## ENGINEERNG SERVICES CHIEF DIRECTORATE

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| **DISCIPLINE** | **Tick (x)** |
|---|---|
| **ARCHITECTURAL SERVICES (AR)** | |
| **LANDSCAPE ARCHITECTURAL SERVICES (LA)** | |
| **ELECTRICAL ENGINEERING SERVICES (EE)** | |
| **MECHANICAL ENGINEERING SERVICES (ME)** | |
| **CIVIL ENGINEERING SERVICES (CE)** | **X** |
| **STRUCTURAL ENGINEERING SERVICES (SE)** | |
| **QUANTITY SURVEY SERVICES (QS)** | |

| **PROJECT DETAILS** | |
|---|---|
| **CLIENT DEPARTMENT** | South African National Defence Force |
| **PROJECT NUMBER:** | N/A |
| **REPORT TITLE** | Flood damage investigation into collapsing perimeter boundary wall |

| **REPORT STAGE** | | | |
|---|---|---|---|
| | **Investigation Report** | **Status Quo Report** | **Preliminary Design Report** |
| | **IR** | **SQR** | **PDR** |
| **Tick [x]** | X | | |

## APPROVALS

### Technical Approval

| | Designation | Name | Signature | Date |
|---|---|---|---|---|
| **Author** | Engineering Technician | Lolita Nkoane | | 18/04/2023 |
| **Reviewed** | Chief Civil Engineer | Nomvuselelo Masuku | | |

### Administrative Approval

| | Designation | Name | Signature | Date |
|---|---|---|---|---|
| **Design Office Approval** | Director | Thuthuka Mbhele | | |
| **Supported** | Project Manager | Bonginkosi Nkala | | |
| **Accepted** | Client Representative | | | |

## Client Comments

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## TABLE OF FIGURES

## 1. INTRODUCTION

A request to visit the South African National Defence Force (SANDF) residential area in Bluff at 2 Periwinkle Garden was issued to assist Facilities Management in assessing the condition of the effects of the April 2022 floods on the adjacent civilian property on 49 Ettrick Road. Thereafter remedial recommendation shall be provided to assist in kerbing future similar occurrences and resolve the standing issue.

The Civil Engineering unit at the Durban regional office through head office Engineering Services (ES) visited the site on 10 November 2022 to look into the adjacent civilian property's precast concrete slab boundary fence that was reported to have started leaning over as a result from the floods.

## 2. SITE LOCATION

The address of the site for discussion is located at 49 Periwinkle Garden adjacent to the SANDF property at 1 and 2 Periwinkle Garden in the Bluff area as tabled and illustrated below. The property on 1 Periwinkle has been included due to the amount of surface runoff that it potentially contributes to the private property on 49 Ettrick and number 2 Periwinkle.

*Table 2-1: Building Location*

| Facility Name | Latitude | Longitude | Location | Local Municipality |
|---|---|---|---|---|
| SANDF: 2 Periwinkle Garden | 29º 55' 30" | 31º 0' 1.8" | Bluff | Ethekwini |
| SANDF: 1 Periwinkle Garden | 29º 55' 29" | 31º 0' 1.7" | Bluff | Ethekwini |
| Private: 49 Ettrick Road | 29º 55' 30" | 31º 0' 1.3" | Bluff | Ethekwini |

