys angoniensis*)

No suitable habitat occurs withinthe reed beds around permanent dam on the site

Vlei Rat (*Otomys irrotatus*)

Suitable habitat exists on the site along the reed beds around permanent eutrophic dam as well as among the semi-aquatic grasses and seepage wetland areas outside the northern boundary of the site. No runs or saucer shaped nests were observed on higher lying ground or in clumps of grass.

Table4. Mammal species recorded in the study area during the brief field survey and supplemented from previous surveys (small mammal trapping) conducted on the site and Glen Austin AH (introduced species are in bold). Actual species lists will most likely contain fewer species due to the high levels of habitat transformation and degradation on and surrounding the site.

COMMON NAME	SCIENTIFIC NAME
Transvaal free-tailed Bat	*Tadarida ventralis*
Eastern Rock Elephant-Shrew	*Elephantulus myurus*
Scrub Hare	*Lepus saxatilis*
House Mouse	***Mus musculus***
African (Common) Mole-rat	*Cryptomys hottentotus*
Woodland Dormouse	*Graphiurus murinus*
Rock Dormouse	*Graphiurus platyops*
Spiny Mouse	*Acomys spinosissimus*
Four-striped Grass Mouse	*Rhabdomys pumilio*
Pouched Mouse	*Saccostomus campestris*
Natal Multimammate Mouse	*Mastomys natalensis*
Southern Multimammate Mouse	*Mastomys coucha*
House Rat	***Rattus rattus***
Highveld Gerbil	*Tatera brantsii*
Tiny Musk Shrew	*Crocidura fuscomurina*
Reddish-Grey Musk Shrew	*Crocidura cyanea*
Southern African Hedgehog	*Atelerix frontalis*

Striped Polecat	*Ictonyx striatus*
South African Large-spotted Genet	*Genetta tigrina*
Yellow Mongoose	*Cynictis penicillata*
Slender Mongoose	*Galerella sanguinea*
Marsh Mongoose	*Atilax paludinosus*
Black-backed Jackal	*Canis mesomelas*
Cape Porcupine	*Hystrix africaeaustralis*
Common Duiker	*Sylvicarpa grimmia*
Cape Clawless Otter	*Aonyx capensis*

HABITAT AVAILABLE FOR SENSITIVE OR ENDANGERED SPECIES

According to the "South African Red Data Book of Terrestrial Mammals" (Smithers 1986) and Skinner and Smithers (1990) updated by the IUCN Council in December 1995, the study area falls within the distribution ranges of 12 species which are placed into one of known threatened species (Endangered, Vulnerable and Rare). Due to the high level of human activity within the study area it is however unlikely that the study area comprises significant habitat for any species of threatened larger mammals. On the basis of the Habitat descriptions provided for the above-mentioned threatened species by Skinner and Chimimba (2005), and the high level of human activity (hunting, poaching) within the study area, it is deemed highly unlikely that the study area provides suitable habitat for 2 above-mentioned threatened species.

Table5. Mammal species of conservation importance possibly occurring on the site (using habitat availability as an indicator)

Common Name	**Scientific Name**	**Conservation Status**
Rough-haired Golden Mole	*Chrysospalax villosus*	Endangered
White-tailed Mouse	*Mystromus albicaudatus*	Endangered A3c

White-tailed Mouse (*Mystromys albicaudatus*) (A.Smith, 1834)

Distribution

White-tailed Mice are confined to the subregion. They occur in the southern, western, eastern and north-eastern parts of the Cape province, in Kwazulu-Natal, the Free State, the south-western and southern parts of Gauteng and Swaziland.

Habitat Preference

In the eastern parts of their distribution range, they follow very closely the savanna grassland zone, but are not confined to this, occurring in the Karoo and in the south-west, in the Cape Macchia Zone (Smithers and Skinner, 1991). In the former Transvaal they were recorded in area of dense grass and sandy soils, but also from rocky areas with good grass cover (Rautenbach 1982). In Kwazulu-Natal they were caught in similar habitat to that in Lesotho being collected in short sparse grassland on a gentle stony slope (Taylor, 1998). They are nocturnal and terrestrial, living in burrows or cracks in the soil (de Graaf, 1981). They appear to be cold adapted and remain inactive during the day in the thermally buffered microenvironment of their burrows (Downs & Perrin, 1995).

Food

Their diet includes insects, seeds and green vegetable matter.

Reproduction

Roberts (1951) stated that they breed throughout the year, but this remains to be confirmed under natural conditions (Skinner and Smithers, 1991).

Limited suitable habitat (cracks in soil) occurs in the sandy soils around the low-lying granite sheets adjacent to the central valley bottom wetland for White-tailed mouse. This habitat will be conserved within the 30m GDARD wetland buffer zone.

Rough-haired Golden Mole *Chrysospalax villosus* (A.Smith, 1833)

Distribution

Recorded from the extreme western parts of the Western Cape through southern and central Kwazulu-Natal into Gauteng (Witbank, Springs, Pretoria and Johannesburg) and into Mpumalanga as far as Sabie and Graskop. (Skinner and Chimimba 2007).

Habitat

Grassland, with a preference for the use of dry ground on the fringes of marshes or damp vleis (Skinner and Smithers, 1991). Specimens from Kwazulu-Natal have been collected in suburban gardens and along the edge of a golf course adjoining a small stream (S, Maree & G.N. Bronner, unpubl. data). They apparently do not make subsurface runs like other golden moles, but excavate burrows, the entrances to which are characterized by loose piles of soil thrown up at the sides and back and which are left open when they leave the burrows to forage. Roberts (1951) thought they lived in chambers within their burrow systems from which they emerge only after rain. From the entrances, through repeated use, tracks are formed to feeding areas, which are marked by the disturbance of the soil in rooting with the horny pad on their noses. If suddenly alarmed when out of the burrows they quickly return to their shelter. In captivity, Roberts (1951) noted that, irrespective of the direction in which they faced, when they were disturbed their reactions were so rapid and the location of the burrow entrance apparently so well known that it was difficult to follow them as they sought refuge within it.

Food

Consists predominantly of insects and earthworms. They emerge from the burrows to feed on the surface normally after rain when they become particularly active (Skinner and Smithers, 1991).

Reproduction

Very little information is known about this aspect of their life history. Roberts (1951) recorded a female with two foetuses, but gave no date of recover of specimen.

Marginally suitable habitat occurs for Rough-haired Golden Mole in the form of the grassy margins and shallow sandy soils within the temporary wet zones of the seepage wetlands and central valley bottom wetland. Large sections are situated on a hard plinthic B horizon or ferricrete layer with limited shallow sandy soils or exposed Dresden Soil Form which restricts and burrowing activities.

Figure11. Large sections along the central valley bottom wetland are situated on a hard plinthic B horizon or ferricrete layer with limited shallow sandy soils or exposed Dresden Soil Form which restricts and burrowing activities of smaller mammals.

No evidence or actual sighting of any sensitive or endangered mammal species were observed during the brief survey. The majority of larger mammal species have disappeared or located suitable habitats away from the area, due to high levels of human activities a well as uncontrolled hunting and poaching as well as habitat alteration and degradation. Smaller mammal species are extremely vulnerable to snares and poaching activities as well as feral cat (*Felis cattus*) and dog populations. Continual habitat destruction, alteration and human disturbances will result in the disappearance of the majority of sensitive or secretive mammal species. It must be stressed however that the above-mentioned species are extremely difficult to observe and even more intensive surveys may not determine their presence, especially pertaining to the Rough-haired Golden Mole as well as White-tailed Mouse.

The conservation and correct management of the remaining primary Egoli Granite grasslands as well as the rocky outcrops and rocky sheets and seasonal and permanent wetland habitats should ensure the conservation of all remaining suitable habitat for the Rough-haired Golden Mole on the site as well as the majority of suitable habitat for the White-tailed Mouse. The formation of a private open space (including the seasonal and permanent wetlands and 30m rocky outcrops/grassland buffer zone) interconnected with a biological corridor stretching along the Jukskei River to the north and the Modderfonteinspruit to the south-west could result in a **positive impact** for remaining mammal populations, if adequate conservation measures are implemented. The fencing off of the entire conserved private open space, prevention of increased human presence and disturbances including illegal dumping, hunting and poaching activities as well as the implementation of a natural fire regime programme could result in increased smaller mammal populations and important refuge areas for any remaining larger mammal species especially the Cape Clawless Otters, Common Duiker and Black-backed Jackal.

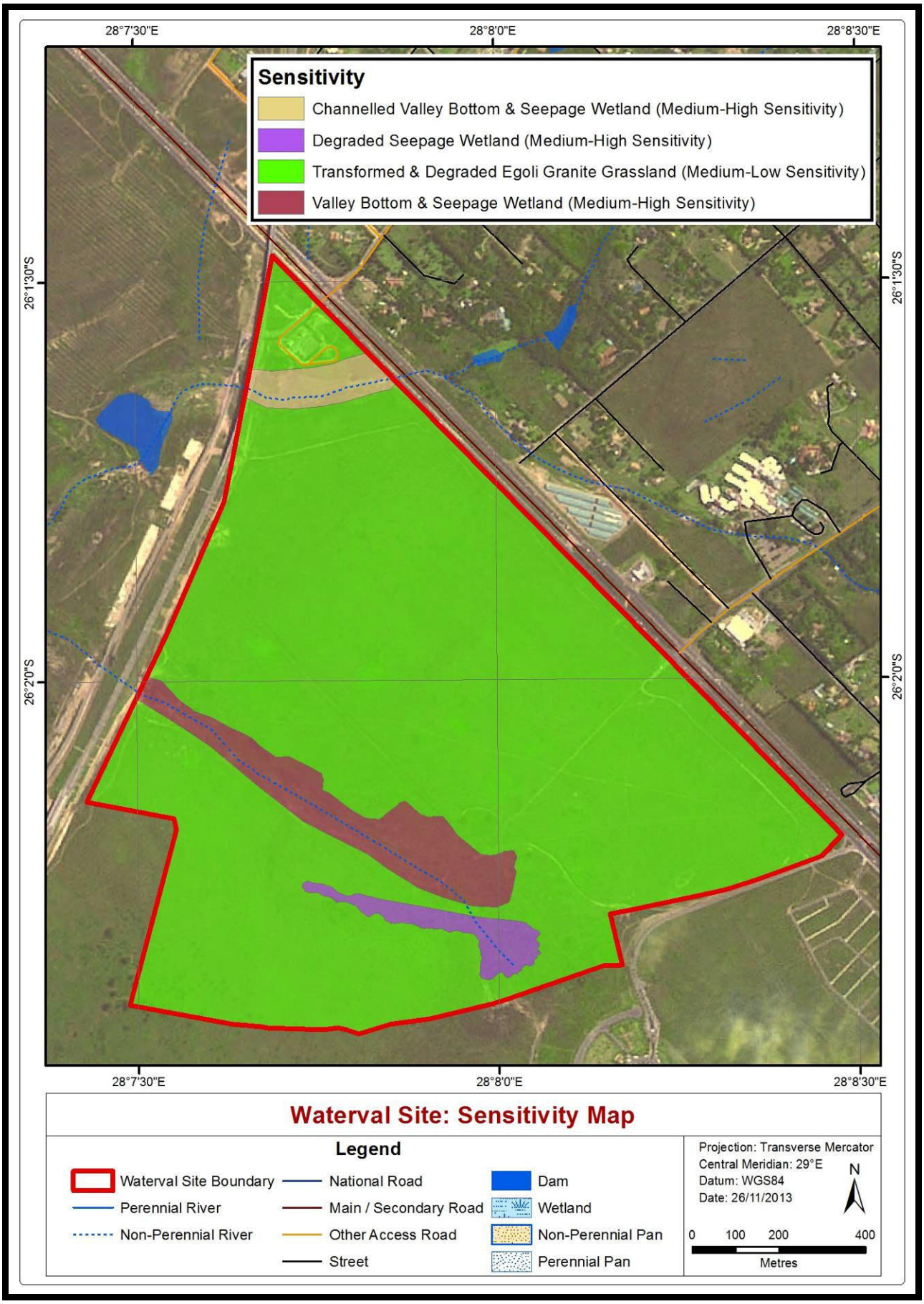

Figure12. Faunal sensitivity map for the proposed Waterval site.

5. SENSITIVE ENVIRONMENTS/HABITATS ON THE WATERVAL SITE:

5.1 EGOLI GRANITE GRASSLANDS (GM10)

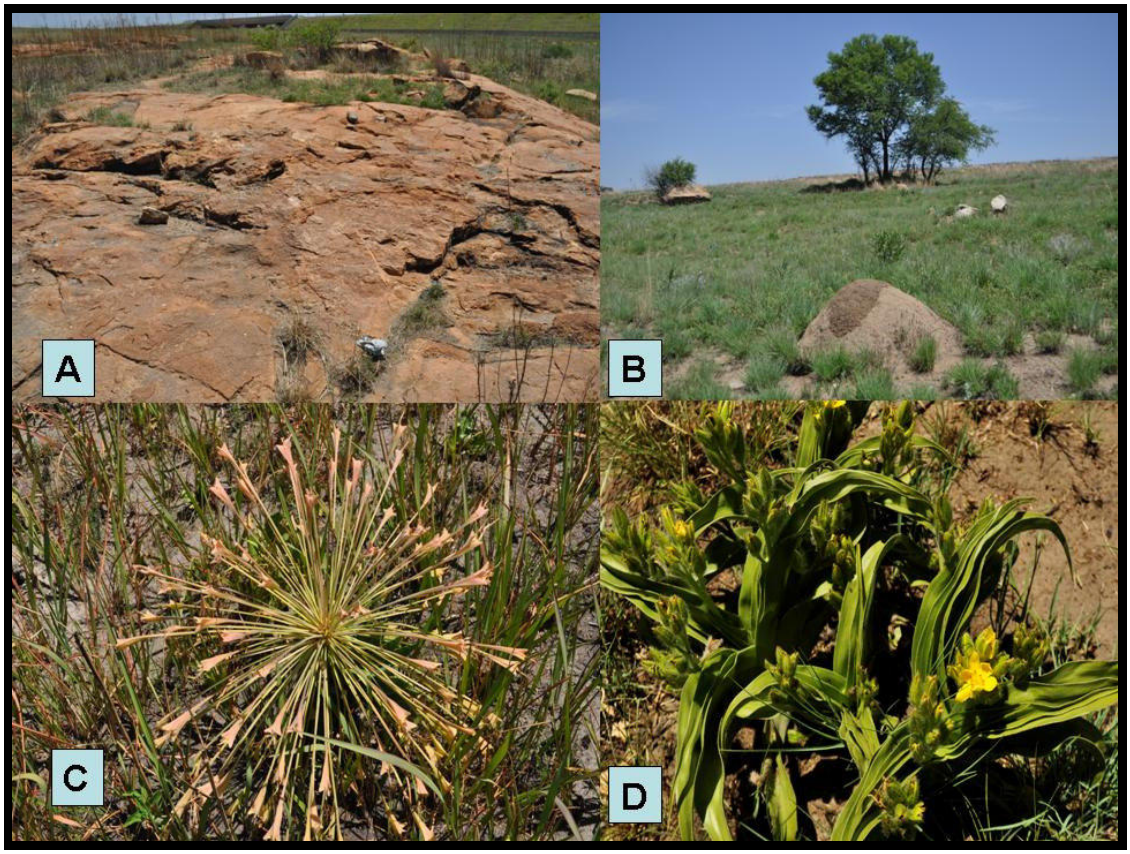

Figure14. Sensitive microhabitats observed on the site included A: Low-lying most embedded granite rock sheets; **B:** Large termite mounds on the southern banks of the Jukskei tributary on the northern portions of the site. **C:** A single red listed 'Declining' Cape Poison Bulb (*Boophone disticha*) was observed within the temporary wet zone of the southern seepage wetlands. **D:** Several (>100) Red Listed 'Declining' African Potatoes (*Hypoxis hemerocallidea*) were observed adjacent to the central valley bottom wetland as well as on the southern portion of the site. A rescue and recovery programme should be implemented prior to vegetation clearance and earthmoving activities. All remaining geophytes should be dug up and planted within the 30m GDARD grassland buffer zone (from the outer edge of the temporary wet zones of the seepage and valley bottom wetlands). See separate wetland report conducted by Wetland Consulting Services.

Egoli Granite Grasslands in the Gauteng Province are highly threatened and are listed as **Endangered**. More than two thirds of this vegetation unit has already undergone transformation mainly due to urbanization, road construction, industrialisation and agricultural activities (cultivation). Only a small fraction (3%) of this vital habitat has been formerly conserved. Conservation targets are the proposed conservation of 24%. These grassland areas form vital habitats for numerous animal species. The majority of suitable grassland habitat is usually severely fragmented resulting in road fatalities of species migrating between habitats. All primary Egoli Granite grassland should be classified as **Sensitive** and of **High Conservation Value** and adequately managed with a natural fire regime determined by a suitably qualified botanist or grassland ecologist (see separate vegetation report conducted by Dr. David Hoare). Access to surrounding open Egoli grassland to the south and south-west must be strictly managed to prevent possible poaching, harvesting of medicinal plants and disturbances to remaining fauna. No driving of vehicles through open grasslands.

5.2 HYDROPHILIC SEDGE AND GRASS SEASONAL SEEPAGE AREAS AND VALLEY BOTTOM WETLANDS

Figure12. The seasonal seepage wetlands along the central valley bottom wetland show a high diversity of plant and animal species and provide critical breeding habitat for the remaining frog species including the protected Giant Bullfrog.

The conservation status of many of the faunal species that are dependant on wetlands reflects the critical status of wetland nationally, with many having already been destroyed. In this study area wetlands, including seasonal seepage wetlands which feed into the central valley bottom wetlands and to a lesser extent the northern tributary of the Jukskei River are important habitats for remaining faunal species. All remaining wetlands (permanent and seasonal) and their associated indigenous grassland and sedge dominated vegetation must be considered as a sensitive habitat.

All wetland habitats including seasonal seepage wetlands situated at Waterval are considered to be **Sensitive** and of **Medium-High conservation importance** for the following reasons:

- Wetlands are characterized by hydric soils and slow flowing water and tall emergent vegetation, and provide habitat for many faunal species. The conservation status of many of the faunal species that are dependant on wetlands reflects the critical status of wetland nationally, with many having already been destroyed. In this study area wetlands, including seasonal pans are important habitats for species such as Giant Bullfrogs, African Grass Owl, Marsh Sylph and possibly Rough-haired Golden Mole.
- The indigenous vegetation of riverine wetlands within the old Transvaal Province and wetlands in general throughout the Grassland Biome, is in danger of being completely replaced by alien invasive species (Henderson & Musil 1997, Rutherford & Westfall 1994). Any remaining areas of indigenous riparian vegetation or marshland vegetation within Gauteng and especially Midrand must therefore be regarded as of **high conservation importance**.
- Several mammal species including Vlei Rats and Marsh Mongoose may occur along the reed margins of the dam for foraging and refuge habitat. Waterbirds, which were formerly restricted to high rainfall areas with natural wetland habitat, make use of man-made dams, and surrounding areas, for feeding, roosting and breeding. Certain amphibian species will utilize the shallow seasonal depressions (created from previous sand mining activities) within the central valley bottom wetland for breeding purposes including Giant Bullfrog Guttural Toad, Common River Frog, Common Caco, Bubbling Kassina. Common Platanna and Common River Frog will be found in permanent waterbodies such as the dams. Reptile species such as the Brown water Snake are associated with wetland habitats including permanent dams.
- The wetlands on the site have been heavily degraded through surrounding anthropogenic activities including the construction of a bulk sewer line in 2005 and the K60 access road to the maintenance depot of the Gautrain.
- An alien vegetation removal programme as well as erosion control mechanisms need to be implemented along the central valley bottom wetland. Disturbed areas should be re-vegetated with an indigenous (to the area) grass seed mixture.

6. POTENTIAL IMPACTS OF THE PROPOSED WATERVAL DEVELOPMENT ON THE ASSOCIATED FAUNA

6.1 Loss of habitat

The proposed mixed use commercial development will most likely result in a **medium-high, short, medium and long-term negative impact** on faunal species utilising these areas. The propose Waterval development should it be approved should be restricted to the transformed secondary grasslands or degraded habitats with low conservation value (see specialist vegetation as well as wetland delineation maps). This will result in the destruction of transformed habitats which offers limited suitable habitat for remaining animal species. Further, direct and indirect impacts of the development include increased access and human presence into the area as well as neighbouring properties. Increased human pressure and activities in these degraded habitats could result in further environmental degradation if environmentally sensitive practices are not followed and maintained throughout all stages of the development.

Mitigation and Recommendations

During the **CONSTRUCTION** phase workers must be limited to areas under construction and access to the undeveloped areas especially the Jukskei River and Modderfontein Spruit and seasonal wetlands including the seepage wetlands and valley bottom wetlands must be strictly regulated (“no-go” areas during construction activities). The entire private open space or conservations areas should be fenced off prior to construction activities. Provision of adequate toilet facilities must be implemented to prevent the possible contamination of ground (borehole) water in the area. All temporary stockpile areas, litter and dumped material and rubble must be removed on completion of construction. All alien invasive plant and tree species should be removed from the site to prevent further invasion. No quad-bikes, motorcycles or off road vehicles and illegal hunting should be permitted in the adjacent properties. Vegetation clearance should be restricted to the areas under construction allowing remaining animals opportunity to move away from the disturbance. No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the site. No hunting with firearms (shotguns, air rifles or pellet guns) or catapults should be permitted on the property as well as neighbouring areas.

