Annexure B: Environmental Investigation Report

Preliminary Route Alignment Study for the Soweto Extension and Cosmo City Junction of the Proposed Gauteng Rapid Rail Integrated Network Extensions

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Abbreviations

Abbreviation	Description
AEL	Atmospheric Emission License
BA	Basic Assessment
CBA	Critical Biodiversity Areas
DBSA	Development Bank of Southern Africa
DFFE	Department of Forestry, Fisheries and Environment
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIR	Environmental Investigation Report
EMF	Environmental Management Framework
EMS	Environmental Management Specifications
EMPr	Environmental Management Programme
ESA	Ecological Support Areas
GA	General Authorisation
GDARD	Gauteng Department of Agriculture and Rural Development
GMA	Gautrain Management Agency
GRRIN	Gauteng Rapid Rail Integrated Network
GRRL	Gautrain Rapid Rail Link
GPG	Gauteng Provincial Government
GTIA	Gauteng Transport Infrastructure Act
HIA	Heritage Impact Assessment
MCA	Multi Criteria Assessment
MEC	Member of the Executive Council
NDP	National Development Plan
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NEM:PA	National Environmental Management: Protected Areas Act
NEM:WA	National Environmental Management: Waste Act
NEM:AQA	National Environmental Management: Air Quality Act
NHRA	National Heritage Resources Act
NPAES	National Protected Areas Expansion Strategy
NWA	National Water Act
PM2.5	Particulate Matter with Aerodynamic Diameter less than 2.5 micrometres
PRASA	Passenger Rail Agency of South Africa
SAHRA	South African Heritage Resources Agency
S&EIR	Scoping and Environmental Impact Reporting
SADC	Southern African Development Community
SCC	Species of Conservation Concern
SDGs	Sustainable Development Goals
SEMAs	Specific Environmental Management Acts

Abbreviation	Description
TBM	Tunnel Boring Machine
TOPS	Threatened or Protected Species
TOD	Transit-Oriented Development
WML	Waste Management License
WUL	Water Use License

Definitions

Term	Definition
Aerodrome	An aerodrome is a term used to describe a location where aircraft take off and land. It is a general term that encompasses all types of aviation facilities, including airports, airfields, and landing strips. Aerodromes can be used for a variety of purposes, including military operations, commercial flights, and private aviation.
At-grade	Typically, at ground level, but may have a vertical placement up to 8m below or above natural ground level.
Bridge (Viaduct)	A viaduct is a specific type of bridge that consists of a series of arches, piers or columns supporting a long-elevated railway. Vertical placement on an elevated viaduct is typically more than 8m above natural ground level.
Critical Biodiversity Areas	Critical Biodiversity Areas (CBA) are areas required to meet biodiversity targets for ecosystems, species, and ecological processes, as identified in a systematic biodiversity plan. These should be maintained in a natural or near-natural ecological condition. This can include biodiversity-compatible land and resource uses. The management objectives for different CBA subcategories are the same.
CBA 1	Areas that are irreplaceable for meeting biodiversity targets. There are no other options for conserving the ecosystems, species, or ecological processes in these areas. Ideally these are to be maintained in natural or near natural ecological condition.
CBA 2	Areas that are the best option for meeting biodiversity targets, in the smallest area, while avoiding conflict with other land uses.
Cut & Cover	A method of building a shallow tunnel by making a cutting which is then lined and covered over. This is a vertical placement of typically up to 8m – 28m below natural ground level.
Deep Tunnel	An underground passageway, dug through surrounding soil, earth or rock, and enclosed (except for the entrance and exit). This is a vertical placement typically 28m and more below natural ground level.
Environmental Assessment Practitioner	The individual responsible for the planning, management, coordination or review of environmental impact assessments, strategic environmental assessments, environmental management programmes or any other appropriate environmental instruments introduced through regulations. As per the requirements of the National Environmental Management Act (No. 107 of 1998) (NEMA), Environmental Assessment Practitioners (EAPs) must be registered with the Environmental Assessment Practitioners Association of South Africa (EAPASA).
Ecological Support Areas	An area that must be maintained in at least semi-natural ecological condition or where further deterioration in ecological condition must be avoided, to support the ecological functioning of CBAs or other Protected Areas; generate or deliver ecosystem services; or to meet remaining biodiversity targets that are not met in natural areas.
ESA 1	Areas that are currently in a natural or semi-natural state. These should be maintained in at least semi-natural ecological condition.
ESA 2	Areas that have been intensively modified (e.g., cultivated) but are nevertheless important for ecological processes. Further intensification of land use in these areas should be avoided.
Fatal Flaw	A fatal flaw is defined as an impact that could have a "no-go" implication for the Project.
Grade I Heritage Site	Resources with qualities so exceptional that they are of special national significance – administered by the South African Heritage Resources Association (SAHRA).
Grade II Heritage Site	Resources significant within the context of a province – administered by the relevant Provincial Heritage Authority
Grade III Heritage Site	Resources significant to a particular community – administered by the relevant local municipality.

Term	Definition
Ground Truthing	The process of verifying data accuracy additional inspections. It is often part of the Environmental Impact Assessment process, where specialists check actual conditions on the ground to confirm or refute data from tools like the Screening Tool. This can involve using GIS data, drone footage, and visual inspections without collecting physical samples.
Multi Criteria Assessment	The Multi Criteria Analysis (MCA) developed for this study included eight weighted assessment criteria against which the route alignment options were scored, evaluated, and compared. A hierarchy of goals, criteria, weights, and scoring were established for the MCA. The Environmental Screening and associated impacts constituted one of the weighting criteria used in the MCA.
National Protected Areas Expansion Strategy	The National Protected Area Expansion Strategy, first published in 2008 (the most recent updated was approved for implementation in 2021), presents a 20-year strategy for the expansion of protected areas in South Africa. It sets protected area targets, maps priority areas for protected area expansion to ensure no further ecosystems become Critically Endangered and makes recommendations on mechanisms to achieve this.
Optimal Option	Wherever mentioned in this Report, refers to the optimal station or route alignment option and configuration as determined within the context, parameters, and level of design development of this study.
Public participation Process	Public participation is one of the cornerstone principles of the NEMA. It is defined as the 'affording civil society opportunities for involvement in environmental governance'. The public participation process is a process by which potential interested and affected parties are given opportunity to comment on, or raise issues relevant to, the application for an environmental authorisation.
Refined optimal Route	Refers to a route alignment that has undergone further detailed analysis and adjustments to enhance its feasibility, sustainability, and efficiency. This process involves optimizing the placement of the route to align with the optimal stations and to meet design criteria.
Sensitive species	The results of the Screening Tool indicating 'Sensitive Species No' means that an EAP or specialist is required to contact the South African National Biodiversity Institute (SANBI) to enquire about these species. In these instances, the name has been withheld as the species may be prone to illegal harvesting and must be protected.

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EXECUTIVE SUMMARY

Project Overview

The scope of this project is to conduct a Preliminary Route Alignment Study and Environmental Investigation thereof for the Soweto Extension and Cosmo City Junction of the proposed Gauteng Rapid Rail Integrated Network (GRRIN) Extensions (the Project) to enable the MEC for Roads and Transport to determine the route. This is required when planning any provincial road or railway line in Gauteng. Route Determination is the first step in defining the future railway reserve. This determined route provides a 400m-wide land corridor within which the future railway line can be designed and implemented.

The Project involves extending the GRRIN to include new routes and stations, thereby enhancing connectivity and supporting economic growth in the Gauteng Province. The study focuses on three main corridors: Little Falls to Jabulani, Cosmo City to Lanseria and Smart City, and Cosmo City to Samrand. These extensions are designed to improve public transportation, reduce traffic congestion, and promote economic development in key areas. The Project also aims to integrate with existing transportation networks, providing seamless connectivity for commuters and supporting the overall development goals of the region.

The extension of the GRRIN is framed within the broader context of both national and international policies. These policies highlight the South African Government's dedication to sustainable development and environmental protection. Central to this vision is the National Development Plan: Vision for 2030 (NDP), which outlines key areas aimed at eradicating poverty, creating jobs, and reducing inequality by 2030. The NDP also stresses the importance of fostering environmental sustainability and resilience, ensuring that natural resources are protected while benefiting human communities.

The Gauteng Transport Infrastructure Act (GTIA) provides a comprehensive legislative framework that consolidates the laws relating to roads and other types of transport infrastructure in the Gauteng Province. The GTIA ensures that all transport infrastructure projects are developed in a manner that is consistent with provincial policies and regulations, promoting sustainable development and efficient use of resources. Compliance with the GTIA means that the Project must undergo rigorous planning and design processes to meet the standards set forth therein. This includes conducting thorough environmental investigations and obtaining necessary approvals to ensure that the project does not adversely impact the environment and aligns with the principles of sustainable development.

The Gauteng Department of Agriculture and Rural Development (GDARD) plays a crucial role in this Project by overseeing the environmental screening and assessment processes. GDARD is responsible for ensuring that all environmental impacts are identified and mitigated in accordance with provincial and national regulations. This includes reviewing environmental impact assessments (EIAs), issuing authorisations, and monitoring compliance with management plans. GDARD's involvement ensures that the Project adheres to stringent environmental standards, protecting biodiversity, water resources, and other critical environmental assets.

The GTIA also emphasises the importance of public participation and stakeholder engagement in the planning and development of transport infrastructure. This ensures that the interests and concerns of affected communities are considered and addressed throughout the Project lifecycle.

By adhering to the provisions of the GTIA and working closely with GDARD, the GRRIN extension aims to achieve a balance between infrastructure development and environmental conservation, contributing to the overall sustainability and resilience of the Gauteng Province.

Report Purpose

As per Section 6(2) of the GTIA, the environmental investigation must be done before determining a route. This Environmental Investigation Report (EIR) presents the findings of the environmental investigation of the Preliminary Route Alignments for the Project.

This Report presents an assessment of the relative environmental impacts of the station position options and route alignment alternatives / options (hereafter referred to as 'route options' or 'options') developed as part of the Preliminary Route Alignment Study for GRRIN extensions Phase 2 and part of Phases 3 and 5. It is a crucial step in planning and developing the GRRIN extensions and identifies associated environmental and social sensitivities. This ensures compliance with environmental regulations and that the Project aligns with sustainability goals.

Additionally, the Report satisfies the requirements of the GDARD for an environmental screening of the proposed route alignment. By conducting this assessment, the Report ensures that potential environmental impacts are identified, and mitigations are proposed, promoting responsible development practices, and safeguarding the natural environment.

The purpose of this Report is therefore to fulfil the requirements for an environmental screening report investigating the various environmental components of the Project. The primary objectives of this Report are to present:

- The findings of the screening of the various station positions and route alignment options for the extension
- An overview of the potential impacts, risks, and opportunities associated with this Project
- An assessment of the South African environmental legislative framework that may influence the Project. This includes identifying regulatory requirements, permits, and licenses needed, the Environmental Impact Assessment (EIA) process required, specialist studies needed, and an approach to the authorisation process.

To achieve these objectives, the following approach was adopted:

- Environmental Screening: Utilised tools such as the Department of Forestry, Fisheries and Environment (DFFE) Screening Tool, Geographic Information System (GIS), drone footage, high-level visual assessments, and ground truthing to identify environmental sensitivities. In doing so, associated impacts and opportunities were also identified
- Options Assessment: Evaluated different route and station options based on environmental screening results, considering site status quo such as land use, and considering not only the physical footprint of the station position and the rail alignment, but also what impact the different vertical placements (at-grade, bridge, cut-and-cover and deep tunnel) would have on the identified sensitivities
- Regulatory Framework Assessment: Outlined applicable legislation and identified necessary permits and licenses, including the necessary EIA process, and proposed an approach to undertaking this environmental authorisation process based on lessons learned from the existing operational Gautrain.

Stations Locations Overview

The Stations Locations section evaluates various potential station positions, per station, for the three corridors. The assessment focuses on environmental sensitivities, social impacts, and the feasibility of each position. The stations considered include Jabulani, Roodepoort, Cradle, Lanseria, Smart City, Fourways, Sunninghill, and Olievenhoutbosch.

Given the footprint associated with the construction and operation of the stations (including associated infrastructure and facilities), regardless of the vertical placement, there will be environmental impacts at the ground level. Therefore, the environmental investigation and screening focussed on the physical location of the station positions only (i.e., Position 0 [from the *Feasibility Study for Possible Extensions to the existing GRRIN* (GMA, 2016)] and alternative positions 1 and 2). Desktop screening and sensitivity mapping were employed to evaluate and compare the various station position options, and identify key environmental sensitivities associated with each alternative. A thorough screening evaluation and comparison was conducted for all options from an environmental perspective.

The desktop screening revealed several environmental sensitivities, including agricultural potential, biodiversity, and proximity to heritage sites. These sensitivities exist due to the presence of critical habitats, watercourses, and conservation zones, as well as historical landmarks. The sensitivities differed between the station options. In most cases, these differences were marginal, but in others, such as the presence of sensitive species and watercourse crossings, the differences were more pronounced. For instance, areas with high agricultural potential were identified, which could be impacted by construction activities. Biodiversity concerns were significant, particularly in regions with critical habitats for vulnerable and endangered species. The presence of watercourses and wetlands added another layer of complexity, as these ecosystems are crucial for maintaining local biodiversity and water quality. Furthermore, the proximity to heritage sites required careful consideration to avoid damaging culturally and historically significant areas. Additional environmental themes were considered based on Screening Tool findings, namely Civil Aviation and Defence. Any adverse impact to surrounding communities from an environmental perspective (such as air, noise, vibration, sense of place, etc.) was also considered.

Several station position options were developed for each station. These options were then evaluated through a Multi-Criteria Analysis (MCA) process to identify optimal options. The environmental sensitivities of the station positions were assessed and taken into consideration in the MCA process, ensuring that the assessment balanced environmental concerns with practical and developmental needs. All optimal station positions defined below will be subject to detailed impact and specialist assessments in future Project stages and EIA phases to ensure comprehensive evaluation and mitigation of potential impacts.

Optimal Station Locations Findings

(Refer to Section 3 for further details on positions)

Station	Environmental Sensitivities	Optimal Station Position from the MCA
Jabulani	**Position 0** has a lower overall environmental sensitivity compared to Positions 1 and 2. It presents fewer challenges in terms of agricultural impact, terrestrial biodiversity, and social impacts. Development of this option would result in lower environmental disruption.	**Position 1 - Deep Tunnel:** This position is strategically located for passenger access to key landmarks such as Bheki Mlangeni Hospital, Jabulani Mall, and Soweto Theatre. The station's location supports future connectivity and development potential, making it a viable choice with manageable environmental impacts.

Station	Environmental Sensitivities	Optimal Station Position from the MCA
Roodepoort	Both **Position 0 and Position 1** present similar environmental impacts, exhibiting the same sensitivity ratings.	**Position 1 - Deep Tunnel:** Located on the western side of the existing PRASA rail line, this position is closer to the CBD area, enhancing accessibility and potential for Transit-Oriented Development (TOD). The site is already zoned for business, providing opportunities for revitalising the CBD.
Cradle	**Position 2** is less sensitive overall because it avoids the additional sensitivities associated with Position 1, such as the presence of more sensitive animal species and its proximity to a graveyard site, which could result in higher negative social impacts. Additionally, Position 2 has a slightly lower sensitivity for palaeontology aspects compared to Position 0 and is less impacted by social factors like noise and visual intrusion.	**Position 1 – Bridge:** This position is strategically located closer to existing residential areas and new planned developments, enhancing accessibility and potential ridership.
Lanseria	**Position 0** is less sensitive overall because it is located within the already developed footprint of Lanseria Airport. This reduces the need for extensive natural vegetation clearance and minimizes habitat disruption.	**Position 1 - At-Grade:** This position offers opportunities for further development on adjacent open land and is strategically located for passenger access to Lanseria International Airport.
Smart City	The proposed Position exhibits several high and very high environmental sensitivities, particularly concerning biodiversity and heritage. As an undeveloped location, low social impact is anticipated.	**Position 1 – Deep Trunnel:** This option is optimal particularly for integration with the Smart City plans. Future station design and development must consider and appropriately mitigate potential environmental impacts, given the greenfield nature and associated sensitive areas.
Fourways	**Position 0** is less sensitive overall because it has lower sensitivities in several key areas, including aquatic biodiversity, archaeological and cultural heritage, and plant species. Its location within an already developed area reduces environmental impacts and simplifies compliance and mitigation processes, despite the additional complications for land acquisition from a social impact perspective.	**Position 1 – Bridge:** Located closer to vacant land and commercial activities around the major road intersection at Fourways, this position enhances accessibility and potential ridership.
Sunninghill	Only one site was assessed, **Position 0**. The site is highly sensitive overall due to its high agricultural sensitivity, very high aquatic and terrestrial biodiversity sensitivity, and concerns about habitat loss as a greenfield area. Moderate visual impacts and potential disruptions to recreational activities also contribute to its sensitivity.	**Position 0 - At-Grade:** Located in a predominantly greenfield area adjacent to the Leeuwkop Prison Grounds, this position supports accessibility and integration with the surrounding urban areas.
Olievenhoutbosch	**Position 1** is less sensitive overall because it has fewer challenges with plant species and terrestrial biodiversity compared to Position 0, which is more sensitive due to its proximity to the Rietspruit River greenbelt and potential sensitive species.	**Position 1 - Cut-and-Cover:** Located in a more densified residential area and closer to the Midrand industrial area, this position enhances accessibility and potential ridership.

Route Alignments Overview

The Route Alignments section evaluates various potential route options for the three corridors of the proposed GRRIN Extensions. The assessment focuses on environmental sensitivities, social impacts, and the feasibility of each route. The routes considered comprise the Little Falls to Jabulani Corridor, Cosmo City to Lanseria Corridor, and Cosmo City to Samrand Corridor.

As with the stations assessment, the desktop screening revealed similar environmental sensitivities, including agricultural potential, biodiversity, proximity to heritage sites, and adverse impacts to surrounding communities. These sensitivities exist due to the presence of critical habitats, watercourses, conservation zones, historical landmarks and significant portions of land requiring expropriation. Differences between the route options were generally marginal, but more pronounced in areas with sensitive species, watercourse crossings and community presence.

Unlike the stations, the footprint associated with the construction and operation of the railway route alignment (including any associated infrastructure) has varying degrees of impacts at the different vertical placement levels. The route determination is for a 400m-wide land corridor within which the future railway line can be designed and implemented. Without final locations, Project designs, and layouts, the precise impacts of the different placements are indeterminable at this stage. Nonetheless, through subjective assessment by professional expertise in railway development and impact assessments, the potential impacts were estimated to a degree that allowed for a comparison of the four vertical placement options. These vertical placement impacts were evaluated in conjunction with the Screening Tool findings and the current land use to determine the status quo of sensitivities. This comprehensive approach ensured that the assessment did not rely solely on the Screening Tool findings but also considered the real-world conditions and existing land uses, providing a more accurate evaluation of environmental sensitivities.

Several route alignment options were developed for each corridor. These options were then also evaluated through the MCA process. The environmental sensitivities (including the initial Screening Tool findings and the adjusted sensitivity ratings considering ground truthing and vertical impacts) of the route alignment options were examined and integrated into the MCA process. This approach ensured that the final selections not only addressed environmental concerns, but also met practical and developmental requirements. All optimal routes will need to undergo detailed impact and specialist assessments in future Project stages and EIA phases to ensure comprehensive evaluation and mitigation of potential impacts.

Optimal Route Alignment Option Findings

(Refer to Section 4 for further details on alignments)

Corridor	Optimal Route Alignment Options from the MCA
Little Falls to Jabulani	The route spans approximately 19 km, all underground/deep tunnel, starting from the end of the Phase 1 alignment near Little Falls Station. It heads south towards Roodepoort Station and then to Jabulani Station. The initial screening identified several high and very high sensitivities across various environmental themes, including agriculture, animal species, aquatic biodiversity, and heritage sites. These sensitivities were primarily due to the presence of high potential soils, critical habitats, multiple watercourse crossings, and proximity to significant heritage sites. The deep tunnel significantly reduced these sensitivities. The underground route ensured that areas with very high sensitivity, such as those supporting threatened ecosystems, and classified as conservation areas, are not disturbed, preserving the terrestrial biodiversity of these areas. This approach not only minimises surface-level environmental impacts, but also

Corridor	Optimal Route Alignment Options from the MCA
	reduced potential social disruptions, as the deep tunnel avoids interactions with residential areas and public amenities. Consequently, the adjusted sensitivity ratings showed a substantial decrease in environmental impacts.
Cosmo City to Lanseria	The route spans approximately 17 km, starting at Cosmo City Station and heading north-west towards Cradle Station before reaching Lanseria International Airport. It includes 9.64 km at-grade and 7.35 km on bridges/viaducts. Due to the Lanseria Airports Company's restrictions, tunnelling could not be used under the existing or planned runway to minimise surface-level impacts, necessitating the use of at-grade and bridge sections. The initial screening highlighted very high sensitivities due to the presence of small holdings, areas of annual crops/cultivation, multiple watercourse crossings, and the proximity to the airport, which raised concerns about potential interference with aviation activities. The use of bridges and viaducts in Option 1 helped to mitigate some impacts, but this vertical placement did not significantly reduce the sensitivities. The bridge sections allowed for some continued use of the land underneath, thereby slightly lowering the overall sensitivity for agriculture. The proximity to Lanseria Airport remained a high sensitivity due to potential risks such as physical obstructions and electromagnetic interference. The extensive green spaces along the corridor meant that impacts on plant and animal habitats, watercourses, and terrestrial biodiversity may be significant. While bridges help preserve some natural habitats, construction impacts and the presence of bridge pillars still pose risks to these sensitive areas. Additionally, the route's proximity to a graveyard site and settlements near Mogale City and more developed properties in the Nooitgedacht area, means that this option requires careful planning to manage social impacts. While this option may have marginally higher environmental sensitivities than other options considered, it performed better across other criteria considered in the MCA. The sensitivities and associated impacts can be adequately managed with careful planning and the implementation of effective management plans and mitigation measures.
Cosmo City to Samrand	The route spans 30.11 km, starting at Cosmo City Station and moving north-east towards Fourways, Sunninghill, and Olievenhoutbosch, before terminating at Samrand Station. It includes 2.88 km at-grade, 1.68 km on bridges/viaducts, 0.63 km cut-and-cover, and 24.93 km in a deep tunnel. The initial screening identified high sensitivities across various environmental themes, including animal species, aquatic biodiversity, and terrestrial biodiversity. These sensitivities were primarily due to the presence of critical habitats, multiple watercourse crossings, and areas classified as conservation zones. The deep tunnel successfully addressed these concerns. By directing the railway below ground, the Project steered clear of regions with significant environmental sensitivity, including those that support endangered ecosystems and are designated as conservation areas. This strategy not only lessened environmental impacts at the surface level but also minimised potential social disturbances, as the deep tunnel avoided residential zones and public facilities. Consequently, the revised sensitivity assessments showed a notable decrease in environmental impacts.