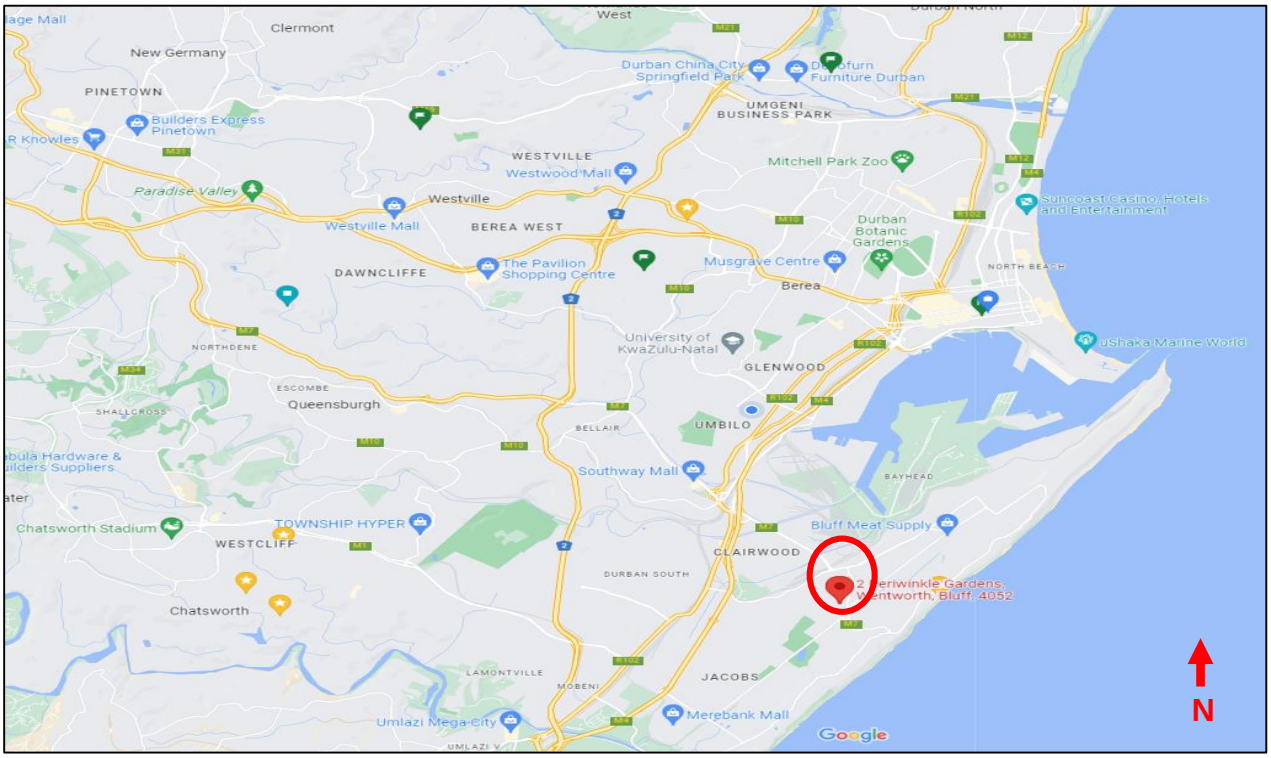


*Figure 2-1: Property Locality*


*Figure 2-2: Aerial View Premises and Affected Properties*

## 3. SITE DESCRIPTION

The area visited on the Bluff is a military residential area that is comprised of:

- A combination of multi-storey apartment dwellings, single storey standalone houses for the SANDF military staff and single storey to double storeyed civilian dwellings made of masonry walls evident in the figures Figure 3-2 to Figure 4-4.
- The SANDF's generally duo-pitch roofed structures collected runoff into onto gutters directed to stormwater grid inlets by means of downpipes as can be seen in Figure 4-1.
- The Bluff area is generally on sloped terrain. Over a perimeter of 2.7km the average slope derived from Google Earth was approximated at 7%. Figure 4-4 to Figure 4-1 attempt to illustrate the sloping conditions and extent in the affected area.
- The area is comprised of approximately 30% of natural ground and 70% of paved surface and roof cover contributing runoff towards the affected boundary fence.
- Figure 4-1 and Figure 4-2 illustrate the locations of the municipal stormwater network and the observed runoff direction in relation to the affected wall and available drainage.
- The precast concrete panel boundary wall belonging to 49 Ettrick Road was constructed in such a way that it served as an unreinforced retaining wall against approximately 300mm of retained soil on the up slope. The wall has no weep holes to allow excess water to escape.
- The ground conditions at number 1 and 3 Periwinkle Garden is comprised of grassed terrain sloped towards 49 Ettrick Road.
- The ground condition at number 2 Periwinkle is partially covered in sand and grassed and sloped parallel to 49 Ettrick Road.
- The property at 49 Ettrick Road had approximately 30 meter stretch of asphalt surfacing sloped along the boundary wall. The drainage provided was a 150mm diameter PVC pipe trenched into the driveway along the properties at 2 Periwinkle Garden and 2 Gansbaai Place. The outlet is within the property onto the open area natural ground running along the wire mesh fence of 2 Gansbaai Place. Refer to Figure 3-2 and Figure 3-3.