6.2 Horticultural Activities

Landscape architects, and the developer, have an opportunity to conserve certain faunal biodiversity present on the site and possibly increase the biodiversity of certain animal species (birds). Vegetation has been reported to be the single most important habitat component for all species of animals. Linked to this, is the preservation, maintenance and creation of tracts of natural and ornamental vegetation in all stages of ecological succession, interconnected by corridors or green belts for escape, foraging, breeding and exploratory movements. Landscaping projects are all too frequently characterized by exotic or indigenous (not to the area) trees, planted at the same time, at the same size and are spaced at regular centred settings. The resulting pattern and structure is one of limited vegetation diversity, trees of uniform size, even age stands and little or no under-story planting. Only a few species of animals (urban exploiters) will occupy these limited niches, leading to decreased faunal biodiversity.

Mitigation and recommendation

Remaining indigenous bulbous geophytes should be retained or replanted wherever possible. Gardens or landscaped areas around the proposed commercial development should be planted with indigenous (preferably using endemic or local species from the area) grasses, forbs, shrubs and trees, which are water wise and require minimal horticultural practices. A species list of suitable species should be compiled for future property owners.

A Re-vegetation and Rehabilitation Manual should be prepared for the use of contractors, landscape architects and groundsmen. Where herbicides are used to clear vegetation, specimen-specific chemicals should be applied to individual plants only. General spraying should be prohibited. All alien vegetation should be eradicated over a five-year period. Invasive species (*Eucalyptus sp., Melia azedarach, Acacia mearnsii, Campuloclinium macrocephalum*) should be given the highest priority.

Where the removal of alien species may leave spoil exposed, alternative indigenous species should be established before eradication takes place. Individual property owners should be encouraged to plant indigenous non-invasive plants. The attention of property owners must be drawn to the most recent Declared Weeds List (2001) in the *Conservation of Agricultural Resources Act* 43 of 1983 and the associated penalties and prohibitions. Horticultural activities such as fertilisers, herbicide and pesticide runoff, increase in alien vegetation and weedy species, dumping of refuge and building material must be strictly managed and be environmentally sensitive and should meet the following requirements:

- Limited to building environs and limited areas of proposed development.
- Limited irrigation by water-wise gardening (use local plants adapted to local conditions).
- Strict fertiliser, pesticide and herbicide control (limited usage)
- Invertebrate pests on the site should be controlled in the following manner:
- The least environmentally damaging insecticides must be applied. Pyrethroids and Phenylpyrazoles are preferable to Acetylcholines. Use insecticides that are specific to the pest (species specific) in question. The lowest effective dosages must be applied. The suppliers advice should always be sought. Do not irrigate for 24 hours after applying insecticides in areas where there is a chance of contaminating water-courses or dams, fungal pathogens should be used in preference to chemical insecticides.
- Reduction of weed and erosion by minimum tillage gardening practices (groundcovers and mulching better in all respects).
- No dumping of any materials in undeveloped open areas and neighbouring properties. Activities in the surrounding open undeveloped areas (especially Modderfontein Spruit and Jukskei River) must be strictly regulated and managed.

6.3 Erosion and Surface runoff

Urban development is characterised by large areas of sealed surfaces such as roads, houses etc. Impermeable surface cover ranges from 15% to 60% of suburban areas to almost 100% in central business districts. Infiltration is considerable reduced with an increase in surface run-off. Run-off is generally discharged to surface water systems and often contains pollutants. Pollutants range from organic matter, including sediments, plant materials and sewage, to toxic substances such as heavy metals, oils and hydrocarbons. Construction activities associated with urban development can lead to massive short term erosion unless adequate measures are implemented to control surface run-off. Sheet erosion occurs when run-off surface water carries away successive thin layers of soil over large patches of bare earth. This type of erosion is most severe on sloping soils, which are weakly structured with low infiltration, which promotes rapid run-off. It occurs on the site where vegetation has been destroyed. Continual erosion in sheet-eroded slopes is a common cause of gully erosion. Gully erosion results from increased flow along a drainage line, especially where protective vegetation has been removed and soils are readily transported. A gully has steep, bare sides and is often narrow and deep. Once formed, a gully usually spreads upstream through continual slumping of soil at the gully head. Gully erosion can be associated with salting as the saline sub-soils are readily eroded.

Mitigation and recommendations

Vegetation plays a critical role in the hydrological cycle by influencing both the quantity and quality of surface run-off. It influences the quantity of run-off by intercepting rainfall, promoting infiltration and thus decreasing run-off. Vegetation can influence water quality in two ways: by binding soils thus protecting the surface layer, and by intercepting surface run-off thus buffering the dams as well as Modderfontein Spruit and Jukskei River against suspended and dissolved substances. When the speed of the run-off is reduced, suspended particles can settle out and dissolve substances, such as nutrients, can be assimilated by plants. The vegetation has a filtering effect. Storm-water and runoff should be channelled towards the existing valley bottom wetlands and 30m grassland buffer zone through a series of shallow seasonal retention/attenuation ponds reducing the erosional force and the potential risk of further disturbance of and any wetland habitats on the site.

The timing of clearing activities is of vital importance. Clearing activities and earth scraping should preferably be restricted to the dry season in order to prevent erosion and siltation. The dry months are also the period when the majority of species are either dormant or finished with their breeding activities. Future soil stockpiling areas must follow environmentally sensitive practices and be situated a sufficient distance away from drainage areas. Severely eroded areas should be stabilised with gabions, rheno mattresses with sediment trapping material. The careful position of soil piles, and runoff control, during all phases of development, and planting of some vegetative cover after completion (indigenous groundcover, grasses etc.) will limit the extent of erosion occurring on the site. Sufficient measures must be implemented to prevent the possible contamination of the surface water and surrounding groundwater.

6.4 Migratory Routes (Fencing)

The migratory movements of several animal (frog, reptile and mammal) species could be completely disrupted by the erection of numerous walls around properties, fences and road networks, which restrict natural movements between suitable foraging and breeding areas. This could potentially result in the disruption of natural gene flow between populations and could result in a high impact on the highly mobile species. Fencing off of residential areas and private property also plays a critical role in impeding the natural migration of the majority of animal species. A trade off thus exists between safety and security on the one hand and movement of animal species on the other.

Mitigation and recommendations

Ideally fences should not restrict the natural migratory movements of certain animals. This is especially important when the property neighbours adjacent open grassland areas. The site offers suitable migratory habitat towards the Jukskei and Modderfontein Spruit. Electric fences have a negative impact on certain animal species including Bushbabies, geckoes, chameleons, bullfrogs and tortoises. Palisade fencing with adequate gaps is recommended for the conserved private open spaces along the palustrine wetlands on the site. Sufficient biological corridors must be implemented along the remaining open primary Egoli Granite grasslands and the Modderfontein Spruit and Jukskei River to the north, south and south-west of the site. Connectivity of the site to suitable habitats will be along the valley bottom wetlands towards the Modderfontein Spruit to the south-west and the Jukskei River to the north and west of the site.

6.5 Artificial Lighting

Artificial lighting will most likely result in a **moderate** to **high** negative short, medium and long- term impact on all nocturnal animal species. Numerous species will be attracted towards the light sources and this will result in the disruption of natural cycles, such as the reproductive cycle and foraging behaviour. The lights may destabilise insect populations, which may alter the prey base, diet and ultimately the well-being of nocturnal insectivorous fauna. The lights may attract certain nocturnal species to the area, which would not normally occur there, leading to competition between sensitive and the more common species.

Mitigation and recommendations

During the construction phase, artificial lighting must be restricted to areas under construction and not directed towards the conserved areas (valley bottom and seepage wetlands r) in order to minimize the potential negative effects of the lights on the natural nocturnal activities. Where lighting is required for safety or security reasons, this should be targeted at the areas requiring attention. Yellow sodium lights or Compressed Flourescent Bulbs (CFL's) should be prescribed as they do not attract as many invertebrates (insects) at night and will not disturb the existing wildlife. Sodium lamps require a third less energy than conventional light bulbs.

6.6 Threatened animals

At a local scale the study site and surrounding grasslands on the site and to the north, east and south comprises suitable habitat for certain threatened animal species namely African Grass Owls, Giant Bullfrogs and Striped harlequin Snakes.

Mitigation and recommendations

As a precautionary mitigation measure it is recommended that the developer and construction contractor as well as an independent environmental control officer should be made aware of the possible presence of certain threatened animal species prior to the commencement of construction activities. In the event that any of the above-mentioned species are discovered or unearthed the consultant and relevant conservation authorities must be informed telephonically within 24 hours of the discovery. If Giant Bullfrogs or Striped Harlequin Snakes are unearthed during any phase of the development, a herpetologist should immediately be brought to the site to evaluate the importance of the record and recommend mitigation measures where necessary.

6.7 Exotic Animals

The introduction and invasion of exotic or alien fish, ducks, cats, dogs, rabbits and birds (mynas) must be prevented as they have negative impacts on remaining animal species.

Mitigation and Recommendation

Ideally no domestic animals should be allowed in the proposed development. If allowed, cats and dogs should ideally be neutered or spayed, preventing unwanted litters and restricted to the residential areas. No exotic animals especially dogs and cats should be allowed in the privately conserved areas of the site as well as adjacent undeveloped areas surrounding the site. All exotic animals entering these sensitive habitats should be humanely as possible removed from the area.

7. CONCLUSION AND RECOMMENDATIONS

At a local (Glen Austin AH-Waterval) scale the study area comprises important habitat for remaining animal species. The old agricultural lands or secondary succession grasslands on the central, southern and south-eastern portions of the site are dominated by transformed habitats that no longer comprise the natural vegetation, and have **little or no conservation** or **biodiversity value**. These areas are ideally suitable for the mixed use commercial development. Development should ideally be situated adjacent to existing roads, electricity, water and sewerage infrastructure. No further sewer lines or linear infrastructure should be permitted along the central valley bottom wetland and 30m grassland buffer zone or across the rocky outcrops or rocky sheets.

Destruction of the transformed habitats on the site will have an impact of **medium-low; short-long term impact** on remaining animal species on the site (associated fauna) if environmentally sensitive practices are implemented throughout all stages of the proposed development. During construction activities, wherever possible, work should be restricted to one area at a time. This will give smaller birds, mammals, reptiles and amphibians an opportunity to move into undisturbed areas close to their natural habitat (north, south and west). The Developer must ensure that no faunal species are intentionally disturbed, trapped, hunted or killed during the construction phase. All sensitive habitats on the site including the seasonally inundated hillslope seepge wetlands and valley bottm wetlands (tributaries of the Jukskei River), rocky outcrops or sheets should be conserved and incorporated into a private open space. These conserved areas must be appropriately managed and ideally rehabilitated with the removal of alien invasive vegetation being the highest priority. If certain habitats have to be destroyed due by the development (disturbed remnant grass patches with limited termite mounds, limited rock outcrops) a **rescue and recovery** programme should ideally be implemented prior to construction activities; especially earth-

scraping and vegetation clearance. Rescued animals can be released in suitable habitat chosen by the relevant conservation authorities (GDARD) and consultant away from the development.

Acknowledgements

The consultant is extremely grateful for the comments, information and recommendations provided from the Gauteng Directorate of Nature Conservation, especially Dr. Craig Whittington-Jones.

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9. APPENDIX

Table5. Frog species recorded from the 228AA QDGC during the South African Frog Atlas Project (SAFAP) according to FrogMAP.

Family	Genus	Species	Common name	Red list category	Atlas region endemic
Bufonidae	*Amietophrynus*	*gutturalis*	Guttural Toad	Least Concern	0
Bufonidae	*Amietophrynus*	*rangeri*	Raucous Toad	Least Concern	0
Bufonidae	*Schismaderma*	*carens*	Red Toad	Least Concern	0
Hyperoliidae	*Kassina*	*senegalensis*	Bubbling Kassina	Least Concern	0
Phrynobatrachidae	*Phrynobatrachus*	*natalensis*	Snoring Puddle Frog	Least Concern	0
Pipidae	*Xenopus*	*laevis*	Common Platanna	Least Concern	0
Pyxicephalidae	*Amietia*	*angolensis*	Common or Angola River Frog	Least Concern	0
Pyxicephalidae	*Amietia*	*fuscigula*	Cape River Frog	Least Concern	0
Pyxicephalidae	*Cacosternum*	*boettgeri*	Common Caco	Least Concern	0
Pyxicephalidae	***Pyxicephalus***	***adspersus***	**Giant Bull Frog**	**Near Threatened**	0
Pyxicephalidae	*Strongylopus*	*fasciatus*	Striped Stream Frog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*cryptotis*	Tremelo Sand Frog	Least Concern	0
Pyxicephalidae	*Tomopterna*	*natalensis*	Natal Sand Frog	Least Concern	0

Red listing source: Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland. SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.

Table6. Reptile species recorded from the 2628AA QDGC during the South African Reptile Conservation Assessment (SARCA) according to ReptileMAP.

Family	Genus	Species	Subspecies	Common name	Red list category	Atlas region endemic
Agamidae	*Agama*	*aculeata*	*distanti*	Distant's Ground Agama	Not Evaluated	1
Agamidae	*Agama*	*atra*		Southern Rock Agama	Not Evaluated	0
Atractaspididae	*Amblyodipsas*	*polylepis*	*polylepis*	Common Purple-glossed Snake	Not Evaluated	0
Atractaspididae	*Aparallactus*	*capensis*		Black-headed Centipede-eater	Not Evaluated	0
Atractaspididae	*Atractaspis*	*bibronii*		Bibron's Stiletto Snake	Not Evaluated	0
Atractaspididae	***Homoroselaps***	***dorsalis***		**Striped Harlequin Snake**	**Lower Risk: Near Threatened**	1
Atractaspididae	*Homoroselaps*	*lacteus*		Spotted Harlequin Snake	Not Evaluated	1
Chamaeleonidae	*Chamaeleo*	*dilepis*	*dilepis*	Common Flap-neck Chameleon	Not Evaluated	0
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Not Evaluated	0
Colubridae	*Crotaphopeltis*	*hotamboeia*		Red-lipped Snake	Not Evaluated	0
Colubridae	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Not Evaluated	0
Colubridae	*Duberria*	*lutrix*	*lutrix*	South African Slug-eater	Not Evaluated	1
Colubridae	*Gonionotophis*	*capensis*	*capensis*	Common File Snake	Not Evaluated	0
Colubridae	*Lamprophis*	*aurora*		Aurora House Snake	Not Evaluated	1
Colubridae	*Lycodonomorphus*	*inornatus*		Olive House Snake	Not Evaluated	1
Colubridae	*Lycodonomorphus*	*rufulus*		Brown Water Snake	Not Evaluated	0
Colubridae	*Lycophidion*	*capense*	*capense*	Cape Wolf Snake	Not Evaluated	0
Colubridae	*Philothamnus*	*hoplogaster*		South Eastern Green Snake	Not Evaluated	0

Colubridae	*Prosymna*	*sundevallii*		Sundevall's Shovel-snout	Not Evaluated	0
Colubridae	*Psammophis*	*brevirostris*		Short-snouted Grass Snake	Not Evaluated	0
Colubridae	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Not Evaluated	0
Colubridae	*Psammophis*	*subtaeniatus*		Western Yellow-bellied Sand Snake	Not Evaluated	0
Colubridae	*Psammophylax*	*rhombeatus*	*rhombeatus*	Spotted Grass Snake	Not Evaluated	0
Colubridae	*Psammophylax*	*tritaeniatus*		Striped Grass Snake	Not Evaluated	0
Colubridae	*Pseudaspis*	*cana*		Mole Snake	Not Evaluated	0
Cordylidae	*Chamaesaura*	*aenea*		Coppery Grass Lizard	Not Evaluated	1
Cordylidae	*Cordylus*	*vittifer*		Common Girdled Lizard	Not Evaluated	0
Elapidae	*Aspidelaps*	*scutatus*	*scutatus*	Speckled Shield Cobra	Not listed	0
Elapidae	*Elapsoidea*	*sundevallii*	*media*	Highveld Garter Snake	Not listed	0
Elapidae	*Hemachatus*	*haemachatus*		Rinkhals	Not Evaluated	0
Elapidae	*Naja*	*mossambica*		Mozambique Spitting Cobra	Not Evaluated	0
Gekkonidae	*Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Not Evaluated	0
Gekkonidae	*Pachydactylus*	*affinis*		Transvaal Gecko	Not Evaluated	1
Gekkonidae	*Pachydactylus*	*capensis*		Cape Gecko	Not Evaluated	0
Gerrhosauridae	*Gerrhosaurus*	*flavigularis*		Yellow-throated Plated Lizard	Not Evaluated	0
Lacertidae	*Nucras*	*lalandii*		Delalande's Sandveld Lizard	Not Evaluated	1
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*conjunctus*	Eastern Thread Snake	Not listed	0
Leptotyphlopidae	*Leptotyphlops*	*scutifrons*	*scutifrons*	Peters' Thread Snake	Not listed	0
Pelomedusidae	*Pelomedusa*	*subrufa*		Marsh Terrapin	Not Evaluated	0
Scincidae	*Acontias*	*gracilicauda*		Thin-tailed Legless Skink	Not Evaluated	1
Scincidae	*Afroablepharus*	*wahlbergii*		Wahlberg's Snake-eyed Skink	Not Evaluated	0

Scincidae	*Trachylepis*	*capensis*		Cape Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*punctatissima*		Speckled Rock Skink	Not Evaluated	0
Scincidae	*Trachylepis*	*varia*		Variable Skink	Not Evaluated	0
Typhlopidae	*Afrotyphlops*	*bibronii*		Bibron's Blind Snake	Not Evaluated	0
Varanidae	*Varanus*	*niloticus*		Water Monitor	Not Evaluated	0
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Not Evaluated	0
Viperidae	*Causus*	*rhombeatus*		Rhombic Night Adder	Not Evaluated	0

Red listing source: 1996 IUCN global listing

Table7: Bird species recorded during field surveys (2006-2013). Actual species list for the area.

Roberts' Number	Common name	Scientific Name
58	Reed Cormorant	*Phalacrocorax africanus*
60	Darter	*Anhinga melanogaster*
62	Grey Heron	*Ardea cinera*
63	Blackheaded Heron	*Ardea melanocephala*
64	Goliath Heron	*Ardea goliath*
65	Purple Heron	*Ardea purpurea*
71	Cattle Egret	*Bulbulcus ibis*
93	Glossy Ibis	*Plegadis falcinellus*
94	Hadeda Ibis	*Bostrychia hagedash*
95	African Spoonbill	*Platalea alba*
99	Whitefaced Duck	*Dendrocygna viduata*
100	Fulvous Duck	*Dendrocygna bicolour*
102	Egyptian Goose	*Alopochea aegyptiacus*
104	Yellowbilled Duck	*Anas undulata*
116	Spurwinged Duck	*Plectropterus gambensis*
148	African Fish-Eagle	*Haliaeetus vocifer*
203	Helmeted Guineafowl	*Numida meleagris*
226	Common Moorhen	*Gallinula chloropus*
228	Redknobbed Coot	*Fulicia cristata*
255	Crowned Lapwing	*Vanellus coronatus*
258	Blacksmith Lapwing	*Vanellus armatus*
260	Wattled Lapwing	*Vanellus senegallus*

297	Spotted Thick-knee	*Burhinus capensis*
352	Redeyed Dove	*Stretopelia semitorquata*
354	Cape Turtle Dove	*Streptopelia capicola*
355	Laughing Dove	*Streptopelia senegalensis*
373	Go-away-Bird	*Corythaixoides concolor*
377	Redchested Cuckoo	*Cuculus solitarius*
382	Klaas's Cuckoo	*Chrysococcyx klaas*
386	Diederik Cuckoo	*Chrysococcyx caprius*
391A	Burchell's Coucal	*Centropus burchellii*
392	Barn Owl	*Tyto alba*
395	Marsh Owl	*Asio capensis*
415	Whiterumped Swift	*Apus caffer*
417	Little Swift	*Apus melba*
424	Speckled Mousebird	*Colius striatus*
464	Blackcollared Barbet	*Lybius torquatus*
473	Crested Barbet	*Tracchyphonus vailantii*
483	Cardinal Woodpecker	*Dendropicos fuscescens*
494	Rufousnaped Lark	*Mirafra africana*
507	Redcapped Lark	*Calandrella cinerea*
526	Greater Striped Swallow	*Hirundo cucullata*
527	Lesser Striped Swallow	*Hirundo abyssinica*
529	Rock Martin	*Hirundo fuligula*
568	Black-eyed Bulbul	*Pycnonotus barbatus*
577	Olive Thrush	*Turdus olivaceus*
595	Anteating Chat	*Myrmecocichla formicivora*
596	Stonechat	*Saxicola torquata*
601	Cape Robin-Chat	*Cossypha caffra*
631	African Marsh Warbler	*Acrocephalus baeticatus*
635	Cape Reed Warbler	*Acrocephalus gracilirostris*
638	African Sedge Warbler	*Bradypterus baboecala*
645	Barthroated Apalis	*Apalis thoracica*
664	Fantailed Cisticola	*Cisticola juncidis*
672	Rattling Cisticola	*Cisticola chiniana*
677	Levaillant's Cisticola	*Cisticola tinniens*
683	Tawnyflanked Prinia	*Prinia subflava*
701	Chinspot Batis	*Batis molitor*
716	Grassveld Pipit	*Anthus cinnamomeus*
727	Orangethroated Longclaw	*Macronyx capensis*
732	Fiscal Shrike	*Lanius collaris*
740	Puffback	*Dryoscopus cubla*

758	*Common Mynah	*Acridothermes tristis*
764	Cape Glossy Starling	*Lamprotornis nitens*
787	Whitebellied Sunbird	*Nectarinia talatala*
796	Cape White-Eye	*Zosterops pallidus*
801	*House Sparrow	*Passer domesticus*
803	Cape Sparrow	*Passer melanurus*
814	Masked Weaver	*Ploceus velatus*
815	Lesser Masked Weaver	*Ploceus intermedius*
824	Southern Red Bishop	*Euplectes orix*
829	Whitewinged Widow	*Euphlectes albonotatus*
832	Longtailed Widow	*Euphlectes progne*
846	Common Waxbill	*Estrilda astrild*
881	Streakyheaded Canary	*Serinus gularis*

* introduced species

Table8. Mammal species recorded, or likely to occur, on site and surrounding area using alternative habitats as indicators of possible species present. Actual species list for the area will most likely contain fewer species due to extensive habitat transformation surrounding the site as well as high levels of human activities on the site.