Refined Optimal Routes

During the development of route alignment options in this study, the optimal routes underwent further refinement. This process involved a detailed analysis and adjustments to enhance the feasibility and sustainability of the alignments. The objectives of this refinement process were to optimise the placement of the routes to align with the optimal station positions. Additionally, the refinement aimed to ensure compliance with parameters in the design criteria, including adjustments to meet gradient and curvature requirements, which enhance the overall safety and efficiency of the routes.

Furthermore, the refined routes were designed to integrate seamlessly with other key GRRIN extension plans and facilities, promoting a cohesive and efficient transportation network. In summary:

- **Little Falls to Jabulani Corridor** - The Refined Optimal route for the Little Falls to Jabulani Corridor showed slight variations in alignment compared to Optimal Option 1. Nonetheless, both routes maintained a consistent vertical placement as deep tunnels, ensuring minimal surface-level disruption. This deep tunnel significantly reduced impacts on surface-level ecosystems, habitats, and human activities, preserving critical biodiversity areas, watercourses, and heritage sites. Consequently, despite the minor horizontal deviations, the environmental impacts of both routes were essentially the same, providing a sustainable solution for the corridor.
- **Cosmo City to Lanseria** – Compared to Optimal Option 1, the Refined Optimal had several differences affecting environmental sensitivities. The length of at-grade rail from Cosmo City to the Cradle Station was reduced, with more cut-and-cover and bridge sections, slightly lowering the environmental impact. However, the fully at-grade portion near the Cradle Station and Depot location had higher environmental and social impacts due to vegetation clearance and proximity to rural communities, including a graveyard site. Towards Lanseria Airport, the alignment remained mostly unchanged, with some vertical placement adjustments reducing the at-grade length and slightly lowering the environmental impact. These refinements were necessary to integrate with the Depot and Smart City access routes, but overall, the Refined Optimal route presented greater environmental and social impacts, mainly due to the proximity of the Depot and Cradle Station locations.
- **Cosmo City to Samrand** - Compared to the Optimal Option 1, the Refined Optimal route presented some differences. At the Cosmo City end, the route was primarily on a bridge, which exhibited slightly reduced impacts compared to the more mixed placement in Optimal Option 1. There was a slight deviation in the Refined Optimal route near the DBSA at the Samrand end, but since this section was also a deep tunnel, the deviation made no difference to the sensitivity findings. Additionally, there was a change to a cut-and-cover section at the Samrand end of the route that was a tunnel in Optimal Option 1. This area, however, was not environmentally sensitive. These refinements were necessary to optimise the alignment and comply with parameters in the design criteria, ensuring a sustainable and optimal route. From an environmental sensitivity perspective, both the Refined Optimal and Optimal Option 1 were essentially the same due to their primarily deep tunnel design.

Environmental and Social Risks and Opportunities

The development of the Project will result in various low to significant environmental and social impacts during the construction and operational phases. Key potential impacts include air quality issues from dust and emissions, increased noise levels from construction equipment and train operations, and vibration affecting nearby structures. Visual intrusion from construction sites and railway infrastructure, and the associated vegetation clearance and habitat destruction / disruptions, and disturbance to wildlife are also significant concerns. Additionally, there is potential for contamination of surface water and groundwater from construction runoff and spills, soil erosion and compaction, and loss of agricultural land. Cultural heritage sites may also be at risk of damage, and there could be disturbances to fossil sites. Socio-economic impacts include the displacement of communities and businesses, increased traffic, and disruption to local transport systems, such as the taxi industry.

To mitigate these impacts, several measures are proposed. Dust suppression techniques and regular maintenance of machinery should be used to address air quality issues, while noise attenuation barriers and scheduling construction activities during daytime hours will manage noise impacts. Vibration dampening techniques and monitoring will help reduce vibration effects. Visual impacts will be minimised by using aesthetically pleasing materials and implementing temporary landscaping. Habitat clearance will be minimised, and habitat restoration plans will be implemented to protect biodiversity; as a last resort, biodiversity offsetting may be required. Contamination risks to surface water and groundwater will be managed through sediment and erosion control measures, spill containment systems, and regular water quality monitoring. Soil erosion and compaction will be addressed by stabilising soil and rehabilitating disturbed areas. A Resettlement Action Plan will be developed for affected communities and businesses, and a Traffic Management Plan will be developed to manage increased traffic and disruptions. Addressing the socio-economic impacts related to the other public transport systems operating in the Project areas will require thorough stakeholder engagement and mitigation planning. These measures aim to minimise environmental and social disruptions, ensuring the Project proceeds responsibly.

Conversely, the Project is expected to bring a range of social and economic benefits. These include job creation during construction, opportunities for local businesses, and economic stimulation through improved connectivity. The Project will provide a reliable public transport system, reducing travel times and alleviating traffic congestion. Environmentally, it will reduce the carbon footprint compared to traditional cars and buses, contributing to cleaner air and a healthier environment. Social benefits include enhanced quality of life through improved accessibility, community development, and increased safety and convenience. The Project will stimulate urban renewal and development around stations, transforming areas into vibrant hubs. It can also offer training opportunities for construction workers and engineers, and ongoing training for operational staff. Improved accessibility for all individuals, including those with disabilities, increased transport safety, and a boost to tourism by offering easier access to tourist destinations are additional benefits. These advantages extend beyond the immediate provision of reliable transport, including but not limited to, positive impacts on local communities, economic development and technological advancement.

To ensure the Project encompasses a comprehensive approach to sustainable development, the Project will need to undergo comprehensive impact assessments and detailed specialist environmental and social assessments. These assessments will define site and project-specific impacts and develop targeted mitigation and enhancement measures, ensuring that the Project proceeds in an environmentally responsible and socially inclusive manner.

Legislative Framework and Permitting Strategy

The development of the GRRIN Extensions Project triggers a wide range of South African environmental legislation (for each corridor / phase). The Project will need to conform with the National Environmental Management Act (NEMA, Act No. 107 of 1998), the National Water Act (NWA), and several other Specific Environmental Management Acts (SEMAs). NEMA serves as the primary legislation for environmental authorisation, providing a comprehensive framework for environmental governance, ensuring that the Project adheres to principles of sustainable development, environmental protection, and public participation. The Gauteng Provincial Environmental Management Framework (GPEMF) also comes into effect, providing guidelines for sustainable development and environmental management within the province.

The GPEMF identifies specific zones where certain activities may be excluded from the requirement to obtain Environmental Authorisation, thereby streamlining the approval process for developments that align with provincial environmental priorities.

Given the scale and nature of this Project, a formal Scoping and Environmental Impact Reporting (S&EIR) process, in accordance with NEMA and the EIA Regulations (GNR 982 of 2014, as amended) will be required for all corridors (or associated phases). This comprehensive process will include various specialist assessments to evaluate potential impacts on agriculture, biodiversity, heritage resources, and more. Several permits may also be required due to the Project's potential impacts on water resources, air quality, waste management, and protected species. These may include a Water Use License (WUL) under the NWA for activities impacting water resources, an Atmospheric Emission License (AEL) under the National Environmental Management: Air Quality Act (NEM:AQA, Act No. 39 of 2004) for specific air quality impacts (predominantly if large generators are used), a Waste Management License (WML) under the National Environmental Management: Waste Act (NEM:WA, Act No. 59 of 2008) for certain waste-related activities, Heritage Permits under the National Heritage Resources Act (NHRA, Act No. 25 of 1999) for activities impacting heritage resources, Biodiversity and Forestry Permits under the National Environmental Management: Biodiversity Act (NEM:BA, Act No. 10 of 2004) and the National Forests Act (NFA, Act No. 84 of 1998) for activities involving protected species or trees, and Borrow Pit Permits under the Mineral and Petroleum Resources Development Act (MPRDA, Act No. 28 of 2002) for the extraction of construction materials.

A comprehensive assessment of potentially applicable legislation and activities, identifying the necessary permits, processes, authorities, and timeframes is included in this Report. For each corridor (or associated phase), an integrated environmental approvals process is proposed to streamline the timeframes and public participation procedures. This approach will consolidate the various permitting and licensing requirements into a cohesive framework, ensuring that all necessary approvals are obtained efficiently. By coordinating the different environmental assessments and stakeholder engagements, the integrated process will reduce duplication of efforts, enhance transparency, and facilitate timely decision-making. This streamlined approach aims to ensure that the Project progresses smoothly while maintaining rigorous environmental standards and fostering meaningful community involvement.

The key competent and commenting authorities involved in this process include the Department of Forestry, Fisheries and the Environment (DFFE), the Gauteng Department of Agriculture and Rural Development (GDARD), and the Department of Water and Sanitation (DWS). Other competent authorities involved in the environmental approvals process for the Project will include:

- The South African Heritage Resources Agency (SAHRA) and the Provincial Heritage Resources Authority – Gauteng (PHRA-G), which oversee heritage resources and permits and the protection of heritage resources
- The Department of Mineral Resources and Energy (DMRE) which handles the approval of borrow pit permits under MPRDA
- Local municipalities, such as the City of Johannesburg, City of Tshwane, and Mogale City Local Municipality (and others), which ensure compliance with municipal by-laws, air quality management, and other local environmental regulations
- The Civil Aviation Authority (CAA) if the Project impacts aviation routes or safety
- The DFFE will also be responsible for biodiversity and forestry permits under NEM:BA and the NFA.

These authorities will ensure that the Project complies with all relevant environmental regulations and standards, facilitating a comprehensive and coordinated approach to environmental management.

In developing this strategy, the lessons learned from the existing Gautrain Rapid Rail Link System project (the currently operating Gautrain line) were examined. The environmental authorisation of this project was a comprehensive and complex undertaking that spanned nine years, highlighting several critical aspects and challenges essential for future phases. Initially, the EIA process was planned to take four years but extended to nine years due to the project's complexity and evolving legislative requirements. These experiences underscore the importance of realistic timelines, flexibility, and thorough planning in managing large-scale infrastructure projects. Key challenges included navigating newly emerging environmental legislation, addressing biophysical and socio-economic impacts, and ensuring effective public participation. The involvement of senior management and robust relationship management strategies were crucial for successfully engaging stakeholders and obtaining the necessary environmental authorisations.

The approach to the environmental authorisation process for this Project will vary based on scale of the phases at the time of implementation, the associated environmental impacts, and regulatory requirements at the time at which implementation is proposed. The full GRRIN Extension project is planned over five phases over a 24-year period. A single comprehensive EIA is impractical due to the phased implementation, extended timeline, and financial burden. Instead, a phased EIA process is advised allowing for detailed, focused assessments and approvals that align with the Project's staggered rollout, ensuring financial prudence and timely execution.

A hybrid approach combining phase-specific EIAs with a supplementary cumulative impact assessment is thus recommended. Phase-specific EIAs provide detailed assessments, cost efficiency, phased approvals, focused stakeholder engagement, and adaptive management. The supplementary cumulative impact assessment offers a holistic view of overall environmental impacts across all phases, cumulative effects management, enhanced mitigation strategies, regulatory compliance, and informed decision-making. Early consultation with relevant authorities and continuous stakeholder engagement are crucial for a smooth and efficient environmental authorisation process, ensuring the project's success and sustainability. Flexibility and adaptability are essential, as new information and changing circumstances may influence the EIA strategy.

Conclusion

The Project aims to extend rapid rail network in the Gauteng Province. In this context, this environmental investigation aimed to investigate the interaction of the proposed route options / alternatives with various aspects of the receiving environment and identify areas of impact. The findings of the environmental screening have been crucial in identifying potential impacts and informing the selection of sustainable and optimal route alignments and station positions. The permitting strategy proposes that all necessary environmental approvals and licenses can be obtained efficiently, facilitating compliance with South African environmental legislation. By adhering to the provisions of the GTIA and working closely with the GDARD, the Project aims to achieve a balance between infrastructure development and environmental conservation. This balance is crucial for the overall sustainability and resilience of the Gauteng Province, aligning with the NDP. Overall, the Project encompasses a comprehensive approach to sustainable development, balancing economic growth, environmental stewardship, and social well-being. By addressing immediate transportation needs and laying the groundwork for future urban development, the Project will contribute to the long-term prosperity and resilience of the region.

1. INTRODUCTION

In 2016, a Feasibility Study was conducted that proposed various planned Gauteng Rapid Rail Integrated Network (GRRIN) routes throughout the Gauteng Province. These routes, including the existing operating Gautrain Rapid Rail Link (GRRL) System (known as Gautrain) and Future GRRIN phases, are presented in Figure 1-1 below.

The Phase 1 extension of the GRRIN, from Marlboro to Little Falls, has already undergone a route alignment study, and the Phase 1 route has already been determined. For the purposes of this Project, this Phase 1 route and the associated station locations at Cosmo City and Little Falls, is regarded as fixed. The Samrand station is a future station forming part of the existing GRRL between Centurion and Midrand and is therefore also regarded as fixed for the purposes of this Project.

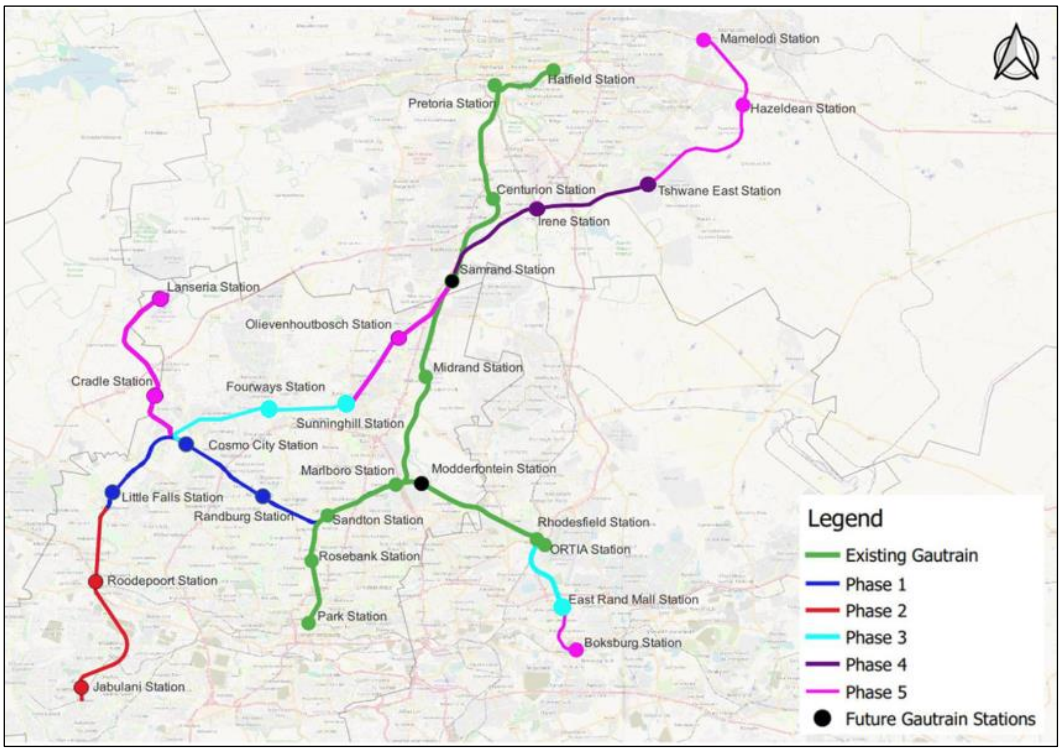


Figure 1-1: Proposed GRRIN Extensions (Phase 1, 2, 3, 4 and 5)

1.1 The Project

Gautrain Management Agency (GMA) appointed Hatch Africa (Pty) Ltd (Hatch) to undertake the Preliminary Route Alignment Study for the Soweto Extension and Cosmo City Junction of the Proposed GRRIN Extensions (hereinafter referred to as the Project). The map, as presented in Figure 1-2 illustrates the extent of this Project within the context of the existing Gautrain / GRRL and adjacent planned GRRIN extensions located in the different Gauteng municipal areas. The blue lines indicate the Phase 1 routes and stations, the yellow highlighted red line indicates the Preliminary Route Alignment scope that forms the focus of this Project and this Report.

The Preliminary Route Alignment Study includes the integration with the proposed Phase 1 extension with interface stations at Cosmo City and Little Falls.

The three new rail corridors that form part of the Project are:

- **Little Falls** to **Jabulani (GRRIN Phase 2 Extensions):** ± 19.9 km with new stations at Jabulani, Roodepoort and Little Falls. The Little Falls station forms part of the GRRIN Phase 1 Extension
- **Cosmo City to Lanseria (Portion of GRRIN Phase 5 Extensions)**: ± 17.4 km with stations at Cosmo City, Cradle, Smart City and Lanseria. The Cosmo City station forms part of the GRRIN Phase 1 Extension. Smart City is an additional station that has been incorporated post the Feasibility Study of 2016
- **Cosmo City to Samrand (Portion of GRRIN Phase 3 & 5 Extensions)**: ± 30.3 km with new stations at Fourways, Sunninghill, Olievenhoutbosch and Samrand. Cosmo City station forms part of the GRRIN Phase 1 Extension.

The three corridors together comprise approximately 68 km of rapid rail extensions.

Additional details on these corridors are provided in Section 4 of this Report.

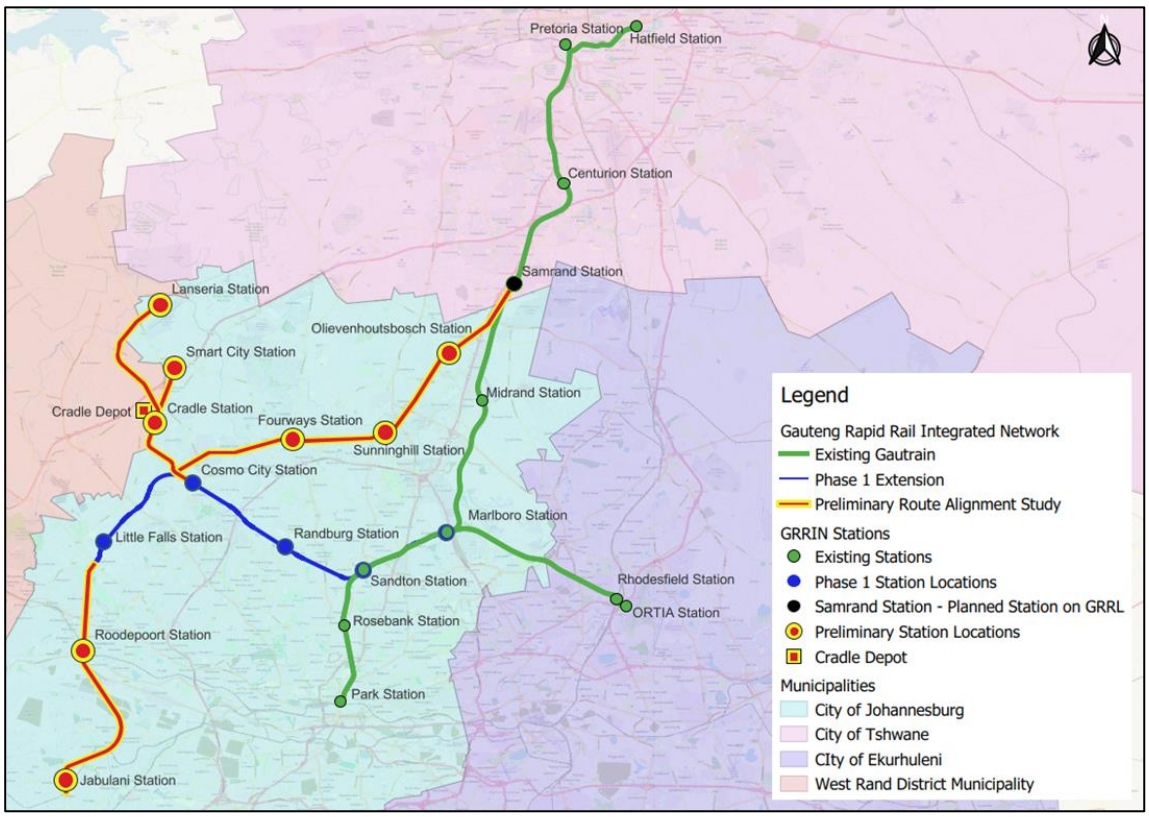


Figure 1-2: Preliminary Route Alignment Study in Relation to Existing Gautrain and Phase 1 GRRIN Extensions

1.2 Guiding Framework for Sustainable Development and Regulatory Compliance of GRRIN Extensions

1.2.1 Integrating Sustainable Development Goals into the GRRIN Extensions

The extension of the GRRIN must be framed within the broader context of both national and international policies. These policies highlight the South African Government's dedication to sustainable development and environmental protection.

Central to this vision is the National Development Plan: Vision for 2030 (NDP), which outlines twelve key areas aimed at eradicating poverty, creating jobs, and reducing inequality by 2030. The NDP also stresses the importance of fostering environmental sustainability and resilience, ensuring that natural resources are protected while benefiting human communities.

In line with the NDP, the South African Government has identified fourteen critical Outcomes based on the Medium-Term Strategic Framework. Several of these Outcomes are particularly relevant to the GRRIN Extensions, including economic growth, infrastructure development, human settlements, environmental protection, and public service enhancement. Outcome 10, which focuses on the protection and enhancement of environmental assets and natural resources, is especially pertinent.

Outcome 10 underscores the government's responsibility to uphold the environmental rights enshrined in the Constitution of the Republic of South Africa (108 of 1996) (the Constitution). Section 24 of the Constitution guarantees everyone the right to an environment that is not harmful to their health or wellbeing and mandates the protection of the environment through reasonable legislative measures. Five sub-outcomes under Outcome 10 are particularly relevant to this Report. These include ensuring ecosystems are sustained and natural resources are used efficiently, developing effective climate change mitigation and adaptation strategies, transitioning to an environmentally sustainable, low-carbon economy, strengthening governance systems and capacity, and promoting sustainable human communities.

These priorities highlight that the GRRIN Extensions must focus on creating sustainable, connected communities. This involves preserving and maintaining ecosystems and their services and implementing effective climate change mitigation and adaptation strategies within a robust governance framework.

The concept of sustainable development, as defined by the World Commission on Environment and Development in 1987, links economic growth with environmental protection. This principle has guided global development goals, including the Millennium Development Goals and the subsequent Sustainable Development Goals (SDGs). The SDGs aim to address a broader range of issues, including poverty, inequality, and climate change, by 2030. The green economy, which promotes human well-being and spatial equity while reducing environmental risks, is closely related to the SDGs and is particularly relevant to the GRRIN Extensions.