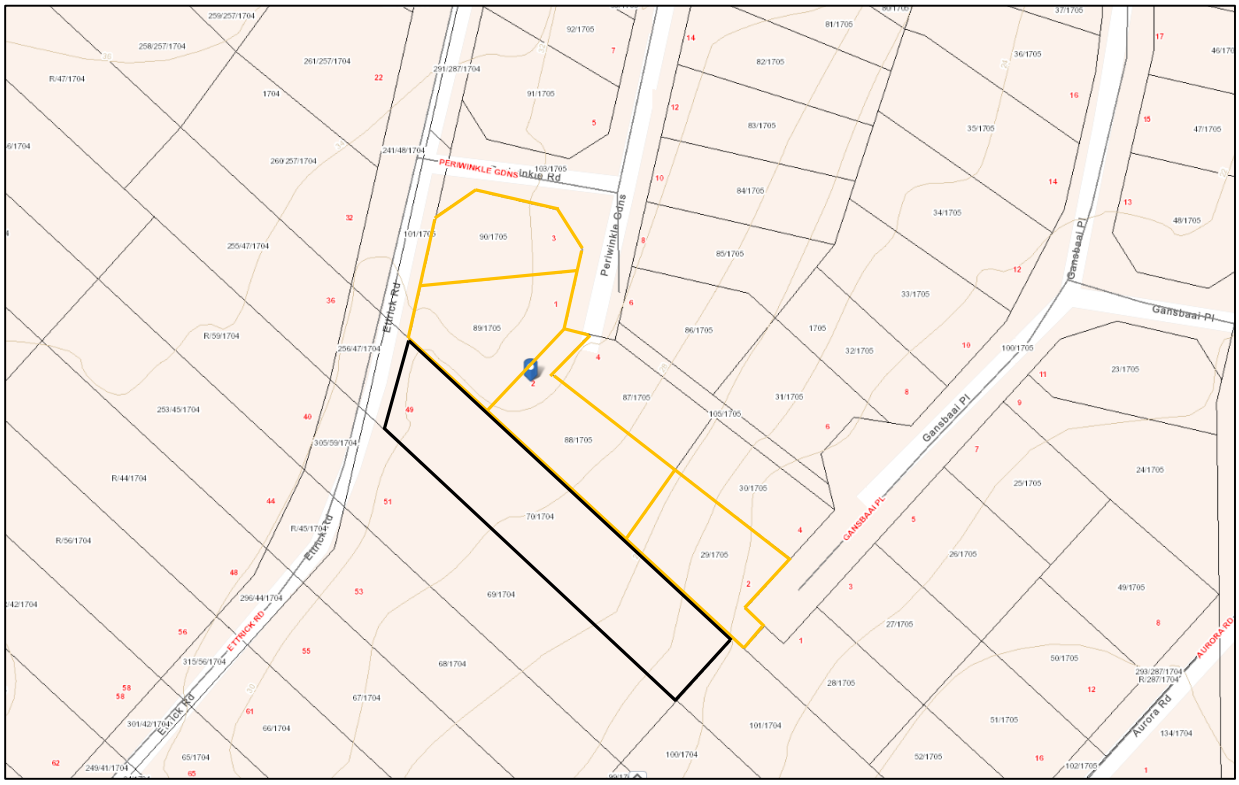


*Figure 3-1: GIS illustration of SANDF Erven **(orange)** against the Affected Civilian Boundary Wall at 49 Ettrick Road **(black)***


*Figure 3-2: Private Dwelling - Site drainage, Surfacing and Precast Concrete Slab Fence*