COMMON NAME	SCIENTIFIC NAME
Tomb Bat	*Taphozous mauritiamus*
*Transvaal free-tailed Bat	*Tadarida ventralis*
Egyptian free-tailed Bat	*Tadarida aegyptiaca*
*Cape Serotine Bat	*Eptesicus capensis*
Yellow House Bat	*Scotophilus dinganii*
Lesser Yellow House Bat	*Scotophilus borbonicus*
Reddish-grey Musk Shrew	*Crocidura cyanea*
Tiny Musk Shrew	*Crocidura fuscomurina*

Swamp Musk Shrew	*Crocidura mariguensis*
*Least Dwarf Shrew	*Suncus infinitesimus*
*South African Hedgehog	*Atelerix frontalis*
*Scrub Hare	*Lepus saxatilis*
House Mouse	*Mus musculus*
*Common Molerat	*Cryptomys hottentotus*
Woodland Dormouse	*Graphiurus murinus*
Rock Dormouse	*Graphiurus platyops*
Angoni Vlei Rat	*Otomys angoniensis*
*Vlei Rat	*Otomys irroratus*
*Striped Mouse	*Rhabdomys pumilio*
Water Rat	*Dasyymys incomtus*
*Pygmy Mouse	*Mus minutoides*
*Multimammate Mouse	*Mastomys coucha*
Namaqua Rock Mouse	*Aethomys namaquensis*
*Red Veld Rat	*Aethomys chrysophilus*
**House Rat	*Rattus rattus*
*Bushveld Gerbil	*Tatera leucogaster*
*Highveld Gerbil	*Tatera brantsii*
Grey Climbing Mouse	*Dendromus melanotis*
Brant's Climbing Mouse	*Dendromus mesomelas*

Chestnut Climbing Mouse	*Dendromus mystacalis*
*Fat Mouse	*Steatomys pratensis*
*Porcupine	*Hystrix africaeaustralius*
African Weasel	*Poecilogale albinucha*
*Striped Polecat	*Ictonyx striatus*
*Large-spotted Genet	*Genetta tigrina*
*Yellow Mongoose	*Cynictis penicillata*
*Slender Mongoose	*Galerella sanguinea*
*Water or Marsh Mongoose	*Atilax paludinosus*
*Black-backed Jackal	*Canis mesomelas*
*Common Duiker	*Sylvicarpa grimmia*

* Field observations of larger mammal species recorded on the Waterfval site and surrounding Glen Austin AH during the period (1991-2013). Identification was determined by visual observations, trapping and animal tracks (footprints and droppings).

**** introduced species**

Appendix 3E: Geotechnical Report

John
Please comment on report for Jukskei View Ext 21-27 Townships (See attached overlay drawing).
Regards Dorie Potgieter.

Crossman, Pape & Associates

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REPORT NO. 06/210/P **OCTOBER 2006**

GEOTECHNICAL INVESTIGATION FOR TOWNSHIP ESTABLISHMENT OF WATERVAL LOW COST HOUSING PROJECT, MIDRAND

1. INTRODUCTION AND TERMS OF REFERENCE

At the request of Mr J Heeger of Group 5 Properties we have carried out a geotechnical investigation for township establishment of the proposed Waterval Low Cost Housing Project, Midrand. A copy of the survey map of the proposed site compiled by Theo Westerveld Professional Land Surveyor was received to facilitate the investigation. A low cost housing development is planned for the area of investigation, the exact layout of which is unknown at this stage.

The terms of reference for the investigation are as follows:

i) to establish in broad terms the nature and relevant engineering properties of the upper soil and rock strata underlying the site.

ii) to comment on suitable excavation procedures for the installation of services.

iii) to present general foundation recommendations for the proposed development.

iv) to comment on any other geotechnical aspects as these may affect the development.

2. SITE DESCRIPTION

The area of investigation covers approximately 130 hectares. The site is bounded to the north east and east by Allandale Road, to the south by an access road and concrete palisade wall of the Waterval Cemetery and by open land to the west and north west.

The area of investigation generally slopes to the north west at an approximate gradient of 1:12. The vegetation on site consists of long veld grass that had recently been burnt at the time of the field investigation as well as areas of numerous large trees in the central southern portion of the site and in the south western corner of the area of investigation. A dry drainage coarse runs south east – north west across the central and western portions of the site. Water flow

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is to the north west in this drainage coarse. A stream coarse is also orientated in a north east to south west (with flow to the south west) along the north western boundary of the site. A couple of dams are situated along this stream coarse.

3. NATURE OF THE INVESTIGATION

3.1 Fieldwork

Fifty test pits (TP1 to TP50) were excavated across the site on 23 and 24 August 2006 using a Cat 416D tractor-loader-backhoe (backacter). The test pits were excavated to refusal of the backacter or the excavation limit of the machine. All test pits were profiled in situ by an engineering geologist and where necessary disturbed and undisturbed samples were taken for laboratory testing. The positions of the test pits are shown on the site plan enclosed (Drawing No 06/210/1). Copies of the recorded test pit soil profiles are presented in Appendix A.

3.2 Laboratory Testing

The following laboratory tests were carried out on the soil samples recovered from the test pits during the field investigation.

i) Atterberg limits and particle size distribution analyses to determine basic engineering properties and to effect classification.

ii) Moisture / density and California Bearing Ratio (CBR) tests to evaluate compaction and related strength characteristics.

iii) Oedometer tests on undisturbed samples to evaluate compressibility characteristics and behaviour upon saturation.

iv) Soil chemistry tests to determine pH and electric conductivity.

Copies of the laboratory test results are presented in Appendix B.

4. SITE GEOLOGY / SOIL PROFILE

The area of investigation is underlain by **granite** of the Halfway House Granite Inlier, as well as localized diabase dykes (see test pits TP7 and TP20). Residual soils have developed from the weathering of the granite and diabase bedrock. Thin transported hillwash soils cover the residual soils across the area of investigation. Scattered areas of **hard rock granite outcrop** are also evident across the north eastern and north western portions of the site.

Based on the fieldwork the area of investigation has been divided into three geotechnical zones. The soil / rock profile within each zone is summarized below.

Zone C	-	Thin hillwash overlying pebble marker overlying localized ferricrete concretions / hardpan ferricrete overlying reworked / residual granite.
Zone C1	-	Hillwash overlying pebble marker overlying localized ferricrete concretion / hardpan ferricrete overlying collapsible reworked residual granite overlying residual granite.
Zone R	-	Hard rock granite outcrop.

These zones are based on the classification system given by the NHBRC and SAICE Code of Practice (1995). The zones are described in the following sub-sections and their approximate areal extent is shown on the site plan enclosed (Drawing No. 06/210/1).

4.1 Zone C

Zone C covers the majority of the site. The upper soil layer consists of loose to medium dense intact silty sand **transported hillwash.** The hillwash is of the order of 0,15m to 0,9m thick (average thickness 0,3m) and is generally underlain by a **transported pebble marker** consisting of loose to medium dense fine to coarse quartz gravel and scattered ferricrete concretions. The pebble marker extends to depths varying between 0,25m and 1,0m (average depth 0,55m).

The hillwash and pebble marker are locally underlain by medium dense of dense and loose to medium dense in places ferruginised **ferricrete concretions** with zones of hardpan ferricrete. This ferricrete layer extends to depths varying between 0,55m and 1,2m (average depth 0,8m). Refusal of the backacter was obtained on soft rock consistency **hardpan ferricrete** in test pits TP1, TP41, TP42 and TP44 at depths varying between 0,55m and 1,2m (average depth 0,85m).

The hillwash, pebble marker and ferricrete layer are underlain by medium dense to dense or dense and firm to stiff or stiff in places cemented and ferruginised silty sand and clayey silty sand in places **reworked residual granite.** The reworked residual granite extends to depths varying between 0,9m and 2,5m (average depth 1,65m). The excavation limit of the backacter was obtained at 3,0m depth within the reworked residual granite in test pits TP13, TP15, TP16 and TP32.
The reworked residual granite is underlain by medium dense to dense or dense jointed silty sand **residual granite.** The residual granite occurs at depths varying between 0,3m and 2,3m (average depth 1,3m). The excavation limit of the backacter was obtained at 3,0m depth within the residual granite in test pits TP3, TP6, TP8, TP9, TP12, TP14, TP22, TP26, TP33, TP38 and TP49. Refusal of the backacter was obtained at depths

varying between 1,0m and 2,8m (average depth 1,75m) on **very soft rock granite / soft rock granite** in the remaining test pits within Zone C.

The hillwash and pebble marker are locally underlain by medium dense becoming stiff with depth ferruginised silty sand / clayey silty sand **reworked residual diabase** to a depth of 2,2m in test pit TP7. The hillwash and reworked residual diabase are underlain by very stiff to very soft rock or dense to very dense jointed clayey silty sand or silty fine sand **residual diabase** at depths of 2,2m and 0,25m in test pits TP7 and TP20 respectively. Refusal of the backacter was obtained on **soft rock diabase** at 2,6m and 1,0m in these respective test pits.

4.2 Zone C1

Zone C1 occurs as a few isolated areas across the area of investigation. The upper soil layer consists of the medium dense intact **transported hillwash** of the order of 0,3m to 0,7m thickness (average thickness 0,5m). The hillwash is generally underlain by a **transported pebble marker** consisting of medium dense silty sand with abundant fine to coarse quartz gravel and scattered ferricrete nodules. The pebble marker extends to depths varying between 0,8m and 1,0m (average depth 0,9m).

The pebble marker is locally underlain by dense ferruginised **ferricrete concretions** and zones of hardpan ferricrete in a matrix of silty sand to a depth of 0,9m in test pit TP34.

The pebble marker and ferricrete layer are underlain by loose to medium dense weakly cemented and ferruginised silty sand **reworked residual granite**. The reworked residual granite extends to depths varying between 1,5m and 1,7m (average depth 1,55m). The reworked residual granite is underlain by dense and medium dense in places jointed silty sand or slightly clayey silty sand **residual granite** at depths varying between 1,5m and 1,7m (average depth 1,55m). The excavation limit of the backacter was obtained at 3,0m depth in test pits TP18 and TP2 within the residual granite. Refusal of the backacter was obtained on **very soft rock granite / soft rock granite** at depths varying between 1,9m and 2,6m (average depth 2,2m) in test pits TP10, TP11 and TP34.

4.3 Zone R

Zone R occurs as scattered **hard rock granite outcrop** at surface across the north eastern and north western portions of the site.

4.4 Water Table

No perched water table or zones of seepage were observed within any of the test pits across the area of investigation.

5. EXCAVATION PROCEDURES

Excavation procedures for earthworks have been evaluated according to the South African Bureau of Standards standardised classification for earthworks (SABS 1200D, DA and DB). According to this classification the area of investigation classifies as **soft excavation** to depths varying between 0,55m and 3,0m (average depth 2,2m). Below these depths the site classifies as **intermediate excavation** on very soft rock consistency hardpan ferricrete and/or very soft rock granite. It is anticipated that the intermediate excavation material would have a thickness of the order of 0,5m to 1,0m below which depths soft excavation may again be encountered below the localized hardpan ferricrete. It is anticipated that where the intermediate excavation material comprises very soft rock granite then the thickness of intermediate excavation material would be of the order of 0,5m, below which depth **hard rock excavation** would be envisaged upon soft rock or better granite bedrock. Such bedrock would require excavation by **blasting**.

Areas of hard rock granite outcrop (Zone R) would require **blasting** from surface.

Notwithstanding the above localized hard rock excavation in the form of hard rock granite corestones could be encountered at random depths within the reworked / residual granite. Large corestones may require blasting prior to removal to spoil.

Further to the comments mentioned above it should be noted that the following would have been required to quantify blast rock to a reasonable degree of accuracy.

- The site would have had to be cleared to expose all granite rock outcrop. Without the clearing of the vegetation extensive areas of outcrop could be missed due to visibility constraints.

- The extent of the outcrop and its location would have had to be surveyed.

- An extensive test pitting operation would then have had to be carried out on the site as part of a detailed geotechnical investigation to evaluate the quantity of rock which may be located at shallow depth below ground surface, that is, sub-outcrop. The test pits would have to be spaced a minimum distance of 30m apart in this instance. Prior to such an exercise being undertaken all stands would have to be clearly pegged on site.

6. GENERAL EVALUATION OF FOUNDING CONDITIONS AND FOUNDING RECOMMENDATIONS

6.1 Zone C

The **hillwash and pebble marker covering Zone C** are considered to be highly compressible / collapsible. These soil layers are **unsuitable** as **founding layers**, even for lightly loaded structures.

Conventional strip / spread foundations for the structures should be placed within the medium dense or better reworked residual granite and/or the very soft rock consistency hardpan ferricrete. The reworked residual granite / hardpan ferricrete is located at depths varying between 0,25m and 1,4m (average depth 0,65m). An allowable bearing pressure of 200kPa is applicable to the hardpan ferricrete and reworked residual granite, under which load conditions total and differential settlements would be insignificant.

Should higher bearing pressures be required then conventional and/or deeper than normal strip spread foundations should be taken down to the medium dense or better residual granite. The residual granite occurs at depths varying between 0,3m and 2,3m (average depth 1,3m). An allowable bearing pressure of 300kPa is applicable to this founding layer. Under these load conditions total and differential settlements would be insignificant.

6.2 Zone C1

The hillwash, pebble marker and reworked residual granite within Zone C1 are considered to be highly compressible. The reworked residual granite is considered to be potentially highly collapsible at bearing pressures in excess of 40kPa. These soil layers are thus unsuitable as founding layers, even for lightly loaded structures.

Conventional strip / spread foundations could be taken down to the loose to medium dense reworked residual granite occurring at depths varying between 0,8m and 1,0m. The allowable bearing pressure would however have to be limited to 40kPa under these conditions. Total and differential settlements would be insignificant under these load conditions.

Deeper than normal strip / spread foundations or alternatively mass concrete piers with ground beams to carry all the brickwork should be taken down to the medium dense to dense or better reworked / residual granite. The reworked / residual granite occurs at depths varying between 1,4m and 1,7m (average depth 1,55m). An allowable bearing pressure of 300kPa is applicable to this founding layer, under which load conditions total and differential settlements would be insignificant.

6.3 Zone R

Conventional strip / spread foundations could be placed directly upon the granite outcrop within Zone R. An allowable bearing pressure of 1500kPa is applicable to the granite outcrop, under which load conditions total and differential settlements would be insignificant. It is noted however that practically a bearing pressure probably of a maximum of 200kPa would be adopted for residential structures. It is however envisaged that difficulties would be encountered in forming foundation excavations in the granite outcrop, that is, overbreak would probably occur after blasting.

Consideration should therefore be given to raising levels by forming engineered terrace platform above the granite outcrop of Zone R. Foundation excavations could then be taken down to granite bedrock. Alternatively these areas of outcrop could be used as **parkland.**

In addition to the above comments and recommendations it is noted that the in situ soils across the whole site are inert, that is, non-expansive. The in situ soils across the site are essentially a silty sand with localized zones of clayey silty sand. The foundation indicator tests carried out on disturbed samples of the in situ soils confirm that the on site soils are non-expansive (see Appendix B).

7. GENERAL

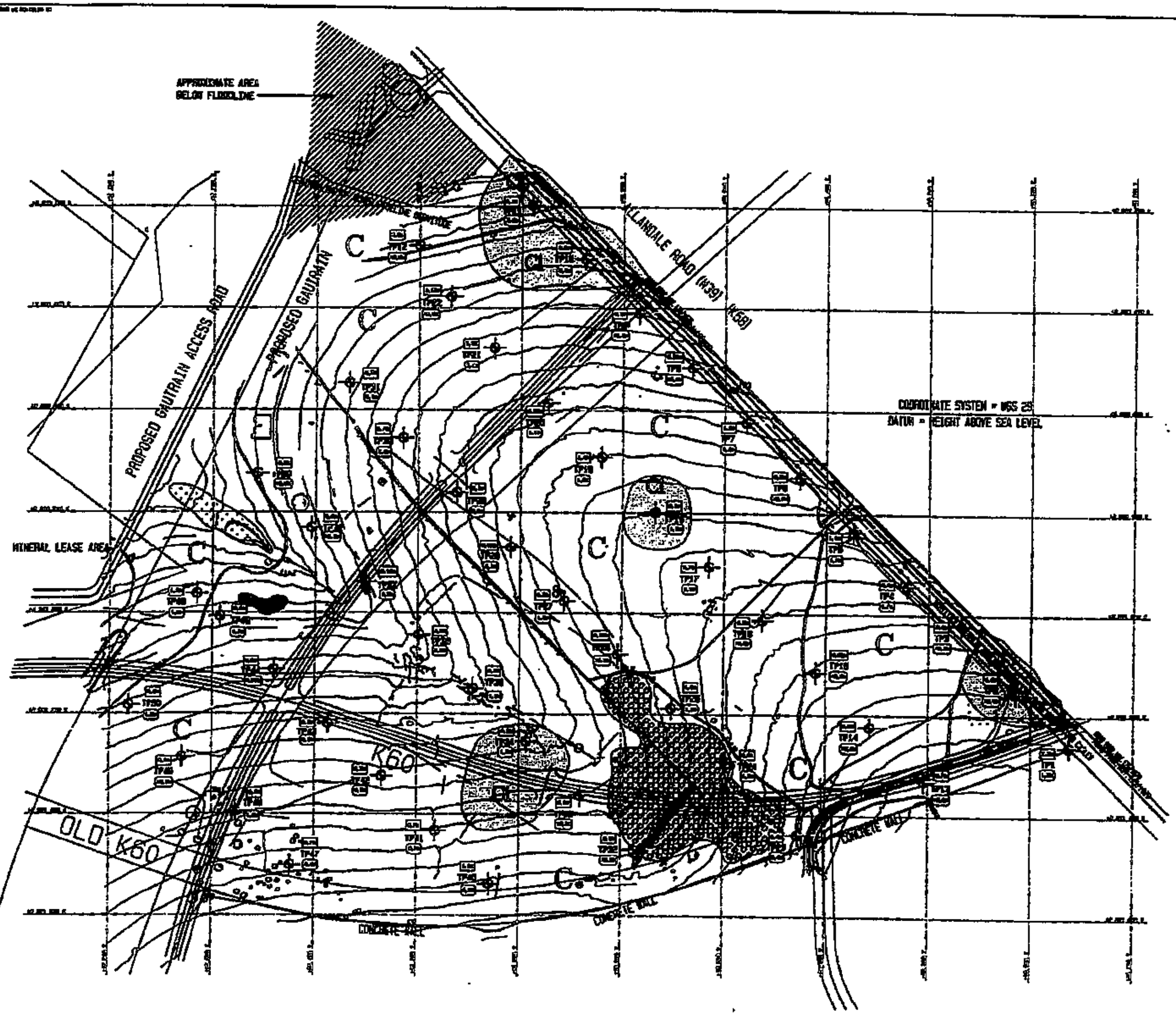
The following additional points are considered pertinent to the overall design / construction of the development.

- The present investigation is of a general nature and as such, zonal boundaries are approximate. Further geotechnical work would be required to define zonal boundaries accurately and to determine the depth of recommended founding layers for individual stands. This could be achieved during a Phase 2 investigation by the profiling the trenches for the bulk services.

- Although no zones of seepage were encountered in the test pits, perched water table conditions could develop at shallow depth in the long term above the granite outcrop within or near Zone R and above the localised hardpan ferricrete (Zone C) during or shortly after periods of heavy and/or continuous rainfall. This needs to be taken into account in the design and construction of structures and roads in these areas. This may involve the installation of a series of suitably designed sub-surface cut-off drains, upslope of roads situated parallel or sub-parallel to the contour.