Within the African context, sustainable development is further supported by Agenda 2063, a strategic framework for socio-economic transformation across the continent up to 2063. Agenda 2063 envisions a prosperous continent with high living standards, well-educated citizens, transformed economies, productive agriculture, healthy ecosystems, and resilience to climate change. To this extent, the NDP also recognises the need for South Africa to transition away from unsustainable resource use, aiming for a low-carbon economy in a cost-effective manner consistent with current policies.

The Southern African Development Community (SADC) emphasises sustainable development, particularly in combating poverty and food insecurity. SADC has identified three main goals: protecting and improving the health, environment, and livelihoods of the people of southern Africa, preserving the region's natural heritage and biodiversity, and supporting regional economic development on an equitable and sustainable basis.

These priorities highlight that the GRRIN extensions must focus on creating sustainable, connected communities.

This involves preserving ecosystems (and ecosystem-services) and implementing effective climate change mitigation and adaptation strategies within a robust governance framework. The Green Book by the Centre for Scientific and Industrial Research further emphasises the need for planning and design actions to adapt to climate change impacts, reduce exposure to hazards, and exploit opportunities for sustainable development. Key actions include protecting critical infrastructure and connecting key transit nodes to support climate resilience and disaster response.

In conclusion, the GRRIN Extensions is not just a transportation project, but a strategic initiative aligned with national and international SDGs. It aims to foster economic growth, environmental sustainability, and social inclusion, ensuring that the benefits of development are widely shared and that the natural environment is preserved for future generations.

1.2.2 The Gauteng Transport Infrastructure Act

The Gauteng Transport Infrastructure Act (Act 8 of 2001), amended by the Gauteng Transport and Infrastructure Act (No. 6 of 2003) (GTIA), is a comprehensive legislative framework that consolidates the laws relating to roads and other types of transport infrastructure in the Gauteng Province. The GTIA provides for the planning, design, development, construction, financing, management, control, maintenance, protection, and rehabilitation of provincial roads, railway lines, and other transport infrastructure within the province.

The GTIA is crucial for the Project as it outlines the regulatory measures and standards that must be adhered to during the Project's lifecycle. This includes the determination of routes, preliminary design, proclamation of provincial roads and railway lines, and the expropriation and compensation processes. The GTIA ensures that all transport infrastructure projects are developed in a manner that is consistent with provincial policies and regulations, promoting sustainable development and efficient use of resources.

The route determination and subsequent development, including Preliminary Design of rail corridors, is governed by the GTIA. The Gauteng Provincial Government's (GPG) overall vision for future rail development includes various rail route options for consideration, ensuring that the extension of the GRRIN aligns with provincial transport policies and sustainable development goals. Compliance with the GTIA means that the Project must undergo rigorous planning and design processes to meet the standards set forth therein. This includes evaluating potential environmental and social impacts of the Project. The GTIA also emphasises the importance of public participation and stakeholder engagement, ensuring that the interests and concerns of affected communities are considered and addressed throughout the Project.

This Project forms part of "Step 1" in the GTIA process which will enable the MEC for Roads and Transport (the MEC) to determine the route of the railway line for the proposed GRRIN Extensions (Figure 1-3).

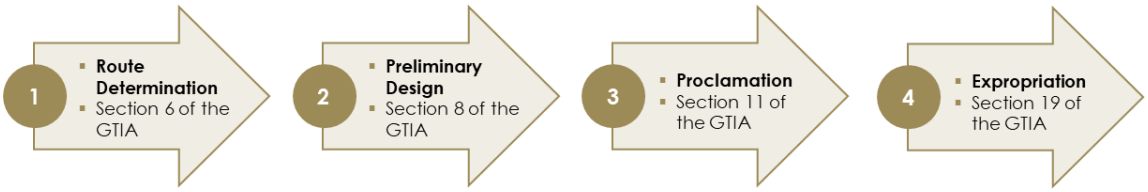


Figure 1-3: GTIA Process for defining a provincial railway line in Gauteng

By adhering to the provisions of the GTIA, the Project can ensure that it meets all legal and regulatory requirements, facilitating smoother Project implementation and reducing the risk of legal challenges. The GTIA's focus on sustainable development aligns with the Project's goals of enhancing public transportation while minimising environmental impacts and promoting economic growth in the region.

In summary, the GTIA provides a critical legal framework that guides the development of the Project, ensuring that it is planned, designed, and executed in a manner consistent with provincial regulations and sustainable development principles. This alignment with the GTIA not only supports the GPG and the Project's goals of enhancing public transportation, but also promotes economic growth and environmental sustainability in the Gauteng Province.

1.3 Options Development and Selection Assessment

1.3.1 Multi-Criteria Analysis

The Project advanced to a stage where a list of potentially viable station positions and route options were compiled. These options included a variety of station positions and route alignment alternatives for each corridor, as well as different vertical placements (e.g. bridge, tunnel etc.) along these routes or over specific portions of the corridors (see Section 1.3.2).

The station options consisted of 'Position 0', derived from the Gauteng Rapid Rail Extensions Feasibility Study (2016). A number of additional station position options were proposed to enhance accessibility and convenience for passengers:

- Jabulani: Two (2) additional positions
- Roodepoort: One (1) additional position
- Cradle: Two (2) additional positions
- Future Smart City: Two (2) new positions[1]
- Lanseria: One (1) additional position
- Fourways: One (1) additional position
- Sunninghill: Zero (0) additional positions
- Olievenhoutbosch: One (1) additional position.

In the case of the routes, 'Option 0', was derived the Feasibility Study (2016), as well two additional options, per corridor, namely Option 1 and Option 2.

[1] Note that the Future Smart City Station was not originally part of the 2016 Feasibility Study, therefore, there is no previous Option 0 for this future station.

These additional options offered alignment alternatives to optimise connectivity and efficiency, each designed to meet specific transportation needs and geographical considerations.

The station and route options underwent a Multi-Criteria Analysis (MCA) process to evaluation relative merits. This process was designed to provide a structured and objective framework for decision-making, ensuring that each option was assessed comprehensively and fairly. The MCA process incorporated eight weighted assessment criteria for station position options (Table 1-1) and five weighted criteria for route options (Table 1-2), each carefully selected to reflect the Project's goals and priorities.

Table 1-1: Station Assessment Goals and Criteria

Goals	Criteria	What It Considers
Enhancing Customer Utility	Integrating Public Transport	Considers the proximity of the station's position relative to nearby transport modes and activity nodes. *For example, a station located closer to nearby activity nodes, like a shopping mall, would be better integrated with the urban surroundings than a station located further away from activity nodes.*
	Accessing the station (360° Station Access)	Considers the ease at which the station precinct is easily accessed or can be made accessible, by conducting a full 360-degree assessment of the area around the station's position. *For example, a station position that only allows access from one side due to surrounding buildings, is less favourable to a station position that allows access from multiple directions.*
Easing Deliverability	Constructability	Considers the complexity of construction and extent of disruption that could be caused by the construction of the station at a particular location. *For example, constructing a station in a location that requires existing buildings to be demolished and relocated, will be more complex than constructing a station in a location where the land is vacant.*
	Cost	Considers the capital cost required to construct the station in that position. *A simple example would be the cost of constructing a station in a dense urban environment with lots of existing infrastructure surrounding it, would be more than constructing a station in a sparse urban environment with less existing infrastructure surrounding it.*
	Alignment with Strategic/Statutory Plans	Considers the extent of conflict that the station position has with any pre-existing statutory plans, and the ease of resolving any such conflicts in future. *An example would be a station in a position that conflicts with the government's plans to build a new water reservoir, is more challenging and less favourable to a position where the state plans to have future commercial developments like a shopping mall.*
Enhancing Urban Integration	Catalysing Development & Growth	Considers the potential for transit Oriented Development (TOD) or space available for other commercialisation and its proximity to the station position. *A simple example would be if there is vacant land available for commercial development around a station position, it would be more preferrable than a station*

Goals	Criteria	What It Considers
		positioned in an area with limited or no space for further commercialisation.
	Community Severance	Considers how communities are disrupted both during construction and operations of the station position. It also considers how the station position together with the railway route potentially separates communities and what impact it may have on the mobility of people. *For example, a station and route going above ground through the middle of a city would be more disruptive than a station and route going through vacant land on the outskirts of a city.*
	Environmental Impact	**Considers how the station position impacts environmental aspects like biodiversity, water, heritage, air, noise etc.** ***For example, a station positioned above ground near an existing river stream, would be less favourable to a station located in an already established urban precinct.***

Table 1-2: Route Alignment Assessment Goals and Criteria

Goals	Criteria	What It Considers
Easing Deliverability	Constructability	Considers the complexity of construction and extent of disruption that could be caused by the construction of the route. *For example, a route that requires construction of a railway line beneath an existing road would be more complex and cause more disruption than a route that runs on a bridge over the same road.*
	Construction Costs	Considers the capital cost required to construct the route. *A simple example would be the cost of constructing a tunnel route is more than constructing a route at-grade (above ground).*
Connecting with Care	Land Acquisition	Considers the total size of land required to construct the route. *For example, a tunnel route would not require any acquisition of land since it is located below ground, however a route at-grade (above ground) will require land to be acquired.*
	Social Impact	Considers how communities are disrupted both during construction and operations of the railway route. It also considers how the route potentially separates communities and what impact it may have on the mobility of people. *For example, a route going above ground through the middle of a city would be more disruptive than a route going through vacant land on the outskirts of a city.*
	Environmental Impact	**Considers how the route impacts environmental aspects like biodiversity, water, heritage, air, noise etc.** ***For example, a route going above ground through an existing river stream would be less favourable to a tunnel route going underground beneath the river.***

One of the key assessment criteria was the environmental impact, of which the outcomes are discussed in detail in this report. This criterion evaluated the potential environmental impacts of each station position and route alignment option, considering aspects such as

biodiversity, water resources, heritage sites, and social impact including land use and noise levels, among others. It involved an analysis of environmental sensitivities along the proposed routes, aiming to identify and mitigate adverse effects on the natural environment. The objective was to assess relative environmental impacts of each route / station option.

The MCA process provided a structured and objective framework for decision-making, ensuring that the selected options aligned with the Project's goals of sustainability, efficiency, and community integration. Incorporating a comprehensive set of criteria, enabled balancing various considerations and selecting viable and beneficial options for this Project. Through this process, optimal station and route options were selected. For the Stations Locations, this Report presents an overview of the assessment of options and presents more detailed screening findings of the optimal station position only (Section 3). For the Route Alignment, the Report presents an assessment of Option 0, from the 2016 Feasibility Study, along with the first Optimal Option (Option 1) and the second Optimal Option (Option 2). These options, per corridor, are defined and compared in Section 4.

1.3.2 Vertical Placement of Options

The options were developed with various vertical placements of the station and railway line along the route options. Sections along a route alignment option could place the station or railway line at one of four different vertical arrangements, abbreviated as A, B, C, or D.

These are described as follows (Figure 1-4):

- **A – At Grade:** typically, at ground level but may have a vertical placement up to 8m below or above existing ground level.
- **B – Bridge (elevated viaduct):** a viaduct is a specific type of bridge that consists of a series of arches, piers or columns supporting a long-elevated railway. Vertical placement on an elevated viaduct is typically more than 8m above existing ground level.
- **C – Cut and Cover:** a method of building a shallow tunnel by cutting into the ground to the desired level, then lining or enclosing the tunnel with concrete and covering it with earth up to existing ground level. Cut-and-cover sections are typically between 8m and 28m below existing ground level.
- **D – Deep Tunnel**[2]**:** an underground passageway, dug through the surrounding soil, earth or rock and then enclosed with concrete, except for the entrance and exit of the tunnel. Deep tunnel sections are typically placed at 28m or more below existing ground level.

[2] For this assessment, it is assumed a tunnel boring machine (TBM) will be used for the construction of deep tunnel railway lines.

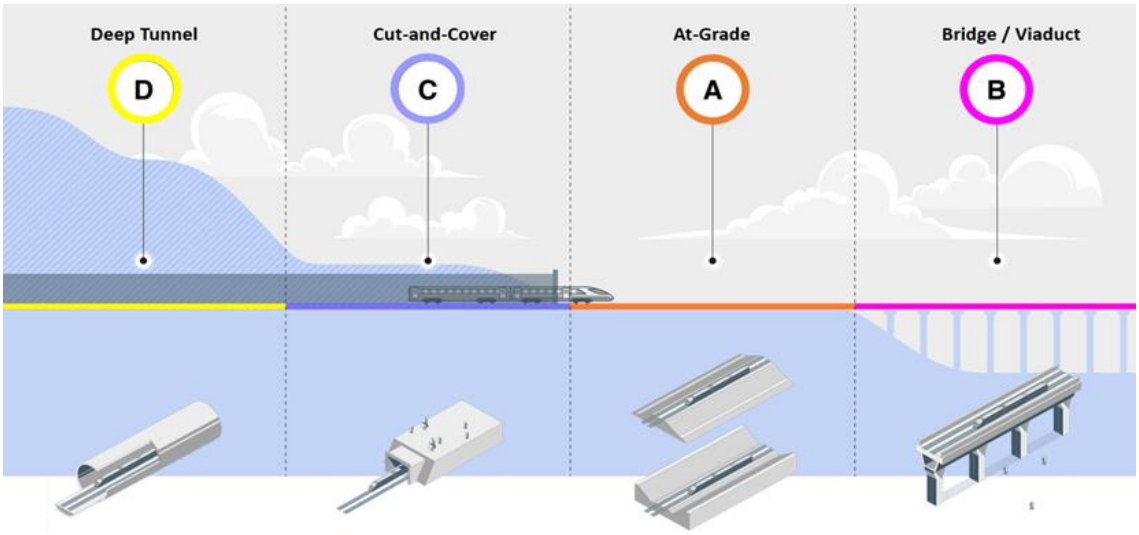


Figure 1-4: Visual Representation of the Rail Vertical Alignments / Placements

For each corridor, a table defines the vertical arrangement along each route option (i.e. how much of the alignment is underground, above ground etc.). In some instances, all four vertical placements can form part of one option, each with various track lengths at these different vertical placements (Refer Section 4).

1.4 Report Purpose

This Report is written to provide the initial environmental assessment of the proposed route alignments and station positions for the GRRIN extensions. It aims to ensure that the Project can be developed to align with sustainable development goals and comply with relevant environmental legislation.

The GTIA, which governs route determination outlines the requirement for an environmental investigation and report in Section 6(2). This Report serves as the Environmental Investigation Report (EIR) for the Project, assessing the environmental screening of the various station position options and route alignment alternatives / options (hereafter referred to as 'route options' or 'options'). Additionally, the report satisfies the requirements of the GDARD for an environmental screening of the proposed route alignment. By conducting this assessment, the Report ensures that potential environmental impacts are identified, and mitigations are proposed, promoting responsible development practices and safeguarding the natural environment.

By adhering to the provisions of the GTIA and working closely with GDARD, the GRRIN extensions aim to achieve a balance between infrastructure development and environmental conservation, contributing to the overall sustainability and resilience of the Gauteng Province.

The purpose of this Report is to fulfil the requirements for an environmental screening report investigating the various environmental components of the Project. It presents:

- The findings of the screening of the various station position and route alignment options for the extension
- An overview of the potential impacts, risks, and opportunities associated with this Project

- An assessment of the South African environmental legislative framework that may influence the Project. This includes identifying regulatory requirements, permits, and licenses needed, the Environmental Impact Assessment (EIA) process required, specialist studies needed, and an approach to the authorisation process.

This Report should be read in conjunction with the Route Determination Report.

2. APPROACH AND METHODOLOGY

This section outlines the methodology used to fulfil the scope of this Report. The scope of work is illustrated in (Figure 2-1) and discussed below:

- Environmental Screening: This initial step involves gathering and reviewing existing environmental data using tools like the Department of Forestry, Fisheries and Environment (DFFE) Screening Tool. It included a desktop review, site verification, and evaluation of the findings to identify potential environmental sensitivities.
- Options Assessment: In this phase, different options were evaluated and compared based on the screening results. This assessment provided technical input into the engineering options analysis, ensuring that environmental considerations were integrated into the decision-making process.
- Environmental and Social Risks and Opportunities: This step focused on identifying potential social / environmental impacts and associated mitigation measures. It also highlighted opportunities that can be leveraged to enhance the Project's social and environmental outcomes.
- Regulatory Framework Assessment: The final step involved outlining the applicable legislation and identifying the necessary permits. It describes the permitting strategy for the Project.

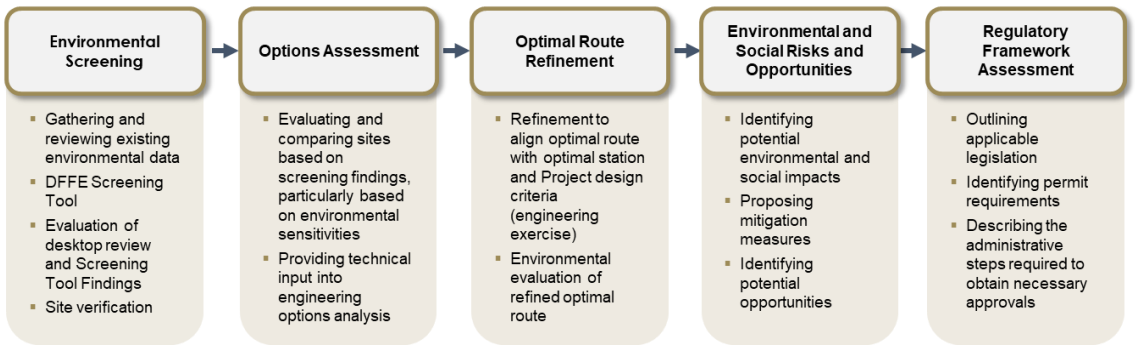


Figure 2-1: Overview of the Report Scope

2.1 Environmental Screening and Options Assessment

2.1.1 Environmental Screening Tool

Initial screening of the environmental related aspects and impacts associated with all station and route options proposed for the Project was key in establishing optimal alternatives. In this high-level screening, key consideration was made for environmental sensitivities, and for minimising negative environmental impact, where plausible.

The Project is anticipated to impact on a range of aesthetic, biophysical, and social aspects of the receiving environment. The DFFE Screening Tool was used to identify the sensitivities associated with proposed station and route options. Below are the key environmental aspects typically considered in identifying environmental sensitivities and impacts (Table 2-1).

Table 2-1: Environmental Sensitivities

Key Categories	Environmental Aspects/Themes
Physical Environment	Topography; Climate; Geology; Soils; Surface Water; Groundwater; Agricultural Potential; Geohydrology.
Aesthetic Environment	Air; Noise; Vibration; Landscape; Visual Intrusion.
Biophysical Environment	Flora (plant species); Fauna (animal species and terrestrial biodiversity); Aquatic and Wetland (aquatic biodiversity); Protected Areas.
Cultural/Archaeological	Cultural Heritage; Archaeology; Palaeontology
Social [3]	Any adverse impact to surrounding communities from an environmental perspective (such as air, noise, vibration, sense of place etc.).
Other	Environmental Management Frameworks relevant to the sites; Civil Aviation; and Defence

The Project progressed to establish a list of station and route options, considering four vertical placements/positions at certain intervals along the routes. The Screening Tool provides an assessment of the physical location at ground level only. Therefore, since not all four vertical positions will result in the same level of impact on the sensitivity features noted in the Screening Tool, the informed professional judgment of environmental consultants and engineers was used to determine the expected impacts on sensitivities identified by the Screening Tool (based on the where the vertical placement lies in those sensitive areas).

The findings of the Screening Tool dictate a sensitivity rating for the different environmental aspects, namely, 'low', 'medium', 'high', and 'very high'. However, there is a possibility for differentiation within a sensitivity rating. For example, two sites may both have a 'high sensitivity' for terrestrial biodiversity, but the sensitivity features[4] may be more significant for one versus the other. As such, a sliding scale was developed (Table 2-2) to enumerate the sensitivity rating and score it to be able to provide a more detailed differentiation between route options. For the scale of the sensitivity rating, the lower the environmental impact or sensitivity (i.e., less of a negative impact), the better the score and higher the value on the scale. The following process has been applied to score the different route options that have the same sensitivity rating:

- If there is little to no differentiation in the sensitivity features between the options, then the 'median score' in the scale is given to all options.
- The greater the number of sensitive features an option has, the more sensitive the option is assumed to be, and as such the lower the end of the scale will be applied.
- Where sensitivities are not present in a specific theme in the Screening Tool (i.e., rating = None), that theme scored a 10 as this was considered a positive finding compared to sites where sensitivities were identified.

These sensitivity ratings and scores formed the basis of the 'Environmental Impact' component of the MCA model.

[3] This category does not make provision for any assessment of socio-economic impacts or findings that are stakeholder engagement / public participation process related. This is a formal assessment required as part of the EIA process.

[4] 'Sensitivity Rating' refers to the various sensitivity classes as per the Screening Tool, namely low, medium, high, and very high; 'Sensitivity Features' on the other hand refers to the specific sensitivities identified - such features include protected areas, wetlands, specific species, grades of heritage sites, land capabilities, etc.

Table 2-2: Sensitivity Rating and the Associated Sliding Scale for Scoring Sensitivities

Sensitivity Rating	Score Scale	Median Score
Very High	0 - 2	1
High	3 - 5	4
Medium	6 - 8	7
Low	9 - 10	9.5
None	-	10

The environmental sensitivities identified by the Screening Tool, the rating / level of this sensitivity (i.e. low to very high), and the sensitivity scores are presented for the station position and route alignment options. Further to the rating and the score, key sensitivity features (such as sensitive species or nearby heritage sites) are noted in text. Additional considerations for impacts such as relocation, visual, noise impacts etc. are also noted in the "Social" theme. Since the Screening Tool does not make provision for these social aspects (see 2.1.2 below), the Social theme was rated subjectively, which is also subject to detailed assessment by an Environmental Assessment Practitioner (EAP) and the relevant qualified specialists during future Project Environmental Impact Assessment (EIA) phases.

Based on desktop-level analysis, no options considered in the analysis of all corridors presented significant fatal flaws. In certain instances, the Screening Tool identified themes of 'very high' sensitivity, however it is perceived that potential impacts posed by the Project can be adequately mitigated to prevent detrimental impacts to the environment (particularly in areas of medium to high sensitivity). However, confirmation of such will be subject detailed specialist assessments and formal EIA and Environmental Authorisation (EA) processes during later / future phases of the Project.