*Figure 3-3: Position of Private Property Drainage Pipe onto Open Ground within Property and Visual of Adjacent SANF Dwelling with Wire Mesh Fencing*

*Figure 3-4: Entrance Level to Two storey Dwelling on the Top Level*

*Figure 3-5: Three Level Dwelling with Entrance on Ground and First Level*

Figure 4-1 is an illustration of the direction of surface flow runoff that potentially contributes to the affected boundary fence that runs along the three properties that include 1 Periwinkle Garden as a contributor. The municipal stormwater (SW) infrastructure in the affected area was comprised of the 3 marked kerb inlets (KI), 2 grid inlets (GI) and 2 SW manholes (MH) as indicated in Figure 4-1 and Figure 4-2.

## 4. SITE INVESTIGATION FINDINGS

No stormwater drainage was identified within the properties lined along the private dwelling on 49 Ettrick Road, namely at numbers 1 and 2 Periwinkle Garden. The surface runoff contributing area slopes perpendicular and parallel to the private dwelling's affected precast concrete slab fencing as referenced in Figure 4-3 and Figure 4-4. The slope at 1 Periwinkle created an open channel against the concrete slab fence at 49 Etterick Road. The concrete slab wall retained an approximated soil volume with an average height of 300mm on the up slope on 1 Periwinkle Garden no weep holes into 49 Ettrick over a length of 30m. The ground conditions at 1 and 3 Periwinkle were identified as sandy with grass cover. The SANDF property on 2 Periwinkle Garden could not be accessed but the ground conditions at 2 Periwinkle were observed to show signs of erosion with stripped grass cover and exposed sand (potentially from the dogs running up against the fence).

The stormwater sheet flow is illustrated in Figure 4-1 and Figure 4-2 flows eastward towards the affected property along and municipal stormwater drainage network is shown to run along the road network in the perimeter. The runoff that had affected the boundary wall had no formal drainage network alleviating stormwater runoff volume within the two properties, 1 and 3 Periwinkle, that collects against the 49 Ettrick. The state of the existing municipal stormwater network could not be determined and the level of maintenance could not be established.

The approximated height, distance and slope were measured and calculated at 1.5m, 6m and 25% respectively as illustrated in Figure 4-3. The average distance measured along the flattest plain from the base of the slope to the boundary along the three properties was 1.5m referenced in Figure 4-4. Accumulated runoff from Ettrick Road and Periwinkle Garden has a potential of reaching the boundary fence in times of heavy rains. Figure 4-5 illustrates the created channel against the private property boundary fence and the slope from 1 and 2 Periwinkle properties channelling runoff into the back yard at 2 Periwinkle.

Along 2 Periwinkle's boundary were loffelstein reinstalled at stepped stacked heights of between 2 and 3 units along the precast concrete slab wall at a length of 15m.