T PAPE Pr.Sci.Nat J DAVEL

CROSSMAN, PAPE & ASSOCIATES



GEOTECHNICAL ZONE	DESCRIPTION
C	THIN HILLWASH / PEBBLEMARKER / LOCALISED FERRICRETE CONCRETIONS / HARDPAN FERRICRETE / REWORKED / RESIDUAL GRANITE
C1	HILLWASH / PEBBLEMARKER / FERRICRETE CONCRETIONS / COLLAPSIBLE REWORKED RESIDUAL GRANITE / RESIDUAL GRANITE
	HARD ROCK GRANITE OUTCROP

LEGEND

TP3 TEST PIT

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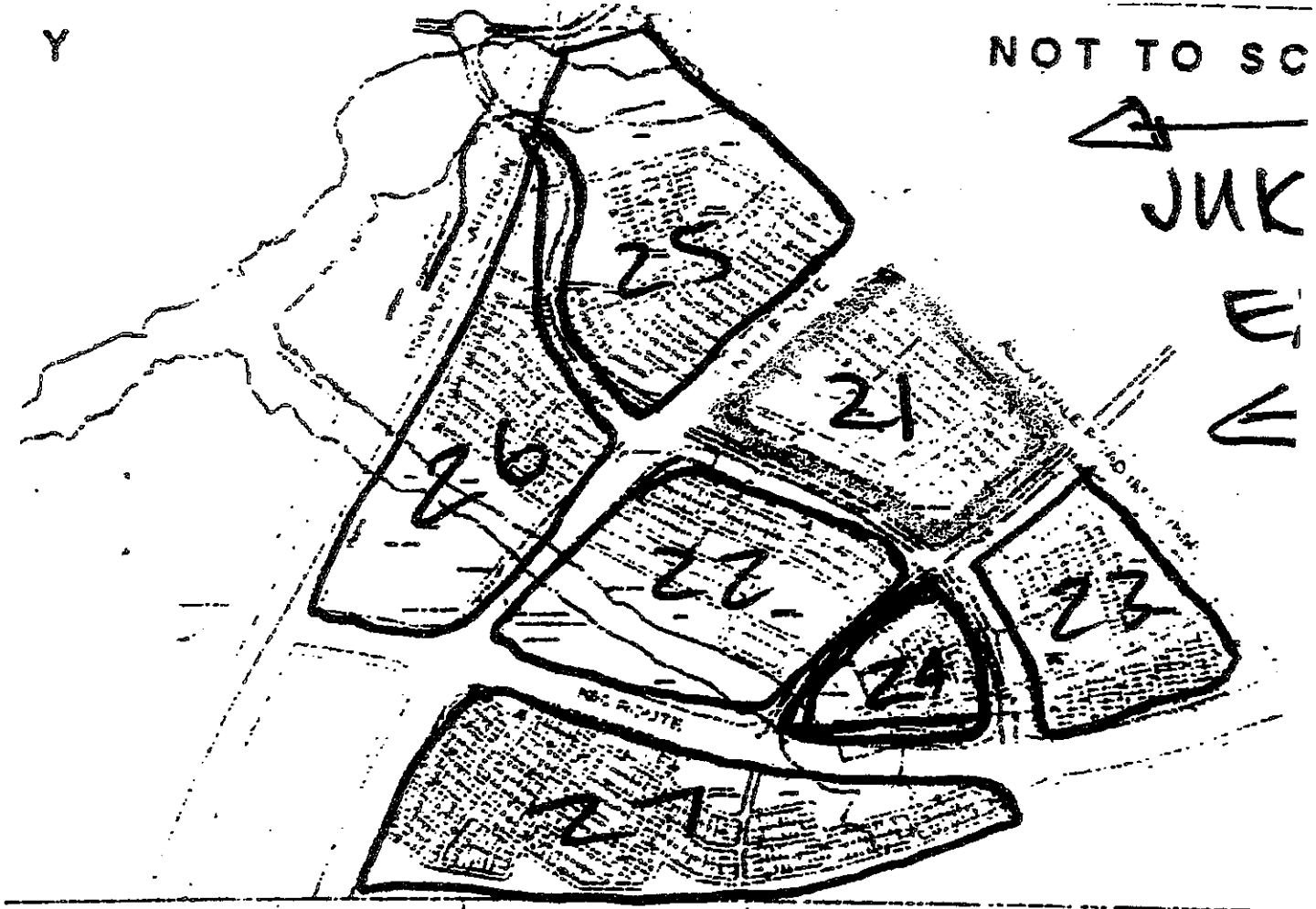
06/210/1



NE	No. OF ERVEN	AREA (ha)	% TOWNSHIP	ERF NU
1 1a)	117	3.6663ha	18.9%	1 -
)				

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HOLE No: TP1
Sheet 1 of 1

JOB NUMBER: 06/210/P

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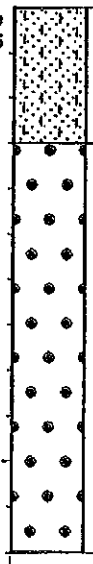

0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist grey yellow brown mottled and blotched orange brown and black. Overall consistency is medium dense ferruginised nodular ferricrete with zones of harpan ferricrete in a matrix of silty sand. Pedogenic.

1.20

NOTES

1) Refusal at 1,2m on soft rock consistency hardpan ferricrete.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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DIAM :
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DATE : 23/08/2006
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X-COORD :
Y-COORD :

HOLE No: TP1

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HOLE No: TP2
Sheet 1 of 1

JOB NUMBER: 06/210/P

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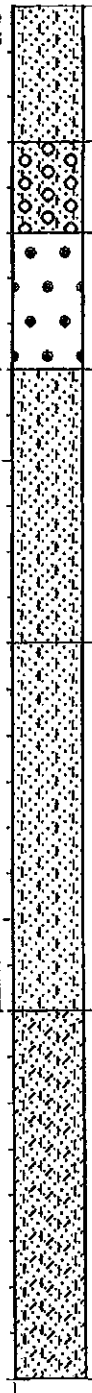

0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.50 Moist yellow brown blotched and mottled red/orange brown and black loose ferruginised ferricrete concretions and small zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.

0.80 Moist grey blotched orange brown and black loose to medium dense or medium dense in places ferruginised silty sand with abundant ferricrete concretions. Reworked residual granite.

1.40 As above but medium dense to dense with zones of slightly clayey silty sand.

2.20 Moist yellow brown speckled black and blotched grey and orange brown medium dense and medium dense to dense in places jointed slightly clayey silty sand. Residual granite with zones of reworked residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 0,8--2,2m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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HOLE No: TP2

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HOLE No: TP3
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist yellow grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel with scattered ferricrete nodules. Pebble marker.

0.60 Moist yellow brown mottled red/orange brown and black medium dense ferruginised ferricrete concretions in a matrix of silty sand. Pedogenic.

0.80 Moist grey brown blotched red yellow orange brown and black dense strongly cemented and ferruginised silty sand. Reworked residual granite.

1.80 Moist to very moist orange brown medium dense to dense jointed slightly clayey silty sand. Redidual granite with scattered zones of reworked residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 1,8--3,0m.

CONTRACTOR :
MACHINE : Cat 416 D
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PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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HOLE No: TP3

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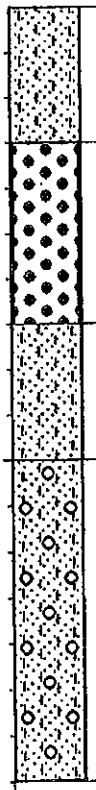
HOLE No: TP4
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist grey brown blotched orange brown and black. Overall consistency is dense ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.

0.70 Moist grey brown blotched orange brown dense strongly cemented and ferruginised silty sand. Reworked residual granite.

1.00 Moist yellow brown speckled off white dense to very dense jointed fine gravelly silty sand. Residual granite.

1.70

NOTES

1) Refusal at 1,7m on very soft rock granite.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel
TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

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HOLE No: TP4

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Housing Project Midrand

HOLE No: TP5
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15

0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.40	Moist grey brown blotched orange brown and black. Overall consistency is dense ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.
0.80	Moist yellow brown loose weakly cemented and ferruginised silty sand. Reworked residual granite.
1.10	As above but grey brown blotched oragne brown medium dense to dense cemented and ferruginised.
1.40	Moist brown speckled black and off white dense to very dense jointed silty sand. Residual granite.
1.70	

NOTES

1) Refusal at 1,7m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 1,0--0,4m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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HOLE No: TP5

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HOLE No: TP6
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist grey brown blotched orange brown and black. Overall consistency is dense ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.

0.90 Moist grey brown blotched yellow brown dense strongly cemented and ferruginised silty sand. Reworked residual granite.

2.00 Moist orange brown speckled off white medium dense to dense jointed slightly clayey silty sand. Residual granite with scattered zones of reworked residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 0,9--2,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP6

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Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP7
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist yellow brown medium dense intact silty sand, Hillwash. Also contains abundant roots in upper 0,15m.

0.90 As above but contains abundant fine to medium quartz gravel and scattered ferricrete nodules. Pebble marker.

1.10 Moist yellow brown blotched orange brown medium dense cemented and ferruginised silty sand, Reworked residual diabase.

1.90 As above but stiff clayey silty sand.

2.20 Moist dark brown grey brown streaked black very stiff to very soft rock jointed clayey silty sand. Residual diabase.

2.60

NOTES

1) Refusal at 2,6m on soft rock diabase.

2) No evidence of water.

3) Disturbed soil sample taken from 0,9--1,9m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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HOLE No: TP7

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Group Five Properties
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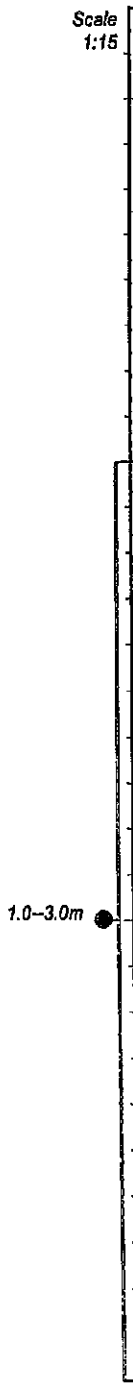
Housing Project Midrand

HOLE No: TP8
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.20 As above but yellow brown with abundant fine to medium quartz gravel and scattered ferricrete nodules. Pebble marker.

0.45 Moist yellow brown blotched red orange brown and black medium dense and medium dense to dense in places ferruginised and cemented silty sand. Reworked residual granite.

1.00 Moist yellow brown speckled off white and black medium dense to dense jointed silty sand. Residual granite.

2.70 As above but dense.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 1,0--3,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP8

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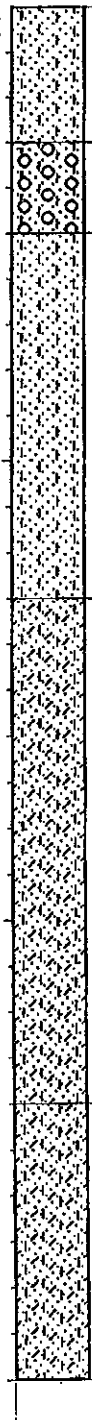
Housing Project Midrand

HOLE No: TP9
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00 Moist dark brown grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel with scattered ferricrete nodules. Pebble marker.

0.50 Moist grey brown blotched dark brown and black medium dense to dense strongly cemented and ferruginised silty sand. Reworked residual granite.

1.30 Moist to very moist yellow brown speckled off white medium dense to dense jointed slightly clayey silty sand. Residual granite.

2.40 As above but medium dense.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP9

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Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP10
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15

0.00	Moist yellow brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.60	As above but contains abundant fine to medium quartz gravel and scattered ferricrete nodules. Pebble marker.
0.80	Moist grey brown blotched red orange brown and black loose to medium dense and medium dense in places weakly cemented and ferruginised silty sand. Reworked residual granite with zones of residual granite.
1.50	Moist orange brown speckled off white dense jointed silty sand. Residual granite.
2.00	

NOTES

1) Refusal at 2,0m on very soft rock granite.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel
TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006
DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP10

Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP11
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist dark brown grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.60 As above but contains abundant fine to coarse quartz gravel with scattered ferricrete nodules. Pebble marker.

1.00 Moist to very moist grey brown blotched and mottled orange brown and black loose to medium dense weakly ferruginised and cemented silty sand. Reworked residual granite.

1.50 Moist orange brown speckled off white dense and medium dense to dense in places jointed silty sand with zones of slightly clayey silty sand. Residual granite with zones of reworked residual granite.

2.60

NOTES

1) Refusal at 2,6m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,1--0,6m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP11

D001

dot.PLOT 4007 J&W

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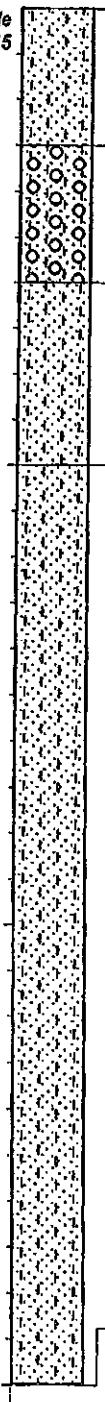
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP12
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.60 Moist yellow brown blotched red orange brown medium dense cemented and ferruginised silty sand. Reworked residual granite.

1.00 Moist yellow orange brown speckled off white medium dense to dense jointed silty sand. Residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel

TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006

DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP12

D001

dot.PLOT 4007 J&W

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Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP13
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 — Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 — As above but contains abundant fine to coarse quartz gravel with scattered ferricret concretions. Pebble marker.

0.70 — Moist grey blotched red orange brown and black medium dense and loose to medium dense in places cemented and ferruginised silty sand. Reworked residual granite.

1.10 — As above but dense.

1.70 — Moist to very moist red orange brown loose to medium dense weakly ferruginised silty sand with zones of gravelly silty sand. Reworked residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 0,7--1,7m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP13

D001

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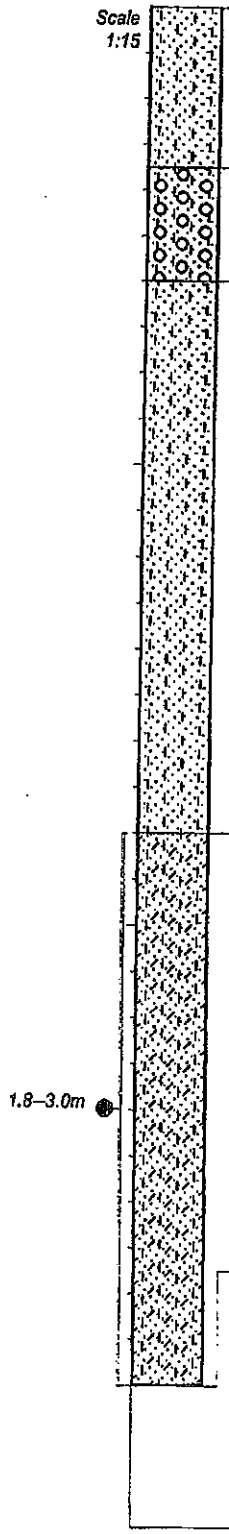
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP14
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.35 As above but medium dense contains abundant fine to coarse quartz gravel with scattered ferricrete nodules. Pebble marker.

0.60 Moist grey brown blotched yellow orange brown and black dense and medium dense in places strongly cemented and ferruginised silty sand. Reworked residual granite.

1.80 Moist orange speckled off white and black dense jointed slightly clayey silty sand. Residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 1,8--3,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP14

D001

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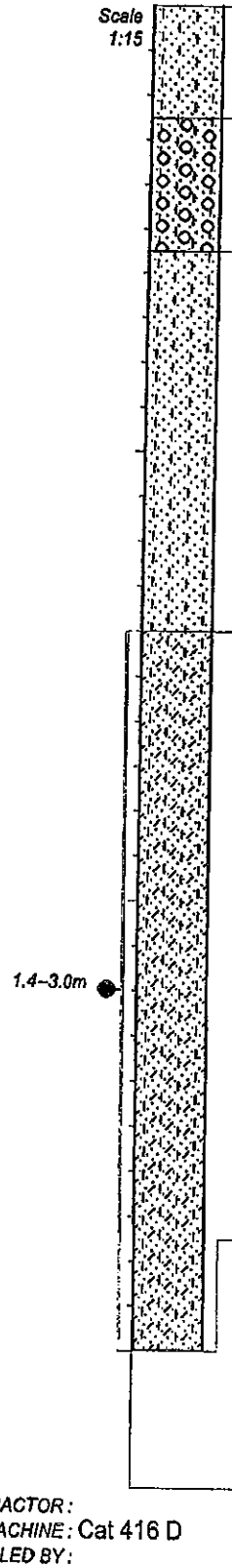
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP15
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.25 As above but loose to medium dense with abundant fine to coarse quartz gravel and scattered ferricrete concretions. Pebble marker.

0.55 Moist grey brown blotched red orange brown and black dense strongly cemented and ferruginised silty sand. Reworked residual granite.

1.40 As above but stiff clayey silty sand.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 1,4--3,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP15

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Group Five Properties
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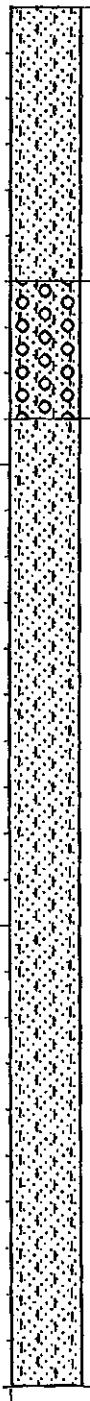
Housing Project Midrand

HOLE No: TP16
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.60 As above but contains abundant fine to coarse quartz gravel with scattered ferricrete concretions. Pebble marker.

0.90 Moist yellow brown mottled and blotched red brown and black dense strongly cemented and ferruginised silty sand with zones of slightly clayey silty sand and abundant ferricrete concretions and quartz gravel. Reworked residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel

TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006

DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP16

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Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP17
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist red brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.70 Moist red brown yellow brown mottled and blotched dark brown and black medium dense to dense and loose to medium dense in places ferruginised and cemented silty sand. Reworked residual granite.

1.50 Moist orange brown speckled off white dense jointed silty sand. Residual granite.

2.50

NOTES

1) Refusal at 2,5m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,7--1,5m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

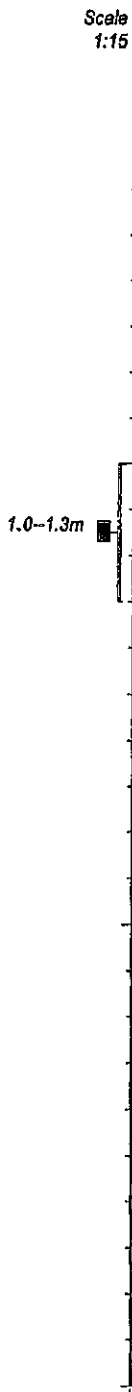
HOLE No: TP17

Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP18
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00 Moist red brown dark brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.70 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.90 Moist to very moist red orange brown loose to medium dense weakly ferruginised silty sand. Reworked residual granite.

1.50 Moist orange brown speckled off white dense jointed silty sand. Residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Undisturbed soil sample taken from 1,0--1,3m.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel

TYPE SET BY: GIII
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006

DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP18

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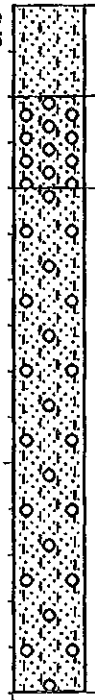
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP19
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.20	As above but contains abundant fine to coarse quartz gravel. Pebble marker.
0.40	Moist orange brown dense and very dense in places jointed fine gravelly silty sand. Residual granite with scattered zones of reworked residual granite.
1.50	

NOTES

1) Refusal at 1,5m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP19

D001

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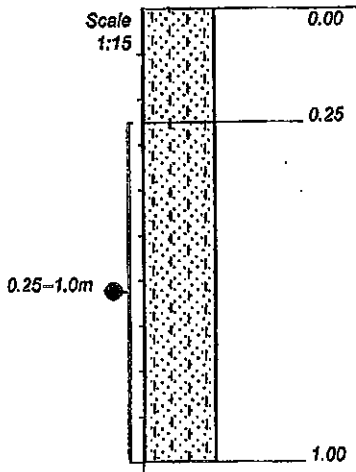
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP20
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 – Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.25 – Moist green yellow brown dense to very dense jointed silty fine sand. Residual diabase.

1.00

NOTES

1) Refusal at 1,0m on very soft rock diabase.

2) No evidence of water.

3) Disturbed soil sample taken from 0,25--1,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
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ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP20

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Group Five Properties
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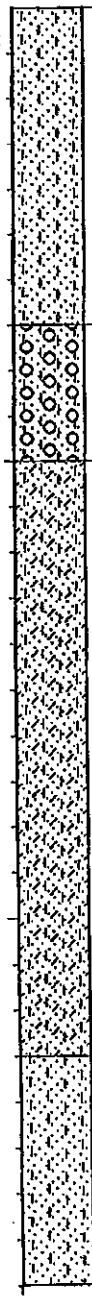
Housing Project Midrand

HOLE No: TP21
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.70 As above but yellow brown with abundant fine to coarse quartz gravel and scattered ferricrete nodules. Pebble marker.

1.00 Moist yellow brown grey brown blotched and mottled orange brown or black medium dense to dense and medium dense in places ferruginised and cemented slightly clayey silty sand. Reworked residual granite with scattered zones of residual granite.

2.30 Moist yellow brown speckled off white and black dense jointed silty sand. Residual granite.

2.80

NOTES

1) Refusal at 2,8m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP21

D001

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Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP22
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist dark brown grey brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel with scattered ferricrete nodules. Pebble marker.

0.55 Moist yellow grey brown blotched red orange brown medium dense and loose to medium dense in places cemented and ferruginised silty sand. Reworked residual granite.