2.1.2 Social Impacts

The Screening Tool does not make provision for 'social' impacts. In this theme, consideration was made for potential adverse impacts to surrounding communities such as displacement (i.e., land acquisition, purchasing and/or expropriation, as a last resort), or from an environmental perspective (i.e., air, noise, vibration, visual, sense of place etc.). As previously stated, these aspects were rated subjectively and are subject to detailed assessment during future Project impact assessment phases.

In considering any adverse impacts to surrounding communities or sensitive social receptors, the following is applicable to all corridors and all route options, and is thus excluded from each corridor sections below:

- Some air quality impacts from dust emissions are expected during construction Phase; during operations, minimal PM_{10} emissions are expected for all route options
- With the adequate mitigation measures in place (such as the installation of noise attenuation barriers in areas of proximity to residential areas), the operation of the existing Gautrain line (GRRL) is not deemed a noise nuisance activity; however, it is noted:
  - During the construction of the existing Gautrain, significant noise impacts were noted as a particular social concern

- The sound of 'metal-on-metal when the train braked' was a significant social complaint during operations of the existing GRRL. This may be evident for all the route options in this phase
- Noise sources coming from warning signals etc. may be a concern for neighbouring residential complexes during operations
- A Noise and Vibration Impact Assessment will need to be undertaken during future detailed EIAs to ascertain the impacts on sensitive noise receptors due to the position of and operations of the railway line.

- According to the broad land cover classification of the greater Gauteng area, large parts of the visual zone surrounding the alignment corridors and route options have been transformed by urban / built-up areas with low scenic quality. However, all the route options for all three corridors cross through greenfield sites in some parts which may result in a moderate visual impact, particularly options close to the river greenbelts, or largely undisturbed areas. Impacts will be greater during the construction phase. A Visual Impact Assessment will need to be undertaken during future detailed EIAs
- Significant traffic impacts will likely be prevalent across all route options during the construction phase. Although certain route options may be more optimal (when considering vertical placement for example), all route options are likely to have some impact on the local road network (be it positive or negative). Negative impacts will be greater during the construction phase. During operations phase, traffic impacts are likely to be minimal in comparison, and likely more positive. A Traffic Impact Assessment will need to be undertaken during future detailed EIAs
- A significant positive impact associated with all corridors, regardless of option, is fewer road traffic accidents and fatalities, increased socio-economic development, etc., subject to a formal Socio-Economic Impact Assessment during future detailed EIAs.

As per the above, the sensitivity rating and scoring given to all route options for 'Social' will be equal and is considered low-medium (unless an apparently high sensitivity from a social perspective is evident for a particular option in which case this will be noted in the social theme for each station or corridor where it applies). The key differentiation in social impact between the route options will need to consider the vertical placement to determine the most suitable route options from this perspective. As such, a more detailed assessment and comparison of social impacts between route options is considered in the adjusted sensitivity assessment, where the vertical placement and ground truthing / status quo is considered (see Section 2.1.4).

2.1.3 Vertical Placement Impacts

Station position options were considered with various vertical placements in the MCA. However, regardless of the vertical placement, there will be environmental impacts at the ground level. Therefore, the station position's receiving environment was assessed as being impacted regardless of the vertical placement. This approach ensured that all potential environmental impacts at the ground level were accounted for, whether the stations were positioned above ground, at ground level, or below ground.

Conversely, for the route alignments, the footprint associated with the construction and operation of the railway lines (including any associated infrastructure) has varying degrees of impacts at the different vertical placement levels.

The route determination is for a 400m-wide land corridor within which the future railway line can be designed and implemented. Without final locations, Project designs, and layouts, the precise impacts of the different placements are indeterminable at this stage. Nonetheless, through subjective assessment by expertise in railway development and impact assessments, the potential impacts were estimated to a degree that allowed for a comparison of the four vertical placement options (Table 2-3).

In summary, the choice of the best method depends on a careful consideration of the specific environmental, financial, engineering and logistical factors at play. Elevated railways on viaducts or bridges tend to balance impacts effectively. Deep tunnels minimise surface disruptions but come with higher costs and technical challenges. Cut-and-cover is a compromise, offering reduced noise and some development opportunities but causing surface disruptions during construction. Each method has its trade-offs, and the decision should be based on future detailed engineering, costs, comprehensive environmental assessments, and local context to mitigate negative impacts and ensure long-term sustainability.

However, purely from an environmental impact perspective, the deep tunnel method would be the optimal solution given the preservation of ecosystems and surface landscapes and is accompanied by fewer (or no) social impacts. The deep tunnel method has an estimated lower impact compared to the other three vertical options (Figure 2-2), making it the preferred placement level from an environmental perspective. The remaining vertical placements have various levels of impacts, particularly during different Project phase (i.e., construction and operation) (which is provided in Table 2-3). Given the nature and intention of the Project, the decommissioning phase has not been considered in this evaluation.

The overall ranking of these placements from least environmental impact to most environmental impact would be: 1. Deep Tunnel, 2. Bridge / Viaduct, 3. Cut and Cover, and 4. At-Grade.

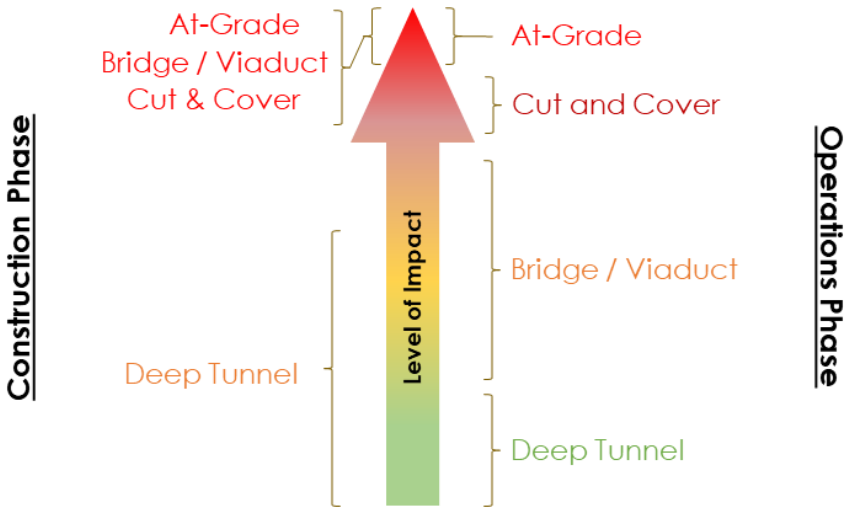


Figure 2-2 Impact Levels of Vertical Placement Options

Table 2-3: Potential Impact Ratings Associated with the Four Vertical Placement Options

Vertical Placement	Potential Associated Impacts	Impact Rating*	
		C	O
At-Grade	Developing at-grade typically has lower construction costs but can disrupt ecosystems, require land clearance, and poses noise and safety concerns. This method will consist of major disturbance and excavation of the surface level, and the installation of permanent surface infrastructure. From an environmental perspective this is likely the option to consist of the greatest negative environmental impact. • Construction: will result in significant impact where sensitivities are prevalent. • Operations: residual negative impact will likely remain as the site will never be restored to natural state.	Very High	Very High
Bridge	An elevated railway on a bridge or viaduct can minimise disruption to the ground and ecosystems but might have a high visual impact. While the operation impact may be lower than at-grade (provided adequate rehabilitation), the construction phase may still pose very high impact. • Construction: will result in significant impact where sensitivities are prevalent. • Operations: likely no significant impact. Provided there is sufficient rehabilitation, some impacts can be reversed, however it is likely that some form of impact will remain.	Very High	Medium
Cut and Cover	In a cut and cover tunnel, the structure is built inside an excavation and covered over with backfill material when construction of the structure is complete. Since all themes to be impacted are based on the surface (or shallow below the surface), there will be significant surface disruption and excavation during construction. A major environmental risk is soil movement in soft soil areas, disturbing potentially sensitive local vegetation and wildlife as a minimum. As opposed to at-grade, there is potential for some form of rehabilitation above-ground which slightly reduces impact at operations. • Construction: will result in significant impact where sensitivities are prevalent. • Operations: provided there is sufficient rehabilitation, some impacts can be reversed, however a high impact may remain.	Very High	High
Deep Tunnel	In this method, tunnels are constructed without disturbing the soil surface, using a Tunnel Boring Machine (TBM). It allows tunnels to be dug in various soil conditions, whether in underground areas that cross municipal areas, rivers, or other surface infrastructure (residential areas, buildings etc.). All themes to be impacted are based on the surface (or shallow below the surface). Since the primary sensitivities are based on the ground-level (and at shallower depths than the proposed deep tunnelling), from an environmental impact perspective, this would be the preferred option. Potential geotechnical or geohydrological impacts will need to be assessed, but this method reduces any noise and safety concerns and preserves surface ecosystems and landscapes. • Construction: impact will be mainly limited to entry points and is considered far lower compared to other vertical placements. Groundwater impacts are to be carefully assessed for both phases). • Operations: likely no impacts expected. *It is important to note that deep tunnel is the preferred option only in the instance that a TBM method of construction is used. Should conventional drilling and blasting methods be used, this will have significantly greater negative environmental impacts.*	Low to Medium	Low

* C = construction phase; O = operations phase

2.1.4 Ground Truthing Screening Tool Findings

Ground truthing the Screening Tool findings is important because it can help confirm or refute the accuracy of the data / findings. To ground truth data, certain portions of the routes were subject to visual inspection.

This is typically undertaken as part of the EIA process where a site sensitivity verification assessment is undertaken by an Environmental Assessment Practitioner (EAP) or relevant specialists. This inspection will confirm or dispute the current use of the land, and the environmental sensitivities as identified by the Screening Tool, such as new developments or infrastructure, the change in vegetation cover or status etc. Through a visual inspection, any fatal flaws, key issues, opportunities, and possible mitigation and enhancement measures associated with the Project can also be identified (this approach does not require the physical collection of any data or specimens at this stage of the study).

Ground truthing of sensitivity findings for this Report was undertaken using GIS data, drone footage and where required, a high-level visual inspection, with no specialist input. The findings of the ground truthing is considered in the overall sensitivity evaluation.

2.1.5 Overall Option Sensitivity

With consideration for all the above, the route alignment option with the longest distance in deep tunnel may likely default as the least environmentally sensitive. However, given the surrounding (above ground) environmental sensitivities, there may be instances where the above ground ecosystem / environment is not noted as environmentally sensitive, and in those instances, another vertical placement option may not result in a negative environmental impact. In order to take this into account to determine the overall sensitivity of the different options, the status quo of the surrounding environment (including current potential environmental sensitivities based on current land use and conditions) was assessed (i.e., ground truthing of Screening Tool findings) in conjunction with the vertical placement.

For each corridor and its associated route alignment options, the findings from the Screening Tool, the current land use (status quo), high-level ground truthing of sensitivities, and the assessment of potential impacts based on vertical placement were all considered to provide a comprehensive understanding of the sensitivities of the options.

2.2 Refinement of Optimal Routes

As part of the route alignment options development process in this study, the optimal route alignments were subject to further refinement. This refinement process involved detailed analysis and adjustments to the optimal alignment to enhance its feasibility and sustainability. The aim of this refinement process was:

- Optimising the placement of the route to align with the optimal station positions, to enhance accessibility, connectivity, and integration.
- Comply with parameters in the design criteria, including adjustments to the alignment to meet gradient and curvature requirements, enhancing the overall safety and efficiency of the route; and
- Integrate with any other key GRRIN extension plans/facilities.

2.3 Environmental and Social Risks and Opportunities

The methodology for assessing the environmental and social risks and opportunities of the Project primarily involved a desktop level evaluation. This approach was chosen due to the preliminary nature of the assessment and the scale of the Project. A thorough desktop level assessment was conducted to identify potential environmental and social impacts and benefits associated with the Project. This involved gathering and analysing existing reports, studies, and data relevant to the Project area, including publicly available EIAs from similar projects, Geographic Information System (GIS) data, and socio-economic conditions.

Based on the nature and scale of the Project, potential impacts were identified for the construction and operational phases, evaluating possible disturbances to local biodiversity, water resources, air quality, and community well-being. The potential social and economic benefits were also assessed, focusing on job creation, economic growth, improved transportation, and environmental sustainability.

For each identified impact, preliminary mitigation measures were suggested to avoid or minimise negative effects, based on best practices and lessons learned from similar projects. The findings from the desktop level assessment have been documented in this report, providing a preliminary overview of the potential impacts and benefits. It is important to note that these findings are based on available data and do not include specific specialist input or site specific / targeted impacts or mitigation measures. More detailed assessments and mitigation measures will be developed during the future EIA phase and associated specialist assessments.

2.4 Regulatory Framework Assessment

Developing the legislative framework and permitting strategy for the Project involved a comprehensive assessment of relevant South African environmental legislation. This process aimed to identify applicable environmental legal requirements and outline the necessary authorisation approvals process.

A thorough desktop-level analysis was conducted to review the current South African environmental legislative framework. This review identified all relevant legislation that may inform the Project, ensuring compliance with regulatory requirements. The analysis included identifying the permits and licenses that will be required, as well as those that may be necessary, for the various Project activities (based on the current concept understanding of the Project.

Following this, an overview of the Environmental Authorisation for the Project was provided, detailing the Integrated Environmental Approvals Process. This included identifying the relevant competent authorities responsible for issuing the necessary approvals, the associated timeframes for obtaining these approvals, and the specialist studies that may be required.

The methodology also involved presenting an approach to the Environmental Authorisation process, taking into consideration lessons learned from the currently operating Gautrain Rapid Rail Link (GRRL) System (i.e. the currently operating Gautrain line). This included understanding the challenges faced during the EIA process, such as navigating emerging environmental legislation, addressing biophysical and socio-economic impacts, and ensuring effective public participation.

Nonetheless, it is important to note that this methodology is still subject to the future EIA phase when a more detailed Project description is available. This future phase will provide more specific information and allow for a more detailed review of the specific permitting and licensing requirements. Additionally, specialist input will be incorporated to ensure that all legal obligations are met and that the Project proceeds in compliance with all relevant environmental laws and standards.

3. ENVIRONMENTAL SCREENING AND ALTERNATIVES ASSESSMENT OF STATIONS

This section of the Report presents the findings of the Environmental Investigation and Screening Evaluation of the various station position options (Table 3-1). Section 4 of the Route Determination Report summarises the processes that were undertaken to identify the optimal station positions, as well as presents additional contextual information.

Given the footprint associated with the construction and operation of the stations (including associated infrastructure and facilities), regardless of the vertical placement, there will be environmental impacts at the ground level. Therefore, the environmental investigation and screening has focussed on the physical location of the station positions only (i.e., Position 0, 1 and 2), and has not made consideration for vertical placement (i.e., A, B, C and D).

Table 3-1: Station Positions – Options Summary

Station	Position 0	Position 1	Position 2	No. of Options
Jabulani (J)	J-0	J-1	J-2	3
Roodepoort (R)	R-0	R-1		2
Cradle (C)	C-0	C-1	C-2	3
Lanseria (L)	L-0	L-1		2
Fourways (F)	F-0	F-1		2
Sunninghill (S)	S-1			1
Olievenhoutbosch (O)	O-0	O-1		2

Desktop screening and sensitivity mapping were employed to evaluate and compare the various station position options, and identifying key environmental sensitivities associated with each alternative. A thorough screening evaluation and comparison was conducted for all options from an environmental perspective which formed a comprehensive standalone Report. Based on the methodology described in Section 2.1, Appendix A - Table A - 1 provides a tabulated overview and summary of the Screening Tool findings of all environmental sensitivity ratings and the associated sensitivity scores for each environmental theme for all station position options.

This section of the Report provides an overview of the screening findings for the various station position options. It provides a more detailed examination of the optimal station position that emerged as the most balanced and viable choice, based on the comprehensive evaluation of all MCA criteria.

The Smart City Station was introduced post the Feasibility Study (2016). This station was not included in the MCA process, and the position was therefore only qualitatively assessed.

3.1 Jabulani Station

3.1.1 Screening of Jabulani Station Options

The land area earmarked for Jabulani Sation is located between Passenger Rail Agency of South Africa's (PRASA's) Inhlazane Rail Station and Bolani Street in Soweto.

Well-known landmarks such as Jabulani Mall, the Soweto Theatre, Jabavu Stadium, Bheki Mhlangeni District Hospital and Jabulani Technical School, are all situated within walking distance or adjacent to the sites. The potential options for this station were narrowed down to three suitable station positions on site (0, 1 and 2) as illustrated in Figure 3-1.

From a landcover and landscape perspective, the Jabulani neighbourhood area is characterised by predominantly urban and built-up areas, but small natural and undeveloped spaces are present (Appendix B). All three options can be considered predominantly greenfield sites given the lack of development on these properties.

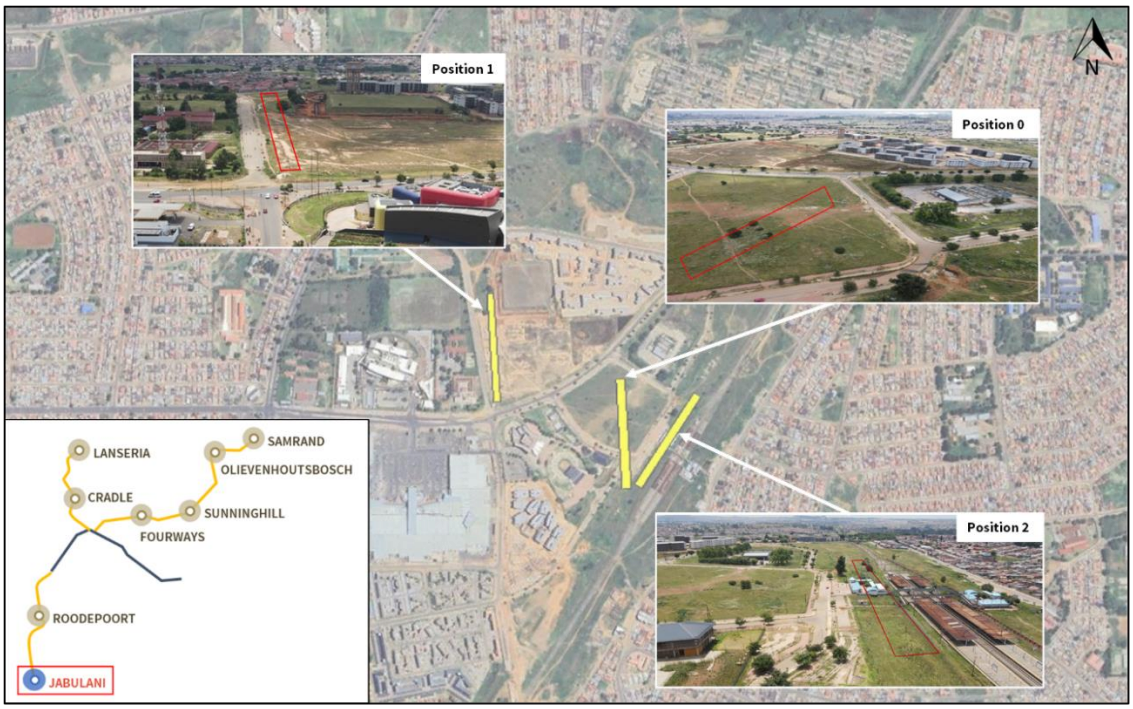


Figure 3-1: Jabulani Station Position Options

The findings of the Screening Tool for the three options associated with the Jabulani Station are presented in Appendix A - Table A - 1. The key screening findings, sensitivity features, and comparisons from an environmental perspective are summarised below. Although the sensitivity ratings between the options show little differentiation, the differences in sensitive features associated with these positions resulted in variations in the overall scoring.

Key screening findings - comparing all options:

- **Agriculture:** Positions 0 and 1 have medium sensitivity, while Position 2 has high sensitivity due to a portion of the site falling within high sensitivity areas. Despite this, the urban nature of the surroundings makes agricultural transformation unlikely
- **Animal Species:** All positions have medium sensitivity, with potential impacts on species such as the Roodepoort Copper Butterfly (*Aloeides dentatis dentatis*), Rough-Haired Golden Mole (*Chrysospalax villosus*), Makwassie Musk Shrew (*Crocidura maquassiensis*), Robert's Shaggy Rat (*Dasymys robertsii*), and Bush Cricket (*Clonia uvarovi*). The urban nature of the area means habitat loss is a concern for all positions, with no significant differentiation between them

- **Aquatic Biodiversity:** All positions have low sensitivity and do not interfere with watercourses (Figure 3-2), indicating minimal impact on aquatic ecosystems. This theme does not differ between the options, making it a non-critical factor in the decision
- **Archaeological & Cultural Heritage:** All positions have very high sensitivity due to proximity to a Grade I Heritage Site and within 2km of a Grade II Heritage site [5]. This may include sites like the Soweto Theatre, Oppenheimer Tower, and Credo Mutwa Cultural Village. The potential for undiscovered graves or artifacts is high, making this a critical consideration for all options without differentiation
- **Civil Aviation**: All positions have medium sensitivity, being located between 15 and 35km from major civil aviation aerodromes [6] and within 8 to 15km of other aerodromes. This theme does not differ between the options, making it a non-critical factor in the decision
- **Defence**: All positions have low sensitivity, indicating minimal impact on defence-related areas. This theme does not differ between the options, making it a non-critical factor in the decision
- **Palaeontology:** All positions have low sensitivity, suggesting a low likelihood of impacting paleontological resources. This theme does not differ between the options, making it a non-critical factor in the decision
- **Plant Species:** All positions have medium sensitivity due to the presence of vulnerable species like *Khadia beswickii,* a small succulent plant listed as a vulnerable species, and two other sensitive species (No. 1252 and No. 1248) whose names are withheld to prevent illegal harvesting. Position 2 has a mix of low and medium sensitivity areas, making it slightly less sensitive overall compared to Positions 0 and 1, which are entirely medium sensitivity
- **Terrestrial Biodiversity:** Position 2 is more sensitive, classified as a Critical Biodiversity Area (CBA) [7] and part of the National Protected Areas Expansion Strategy (NPAES)[8]. Positions 0 and 1 are less sensitive but still have very high sensitivity due to their classification as Ecological Support Areas (ESA) [9]. All options are located within the Endangered Tsakane Clay Grassland ecosystem [10]. Position 2's higher sensitivity makes it less favourable (Figure 3-2)
- **Social:** Impacts on sensitive social receptors are similar across options. Position 1 may have additional social impacts due to the nearby Jabulani Taxi Rank, which could affect local traffic and community dynamics, making it slightly less favourable.

[5] Section 7 of the National Heritage Resources Act differentiates between a 3-tier system of managing heritage resources. These are: Grade I – Resources with qualities so exceptional that they are of special national significance – administered by SAHRA; Grade II – Resources significant within the context of a province – administered by the relevant Provincial Heritage Authority (PHRA); and Grade III – Resources significant to a particular community – administered by the relevant authority.