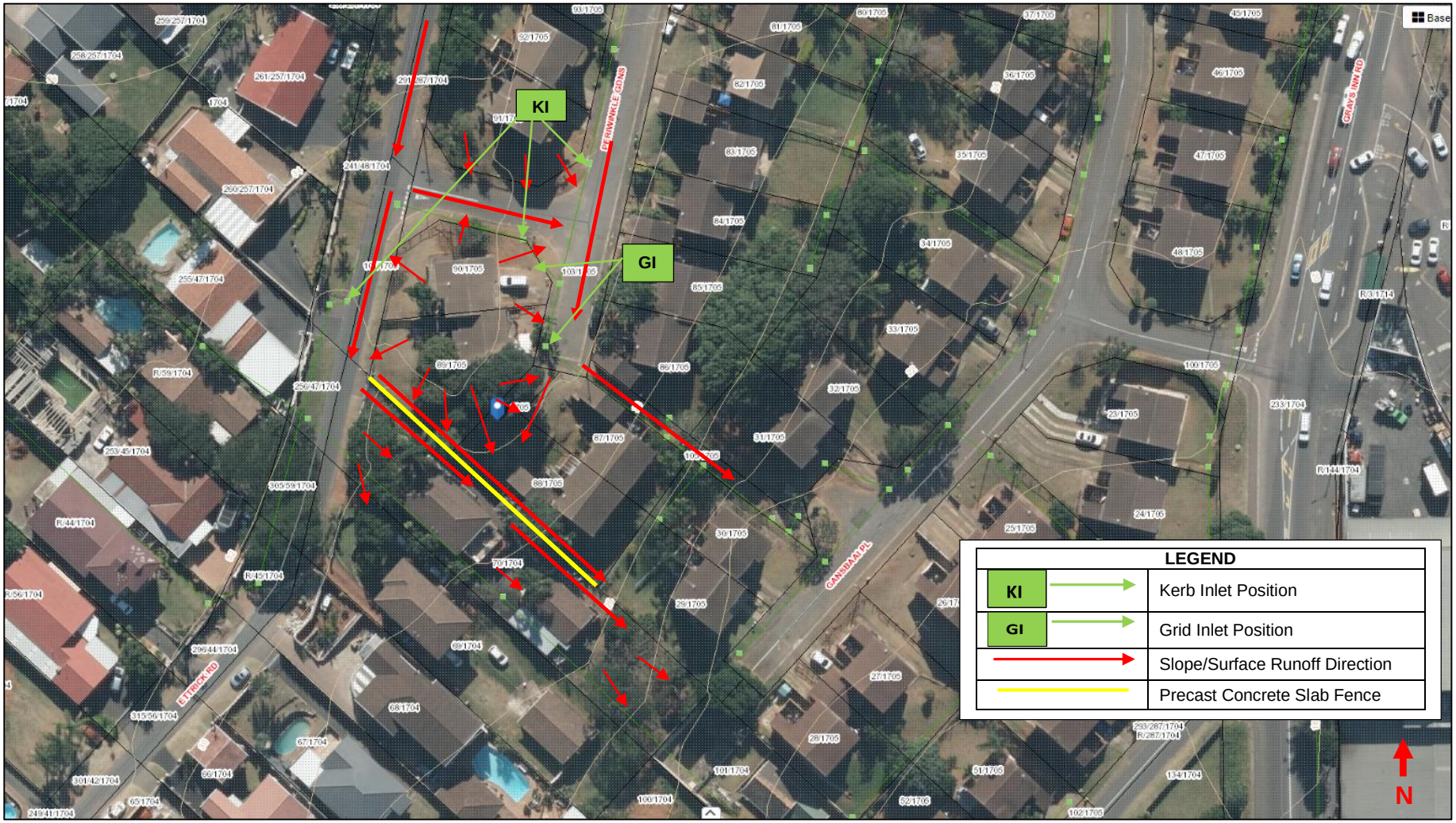


*Figure 4-1: Runoff Direction, Affected Boundary Fence and Municipal Stormwater Infrastructure*