1.10 Moist yellow brown speckled off white medium dense to dense and medium dense in places jointed silty sand. Residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 0,55--1,1m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP22

D001

dot.PLOT 4007 J&W

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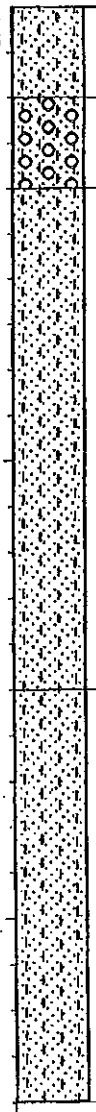
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP23
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.20 As above but contains abundant fine to coarse quartz gravel with scattered ferricret concretions. Pebble marker.

0.40 Moist grey brown blotched orange brown and black medium dense to dense and medium dense in places cemented and ferruginised silty sand. Reworked residual granite.

1.50 Moist yellow brown speckled black and off white dense and medium dense to dense in places jointed silty sand. Residual granite.

2.40

NOTES

1) Refusal at 2,4m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP23

D001

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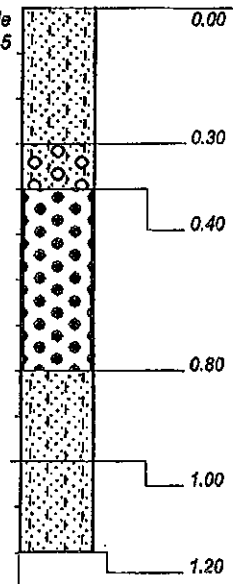
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP24
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.30	As above but contains abundant fine to coarse quartz gravel. Pebble marker.
0.40	Moist grey brown blotched orange brown and black. Overall consistency is medium dense ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.
0.80	Moist grey brown blotched orange brown and black medium dense to dense and loose to medium dense in places ferruginised and cemented silty sand. Reworked residual granite.
1.00	Moist yellow brown speckled off white and black dense to very dense jointed silty sand. Residual granite.
1.20	

NOTES

1) Refusal at 1,2m on very soft rock granite.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel

TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006

DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP24

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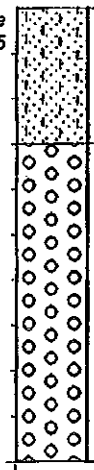
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP25
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist dark brown orange brown overall consistency is medium dense to dense ferruginised silty sand with abundant fine to coarse quartz and granite gravel and ferricrete concretions. Pebble marker.

1.00

NOTES

1) Refusal at 1,0m on very soft rock/soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP25

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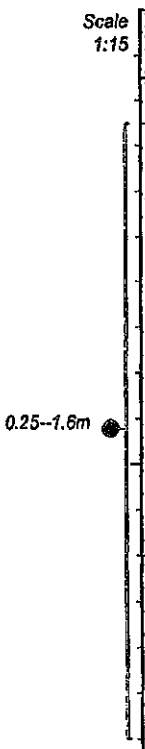
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP26
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00	Moist dark brown grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.15	As above but contains abundant fine to coarse quartz gravel with scattered ferricrete concretions. Pebble marker.
0.25	Moist red brown speckled off white blotched grey and yellow brown medium dense and medium dense to dense in places jointed silty sand. Residual granite with zones of reworked residual granite.
1.20	As above but medium dense to dense and dense in places.
1.60	Moist yellow brown speckled off white medium dense jointed silty sand. Residual granite.
3.00	

NOTES

1) No refusal at 3,0m.

2) No evidenence of water.

3) Disturbed soil sample taken from 0,25--1,6m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP26

D001

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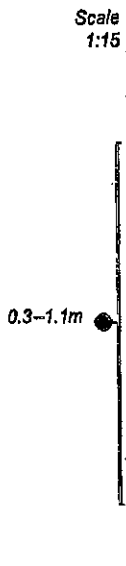
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP27
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist red orange brown speckled off white blotched dark brown orange brown dense jointed silty sand. Residual granite with zones of reworked residual granite.

1.10 As above but dense to very dense.

1.20

NOTES

1) Refusal at 1,2m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,3--1,1m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP27

D001

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Group Five Properties
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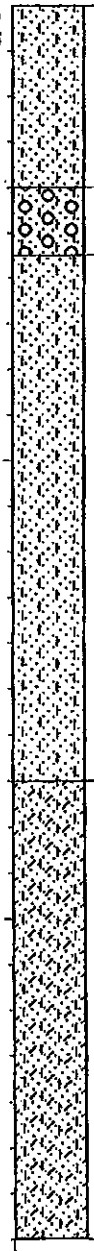
Housing Project Midrand

HOLE No: TP28
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.55 Moist grey blotched red orange brown and black dense and medium dense to dense in places strongly cemented and ferruginised silty sand. Reworked residual granite.

1.70 Moist to very moist orange brown speckled off white dense jointed slightly clayey silty sand. Residual granite.

2.70

NOTES

1) Refusal at 2,7m on very soft rock granite.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel

TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006

DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP28

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Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP29
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.15	As above but contains abundant fine to coarse quartz gravel. Pebble marker.
0.25	Moist grey brown blotched orange brown and black overall consistency is loose to medium dense and medium dense in places ferruginised ferricrete concretions with zones of hardpan ferricret in a matrix of silty sand. Pedogenic.
0.80	Moist dark brown grey brown blotched and mottled orange brown and black dense strongly cemented and ferruginised silty sand. Reworked residual granite.
1.50	As above but firm to stiff clayey silty sand with zones of residual granite.
2.50	

NOTES

1) Refusal at 2,5m on soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 1,5–2,5m.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel
TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006
DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP29

D001

dot.PLOT 4007 J&W

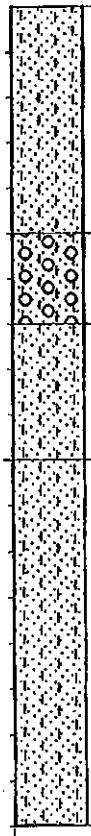
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP30
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown yellow brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.50 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.70 Moist yellow brown mottled and blotched orange brown and black medium dense and loose to medium dense in places cemented and ferruginised silty sand. Reworked residual granite.

1.00 Moist orange brown speckled off white and black dense jointed silty sand. Residual granite.

1.80

NOTES

1) Refusal at 1,8m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP30

D001

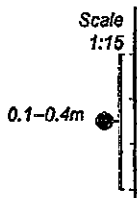
dol.PLOT 4007 J&W

Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP31
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00 — Moist dark brown grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40 — As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.50 — Moist dark brown blotched orange brown and black with zones of yellow brown medium dense and loose to medium dense in places cemented and ferruginised silty sand. Reworked residual granite with abundant zones of residual granite.

0.90 — Moist yellow orange brown blotched dark brown and black dense jointed silty sand with zones of gravelly silty sand. Residual granite with zones of reworked residual granite.

2.10

NOTES

1) Refusal at 2,1m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,1--0,4m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP31

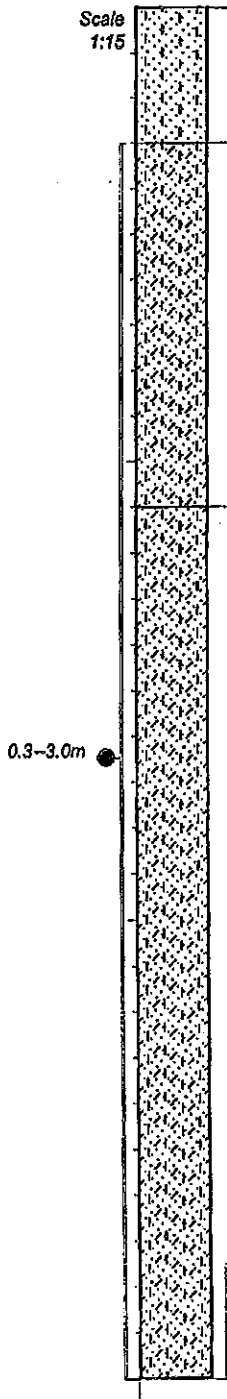
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP32
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist to very moist grey brown blotched orange brown stiff strongly cemented and ferruginised clayey silty sand. Reworked residual granite.

1.10 As above but firm to stiff and stiff in places.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 0,3--3,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP32

dot.PLOT 4007 J&W

Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP33
Sheet 1 of 1

JOB NUMBER: 06/210/P

0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.60 Moist to very moist grey brown blotched orange brown stiff strongly cemented and ferruginised clayey silty sand. Reworked residual granite.

1.60 Moist to very moist grey brown orange brown dense jointed slightly clayey silty sand with zones of clayey silty sand. Residual granite with zones of reworked residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Undisturbed saoil sample taken from 0,3--0,5m.

4) Disturbed saoil sample taken from 0,6--1,6m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP33

D001

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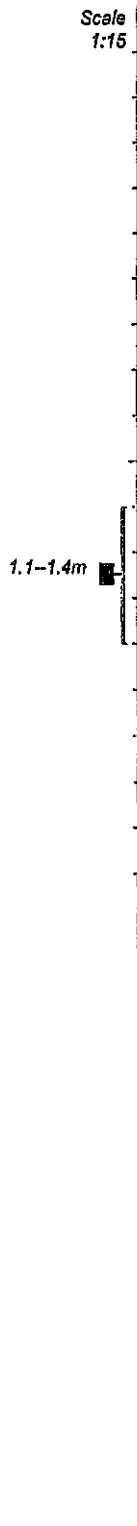
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP34
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist yellow brown medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist grey brown blotched orange brown and black. Overall consistency is dense ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.

0.90 Moist light grey brown blotched and mottled orange brown and black loose to medium dense weakly cemented and ferruginised silty sand. Reworked residual granite.

1.70 Moist yellow brown speckled off white and black blotched grey brown dense jointed slighlty clayey silty sand. Residual granite with zones of reworked residual granite.

1.90

NOTES

1) Refusal at 1,9m on soft rock granite.

2) No evidence of water.

3) Undisturbed soil sample taken from 1,1--1,4m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP34

D001

dot.PLOT 4007 J&W

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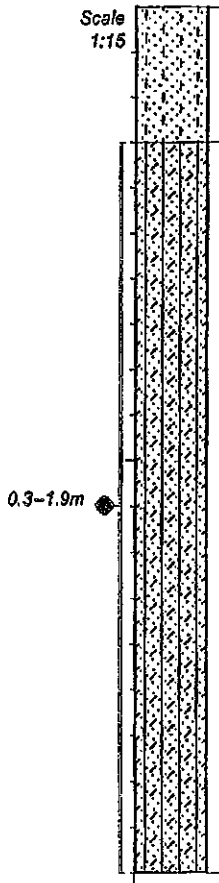
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP35
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 Moist yellow grey brown blotched orange brown and black stiff strongly ferruginised and cemented slightly clayey silt sand with zones of silty sand. Reworked residual granite.

1.90

NOTES

1) Refusal at 1,9m on soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,3--1,9m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP35

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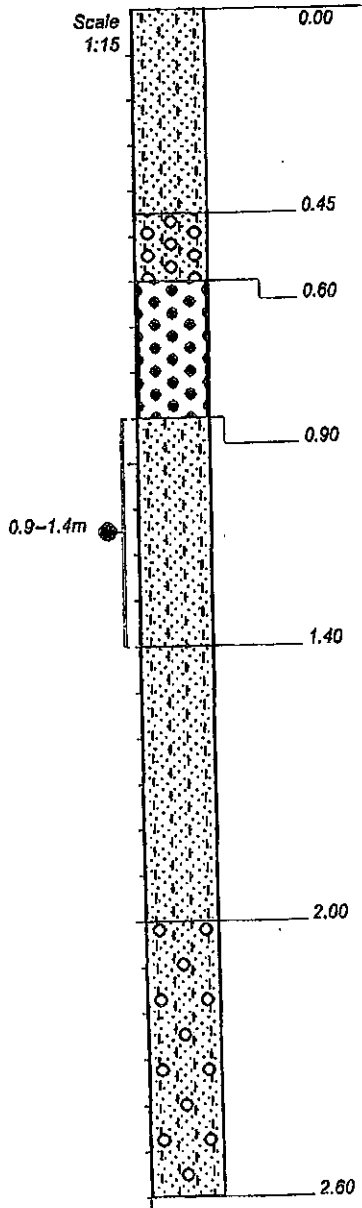
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP36
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.45	As above but contains abundant fine to coarse quartz gravel and scattered ferricrete concretions. Pebble marker.
0.60	Moist grey brown blotched orange brown and black. Overall consistency is medium dense to dense and dense in places ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.
0.90	Moist grey brown blotched orange brown with zones of yellow brown dense strongly cemented and ferrugnised silty sand with zones of slightly clayey silty sand. Reworked residual granite with zones of residual granite.
1.40	Moist yellow brown blotched dark brown and grey dense jointed silty sand. Residual granite with zones or reworked residual granite.
2.00	As above but gravelly silty sand.
2.60	

NOTES

1) Refusal at 2,6m on soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,9--1,4m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP36

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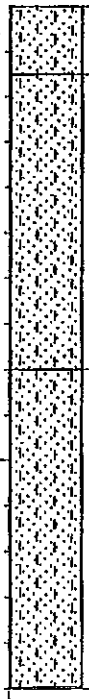
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP37
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.15 Moist yellow grey brown blotched orange brown and black dense strongly cemented and ferruginised silty sand. Reworked residual granite.

0.80 Moist orange brown speckled off white and black dense jointed silty sand. Residual granite.

1.50

NOTES

1) Refusal at 1,5m on soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP37

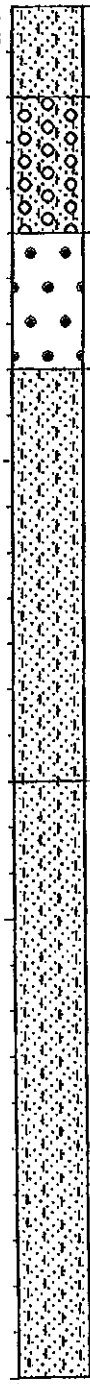
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP38
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 — Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.20 — As above but contains abundant fine to coarse quartz gravel with scattered ferricrete concretions. Pebble marker.

0.50 — Moist yellow brown blotched and mottled orange brown and black loose to medium dense and medium dense in places ferruginised ferricrete concretions with minor zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.

0.80 — Moist yellow grey brown blotched orange brown and black dense strongly cemented and ferruginised silty sand. Reworked residual granite.

1.70 — Moist orange brown speckled off white medium dense to dense and dense in places jointed silty sand. Residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP38

D001

dot.PLOT 4007 J&W

Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP39
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15

0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.50 Moist yellow grey brown blotched red orange brown medium dense and loose to medium dense in places cemented and ferruginised silty sand. Reworked residual granite.

0.80 As above but medium dense to dense.

1.20 Moist orange brown speckled off white medium dense to dense jointed silty sand. Residual granite.

3.00

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 1,2--3,0m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP39

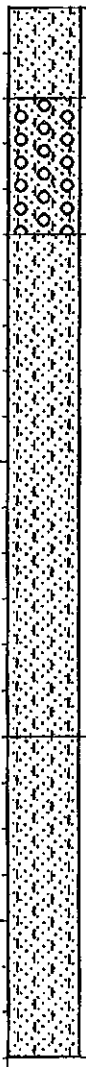
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP40
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.20	As above but contains abundant fine to coarse quartz gravel and scattered ferricrete concretions. Pebble marker.
0.50	Moist orange brown blotched grey brown and dark brown dense and medium dense to dense in places strongly cemented and ferruginised silty sand. Reworked residual granite.
1.60	Moist orange brown speckled off white dense jointed silty sand. Residual granite.
2.30	

NOTES

1) Refusal at 2,3m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

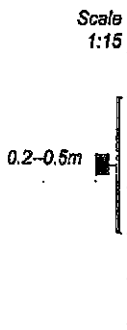
HOLE No: TP40

Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP41
Sheet 1 of 1

JOB NUMBER: 06/210/P



0.00 Moist light yellow brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.70

NOTES

1) Refusal at 0,7m on soft rock consistency hardpan ferricrete.

2) No evidence of water.

3) Undisturbed soil sample taken from 0,2--0,5m.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel
TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006
DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP41

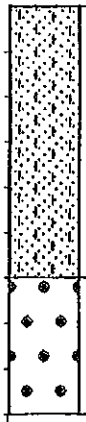
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP42
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist yellow brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.60 Moist light grey brown with zones of orange brown mottled black. Overall consistency is dense strongly ferruginised ferricrete concretions with abundant zones of hardpan ferricrete. Pedogenic.

0.90

NOTES

1) Refusal at 0,9m on soft rock consistency hardpan ferricrete.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP42

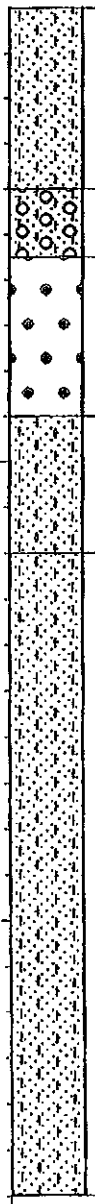
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP43
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.55 Moist yellow brown blotched and mottled red brown and black. Overall consistency is loose to medium dense and medium dense in places ferruginised ferricrete concretions with zones of hardpan ferricrete in a matrix of silty sand. Pedogenic.

0.90 Moist orange brown speckled off white blotched dark brown and black medium dense to dense and medium dense in places jointed silty sand. Residual granite with abundant zones of reworked residual granite.

1.20 Moist orange brown speckled off white medium dense to dense and dense in places jointed silty sand. Residual granite.

2.60

NOTES

1) Refusal at 2,6m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP43

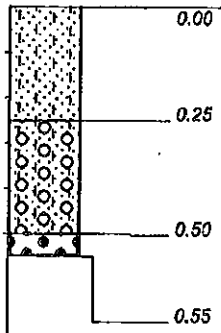
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP44
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.25	As above but medium dense to dense with scattered ferricrete concretions and abundant fine to coarse quartz gravel. Pebble marker.
0.50	Moist red orange brown mottled black dense to very dense strongly ferruginised hardpan ferricrete. Pedogenic.
0.55	

NOTES

1) Refusal at 0,55m on soft rock consistency hardpan ferricrete.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP44

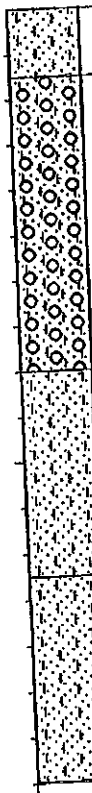
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP45
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.15 As above but loose and medium dense to dense in places with abundant ferricrete concretions and zones of hardpan ferricrete and fine to coarse quartz gravel. Pebble marker.

0.80 Moist grey brown blotched and mottled orange brown and black medium dense to dense and loose to medium dense in places ferruginised and cemented silty sand. Reworked residual granite.

1.25 Moist orange brown speckled off white dense jointed silty sand with zones of gravelly silty sand and zones of reworked residual granite. Residual granite.

1.70

NOTES

1) Refusal at 1,7m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP45

dot.PLOT 4007 J&W

D001

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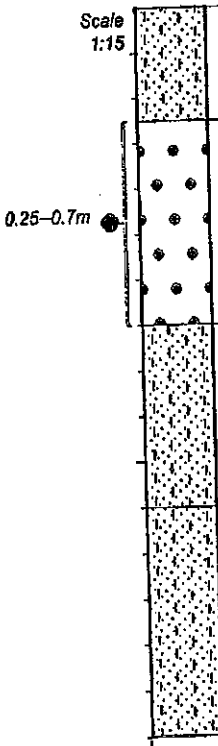
Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP46
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.25	Moist dark brown mottled red brown and black loose to medium dense ferruginised nodular ferricrete in a matrix of silty sand. Pedogenic.
0.70	Moist dark brown blotched and mottled red orange brown and black loose to medium dense and medium dense in places weakly cemented and ferruginised silty sand. Reworked residual granite with zones of residual granite.
1.10	Moist yellow brown speckled black and off white dense jointed silty sand with zones of gravelly silty sand. Residual granite.
1.60	

NOTES

1) Refusal at 1,6m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,25--0,7m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP46

dot.PLOT 4007 J&W

D001

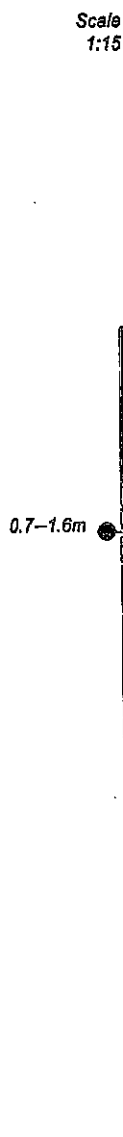
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP47
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose to medium dense intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.40 As above but contains abundant fine to coarse quartz gravel. Pebble marker.

0.70 Moist orange brown blotched and mottled red brown and black medium dense and medium dense to dense in places ferruginised and cemented silty sand. Reworked residual granite with zones of residual granite.

1.60 Moist orange brown speckled off white dense jointed silty sand. Residual granite.

2.40

NOTES

1) Refusal at 2,4m on very soft rock granite.

2) No evidence of water.