[6] Aerodromes can include small general aviation airfields, large commercial airports, and military air bases.

[7] CBA 1 are areas that are irreplaceable for meeting targets and CBA 2 are areas that are the best option for meeting biodiversity targets in the smallest area while avoiding conflict with other land uses.

[8] Strategy that sets protected area targets, maps priority areas for protected area expansion to ensure no further ecosystems become Critically Endangered and makes recommendations on mechanisms to achieve this.

[9] ESAs are areas that are important for maintaining the ecological processes on which CBAs depend. This category has also been split into ESA1 and ESA2 based on land cover. ESA1s are in a largely natural state, and are important for supporting CBAs, while ESA2s are no longer intact but potentially retain significant importance from an ecological process perspective.

[10] The Tsakane Clay Grassland is a short, dense grassland on flat to slightly undulating plains and low hills. A mixture of grasses such as *Themeda triandra, Elionurus muticus* and *Eragrostis* species dominates the vegetation

In summary, Position 0 has the lower overall environmental sensitivity compared to Positions 1 and 2. It presents fewer challenges in terms of agricultural impact, terrestrial biodiversity, and social impacts, making it the most suitable option for development with minimal environmental disruption. Position 0 has a medium sensitivity rating for agriculture, similar to Position 1, but significantly lower than Position 2, which has a high sensitivity. This means Position 0 is less likely to require detailed specialist assessment. In terms of terrestrial biodiversity, Position 0 and Position 1 both have very high sensitivity ratings, while Position 2 is even more sensitive due to its classification as a CBA and its inclusion in the NPAES. This makes Position 0 less sensitive and more favourable from a biodiversity perspective. Additionally, Position 0 avoids significant social impacts, such as those associated with the Jabulani Taxi rank near Position 1, making it a more socially acceptable option.

The findings of the Screening Tool support Position 0 to be the least sensitive.

3.1.2 Optimal Jabulani Station from MCA

The MCA revealed that **Position 1 – Deep Tunnel** was optimal. highest ranking and was most optimal.

Position 0 has limitations that affect its viability. It restricts future connectivity to the south due to its station orientation and proximity to the existing PRASA Rail Line. The route alignment for this option traverses a recently developed residential complex, making future extensions challenging. Additionally, substantial earthworks would be required due to the site's slope.

Position 1, on the other hand, offers several advantages. It is better located for passenger access to key landmarks such as Bheki Mlangeni Hospital, Jabulani Mall, and Soweto Theatre. Although passengers transferring between the PRASA Station and Jabulani Station will have to walk approximately 450 meters, the route alignment allows for future southern extensions. The site is flat, providing space for development and easy access to various transport modes.

Based on the MCA and various workshops, the Deep Tunnel option for Position 1 is recommended for the Jabulani Station. This option balances environmental considerations with practical aspects of connectivity, development potential, and future extensions.

Key screening findings – optimal option:

- **Moderate Agricultural Sensitivity:** The position has medium sensitivity for agriculture, indicating some potential for agricultural use, but the urban context makes significant agricultural transformation unlikely
- **Balanced Biodiversity Impact:** While there is a medium sensitivity for animal species and plant species, the position does not have the highest sensitivity ratings, suggesting that with proper management and mitigation measures, the impact on local biodiversity can be minimised. Overlap of important areas and ESAs (Figure 3-2) would require the necessary terrestrial biodiversity specialist assessments to determine scale of impacts

- **Low Aquatic Biodiversity Impact:** The site does not cross any watercourses (Figure 3-2) and has low sensitivity for aquatic biodiversity, indicating minimal impact on aquatic ecosystems
- **Manageable Archaeological and Cultural Heritage Sensitivity:** Although the position has very high sensitivity for archaeological and cultural heritage, this is consistent across all options. Proper archaeological assessments and heritage management plans can mitigate potential impacts
- **Civil Aviation Compatibility:** The medium sensitivity for civil aviation suggests that the site is compatible with nearby aerodromes, reducing potential conflicts with aviation activities
- **Low Defence Sensitivity:** The position has low sensitivity for defence indicating minimal impact in this theme
- **Low Palaeontology Sensitivity:** The position has low sensitivity for Palaeontology indicating minimal impact in this theme
- **Social and Accessibility Benefits:** Position 1 is well-located for passenger access to key landmarks such as Bheki Mlangeni Hospital, Jabulani Mall, and Soweto Theatre. This enhances the station's utility and integration with the community, providing social benefits that complement environmental considerations.

Overall, Position 1 balances environmental sensitivity with practical considerations, making it a viable option for development with manageable environmental impacts. Based on the screening findings above, several specialist studies will be required. Particularly in themes with a high or very high sensitivity ratings, specific detailed specialist assessments may be required (see Appendix C). In certain instances, a detailed specialist assessment may not be required, and a 'Specialist Compliance Statement' in terms of NEMA will suffice. Appendix C is applicable to all stations and will not be repeated.

Based on the MCA Position 1 at the deep tunnel vertical placement is the optimal option for the Jabulani Station

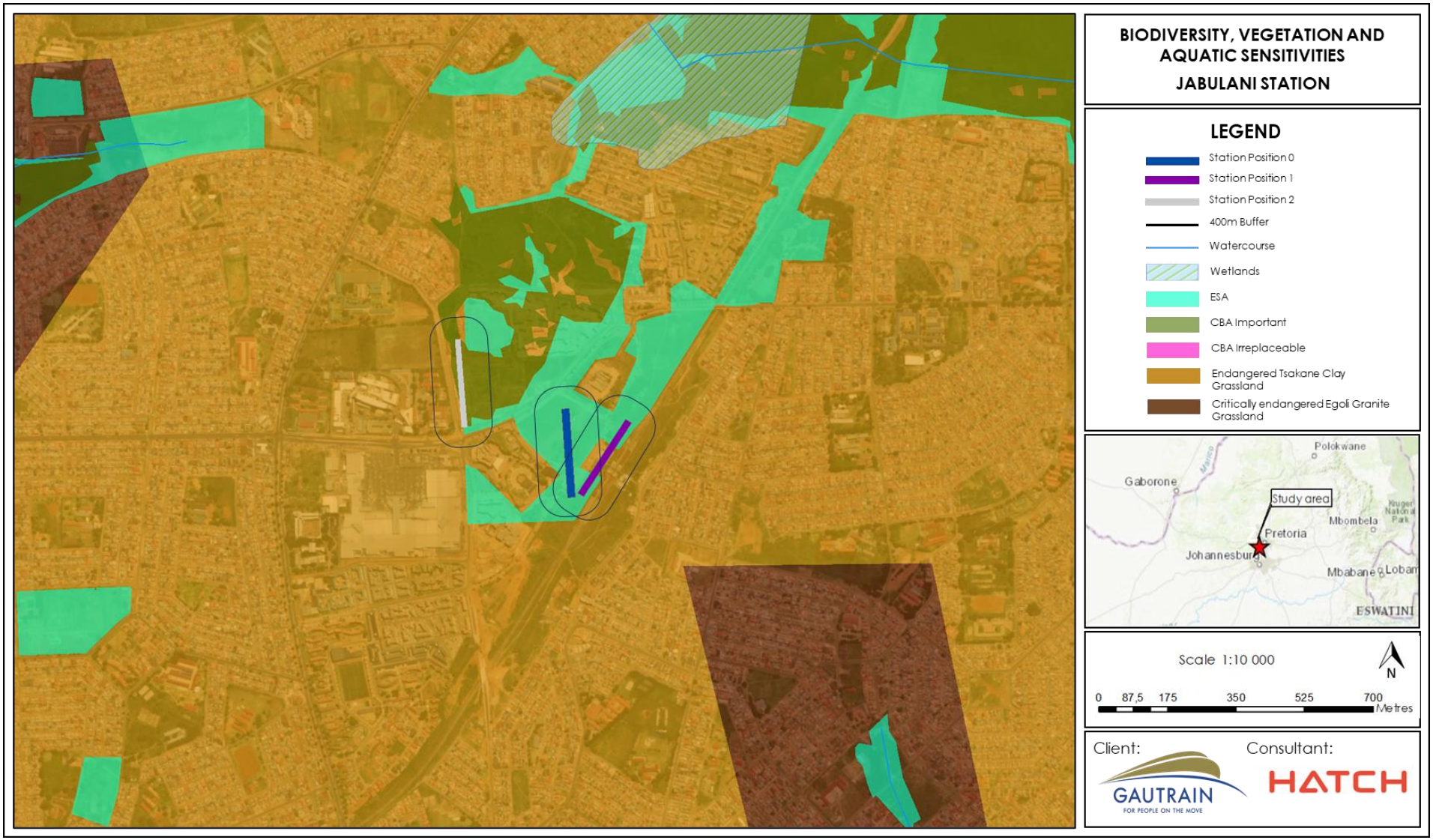


Figure 3-2: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Jabulani Station Options

3.2 Roodepoort Station

3.2.1 Screening of Roodepoort Station Options

The land area earmarked for this station is located adjacent to the existing PRASA Roodepoort Station, which is located parallel to Albertina Sisulu Road immediately east of the Roodepoort Central Business District. There are two key taxi ranks located on the north-eastern and south-western side of the existing PRASA station. These two facilities are strategically located to serve the north-eastern and south-western travel routes, respectively. Two station position options were considered for the Roodepoort Station (0 and 1) as illustrated in Figure 3-3.

From a landcover and landscape perspective, the area is characterised by predominantly urban and built-up industrialised and commercial area (Appendix B). While the Roodepoort area has numerous parks and green areas, Position 0 location is proposed to be placed on an undeveloped portion of land adjacent to an existing railway line, and Position 1 on a brownfield site with existing infrastructure, thereby reducing impacts.

Figure 3-3: Roodepoort Station Position Options

The findings of the Screening Tool for the two options associated with the Roodepoort Station are presented in Appendix A - Table A - 1Table A - 1. The key findings, sensitivity features, and comparisons from an environmental perspective are summarised below. Although the sensitivity ratings between the options showed no differentiation, the differences in sensitive features associated with these positions have resulted in variations in the overall scoring.

Key screening findings - comparing all options:

- **Agriculture**: Both positions have medium sensitivity. Despite the agricultural land capability noted in the Screening Tool report, the current urban land use and sprawl make agricultural transformation unlikely

- **Animal Species**: Both positions have medium sensitivity due to the potential presence of species such as the Rough-Haired Golden Mole, Makwassie Musk Shrew, Robert's Shaggy Rat, Spotted-Necked Otter (*Hydrictis maculicollis*), Bush Cricket, And Oribi (*Ourebia ourebi;* for Position 1 only). The urban and industrial nature of the area makes the presence of larger species like otters and oribi unlikely
- **Aquatic Biodiversity**: Both positions avid watercourses (Figure 3-4) and have low sensitivity, indicating minimal impact on aquatic ecosystems. This theme does not differ between the options
- **Archaeological & Cultural Heritage**: Both positions have very high sensitivity due to proximity to a Grade II Heritage Site. Important heritage sites in the area include the Roodepoort Town School, Old Municipal Chambers, and Confidence Reef in Kloof-en-Dal Nature Reserve
- **Civil Aviation**: Both positions have medium sensitivity, being located between 15 and 35km from major civil aviation aerodromes and within 8 to 15km of other aerodromes
- **Defence**: Both positions have low sensitivity, indicating minimal impact on defence-related areas. This theme does not differ between the options
- **Palaeontology**: Both positions have low sensitivity, suggesting a low likelihood of impacting paleontological resources. This theme does not differ
- **Plant Species**: Both positions have low sensitivity, indicating minimal impact on plant species. This theme does not differ
- **Terrestrial Biodiversity**: Both positions have very high sensitivity due to the classification within a vulnerable ecosystem, the Soweto Highveld Grassland (Figure 3-4). All CBAs, ESAs and other sensitive areas are avoided
- **Social Impact**: Both positions have comparative sensitivity findings.

After an evaluation of the environmental considerations for the proposed Roodepoort Station, it is evident that both Position 0 and Position 1 present similar environmental impacts, exhibiting the same sensitivity ratings. The urban and industrial nature of the area, combined with the presence of existing infrastructure, mitigates some potential impacts from Position 0, and particularly for Position 1, which is situated on a brownfield site. Given the lack of differentiation in environmental sensitivity and scoring between the two positions, the decision on the optimal station position will likely hinge on other critical factors such as cost, ease of construction, and integration with existing infrastructure. Both positions are strategically located to serve the Roodepoort Central Business District (CBD) and are well-connected to key transport routes, enhancing their viability.

Position 0 and Position 1 are rated the same from an environmental perspective.

3.2.2 Optimal Roodepoort Station from MCA

Position 1 – Deep Tunnel emerged as the optimal option from the MCA.

Rail alignment options played a significant role in defining workable station options for Roodepoort, as the topography between Little Falls station and Roodepoort Station necessitates a tunnel connection.

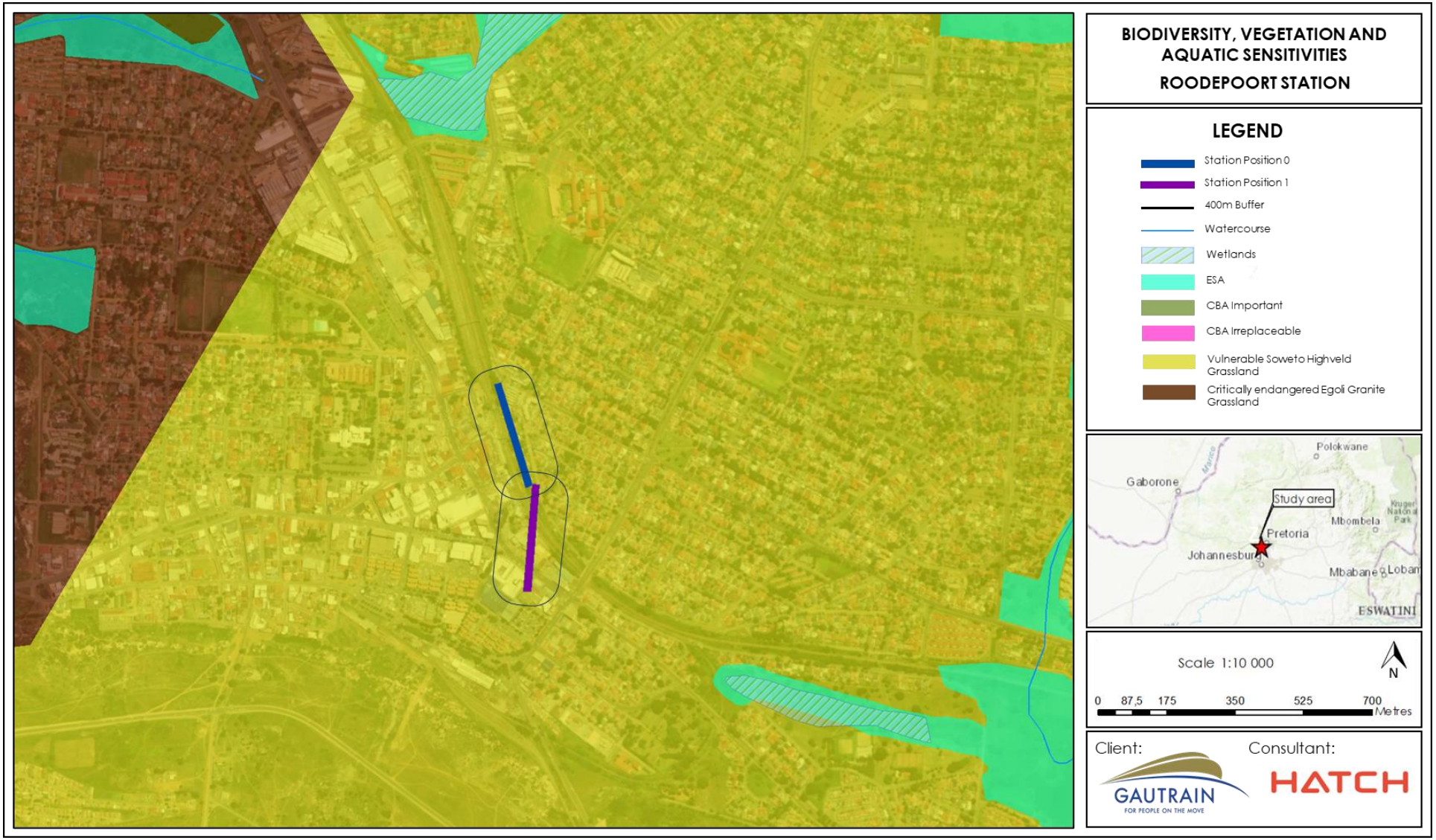


Figure 3-4: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Roodepoort Station Options

Position 0 is located on the north-eastern side of the existing PRASA station, adjacent to an existing taxi rank that serves the north-eastern and north-western sides of the station. Another taxi rank on the south-western side serves the southern, south-western, eastern, and north-eastern sides. The PRASA rail line divides the Roodepoort CBD and residential areas at Roodepoort Station. Position 0 requires development in a residential area, and commuters would need to cross the PRASA rail line to access the Roodepoort CBD. This isolation from the CBD by the rail line hampers integration and the development of an integrated Transit-Oriented Development (TOD) around the station. Access routes to and from the station would be through residential areas, which are not major feeder roads.

Position 1, on the other hand, is located on the western side of the existing PRASA rail line, closer to the CBD area. The site is already zoned for business, providing an opportunity to revitalise the CBD. Access routes to and from the station include major roads such as the R24, Van Wyk Street, Albertina Sisulu Road, and 4th Street. The proximity to the CBD and key transport modes enhances connectivity and supports the development of commercial properties around the station footprint. This site also offers higher potential for TOD.

Based on the review of the two options with current information, Position 1, Deep Tunnel, is recommended for the Roodepoort Station. This option balances environmental considerations with practical aspects of connectivity, development potential, and future extensions.

Key screening findings – optimal option:

- **Urban Context:** The site is located in a predominantly urban and built-up area, reducing the likelihood of significant agricultural or natural habitat disruption
- **Brownfield Site:** Position 1 is on a brownfield site with existing infrastructure, which minimises the environmental impact compared to developing a greenfield site (particularly considering important biodiversity areas and sensitive species)
- **Low Impact on Aquatic and Plant Species:** The site has low sensitivity for aquatic biodiversity and plant species, indicating minimal impact on these ecosystems. Sites share other terrestrial biodiversity sensitivities (Figure 3-4)
- **Manageable Archaeological and Cultural Heritage Sensitivity:** Although the site has very high sensitivity for archaeological and cultural heritage, this is consistent across all options. Proper archaeological / heritage impact assessments (HIA) and management plans can mitigate potential impacts
- **Civil Aviation Compatibility:** The medium sensitivity for civil aviation suggests that the site is reasonably compatible with nearby aerodromes, reducing potential conflicts with aviation activities
- **Low Defence Sensitivity:** The site has low defence sensitivity, indicating minimal impact on this theme
- **Low Palaeontology Sensitivity:** The site has low palaeontology sensitivity, indicating minimal impact on this theme.
- **Social and Accessibility Benefits:** Position 1 is well-located for passenger access to key landmarks and transport routes, enhancing the station's utility and integration with the community, providing social benefits that complement environmental considerations.

Overall, Position 1 balances environmental sensitivity with practical considerations, making it a viable option for development with manageable environmental impact.

Based on the MCA Position 1 at the deep tunnel vertical placement is the optimal option for the Roodepoort Station

3.3 Cradle Station

3.3.1 Screening of Cradle Station Options

The land area earmarked for the Cradle Station is located on the eastern border of the Mogale City Local Municipality, neighbouring informal settlements of Cosmo City and Roodepoort. The sites are located approximately 4km from known landmarks such as Cosmo City Shopping Centre. Potential options were narrowed down to three suitable station positions on site, as illustrated in Figure 3-5.

From a landcover and landscape perspective, desktop level assessment revealed the area is characterised by open grasslands, agricultural holdings, small businesses, and urban small holdings (Appendix B). Rural communities border the erven to the south, and to the far east of the site positions. Adjacent to one of the sites (Position 1) is a graveyard presumably used by the neighbouring informal settlements. As a whole the area consists of predominantly natural and undeveloped green spaces.

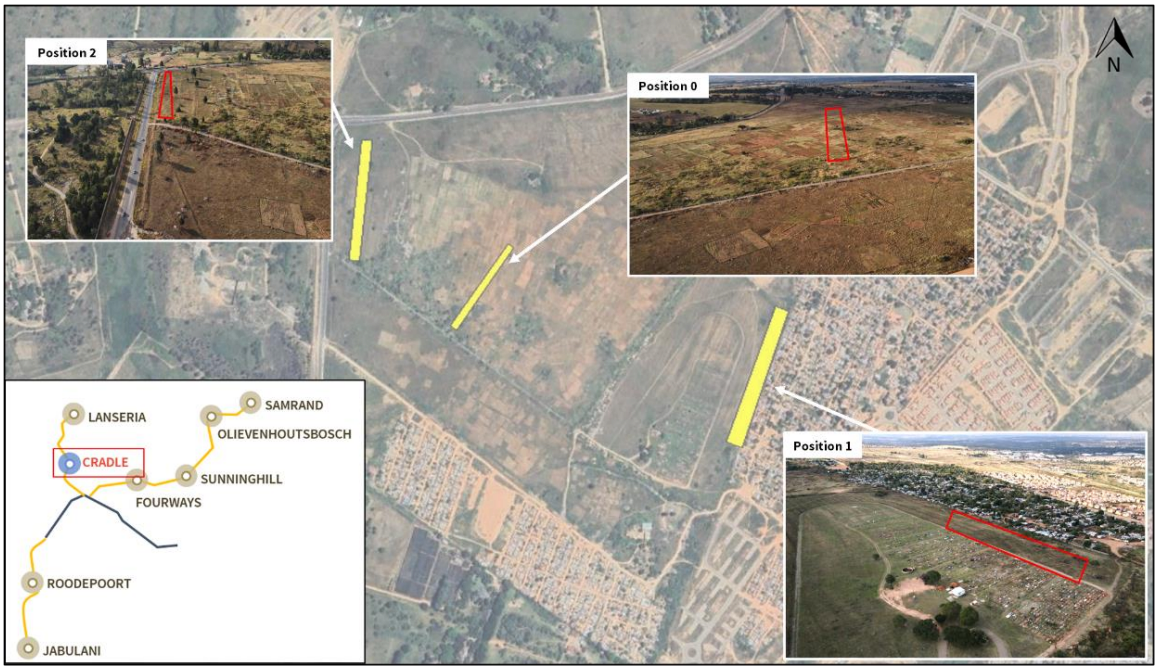


Figure 3-5: Cradle Station Position Options

The findings of the Screening Tool for the three options associated with the Cradle Station are presented in Appendix A - Table A - 1Table A - 1. The key findings, sensitivity features, and comparisons from an environmental perspective are summarised below. Some differences in the sensitivity ratings resulted in slight variations in the overall scoring.