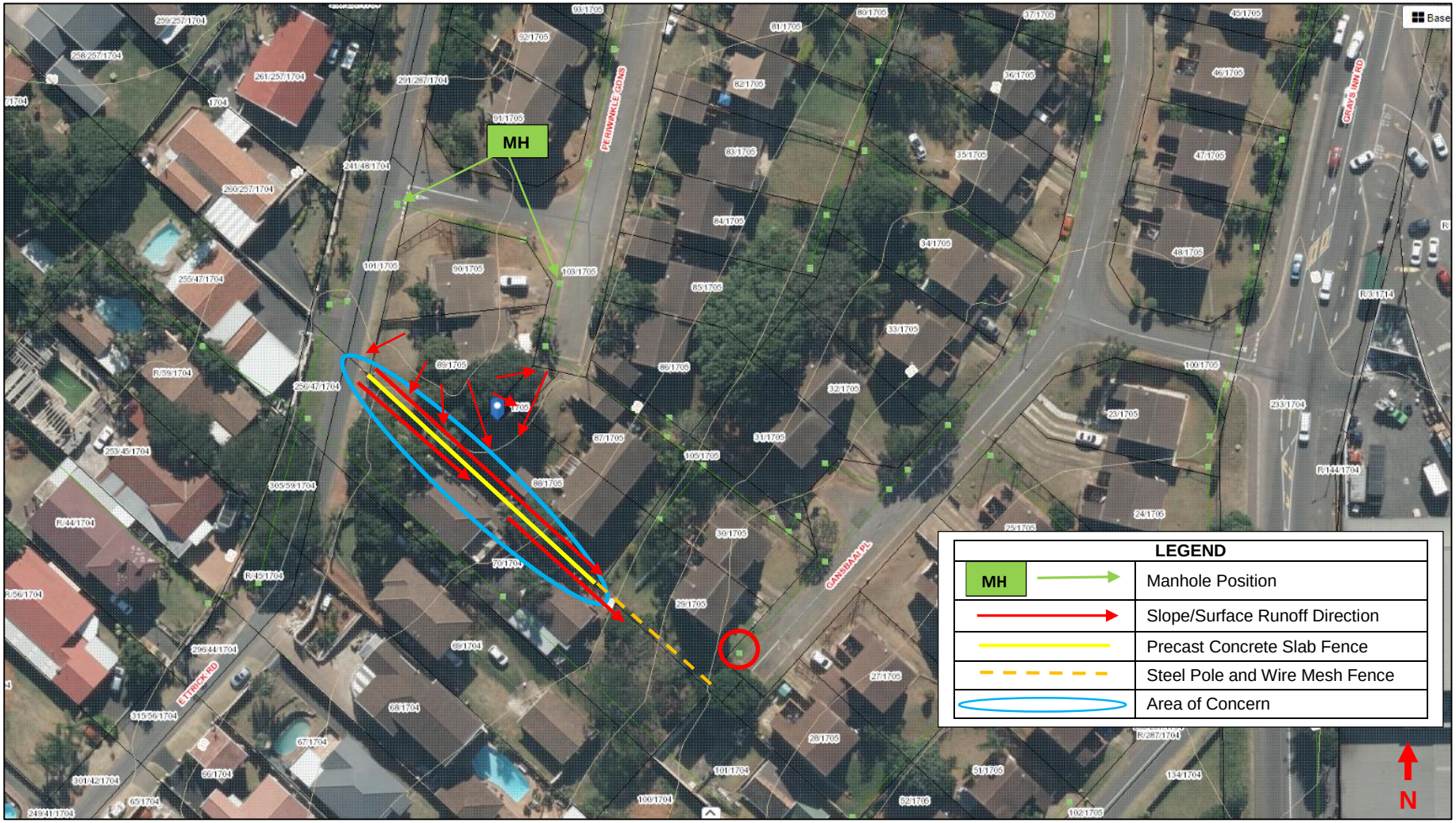


*Figure 4-2: Affected Property Boundary Fence and Closest Stormwater Receiving Infrastructure*


*Figure 4-3: Slope Running Parallel to Affected Private Property Precast Concrete Slab Fencing*


*Figure 4-4: Slope Running Perpendicular to Affected Private Property Precast Concrete Slab Fencing*

- The channelled areas measured as follows in Table 4-1:

*Table 4-1:*

| Facility Name | Length (m) | Width (m) | Area (m²) |
|---|---|---|---|
| 1 Periwinkle Garden | 19.0 | 1.5 | 28.5 |
| Upper: 2 Periwinkle Garden | 11.5 | 1.5 | 17.3 |
| Lower: 2 Periwinkle Garden | 24.0 | 1.5 | 36.0 |
| Wire Fenced: 49 Ettrick Road | 26.0 | Vegetation cover: | |
| Total Area | | | 81.8 |


*Figure 4-5: Channelling Point against Private Boundary Fence from 1 and 2 Periwinkle into Back Yard at 2 Periwinkle*