3) Disturbed soil sample taken from 0,7--1,6m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP47

D001

dot.PLOT 4007 J&W

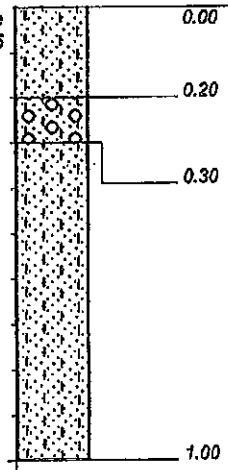
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP48
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.20	As above but contains abundant fine to coarse quartz gravel with scattered ferricrete concretions. Pebble marker.
0.30	Moist orange brown grey brown blotched and mottled red brown and black dense to very dense strongly ferruginised and cemented silty sand. Reworked residual granite.
1.00	

NOTES

1) Refusal at 1,0m on very dense reworked residual granite.

2) No evidence of water.

CONTRACTOR:
MACHINE: Cat 416 D
DRILLED BY:
PROFILED BY: J Davel

TYPE SET BY: Gill
SETUP FILE: STANDARD.SET

INCLINATION:
DIAM:
DATE:
DATE: 23/08/2006

DATE: 05/10/06 11:34
TEXT: ..G:\06210P.TXT

ELEVATION:
X-COORD:
Y-COORD:

HOLE No: TP48

D001

dot.PLOT 4007 J&W

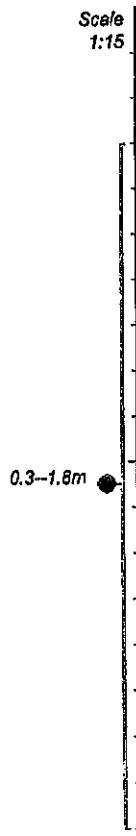
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP49
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00	Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.
0.15	As above but contains abundant fine to coarse quartz gravel with scattered ferricrete concretions. Pebble marker.
0.30	Moist orange brown blotched and mottled dark brown grey brown and black medium dense and loose to medium dense in places cemented and ferruginised silty sand. Reworked residual granite.
0.80	As above but medium dense to dense and medium dense in places.
1.80	Moist dark orange brown speckled blackand off white medium dense to dense and dense in places jointed silty sand. Residual granite.
3.00	

NOTES

1) No refusal at 3,0m.

2) No evidence of water.

3) Disturbed soil sample taken from 0,3--1,8m.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel

TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006

DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP49

D001

dot.PLOT 4007 J&W

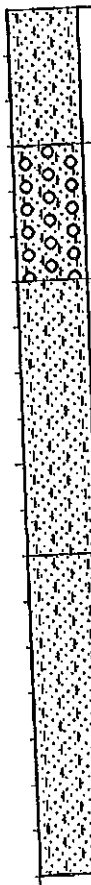
Crossman Pape & Associates

Group Five Properties
Waterval Low Cost
Housing Project Midrand

HOLE No: TP50
Sheet 1 of 1

JOB NUMBER: 06/210/P

Scale 1:15



0.00 Moist dark brown grey brown loose intact silty sand. Hillwash. Also contains abundant roots in upper 0,15m.

0.30 As above but contains abundant fine to coarse quartz gravel with abundant ferricrete concretions. Pebble marker.

0.60 Moist yellow grey brown blotched orange brown and black dense strongly cemented and ferruginised silty sand. Reworked residual granite with zones of residual granite.

1.20 Moist yellow orange brown speckled off white dense jointed silty sand. Residual granite with zones of reworked residual granite.

1.90

NOTES

1) Refusal at 1,9m on very soft rock granite.

2) No evidence of water.

CONTRACTOR :
MACHINE : Cat 416 D
DRILLED BY :
PROFILED BY : J Davel
TYPE SET BY : Gill
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 23/08/2006
DATE : 05/10/06 11:34
TEXT : ..G:\06210P.TXT

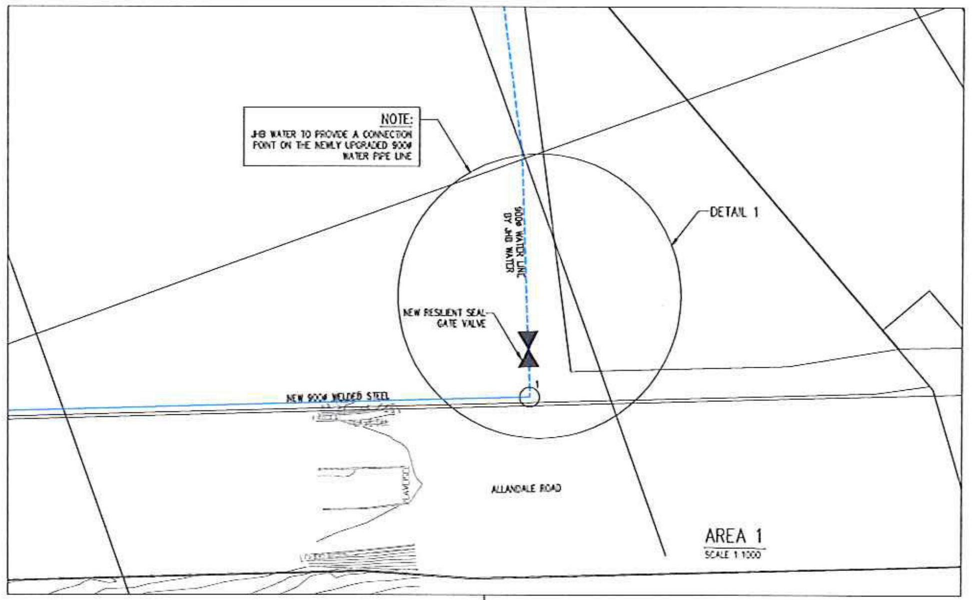
ELEVATION :
X-COORD :
Y-COORD :

HOLE No: TP50

dot.PLOT 4007 J&W

D001

Appendix 4: Design Drawings and Construction Method Statements



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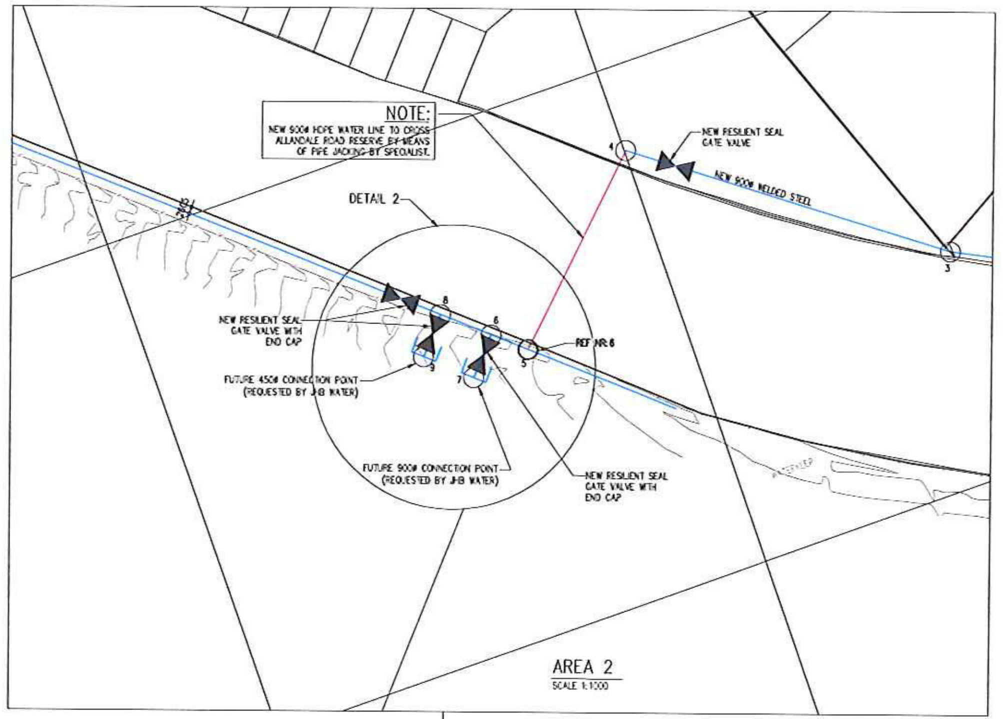
SCALE 1:1000



AREA 2
SCALE 1:1000

GENERAL NOTES:

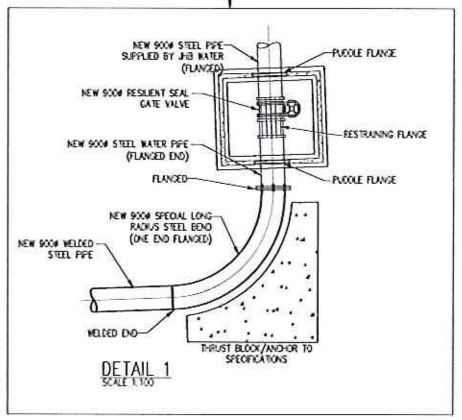
1. ALL BRICKWORK TO BE PLASTERED EXTERNALLY AND INTERNALLY TO ENSURE WATERTIGHT CHAMBER. USE ENGINEERING BRICKS
2. CONCRETE FOR THE BASE AND ROOF SLAB TO BE GRADE 25/19. COVER TO REINFORCEMENT = 30mm
3. ALL FITTINGS TO BE PAINTED WITH COPON KS/R88 EPOXY PAINT. AFTER INSTALLATION 5mm BFGW REPAIR WRAP COATING
4. ALL FLANGES TO TABLE 1500 OF SANS 1123
5. PIPES TO BE WRAPPED WITH 6mm THICK MALTHOID WRAPPING THROUGH WALLS
6. CHAMBER DIMENSION AND DEPTH ARE SUBJECT TO CHANGE UPON CONFIRMATION OF THE EXISTING PIPE LOCATION AND DEPTH
7. FITTINGS ARE SUBJECT TO CHANGE UPON CONFIRMATION OF THE EXISTING PIPE MATERIALS
8. EVERY CHAMBER MUST HAVE A 100mm DIAMETER VENT PIPE WITH MOSQUITO GAUZE
9. PEDESTALS TO BE PROVIDED AS DIRECTED BY THE ENGINEER AT SITE
10. VALVE KEY HOLES TO BE PROVIDED IN THE ROOF ABOVE EVERY VALVE OR AS DIRECTED
11. DEPTH OF CHAMBERS TO BE DETERMINED ON SITE
12. ENGINEERING BRICKS WITH BRICK-FORCE EVERY 3rd COURSE FOR ALL CHAMBERS
13. ROOF SLAB TO BE MADE OF PRECAST PANELS
14. 230mm BRICK-WALL OF 1m HIGH FROM BASE SLAB

PRESSURE REDUCING VALVE(CLAYTON + ANTI CAVITATION RING)

ALL PRV SHALL COMPLY WITH FOLLOWING SPECIFICATIONS:

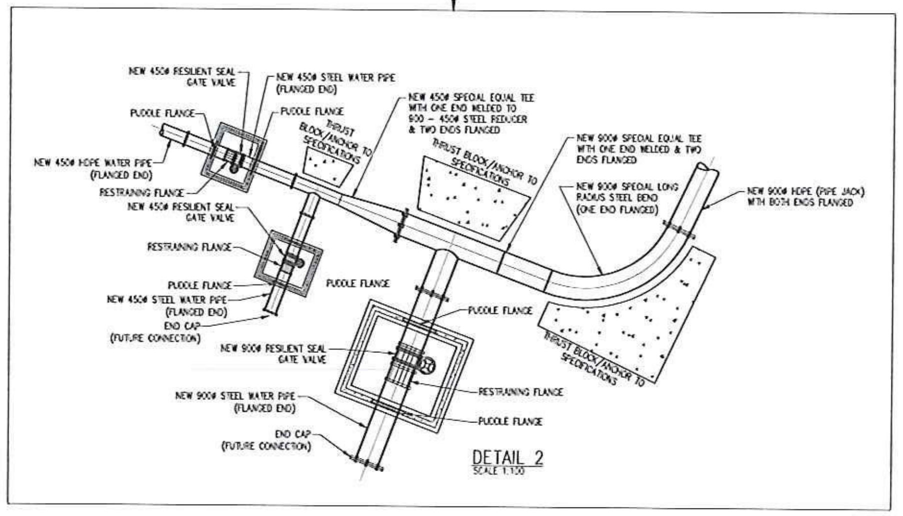
a. E90G-01ABECSI x101 PRESSURE REDUCING VALVES
b. DUCTILE IRON BODY AND COVER WITH STAINLESS STEEL TRIM
c. FUSION BONDED EPOXY COATED INTERNALLY AND EXTERNALLY TO A MINIMUM OF 250 MICRONS PN 25 RATED
d. COMPLETE WITH FULLY ADJUSTABLE CRD PRESSURE REDUCING PILOT VALVE (ADJUSTABLE DOWNSTREAM BETWEEN 2.1 BARS AND 21 BARS)
e. WITH PRESSURE GAUGE, OPENING AND CLOSING SPEED CONTROLS AND x101 VISION POSITION INDICATOR.
f. MUST BE FLANGED AND DRILLED TO SANS 1123 TABLE 1600, INCLUDING CUTTING OF PIPES,COUPLING etc
g. MUST BE COMPLETE WITH H-TYPE STRAINER-DUCTILE IRON BODY AND COVER-STAINLESS STEEL REMOVABLE IN A DUCTILE IRON FUSION BONDED EPOXY COATED FRAME 2mm MESH-FUSION BONDED EPOXY INTERNALLY AND EXTERNALLY TO A MINIMUM OF 250mm MICRON - PN 25 RATED FLANGED AND DRILLED TO SANS 1123 TABLE 1600 FACE TO FACE = 900mm
h. WALLS TO BE REINFORCEMENT CONCRETE.

LOCALITY MAP



DETAIL 1
SCALE 1:100

DG CONSULTING ENGINEERS
9 Hibiscus Street, Lynnwood Ridge
PRETORIA
Tel no: 012 369 6720
REGISTRATION NO: 2000/021627/07
Name: JH Gelderblom
Pr Eng: 910375



DETAIL 2
SCALE 1:100

CONSULTING ENGINEERS
DG CONSULTING ENGINEERS
FREESIA NO 9 LYNNWOOD RIDGE 0040
TEL: 012 369 6720

DESIGNED	PW NEL	AUGUST 2015
DRAWN	PW NEL	AUGUST 2015
CHECKED	H GELDERBLOM	DATE
	SIGNATURE	
	ECSA REG No	
APPROVED BY		DATE
	SIGNATURE	
	ECSA REG No	

Johannesburg Water

17 HARRISON STREET
MARSHALLTOWN
2107

TEL: (011) 688-1400
FAX: (011) 688-1529

Joburg

JUKSKEI VIEW EXT 134

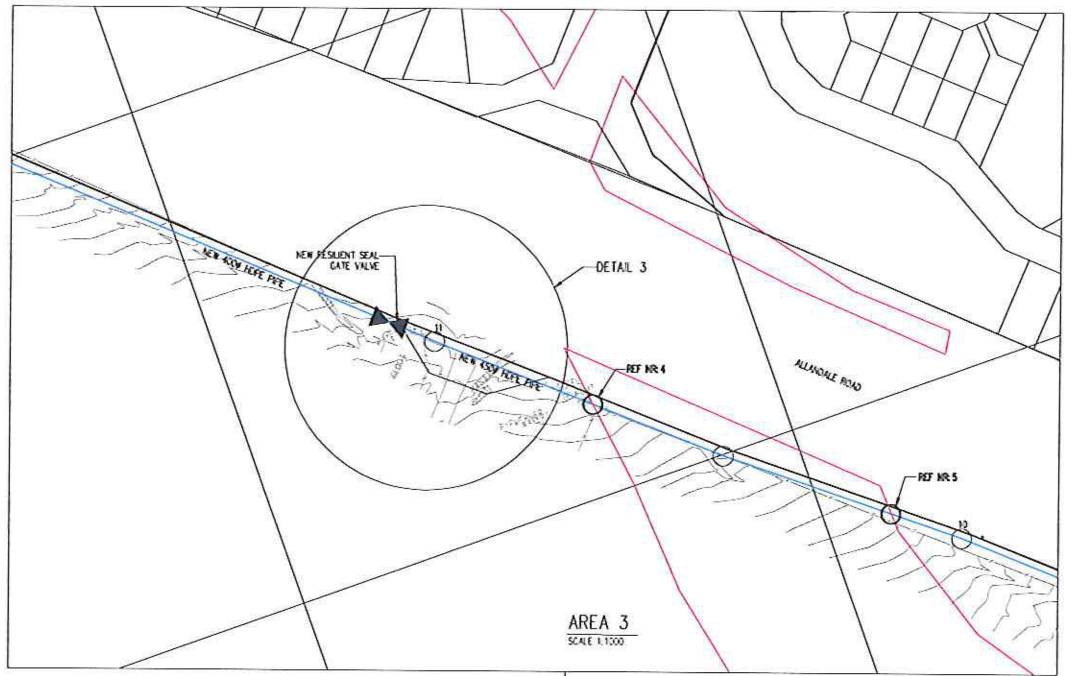
BULK WATER UPGRADE FOR JUKSKEI VIEW EXT 134 – DETAILS (PART 1)

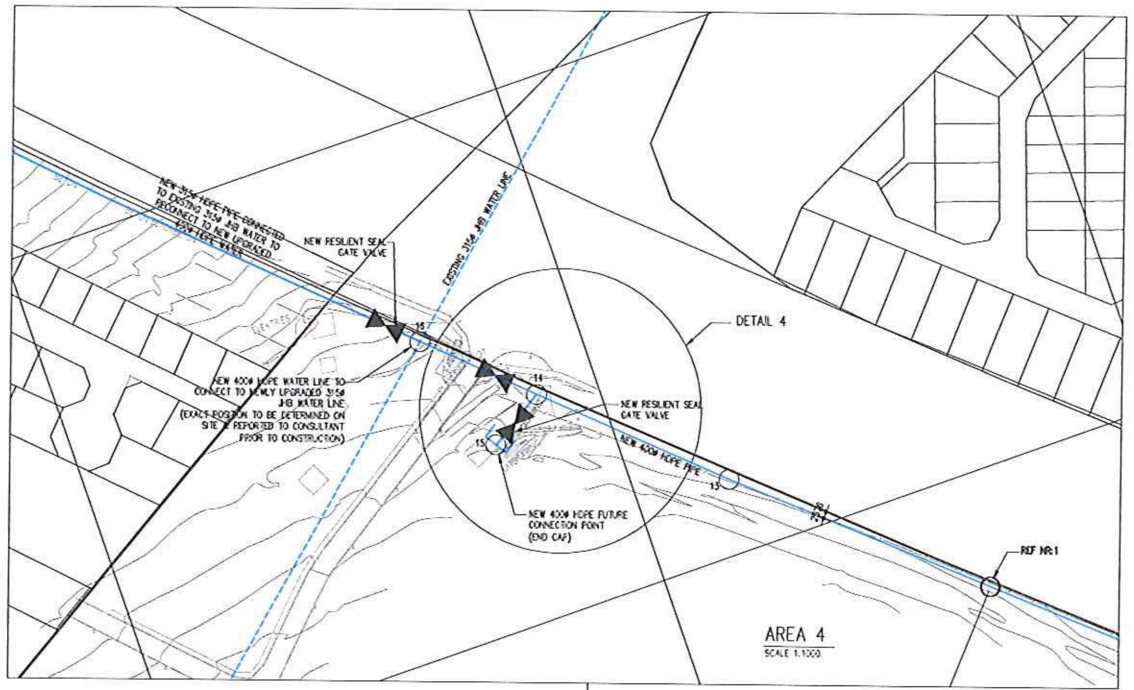
AMENDMENTS

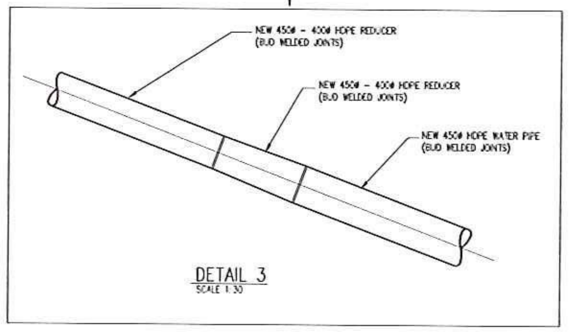
SCALE	REV	DESCRIPTION	APPROVED	DATE
1:4000	REV A	WATER UPGRADE DETAILS	PW NEL	2017/03/13
AS SHOWN	REV B	ENLARGED AREAS & DETAILS	PW NEL	2017/03/28

DRAWING No. 1051-02-603

PROJECT No: 1051-02-603A
REV: B
ORIGINAL PAGE SIZE: A0
SHEET 1 OF 1
FILE No

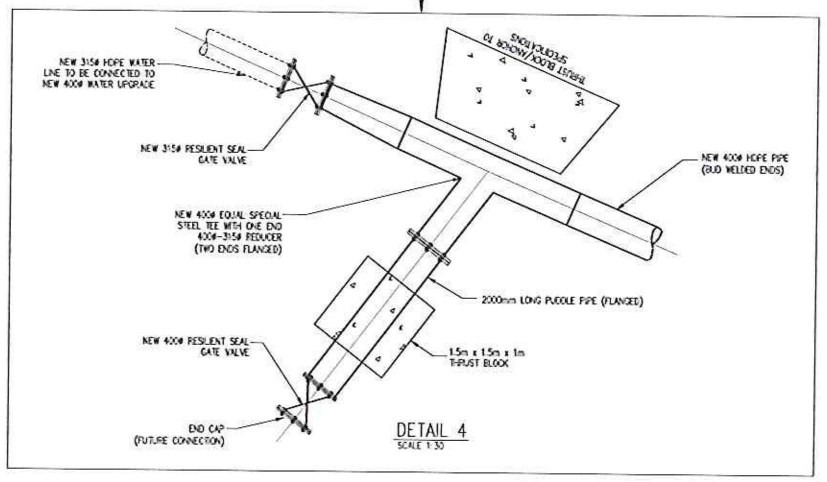






DG CONSULTING ENGINEERS
9 Hibiscus Street, Lynnwood Ridge
PRETORIA
Tel no: 012 369 6720
REGISTRATION NO: 2000/021627/07
Name: JH Gelderblom