Key screening findings - comparing all options:

- **Agriculture:** All positions have high sensitivity, with portions of both medium and high sensitivity in this theme. The sites are located in the Urban Development Zone, Zone 1 of the Gauteng Provincial Environmental Management Framework (GPEMF)[11], suggesting that the development is appropriately located to not compromise agricultural resources in Gauteng Province
- **Animal Species:** All positions have medium sensitivity due to the potential presence of species such as the African Grass Owl (*Tyto capensis*) and Roodepoort Copper Butterfly for Position 1 only, Makwassie Musk Shrew, Robert's Shaggy Rat for Positions 0 and 1, and Spotted-Necked Otter and others across options. The natural vegetation will need to be cleared, resulting in habitat loss for any occurring species
- **Aquatic Biodiversity:** All positions have low sensitivity, avoiding watercourses, indicating minimal impact on aquatic ecosystems (Figure 3-6). This theme does not differ between the options
- **Archaeological & Cultural Heritage:** All positions have low sensitivity, indicating minimal impact on archaeological and cultural heritage resources. This theme does not differ between the options
- **Civil Aviation:** All positions have very high sensitivity due to their location within 8km of a major civil aviation aerodrome and other civil aviation aerodromes. This theme does not differ between the options
- **Defence:** All positions have low sensitivity, indicating minimal impact on defence-related areas. This theme does not differ between the options
- **Palaeontology:** Position 0 has low sensitivity, while Positions 1 and 2 did not return any findings for this theme. This indicates that Position 0 may have a slightly higher sensitivity for palaeontology
- **Plant Species:** All positions have medium sensitivity due to the potential presence of species such as *Melolobium subspicatum*, a flowering Gauteng endemic and listed as a red data plant species (vulnerable species), and Sensitive Species No. 1248
- **Terrestrial Biodiversity:** All positions have very high sensitivity due to their classification within the Critically Endangered Egoli Granite Grassland Ecosystem. Position 1 is more sensitive due to additional classifications as ESA 1, CBA 1, CBA 2, and NPAES (Figure 3-6)
- **Social Impact:** Position 1 may have higher social impacts due to its proximity to rural communities and a graveyard site, which could result in higher negative social impacts.

[11] GPEMF is a strategic environmental management tool used to guide sustainable development in the Gauteng Province. It identifies environmental sensitivities and provides a framework for land use planning and decision-making. Zone 1 is designated for urban development and is considered appropriate for development activities that do not compromise significant environmental resources. It aims to support sustainable urban growth while protecting key environmental assets. Zone 5 is typically designated for areas with high environmental sensitivity, where development is either restricted or requires stringent environmental assessments and mitigation measures. See Section Table 6-2 for more information on the GPEMF.

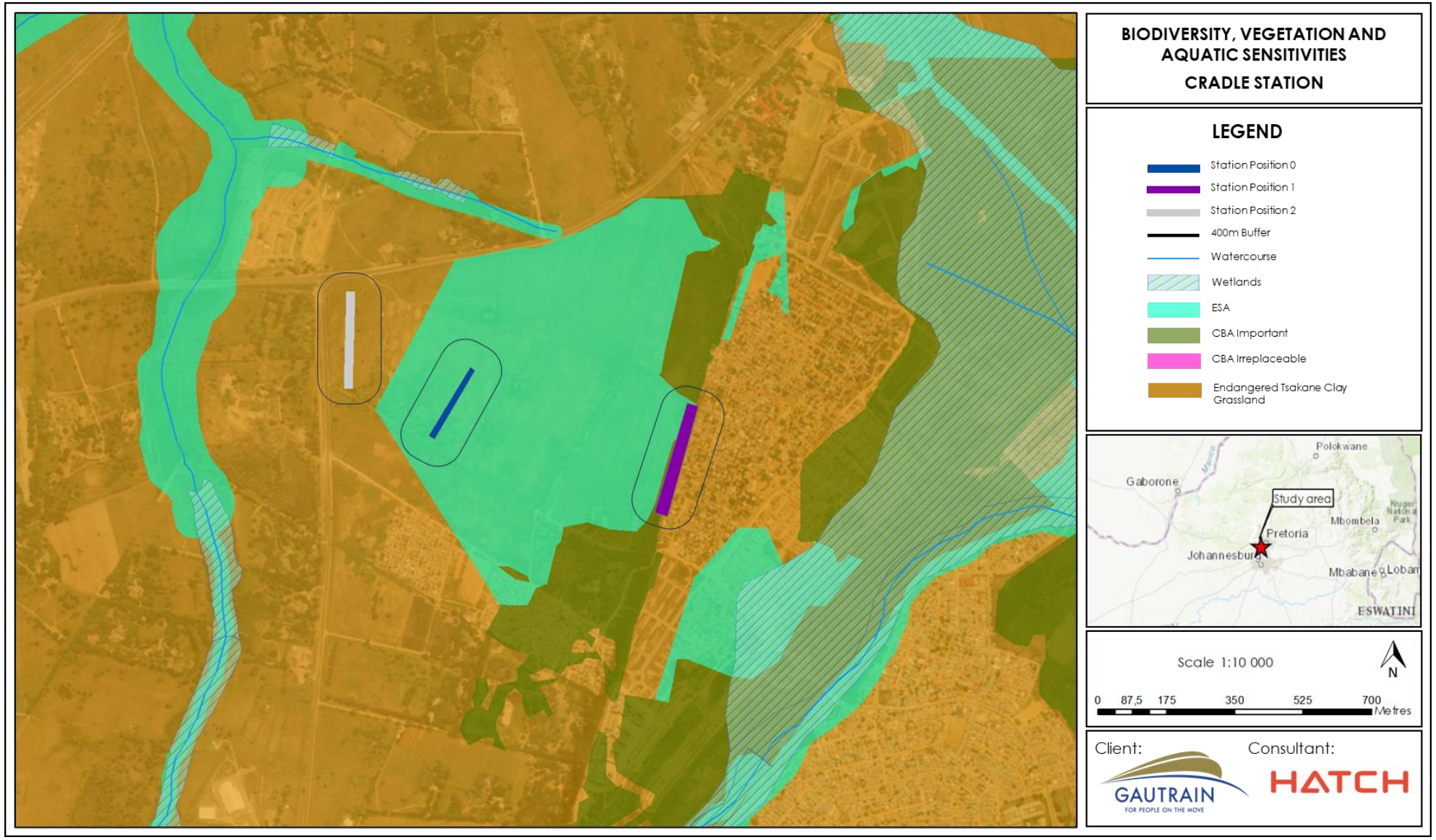


Figure 3-6: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Cradle Station Options

Position 2 stands out as the least sensitive option, with the highest overall score. It has high sensitivity for agriculture, similar to the other positions, but it avoids the additional sensitivities associated with Position 1, such as the presence of more sensitive animal species and its proximity to a graveyard site, which could result in higher negative social impacts. Position 2 also has a slightly lower sensitivity for palaeontology aspects compared to Position 0. From a terrestrial biodiversity perspective, Position 2 is classified within the Critically Endangered Egoli Granite Grassland Ecosystem, similar to the other positions. However, Position 1 is more sensitive due to additional classifications as ESA 1, CBA 1, CBA 2, and NPAES, making Position 2 a more favourable option. In terms of social impact, including noise and visual intrusion, Position 2 is also likely to be lower in impact severity.

Position 2 is the least sensitive from an environmental perspective.

3.3.2 Optimal Cradle Station from MCA

Position 1 – Bridge position emerged as the optimal option from the MCA and expert judgement.

While the MCA identified Position 2 as the highest-ranked option, discussions with the various technical teams highlighted several factors that make Position 1 the optimal choice for the Cradle Station. Position 2, although highly ranked, is less favourable due to its distance from the Cosmo City residential area, which is a key driver for ridership.

The optimal location for the Rolling Stock Depot, driven by topography and land availability, is situated between Position 1 and Position 2. This depot location would create a barrier for people traveling from Marina Street towards the informal settlement and the Cosmo City north-western expansion, making Position 2 less accessible and less attractive for commuters.

Position 1, despite being close to a graveyard site and an informal settlement, offers several advantages. It is located closer to the existing residential area and new planned developments, enhancing accessibility and potential ridership. The proximity to major roads and transport modes supports the development of commercial properties around the station footprint, offering higher potential for Transit-Oriented Development (TOD). Additionally, the route alignment for Position 1 allows for flexibility in shifting the station position along the corridor, which could further improve ridership figures and open up stronger TOD opportunities.

Key screening findings – optimal option:

- **Proximity to Residential Areas:** Position 1 is strategically located closer to existing residential areas and new planned developments, enhancing accessibility and potential ridership. This proximity supports the development of TOD and integrates well with the surrounding urban areas
- **Higher social impacts:** The proximity to a graveyard site and rural communities may result in higher social impacts. These include potential disruptions to local communities and sensitivities related to the graveyard, which need to be carefully managed through stakeholder engagement and socio-economic impact assessments. This proximity may complicate the EIA process further, as grave relocation under the National Heritage Resources Act may likely be required.

This process involves obtaining the necessary permits, conducting a HIA, and ensuring appropriate compensation and respectful handling of human remains, all of which necessitate careful planning and stakeholder engagement.

- **Animal Species Sensitivity:** The site has medium sensitivity for animal species, with additional sensitive species identified, such as the African Grass Owl and Roodepoort Copper Butterfly. This requires careful planning and mitigation measures to protect these species
- **Low Impact on Aquatic and Plant Species:** The site has low sensitivity for aquatic biodiversity and medium sensitivity for plant species, indicating manageable impacts on these ecosystems. Proper assessments and compliance statements can mitigate potential impacts
- **Very High Sensitivity for Terrestrial Biodiversity:** Position 1 is classified within CBAs and the NPAES, making it more sensitive from a biodiversity perspective. This necessitates detailed terrestrial biodiversity specialist assessments and could complicate development
- **Manageable Archaeological and Cultural Heritage Sensitivity:** Although the site has low sensitivity for archaeological and cultural heritage, proper archaeological assessments may still be required
- **Civil Aviation Compatibility:** The site is in very high sensitivity for civil aviation due to its proximity to a major aerodrome. A Civil Aviation Compliance Statement will be required to ensure compatibility and reduce potential conflicts with aviation activities
- **Low Defence Sensitivity:** The position has low sensitivity for defence indicating minimal impact in this theme
- **Low Palaeontology Sensitivity:** The position has low sensitivity for Palaeontology indicating minimal impact in this theme
- **Social and Accessibility Benefits:** Position 1 is well-located for passenger access to key landmarks and transport routes, enhancing the station's utility and integration with the community.

Based on the MCA Position 1 on a bridge vertical placement is the optimal option for the Cradle Station

3.4 Lanseria Station

3.4.1 Screening of Lanseria Station Options

The land area earmarked for Lanseria Station are proximal to the Lanseria International Airport. Potential options were narrowed down to two suitable station positions on site, as illustrated in Figure 3-7.

From a landcover and landscape perspective, desktop level assessment revealed the area is characterised by predominantly natural / undeveloped areas (open grassland), with some cultivation and a small percentage of urban and rural built-up areas (Appendix B) in the form of the Lanseria Airport, and nearby (200 - 500m) rural development. No rural communities border the proposed erven.

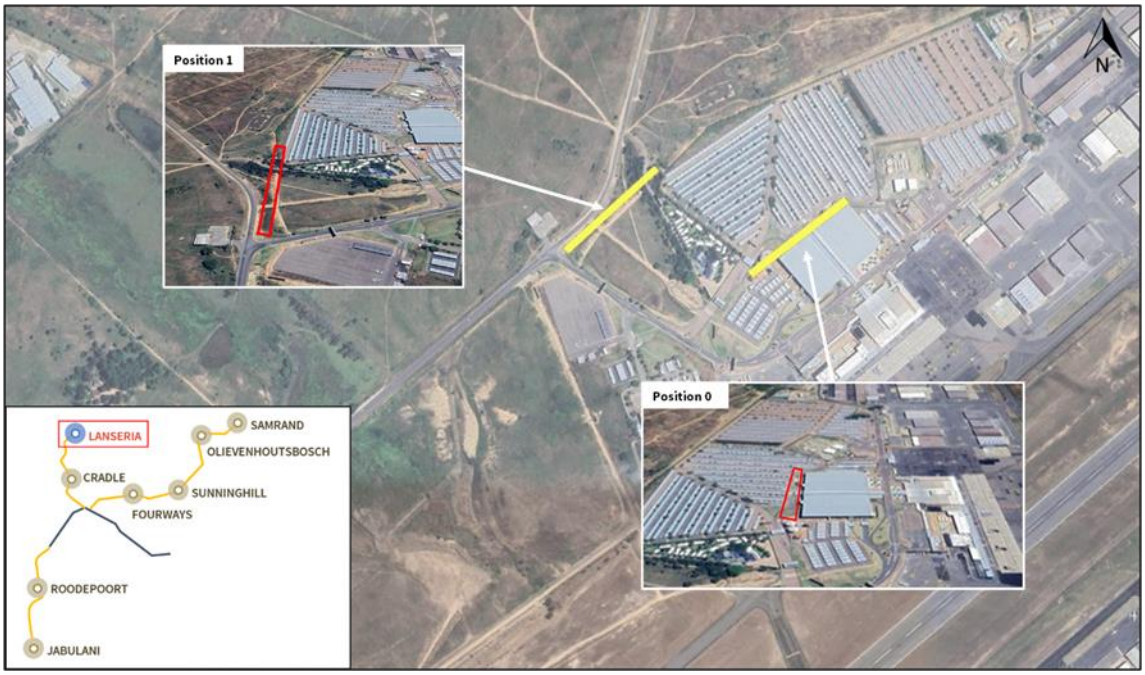


Figure 3-7: Lanseria Station Position Options

The findings of the Screening Tool for the two options associated with the Lanseria station are presented Appendix A - Table A - 1Table A - 1. The key screening findings, sensitivity features, and comparisons from an environmental perspective are summarised below. Although the sensitivity ratings between the options show little differentiation, the differences in sensitive features associated with these positions have resulted in variations in the overall scoring, particularly in the Animal Species theme.

Key screening findings - comparing all options:

- **Agriculture:** Both positions have medium sensitivity for agriculture and are located in the Urban Development Zone, Zone 1 of the GPEMF indicating that the development is appropriately located to avoid compromising agricultural resources
- **Animal Species:** Position 1 has high sensitivity due to the potential presence of species such as the African grass owl, Makwassie musk shrew, spotted-necked otter, and bush cricket. Position 0 has medium sensitivity. Natural vegetation clearance at Position 1 will result in habitat loss for these species, making it more sensitive
- **Aquatic Biodiversity:** Both positions have low sensitivity, avoiding watercourses and indicating minimal impact on aquatic ecosystems (Figure 3-8)
- **Archaeological & Cultural Heritage:** Both positions have low sensitivity, indicating minimal impact on archaeological and cultural heritage resources
- **Civil Aviation:** Both positions have very high sensitivity due to their proximity within 8km of a major civil aviation aerodrome and other civil aviation aerodromes (i.e., Lanseria Airport)
- **Defence:** Both positions have medium sensitivity due to their proximity to a Military and Defence Site
- **Palaeontology:** No sensitivity findings were returned for either position in this theme

- **Plant Species:** Both positions have medium sensitivity due to the potential presence of species such as *Melolobium subspicatum* (a vulnerable species) and Sensitive species No. 1248. Position 1, located in grassland type vegetation, is more sensitive due to the need for natural vegetation clearance
- **Terrestrial Biodiversity:** Both positions have very high sensitivity due to their classification within the endangered Egoli Granite Grassland ecosystem (Figure 3-8); however, Position 0 has previously been transformed
- **Social Impact:** Both positions have low sensitivity regarding social impacts such as noise and air quality. However, Position 1 is in close proximity to a taxi rank, which may cause significant social impacts that need to be assessed during the socio-economic impact and stakeholder engagement processes.

Overall, Position 0 is presents a lower environmental sensitivity, primarily due to its location within the already developed footprint of the Lanseria Airport. This reduces the need for extensive natural vegetation clearance and associated habitat disruption, regardless of the Screening Tool findings.

Position 0 is the least sensitive from an environmental perspective.

3.4.2 Optimal Lanseria Station from MCA

The MCA revealed that **Position 1 – At-Grade**, achieved the highest ranking.

Although the walking distance from the station to the terminal area was a concern, it is shorter than the distance at OR Tambo station. Additionally, Position 1 offers opportunities for further development on the adjacent open land. Therefore, the At-Grade option for Position 1 is recommended.

Key screening findings – optimal option:

- **Moderate Agricultural Sensitivity**: The site has medium sensitivity for agriculture. Located in the Urban Development Zone, Zone 1 of the GPEMF, the development is appropriately situated to avoid compromising agricultural resources in Gauteng Province
- **High Animal Species Sensitivity:** The site has high sensitivity due to the potential presence of species such as the African Grass Owl, Makwassie Musk Shrew, Spotted-Necked Otter, and Bush Cricket. Natural vegetation clearance will result in habitat loss for these species, necessitating biodiversity and faunal impact assessments and mitigation measures
- **Low Aquatic Biodiversity Impact:** The site has low sensitivity for aquatic biodiversity, avoiding watercourses and indicating minimal impact on aquatic ecosystems (Figure 3-8)
- **Manageable Archaeological and Cultural Heritage Sensitivity:** The site has low sensitivity for archaeological and cultural heritage, indicating minimal impact on these resources
- **High Civil Aviation Sensitivity:** The site has very high sensitivity due to its proximity within 8km of a major civil aviation aerodrome and other civil aviation aerodromes, necessitating stringent compliance with aviation regulations

- **Moderate Defence Sensitivity:** The site has medium sensitivity due to its proximity to a Military and Defence Site, requiring compliance statements and potential mitigation measures
- **No Palaeontology Sensitivity:** No sensitivity findings were returned for this theme
- **Medium Plant Species Sensitivity:** The site has medium sensitivity due to the potential presence of species such as *Melolobium subspicatum* (a vulnerable species) and Sensitive species No. 1248. Natural vegetation clearance may require a Terrestrial Plant Species Specialist Assessment Report or a Terrestrial Plant Species Compliance Statement, and possibly a search and rescue operation for these species
- **High Terrestrial Biodiversity Sensitivity:** The site has very high sensitivity due to its classification within the endangered Egoli Granite Grassland Ecosystem, likely requirement comprehensive terrestrial biodiversity assessments. Regardless, all key biodiversity areas and watercourses are avoided (Figure 3-8)
- **Social Impact:** The site has low sensitivity regarding social impacts such as noise and air quality. However, its proximity to a taxi rank may cause significant social impacts that need to be assessed during the socio-economic impact and stakeholder engagement processes.

Overall, Position 1 – At-Grade is a viable option for development, balancing all criteria. Considering the above screening findings, impacts can be managed with appropriate mitigation measures.

Based on the MCA Position 1 at-grade vertical placement is the optimal option for the Lanseria Station

3.5 Smart City Station

Along the Cosmo City to Lanseria route, the Greater Lanseria Master Plan (GLMP) proposed the development of a new city near the Lanseria Airport, named the Lanseria Smart City. The future Smart City Station forms part of the GLMP which includes plans to incorporate a rapid rail station as part of the public transport interventions for the City. For this reason, only one station position was identified which aligns with Smart City development plans as per the GLMP. The proposed future Smart City Station is located in an area within the Smart City designated for Public Open space.

The Smart City Station was not originally part of the 2016 Feasibility Study. It was added to this Project to maintain flexibility and futureproof the Cosmo City to Lanseria Route to allow for future integration of the route with the Smart City and enable prospective extensions beyond Gauteng to link up with the High-Speed Rail.

The Smart City Station position (Figure 3-9) underwent desktop-level environmental screening and did not form part of the MCA process or any detailed quantified assessment at the commencement of this Study. The findings were qualitatively assessed to determine likely environmental and social impacts constituting red flags or go / no-go options.