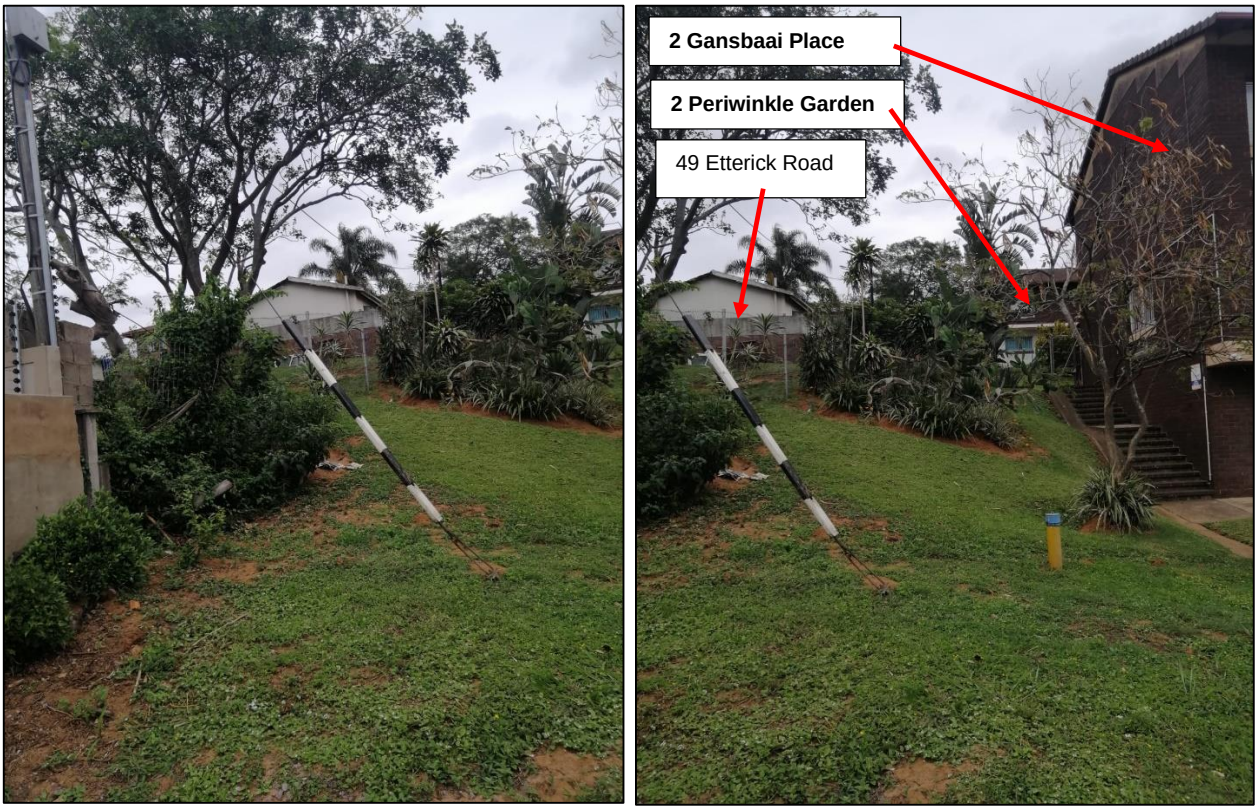


*Figure 4-6: Vegetation cover on 2 Gansbaai Place on bottom end to 49 Ettrick Road and directly below 2 Periwinkle Garden*


*Figure 4-7: Corrosion path downhill along retainers*

*Figure 4-8: Signs of downhill erosion at 2 Periwinkle Garden along 49 Etterick Road's Boundary fence*

## 5. OPTIONS CONSIDERED FOR REMEDIAL WORK

### 5.1. Retaining wall

The site location is situated on sloped terrain approximately 2 kilometres from the sea. The area had limited vegetation growth on sandy soil conditions which ensures speedy infiltration due to the large un-compactable voids present. This means that the soil would naturally become over saturated faster than slow infiltrating soil types thus creating a faster flooding plane.

### 5.2. Landscaping and Subsoil Drainage

The natural ground is a better drainage consideration that can be enhanced by the introduction of plants as a landscaping intervention to naturally reduce sheet flow and promote infiltration. A perforated 250mm pipe introduced beneath the collection area at the bottom of the slope along the 49 Ettrick Road's boundary wall will assist the soil's ability to absorb water faster to be discharged into the municipal stormwater network on Gansbaai Place.