Pr Eng: 910375



GENERAL NOTES:

1. ALL BRICKWORK TO BE PLASTERED EXTERNALLY AND INTERNALLY TO ENSURE WATERTIGHT CHAMBER. USE ENGINEERING BRICKS
2. CONCRETE FOR THE BASE AND ROOF SLAB TO BE GRADE 25/19. COVER TO REINFORCEMENT = 30mm
3. ALL FITTINGS TO BE PAINTED WITH COPON KS/R68 EPOXY PAINT. AFTER INSTALLATION 5mm BFGW REPAIR WRAP COATING
4. ALL FLANGES TO TABLE 1600 OF SANS 1123
5. PIPES TO BE WRAPPED WITH 6mm THICK MALTHOID WRAPPING THROUGH WALLS
6. CHAMBER DIMENSION AND DEPTH ARE SUBJECT TO CHANGE UPON CONFIRMATION OF THE EXISTING PIPE LOCATION AND DEPTH
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14. 230mm BRICK WALL OF 1m HIGH FROM BASE SLAB

PRESSURE REDUCING VALVE(CLAYTON + ANTI CAVITATION RING)

ALL PRV SHALL COMPLY WITH FOLLOWING SPECIFICATIONS:

a. 690G-01ABEC5I x101 PRESSURE REDUCING VALVES
b. DUCTILE IRON BODY AND COVER WITH STAINLESS STEEL TRIM
c. FUSION BONDED EPOXY COATED INTERNALLY AND EXTERNALLY TO A MINIMUM OF 250 MICRONS PN 25 RATED
d. COMPLETE WITH FULLY ADJUSTABLE CRD PRESSURE REDUCING PILOT VALVE (ADJUSTABLE DOWNSTREAM BETWEEN 2.1 BARS AND 21 BARS)
e. WITH PRESSURE GAUGE, OPENING AND CLOSING SPEED CONTROLS AND x101 VISION POSITION INDICATOR.
f. MUST BE FLANGED AND DRILLED TO SANS 1123 TABLE 1600, INCLUDING CUTTING OF PIPES,COUPLING etc
g. MUST BE COMPLETE WITH H-TYPE STRAINER-DUCTILE IRON BODY AND COVER-STAINLESS STEEL REMOVABLE IN A DUCTILE IRON FUSION BONDED EPOXY COATED FRAME 2mm MESH-FUSION BONDED EPOXY INTERNALLY AND EXTERNALLY TO A MINIMUM OF 250mm MICRON – PN 25 RATED FLANGED AND DRILLED TO SANS 1123 TABLE 1600 FACE TO FACE = 900mm
h. WALLS TO BE REINFORCEMENT CONCRETE

LOCALITY MAP

CONSULTING ENGINEERS
DG CONSULTING ENGINEERS
FREESIA NO 9 LYNNWOOD RIDGE 0040
TEL: 012 369 6720

DESIGNED	PW NEL	AUGUST 2016
DRAWN	PW NEL	AUGUST 2016
CHECKED	H GELDERBLOM	DATE
	SIGNATURE	
	ECSA REG No	
APPROVED BY		DATE
	SIGNATURE	
	ECSA REG No	

Johannesburg Water

17 HARRISON STREET
MARSHALLTOWN
2107

TEL: (011) 688-1400
FAX: (011) 688-1529

Joburg

JUKSKEI VIEW EXT 134

BULK WATER UPGRADE FOR JUKSKEI VIEW EXT 134 – DETAILS (PART 2)

AMENDMENTS

SCALE	REV	DESCRIPTION	APPROVED	DATE
1:4000	REV A	WATER UPGRADE DETAILS	PW NEL	2017/03/13
AS SHOWN	REV B	ENLARGED AREAS & DETAILS	PW NEL	2017/03/28

DRAWING No. 1051-02-603

1051-02-603B	B
PROJECT No	REV

A0 SHEET 1 OF 1
ORIGINAL PAGE SIZE
FILE No

2000/021627/07
CONSULTING ENGINEERS (PTY) LTD
DG Corner
No.9 Hibiscus Street - Lynnwood Ridge
P.O Box 76294 - Lynnwood Ridge - 0040
Tel: (012) 369 6720 - Fax: (012) 348 9978

Our ref: 1051p/758

February 2017

ATTENTION: Department of Water & Sanitation.

LAND PARCEL 3 & 24 WATERFALL
METHOD STATEMENT FOR WATERFALL BULK WATER SUPPLY

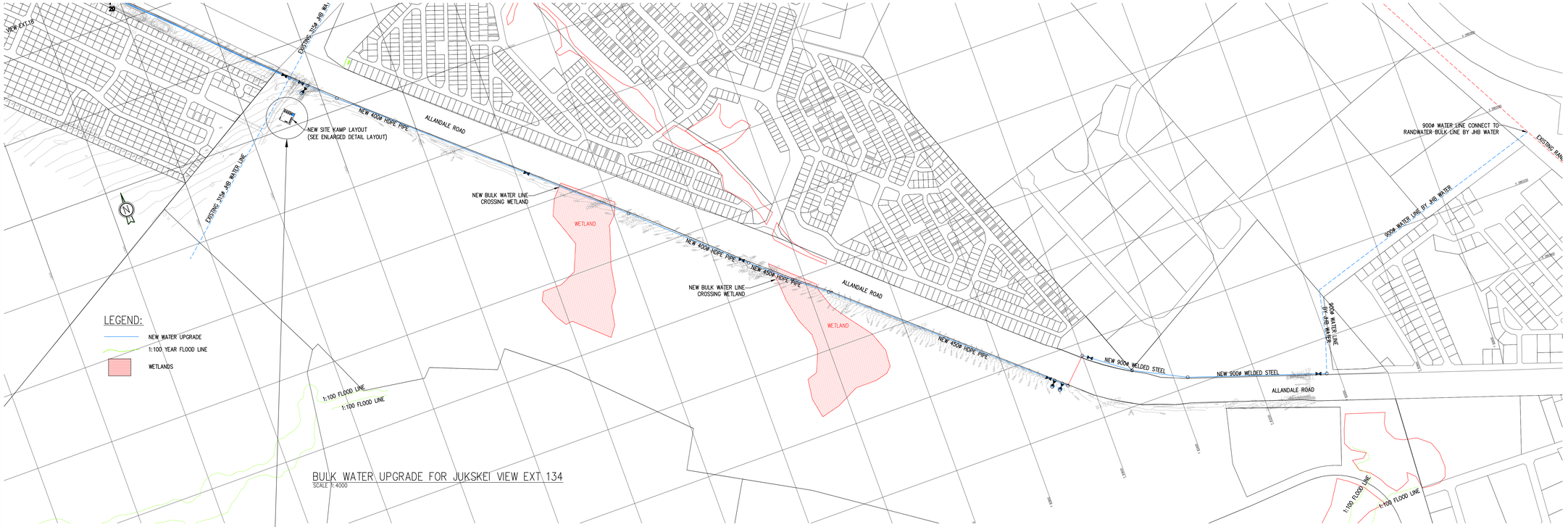
The following method statement are for wetland crossings. Please refer to drawing 1051-02-603 indicating the relevant detail on such a crossing.

All crossings to be done in wetland areas will be fenced to protect the rest of the wetland. The fenced off width should be approximately 5 meters wide depending on the conditions.

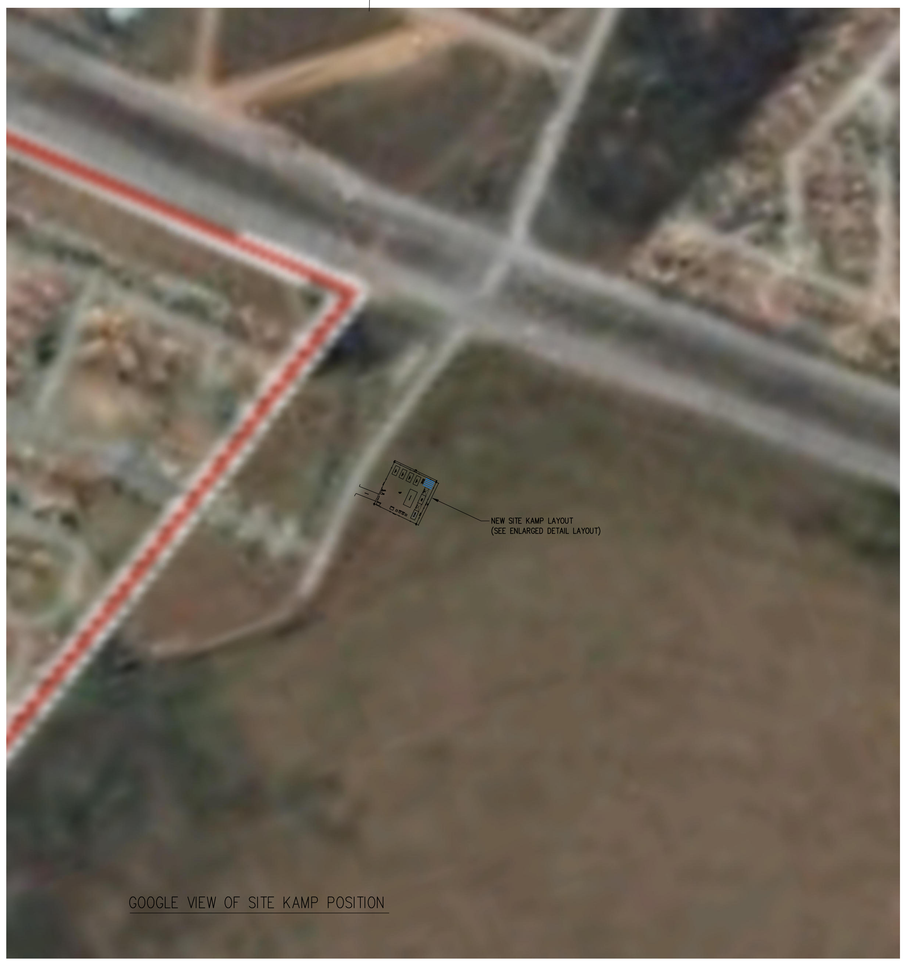
The pipes crossing through a wetland will be constructed by means of open trench excavations, excavated with an excavator machine. The pipes in the trench will be concrete in-cased with 15MPa concrete as shown on the detail attached. The backfill over the concrete in-cased pipes will be done in 150mm layers using the dried out in-situ material. All excavated material will be stockpiled outside the wetland area during the construction phase.

In the drier season wetland areas will be crossed by means of open trench excavations. The pipes will be laid on top of a drainage layer (refer to detail) where after the trench will be backfilled in 150mm layers with the in-situ material.

Boshoff Taljaard
For DG Consulting Engineers



BULK WATER UPGRADE FOR JUKSKEI VIEW EXT 134
SCALE 1:4000



GOOGLE VIEW OF SITE KAMP POSITION

MASTER LAYOUT PLAN (SITE LAYOUT)
SCALE 1:100

LOCALITY PLAN

LEGEND:

- 1.8m HIGH DIAMOND MESH FENCE WITH RAZOR WIRE
- 2 x 6m x 1.8m HIGH ACCESS GATE FOR VEHICLES
- 1 x 1m x 1.8m HIGH ACCESS FOR STAFF
- LIGHTS
- ACCESS ROAD
- SANITATION FACILITIES
- CONSTRUCTION PLANT
- WATER POINT
- ASSEMBLY POINT
- GUARD HOUSE
- STORAGE CONTAINER
- REVERSE PARKING
- COVERED EATING AREA
- SHADED AREA
- SITE OFFICE
- BUILDING MATERIAL STORAGE AREA
- SITE CAMP (900m²)

NO	DATE	REVISION	DRAWN	CHECKED
A	13-02-2017	ISSUED FOR APPROVAL	PWN	BJT
B	03-03-2017	ISSUED FOR APPROVAL REV 1	PWN	BJT
C	13-03-2017	LEGEND ADDED ON CAD LAYOUT	PWN	BJT

CONSULTING ENGINEERS (PTY) LTD
9 Hibiscus Street – c/o Hibiscus & Freesia Streets
Lynnwood Ridge – 0040
P.O. Box 76294 – Lynnwood Ridge – 0040
Tel: 012 369 6720 – Fax: 012 348 9978

SIGNATURE	DATE	
DESIGNED PWNEL	02/2017	SCALE AS SHOWN
DRAWN PWNEL	02/2017	SHEET SIZE A0

D&G DRAWING NUMBER
1051–MASTER LAYOUT PLAN

CLIENT
ATTACQ

ARCHITECT/MAIN AGENT

PROJECT
LP3 & 24 WATERFALL BULK WATER SUPPLY

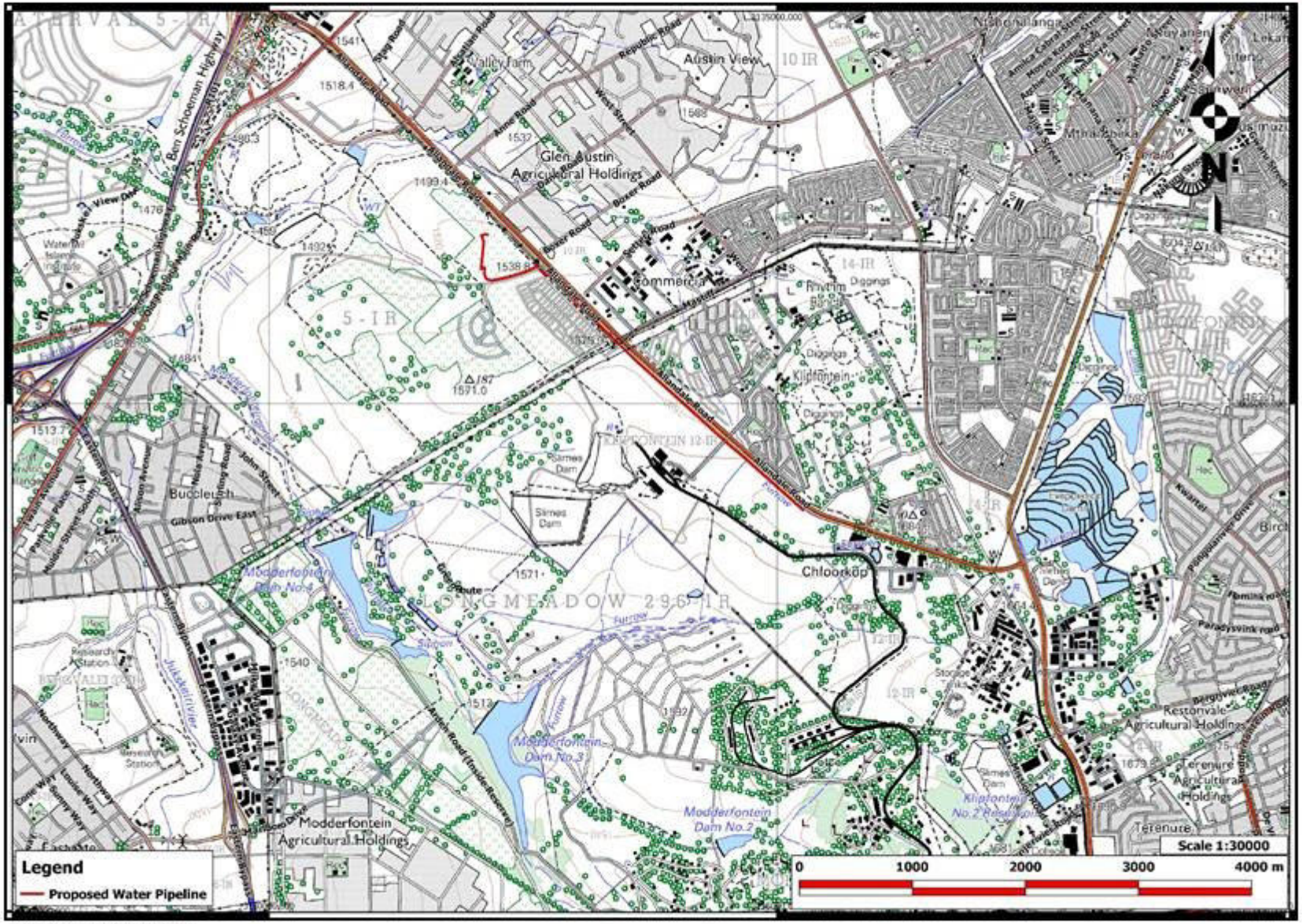
DRAWING TITLE
MASTER LAYOUT PLAN

Appendix 5: Maps/Photos

Bokamoso Environmental Consultants
Website: www.bokamoso.net
E-Mail: Lizelleg@mweb.co.za

Waterval Bulkwater Supply

Locality Map

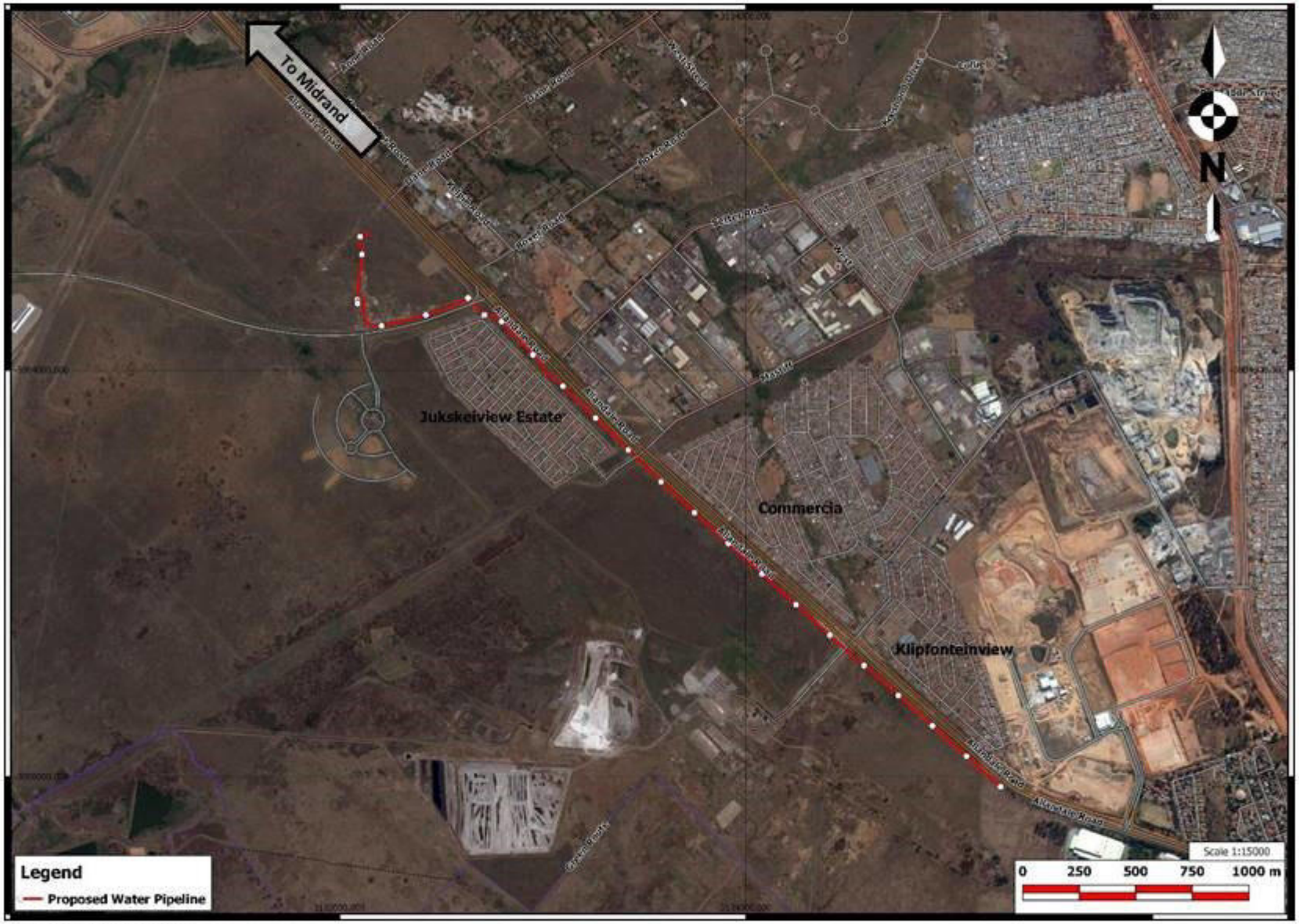


Projection – Transverse Mercator
Datum- Hartebeeshoek 1994
Reference Ellipsoid –WGS 1984
Central Meridian -29

Bokamoso Environmental Consultants
Website: www.bokamoso.net
E-Mail: Lizelleg@mweb.co.za