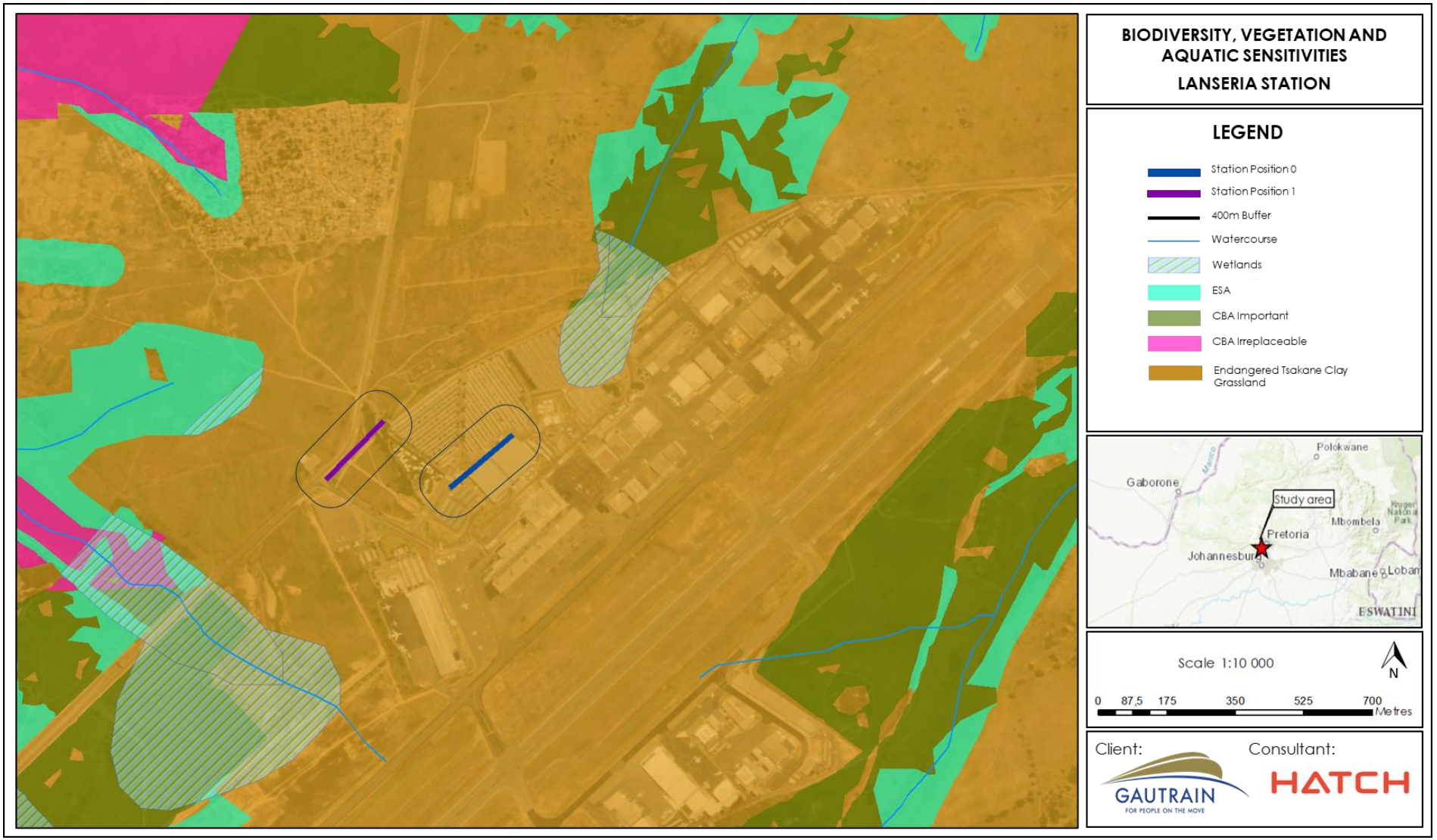


Figure 3-8: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Lanseria Station Options

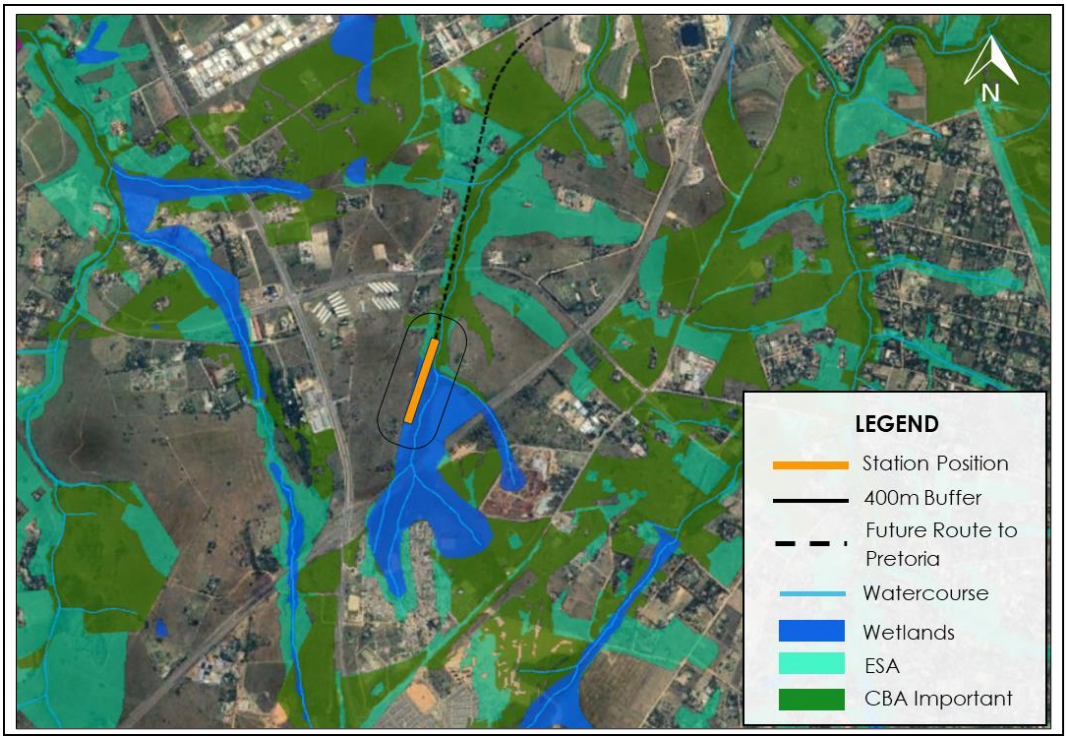


Figure 3-9: Future Smart City Station Position and Associated Biodiversity and Aquatic Sensitivities

The screening assessment on the proposed Smart City Station position found the following:

- **Agriculture:** The site has medium sensitivity due to its moderate land capability. Nonetheless, it is located in Zone1 of the Urban Development Zone, suggesting that the development is appropriately placed to avoid compromising agricultural resources
- **Animal Species:** High sensitivity is noted due to the potential presence of the African Grass Owl, and medium sensitivity for species such as Robert's Shaggy Rat and Spotted-Necked Otter, among others. The site is also predominantly a greenfield area, meaning habitat loss is a concern
- **Aquatic Biodiversity:** Very high sensitivity is identified along the proposed positioning due to its overlapping with a wetland area, the Mesic Highveld Grassland Bioregion (seep and valley bottom)
- **Archaeological & Cultural Heritage:** Very high sensitivity is noted because the site is within 50m of a Grade IIIc Heritage Site and 150m of a Grade IIIA site. It is not clear what these sites are from a desktop assessment, and specialist on-site investigation is required. These proximities indicate potential impacts on significant cultural and historical resources
- **Civil Aviation:** High sensitivity due to the site's proximity to numerous civil aviation aerodromes
- **Defence:** Low sensitivity overall, indicating minimal impact on defence-related activities or installations
- **Plant Species:** Medium sensitivity due to the potential presence of vulnerable species like Melolobium subspicatum and Sensitive species No. 1248. The potential presence of these species (and it being undeveloped land) suggests that development could impact local flora.

- **Terrestrial Biodiversity:** Very high sensitivity due to the site's classification within CBAs, ESAs, and the Critically Endangered Egoli Granite Grassland Ecosystem. These areas are vital for maintaining ecological integrity and biodiversity
- **Social Impact:** Low sensitivity is anticipated overall as the development of this station does not infringe on any existing properties or development activities. This suggests a lower potential for noise impact. But moderate visual impacts might occur due to the undisturbed scenic quality of the area.

The Smart City Station location, which is proposed to be deep tunnel placement, exhibits several high and very high environmental sensitivities, particularly concerning biodiversity and heritage. Given its location in a biodiversity-sensitive area, adjacent to a non-perennial river, wetland system, and overlapping CBAs and ESAs (Figure 3-9), these aspects require particular attention. While the site is suitable for development within an Urban Development Zone, careful planning and mitigation strategies are essential to manage potential impacts effectively. Prioritizing environmental conservation and heritage protection will be crucial to ensure sustainable and responsible growth. The proposed station position is optimal considering various criteria, including cost, engineering, and design, especially for integration with the Smart City plans as this position allows the Smart City residents convenient access to the station. The associated environmental impacts will need to be comprehensively assessed and appropriately managed.

3.6 Fourways Station

3.6.1 Screening of Fourways Station Options

Fourways Station will serve the major activity nodes located in the vicinity of the Winnie Mandela Drive and Witkoppen Road intersection, namely Fourways Mall, Montecasino, Fourways Crossing and medium- to high income residential areas. The potential options for this station were narrowed down to two suitable station positions on site (0 and 1) as illustrated in Figure 3-10.

Figure 3-10: Fourways Station Position Options

From a landcover and landscape perspective, the area is characterised by predominantly urban and built-up areas, but small natural and undeveloped areas are present (Appendix B).

The findings of the Screening Tool for the two options associated with the Fourways Station are presented Appendix A - Table A - 1. The key screening findings, sensitivity features, and comparisons from an environmental perspective are summarised below. Clear differences are evident in the environmental sensitivity ratings. The differences in sensitivity features associated with these options resulted in stark differences in the scoring

Key screening findings - comparing all options:

- **Agriculture:** Both positions have medium sensitivity. The sites are located in Zone 1 of the GPEMF, indicating that the development is appropriately located to not compromise agricultural resources in Gauteng Province
- **Animal Species:** Both positions have medium sensitivity due to the potential presence of species such as the Lobatse Hinge-Back Tortoise (*Kinixys lobatsiana*) (Position 1 only), Rough-Haired Golden Mole, Spotted-Necked Otter, and others. Position 1 is more sensitive due to its location in an open greenfield site with natural vegetation that will need to be cleared, resulting in habitat loss
- **Aquatic Biodiversity:** Position 0 has low sensitivity, while Position 1 has very high sensitivity due to the intersection with two classified wetlands (Mesic Highveld Grassland Bioregion - Seep and Valley-bottom). Position 0 would have a lower impact and is the preferred option for this theme (Figure 3-11)
- **Archaeological & Cultural Heritage:** Position 1 has very high sensitivity due to its location within 5km of a Grade I Heritage Site. Position 0 is the less sensitive option for this theme with a low sensitivity
- **Civil Aviation:** Both positions have very high sensitivity due to their proximity to major civil aviation aerodromes and other civil aviation facilities. There is no distinction in sensitivity between the options
- **Defence:** Both positions have medium sensitivity due to their proximity to a Military and Defence Site. There is no differentiation between the options
- **Palaeontology:** No sensitivity was found for either position in this theme
- **Plant Species:** Position 0 has low sensitivity, while Position 1 has medium sensitivity due to the potential presence of species such as Melolobium subspicatum (vulnerable species) and Sensitive species No. 1248
- **Terrestrial Biodiversity:** Both positions have very high sensitivity due to their classification within the Critically Endangered Egoli Granite Grassland Ecosystem. Position 1 is more sensitive due to additional classifications as ESA 1 and ESA 2 (Figure 3-11)
- **Social Impact:** Position 0 is located within an existing residential area with high-value properties that will need to be acquired, causing social and capital complications. Position 1 may also have high social impacts due to its proximity to the Monte Casino Bird Gardens that will be impacted, and an informal taxi rank, which could result in further socio-economic impacts.

Position 0 is generally the least sensitive from an environmental perspective as it has lower sensitivities in several key themes, including aquatic biodiversity, archaeological and cultural heritage, and plant species (i.e. already developed). Contrary to this social impact causes additional complications for a land acquisition perspective. Nonetheless, from an environmental perspective, Position 0 a more favourable choice for minimising environmental impacts and simplifying the compliance and mitigation processes.

Position 0 is the least sensitive from an environmental perspective.

3.6.2 Optimal Fourways Station from MCA

Based on the MCA, **Position 1 – Bridge** level, emerged as the station position with the highest ranking. The options and the availability of land to serve the sites, as well as the purchase of potential land to facilitate the development of the station and associated facilities was considered. Position 0 is located within an existing residential area with high-value properties that will need to be acquired. Provision of access roads to/from the site from Witkoppen Road and Winnie Mandela Drive may be challenging. Also, limited TOD will be able to develop at this site due to the high densification that has already taken place around this site.

Position 1 is further to the east and is located closer to vacant land located north of Witkoppen Road. This property will be able to facilitate the development of station facilities that are better suited to link into the existing road network and commercial activities around the major road intersection point at Fourways. This site, although very contained, will also better facilitate future TOD around the station and can integrate more effectively with the other transportation modes that exist around the station option.

Key screening findings – optimal option:

- **Accessibility:** Position 1 is strategically located closer to vacant land and commercial activities around the major road intersection in Fourways, enhancing accessibility and potential ridership. This proximity supports the development of TOD and integrates well with the surrounding urban areas. Therefore, this position is well-located for passenger access to key landmarks and transport routes, enhancing the station's utility and integration with the community
- **Higher Social Impacts:** The proximity to the Monte Casino Bird Gardens and an informal taxi rank may result in higher social impacts. These include potential disruptions to local communities and sensitivities related to the bird gardens, which need to be carefully managed through the stakeholder engagement process
- **Animal Species Sensitivity:** The site has medium sensitivity for animal species which may require a terrestrial impact assessment
- **High Impact on Aquatic and Plant Species:** The site has very high sensitivity for aquatic biodiversity due to the intersection with two classified wetlands (Figure 3-11) and medium sensitivity for plant species, indicating potentially significant impacts on these ecosystems. Proper assessments and compliance statements are necessary to mitigate potential impacts
- **Very High Sensitivity for Terrestrial Biodiversity:** Position 1 is classified within CBAs and the Critically Endangered Egoli Granite Grassland Ecosystem, making it potentially

sensitive from a biodiversity perspective. This is likely to require detailed terrestrial biodiversity specialist assessments (Figure 3-11)

- **Manageable Archaeological and Cultural Heritage Sensitivity:** Although the site has very high sensitivity for archaeological and cultural heritage due to its location within 5km of a Grade I Heritage Site, a heritage assessment will determine if any impacts are anticipated
- **Civil Aviation Compatibility:** The site has very high sensitivity for civil aviation due to its proximity to major aerodromes, but a Civil Aviation Compliance Statement will ensure compatibility and reduce potential conflicts with aviation activities
- **Medium Defence Sensitivity:** The site has medium sensitivity for defence due to its proximity to a Military and Defence Site, but this is unlikely to cause impacts or compliance concerns
- **Low Palaeontology Sensitivity:** The site has no sensitivity for palaeontology, indicating no-minimal impact in this theme.

Position 1 offers better integration with the existing road network and commercial activities, facilitating future TOD. Despite higher sensitivities in certain environmental themes, such as aquatic biodiversity and archaeological heritage, the strategic location of Position 1 enhances accessibility and potential ridership, making it a more viable option compared to Position 0. The proximity to vacant land and major road intersections further supports its selection, ensuring better connectivity and development potential.

Based on the MCA Position 1 bridge vertical placement is the optimal option for the Fourways Station

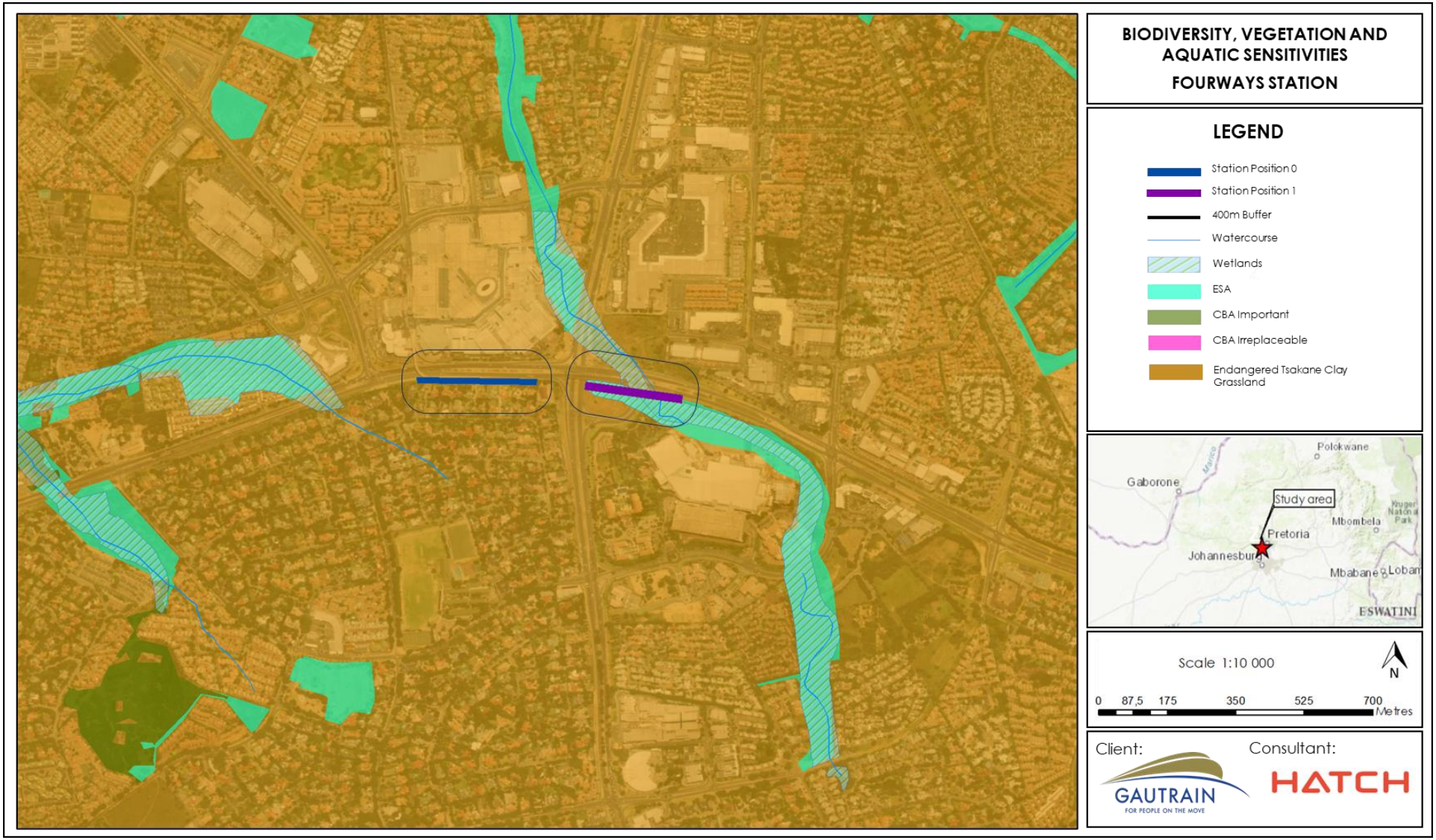


Figure 3-11: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Fourways Station Options

3.7 Sunninghill Station

3.7.1 Screening of Sunninghill Station Option

Only one option has been considered for the Sunninghill Station (Figure 3-12).

From a landcover and landscape perspective, the Sunninghill area is characterised by half of the area being residential urban and built-up areas, the other half being natural and undeveloped areas (Appendix B). The areas proximal to the proposed site options are largely open green spaces (including the adjacent Leeuwkop Prison Grounds and a mountain biking trail), with nearby residential estates.

As only one option has been considered for this station, there is no comparison or finding for an optimal option. While no comparison is required for this station, the Screening Tool was still used to garner an understanding for the associated environmental sensitivities.

Figure 3-12: Sunninghill Station Position Option

The findings of the Screening Tool for the option proposed for the Sunninghill is presented in Appendix A - Table A - 1 The key screening finding and sensitivity features are summarised below.

Key screening findings:

- **Agriculture:** The site has high sensitivity due to its proximity to the Leeuwkop Prison Grounds, which includes open plantations and crops. However, it is located in the Urban Development Zone, suggesting that the development is appropriately placed to avoid compromising agricultural resources
- **Animal Species:** Medium sensitivity is noted due to the potential presence of species such as the Robert's Shaggy Rat, Spotted-Necked Otter, Oribi, and The Lobatse Hinge-Back Tortoise, among others. The site is a greenfield area, meaning habitat loss is a concern

- **Aquatic Biodiversity:** Very high sensitivity is identified, particularly in the western portion of the site, due to its proximity to a wetland in the Mesic Highveld Grassland Bioregion (Figure 3-13)
- **Archaeological & Cultural Heritage:** Very high sensitivity is noted because the site is within 5km of a Grade I Heritage Site, likely the Liliesleaf Farm
- **Civil Aviation:** High sensitivity due to the site's proximity to major civil aviation aerodromes, including Grand Central Airport and Lanseria International Airport
- **Defence:** Medium sensitivity is noted, possibly due to the proximity to the Leeuwkop Prison Grounds
- **Plant Species:** Medium sensitivity due to the potential presence of vulnerable species like Melolobium subspicatum and Sensitive species No. 1248
- **Terrestrial Biodiversity:** Very high sensitivity due to the site's classification within CBAs and the Critically Endangered Egoli Granite Grassland Ecosystem (Figure 3-13)
- **Social Impact:** Low sensitivity overall, but considerations include moderate visual impacts due to the scenic quality of the area, and potential disruptions to recreational activities like hiking and mountain biking on the now-debunked Leeuwkop Golf Course grounds.

3.7.2 Optimal Sunninghill Station from MCA

Other options at alternative sites were not considered for Sunninghill as the location was deemed to be optimal with the planned route. The recommendation for Sunninghill station is **Option 0 - At-Grade.**

Position 0 at-grade vertical placement is the only and optimal option for the Sunninghill Station

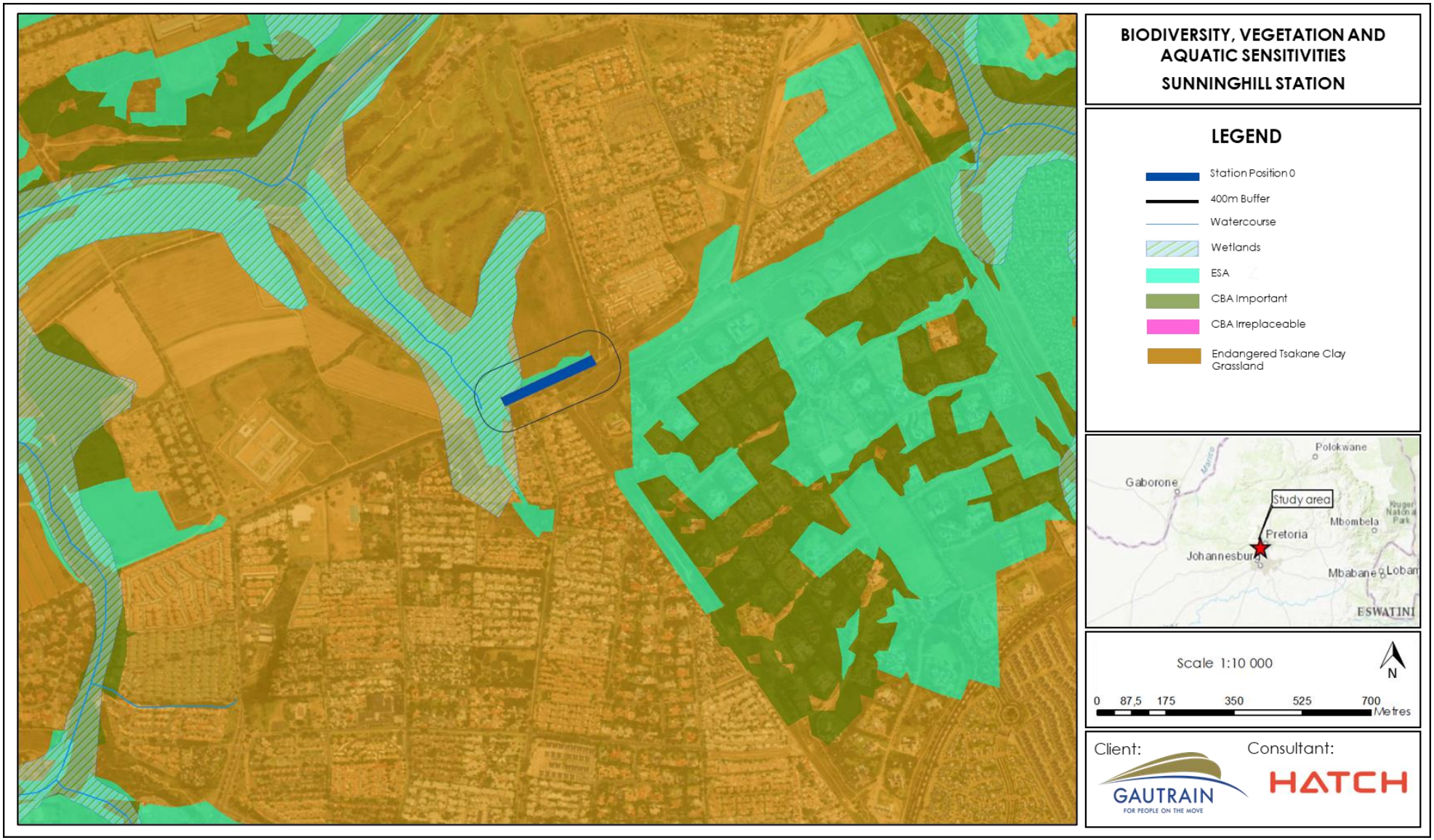


Figure 3-13: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Sunninghill Station Option

3.8 Olievenhoutbosch Station

3.8.1 Screening of Olievenhoutbosch Station Options

The position of this station is more flexible, with Position 0 in Garden Road representing the original location from the 2016 Feasibility Study and Position 1 an alternative suitable location in Eighth Road in Noordwyk, on a significantly different horizontal rail alignment identified by the technical team. The potential options for this station were narrowed down to two suitable station positions on site (0, and 1) as illustrated in Figure 3-14.