Waterval Bulkwater Supply

Aerial Street Map



Projection – Transverse Mercator
Datum- Hartebeeshoek 1994
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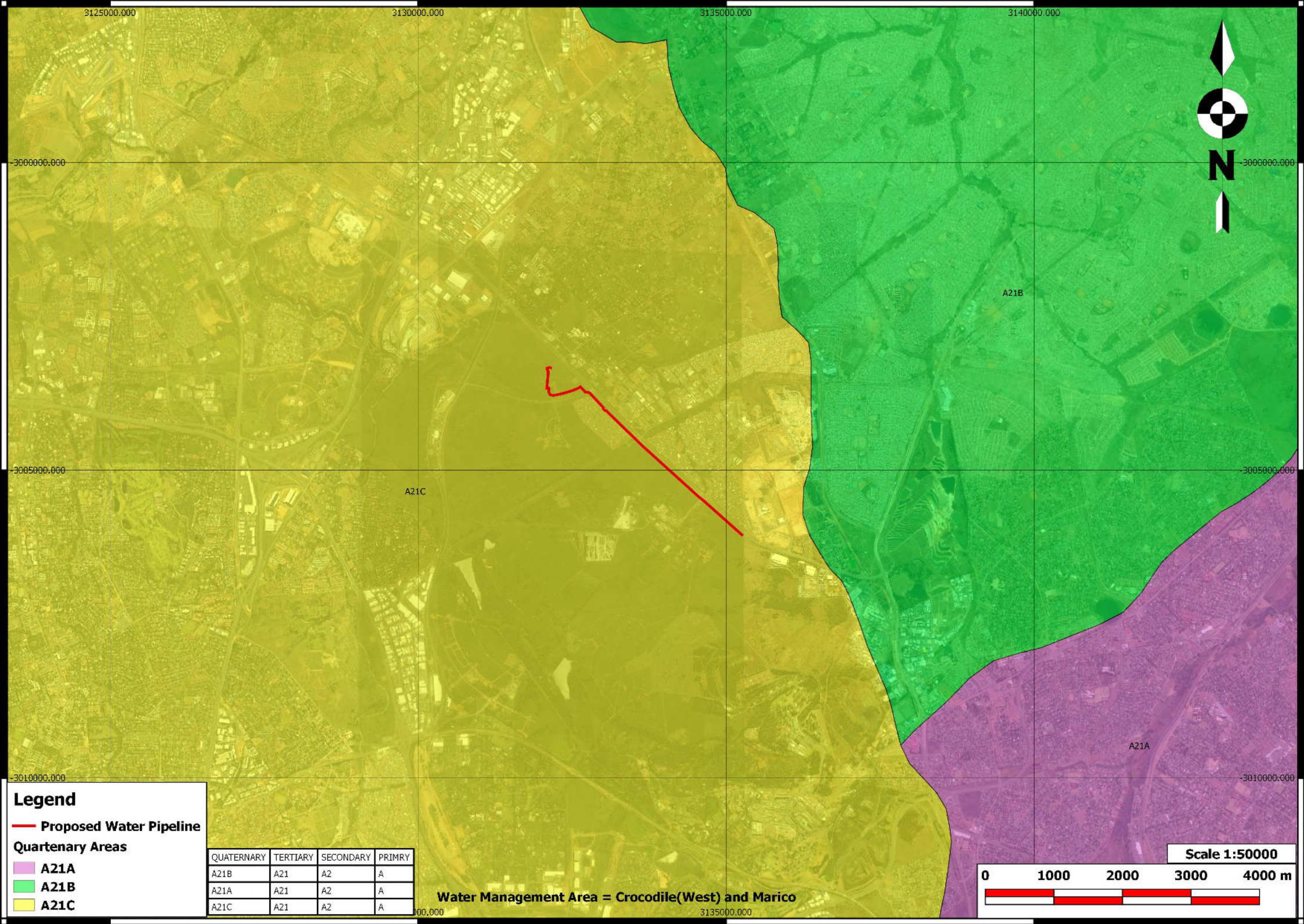
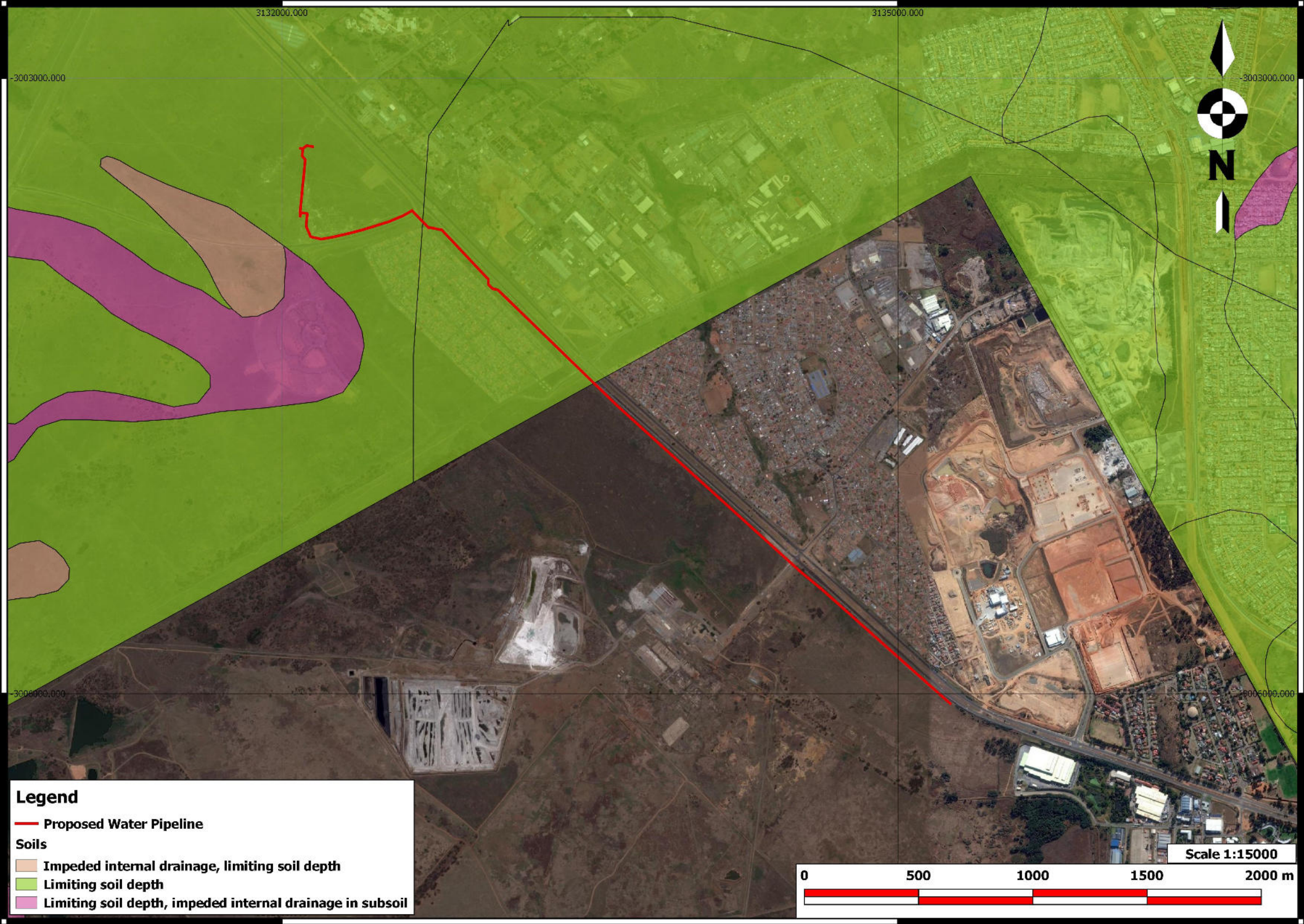
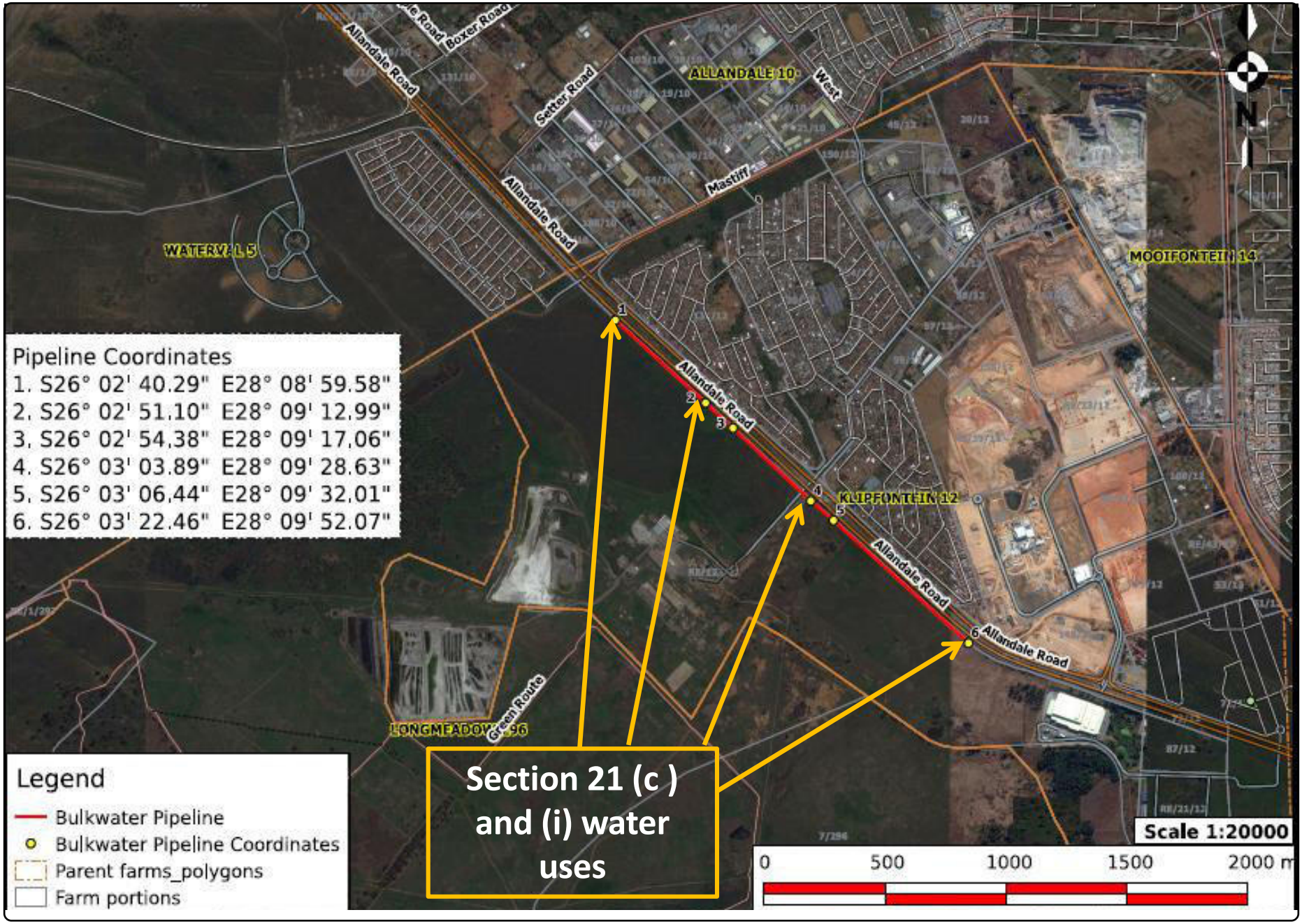
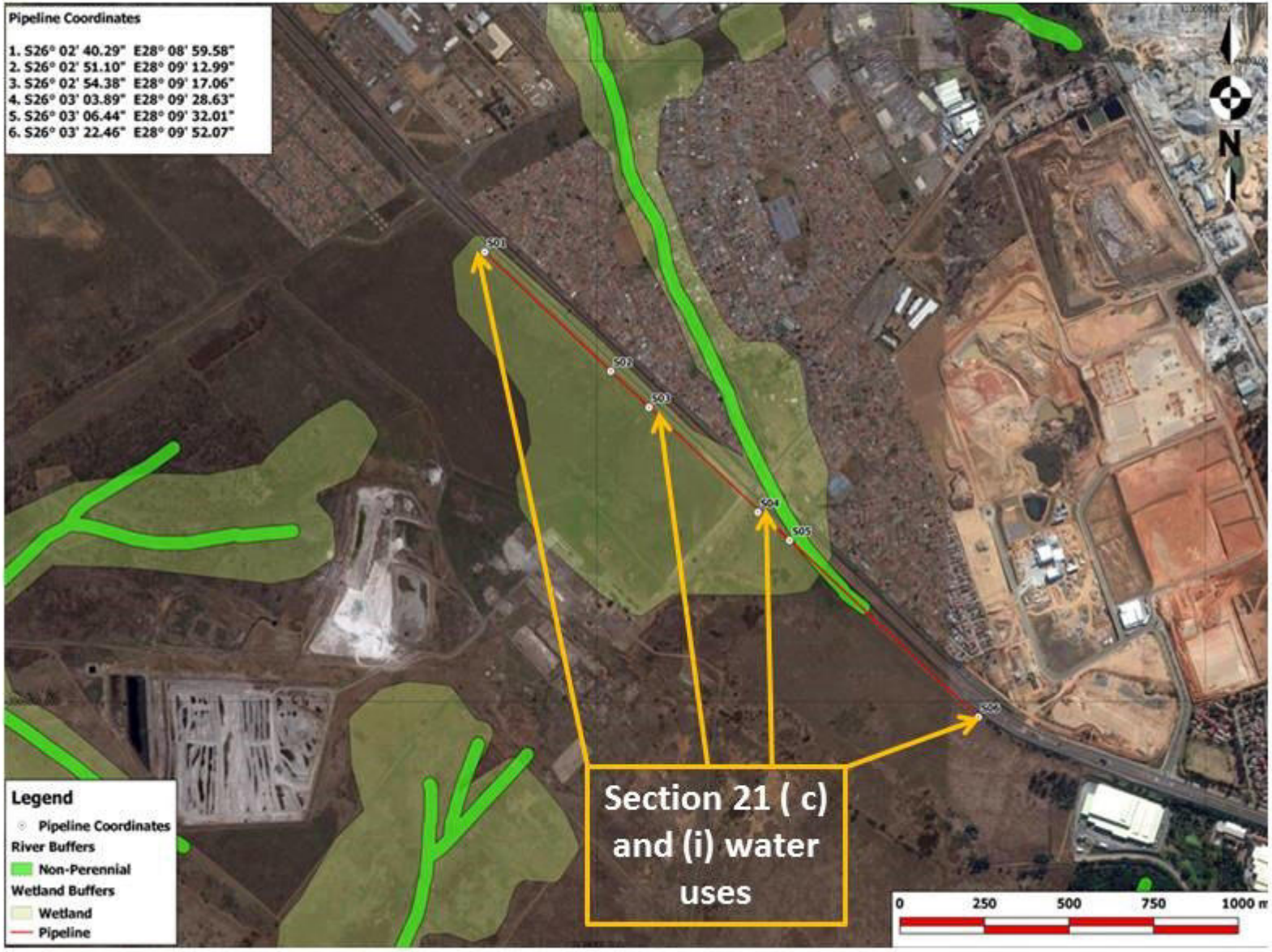
Central Meridian -29


3125000.000
3130000.000
3135000.000
3140000.000
-3000000.000
-3005000.000
-3010000.000
A21B
A21C
A21A
N
Legend
Proposed Water Pipeline
Quartenary Areas
A21A
A21B
A21C
QUATERNARY | TERTIARY | SECONDARY | PRIMRY
A21B | A21 | A2 | A
A21A | A21 | A2 | A
A21C | A21 | A2 | A
Water Management Area = Crocodile(West) and Marico
Scale 1:50000
0 1000 2000 3000 4000 m


3132000.000
3135000.000
-3003000.000
-3003000.000
-3008000.000
-3008000.000
N
Legend
Proposed Water Pipeline
Soils
Impeded internal drainage, limiting soil depth
Limiting soil depth
Limiting soil depth, impeded internal drainage in subsoil
Scale 1:15000
0
500
1000
1500
2000 m


Pipeline Coordinates
1. S26° 02' 40.29" E28° 08' 59.58"
2. S26° 02' 51.10" E28° 09' 12.99"
3. S26° 02' 54.38" E28° 09' 17.06"
4. S26° 03' 03.89" E28° 09' 28.63"
5. S26° 03' 06.44" E28° 09' 32.01"
6. S26° 03' 22.46" E28° 09' 52.07"
Legend
Bulkwater Pipeline
Bulkwater Pipeline Coordinates
Parent farms_polygons
Farm portions
Section 21 (c) and (i) water uses
Allandale Road
Setter Road
Boxer Road
Mastiff
ALLANDALE 10
West
WATERVAL 5
MOOIFONTEIN 14
KLIPFONTEIN 12
LONGMEADOW 96
Green Route
N
Scale 1:20000
0
500
1000
1500
2000 m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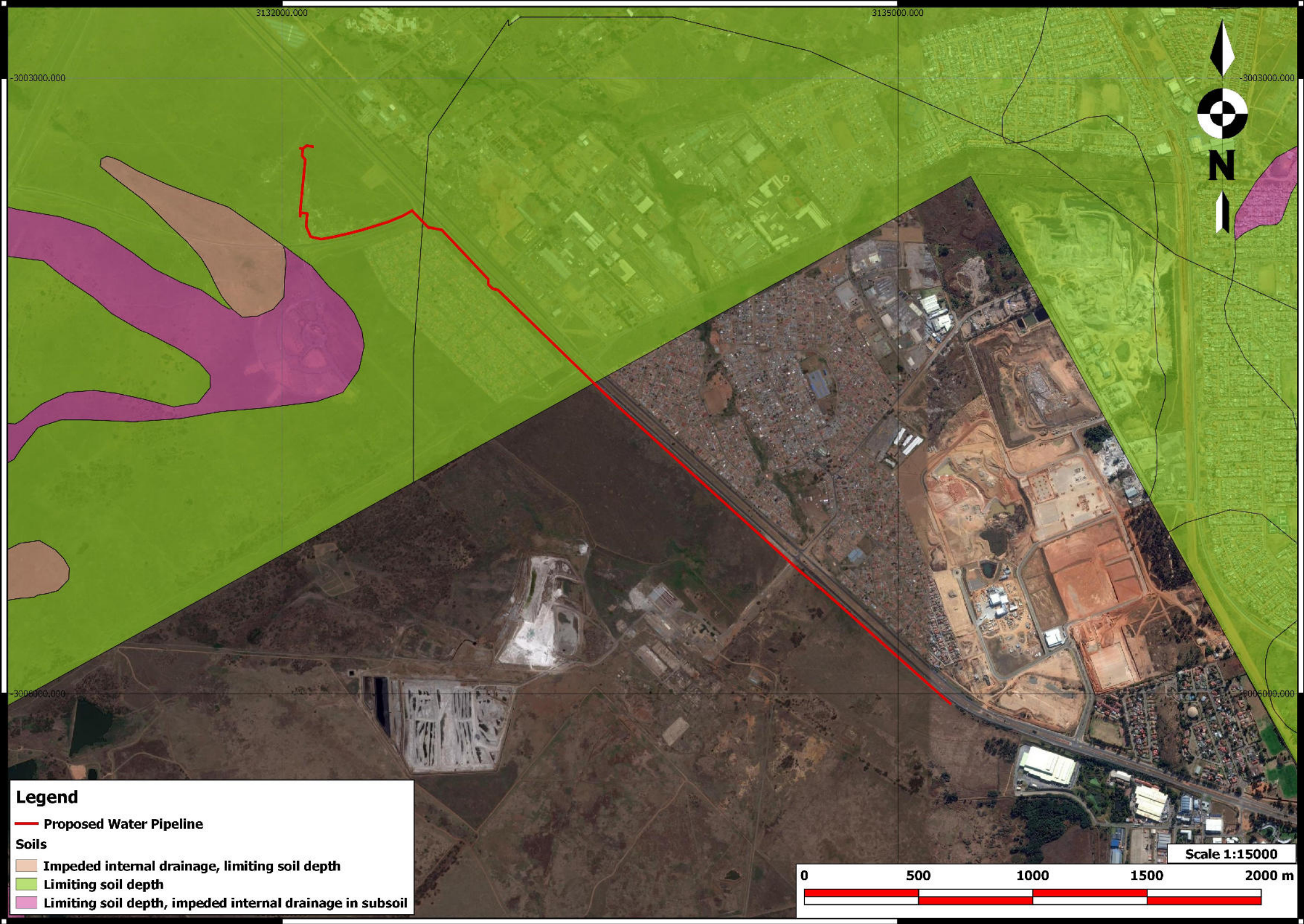
6. S26° 03' 22.46" E28° 09' 52.07"
N
Legend
Pipeline Coordinates
River Buffers
Non-Perennial
Wetland Buffers
Wetland
Pipeline
Section 21 (c) and (i) water uses
0
250
500
750
1000 m


3132000.000
3135000.000
-3003000.000
-3003000.000
-3008000.000
-3008000.000
N
Legend
Proposed Water Pipeline
Soils
Impeded internal drainage, limiting soil depth
Limiting soil depth
Limiting soil depth, impeded internal drainage in subsoil
Scale 1:15000
0
500
1000
1500
2000 m


Legend
Proposed Water Pipeline
River Buffers
Non-Perennial
Perennial
Wetland Buffers
Waterbody
Wetland
Drainage Lines2
5m Contours
N
Scale 1:15000
0
500
1000
1500
2000 m