From a landcover and landscape perspective, the Noordwyk area is characterised by predominantly residential urban and built-up areas, but small natural and undeveloped, and greenbelt areas are present (Appendix B). The areas proximal to the proposed site options are largely medium-high income residential estates, smaller open green spaces and the nearby Rietspruit River greenbelt.

Figure 3-14: Olievenhoutbosch Station Position Option

The findings of the Screening Tool for the two options associated with the Olievenhoutbosch Station are presented in Appendix A - Table A - 1. The key screening findings, sensitivity features, and comparisons from an environmental perspective are summarised below. There is little differentiation between options, however differences in sensitivity features associated with these options resulted in differences in the scoring.

Key screening findings - comparing all options:

- **Agriculture:** Both positions have high sensitivity. The sites are located in Zone 1 of the GPEMF, indicating that the development is appropriately located to avoid compromising agricultural resources
- **Animal Species:** Both positions have medium sensitivity due to the potential presence of species such as the Makwassie Musk Shrew (Position 0 only), Robert's Shaggy Rat and Spotted-Necked Otter, among others. Position 0 is in close proximity to a high sensitivity site, making it potentially less favourable

- **Aquatic Biodiversity:** Both positions have low sensitivity, avoiding watercourses and indicating minimal impact on aquatic ecosystems (Figure 3-15)
- **Archaeological & Cultural Heritage:** Both positions have low sensitivity, indicating minimal impact on archaeological and cultural heritage resources
- **Civil Aviation:** Both positions have high sensitivity due to their proximity within 8km of a civil aviation aerodrome and other aviation-related features. There is no distinction in sensitivity between the options
- **Defence:** Both positions have medium sensitivity due to their proximity to a Military and Defence Site
- **Palaeontology:** No sensitivity findings were returned for either position in this theme
- **Plant Species:** Position 0 has medium sensitivity due to the potential presence of species such as *Melolobium subspicatum* (a vulnerable species) and Sensitive species No. 1248. Position 1 has low sensitivity, making it the less sensitive option in this theme
- **Terrestrial Biodiversity:** Both positions have very high sensitivity due to their classification within the critically endangered Egoli Granite Grassland Ecosystem. Position 1 is also classified as an ESA 2 (Figure 3-15), making it slightly more sensitive
- **Social Impact:** Position 0 may have a moderate visual impact due to its proximity to the Rietspruit River greenbelt.

Position 1 has a lower overall environmental sensitivity compared to Position 0. It presents fewer challenges in terms of plant species and terrestrial biodiversity, making it the most suitable option for development with minimal environmental disruption. Position 0 has higher sensitivity due to its proximity to the Rietspruit River greenbelt and the potential presence of sensitive species. Both positions have similar high sensitivities in several other themes, but Position 1's lower sensitivity in some themes makes it the more favourable option.

Position 1 is the least sensitive from an environmental perspective.

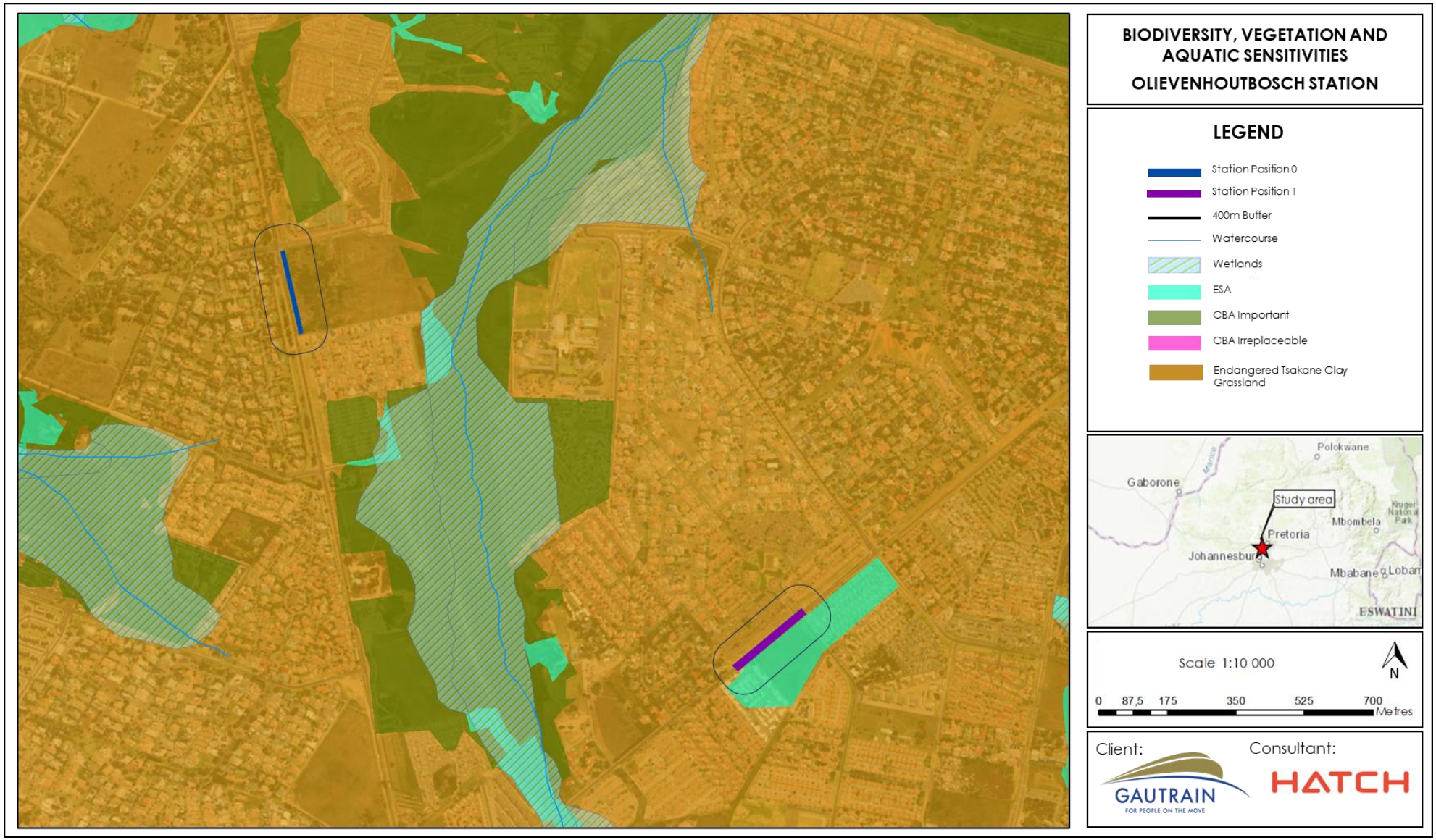


Figure 3-15: Biodiversity, Vegetation and Aquatic Sensitives Associated with the Olievenhoutbosch Station Options

3.8.2 Optimal Olievenhoutbosch Station from MCA

Based on the MCA, **Position 1 - Cut-and-Cover**, emerged as the station position with the highest ranking.

Position 0 is located along an existing bus route that runs along Garden Road. The area around this station is not that densified. Towards the western and north-western side of the adjacent complex at the station location, there are several small holding developments that will not generate high ridership. This position also requires a tight curve in the route alignment on the northern side to skirt the Blue Valley Estate, with a negative impact on the train speed profile and travel time.

Position 1 is located in a denser residential area and is also closer to the Midrand industrial area located east of the N1. This will generate higher ridership figures from the catchment area around the station. Furthermore, the route alignment for this station provides a smoother alignment towards Samrand Station, resulting in a higher train speed and shorter travel time between Samrand and Olievenhoutbosch Stations.

Key screening findings – optimal option:

- **Proximity to Residential Areas:** The site is located in a more densified residential area and is closer to the Midrand industrial area east of the N1, which will generate higher ridership figures from the catchment area around the station
- **High Agricultural Sensitivity:** While screening showed high sensitivity for agriculture, being located in Zone 1 of the GPEMF means the development is appropriately situated to avoid compromising agricultural resources in Gauteng Province. An agricultural compliance statement will likely be required, nonetheless
- **Medium Animal Species Sensitivity:** The site has medium sensitivity due to the potential presence of species certain sensitive species. Natural vegetation clearance will result in habitat loss for these species, necessitating biodiversity and faunal impact assessments and mitigation measures
- **Low Aquatic Biodiversity Impact:** The site has low sensitivity for aquatic biodiversity, avoiding watercourses and indicating minimal impact on aquatic ecosystems (Figure 3-15)
- **Manageable Archaeological and Cultural Heritage Sensitivity:** The site has low sensitivity for archaeological and cultural heritage, indicating minimal impact on these resources
- **High Civil Aviation Sensitivity:** The site has high sensitivity due to its proximity within 8km of a civil aviation aerodrome and other aviation-related features, necessitating stringent compliance with aviation regulations
- **Moderate Defence Sensitivity:** The site has medium sensitivity due to its proximity to a Military and Defence Site, requiring compliance statements and potential mitigation measures
- **No Palaeontology Sensitivity:** No sensitivity findings were returned for this theme
- **Very High Terrestrial Biodiversity Sensitivity:** The site has very high sensitivity due to its classification within the critically endangered Egoli Granite Grassland ecosystem and ESA 2 (Figure 3-15), possibly requiring comprehensive terrestrial biodiversity assessments

- **Social Impact:** The sites' location proximal to a densely populated residential area may require careful management of construction and operational impacts to minimise disruption to the community.

Overall, Position 1 Cut-and-Cover is a viable option for development, balancing all criteria. Considering the above screening findings, impacts can be managed with appropriate mitigation measures.

Based on the MCA Position 1 at cut and cover vertical placement is the optimal option for the Olievenhoutbosch Station

4. ENVIRONMENTAL SCREENING AND ALTERNATIVES ASSESSMENT OF ROUTE ALIGNMENT OPTIONS

This section of the Report presents the findings of the environmental screening and alternatives assessment for the route alignment options across the three corridors. Section 6 of the Route Determination Report outlines the process that was followed for the development of route alignment options and the processes undertaken to evaluate each option, to identify an optimal route option per corridor. The term "optimal route alignment", wherever mentioned in this Report, refers to the optimal route alignment and configuration as determined within the context, parameters, and level of design development of this study.

A sensitivity mapping exercise of all options was undertaken to proactively identify sensitive areas that should be avoided by the route alignments or, alternatively, highlight the potential impacts that would likely be associated with the options that require specific mitigation measures. Individual and composite maps illustrating the various environmental sensitivities are presented in figures throughout this section. These maps, developed exclusively from desktop and GIS data, overlay the proposed route options with key environmental aspects. The maps highlight environmental sensitivities likely to be impacted by the Project, including vegetation types, critical biodiversity and ecological support areas, protected areas, rivers, streams, and land cover/land use. It is important to note that these maps were created without the support of fieldwork by specialists. Therefore, while they provide valuable preliminary insights, they cannot replace the detailed on-site assessments that will be conducted during future EIA phases. Ground truthing of the screening and sensitivity findings for this Report was undertaken using GIS data, drone footage, and where required, a high-level visual inspection, with no specialist input.

Two options for each corridor underwent the MCA process. This section of the Report presents environmental screening findings of the two options. The subsequent sub-sections delve specifically into the environmental aspects of Option 0 (Feasibility 2016), the first optimal option (Option 1), and the second optimal option (Option 2). These sub-sections offer an examination of the potential environmental impacts and overall sustainability of each option.

Conversely to the stations, for the route alignment, the footprint associated with the construction and operation of the railway lines (including any associated infrastructure) has varying degrees of impacts at the different vertical placement levels. The route determination is for a 400m-wide land corridor within which the future railway line can be designed and implemented. Without final locations, Project designs, and layouts, the precise impacts of the different placements are indeterminable at this stage. Nonetheless, through subjective assessment by expertise in railway development and impact assessments, the potential impacts were estimated to a degree that allowed for a comparison of the four vertical placement options (Table 2-3). The route alignment options, and the associated vertical placements discussed in this section are presented in Table 4-1 below.

Table 4-1: Route Alignment Options Summary

Route Alignment Options	Total Track Length (km)	Track lengths (km) at the various vertical placements			
		At-Grade	Bridge/Viaduct	Cut & Cover	Deep Tunnel
Little Falls to Jabulani Corridor					
Option 0 [12]	*18.14 km*				
Option 1	18.92	-	-	-	18.92
Option 2	18.92	2.36	0.81	0.22	15.53
Cosmo City to Lanseria					
Option 0	*15.61 km*				
Option 1	16.98	9.64	7.35	-	-
Option 2	17.05	9.61	7.45	-	-
Cosmo City to Samrand					
Option 0	*39 km*				
Option 1	30.11	2.88	1.68	0.63	24.93
Option 2	30.44	3.39	3.19	0.82	23.04

By presenting these findings, this section aims to provide a clear and thorough understanding of the environmental considerations that influenced the selection of the optimal route options. This ensures that the Project aligns with environmental sustainability goals while meeting the transportation needs of the region.

4.1 Little Falls to Jabulani Corridor

The total route length is approximately 19 km in length (from Little Falls Station to Jabulani Station) and traverses in a southerly direction through to the proposed Roodepoort Station before proceeding to the proposed Jabulani (end) Station.

For this Project, the start point of the route alignment for this corridor is at the end of the Phase 1 alignment battery limit, located approximately 1.60km south of the proposed Little Falls Station Platform. This route starts at the end point of the proposed GRRIN Phase 1 route alignment that goes from Marlboro to just beyond Little Falls Station, via the proposed Cosmo City and Randburg stations (Figure 4-1).

[12] **Option 0** was derived from the Gauteng Rapid Rail Extensions Feasibility Study (2016) and serves as a **benchmark for comparison purposes only.** The shape files associated with this option were not provided for assessment and therefore the vertical profile is excluded from the comparison. This option did not undergo the MCA process or any comprehensive environmental screening assessment. Consequently, it was not quantitatively assessed for comparison purposes.

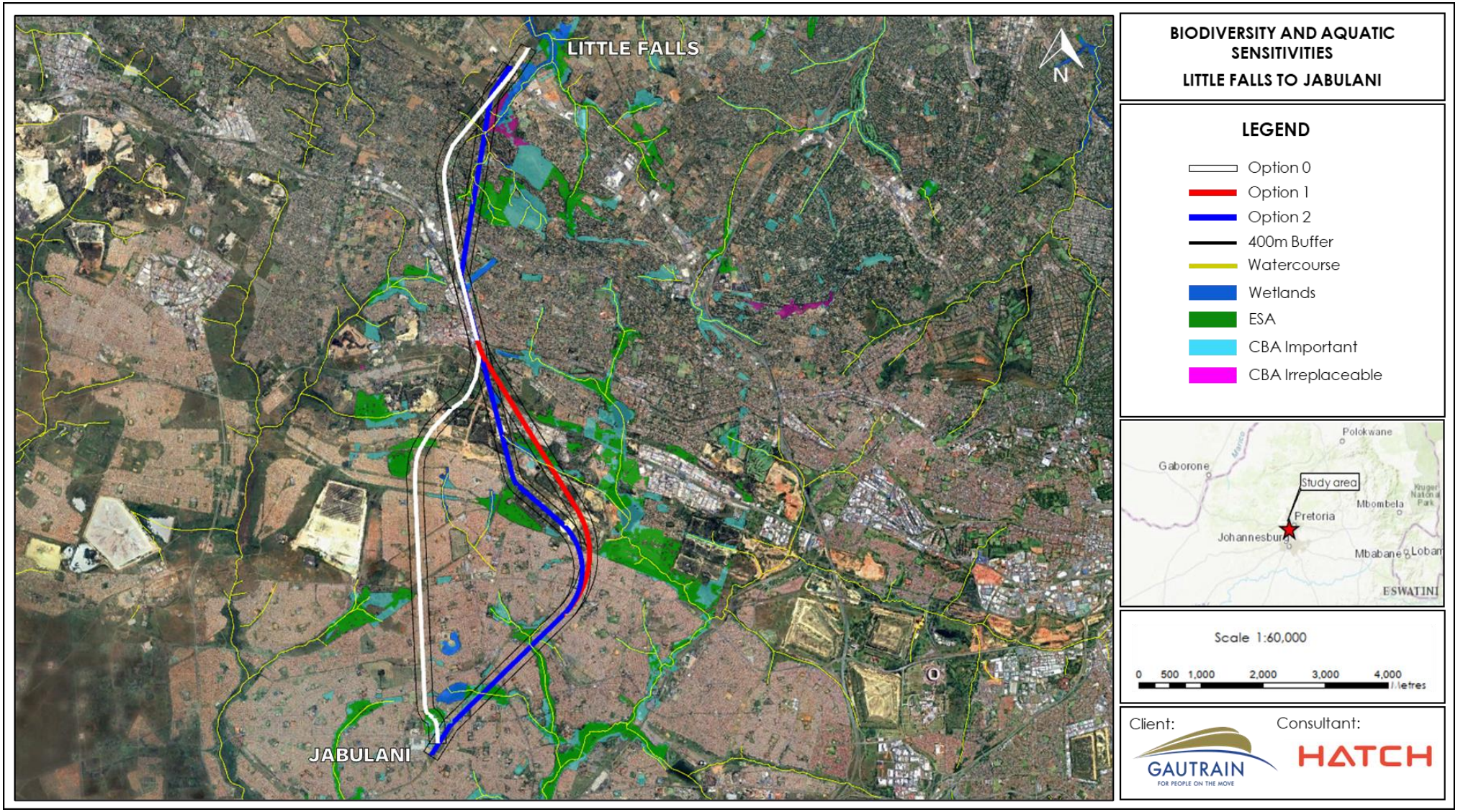
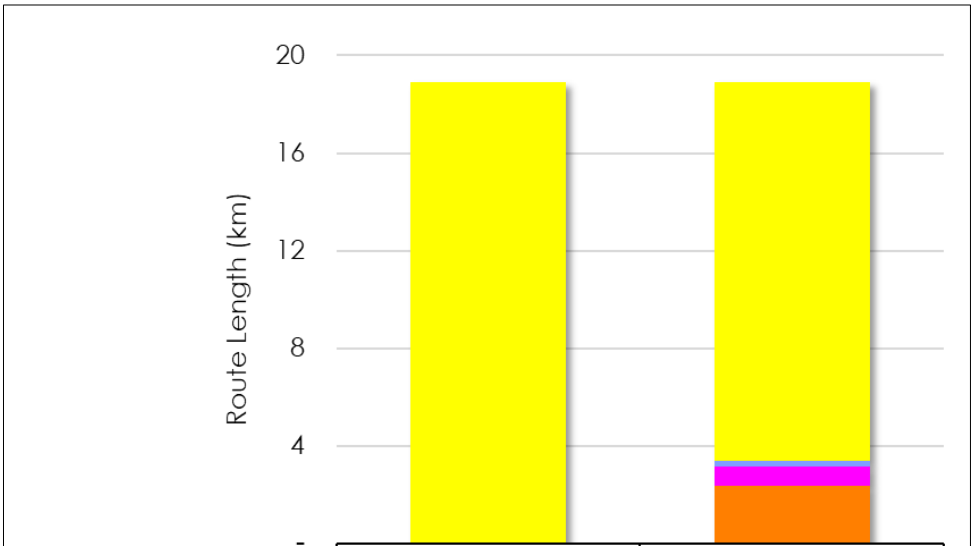


Figure 4-1: Little Falls to Jabulani Route Alignment Options including Biodiversity and Aquatic Sensitivities

This corridor has a dolomitic zone that was identified as part of the geological desktop study, and avoiding such formed a key consideration in the development of the options. Figure 4-2 below illustrates the detailed lengths (in km), including the vertical alignment positions (A, B, C or D), for Optimal Option 1 and Option 2.



	Option 1	Option 2
Deep Tunnel (km)	18.92	15.53
Cut-&-Cover (km)	-	0.22
Bridge / Viaduct (km)	-	0.81
At-Grade (km)	-	2.36

Figure 4-2: Varying Vertical Alignment Distances for each Little Falls to Jabulani Option

The routes can be described as:

- **Option 1:** The route alignment spans 18.92 km and exclusively features a deep tunnel track type (Figure 4-3). This complete tunnel route was designed to capitalise on the cost benefits of using a TBM over extended distances. Starting from the end point of the proposed GRRIN Phase 1 route alignment, approximately 1.6 km south of the proposed Little Falls station, the route heads south directly towards Roodepoort Station, passing through the Helderkruin and Horizon View settlements. It then runs parallel to the existing PRASA line through Roodepoort Station, crossing beneath the existing PRASA line, continuing under the R41 road and AfriSam Roodepoort Plant, before shifting to a south-west direction into the Meadowlands East settlement, avoiding the dolomite area. Finally, it proceeds beneath the existing PRASA line, running parallel to the line adjacent to the existing Inhlazane Station, connecting to a below-ground Jabulani Station
- **Option 2:** While similar to Option 1 in terms of the overall route alignment and length (18.92 km), Option 2 differs in several key aspects. It incorporates a mix of track types: 12% at-grade, 4% bridge/viaduct, 1% cut-and-cover, and 82% deep tunnel (Figure 4-3). The route starts at the same point as Option 1 and follows a similar path towards Roodepoort Station, passing through the Helderkruin and Horizon View settlements, and runs parallel to the existing PRASA line through to Roodepoort Station.

However, it diverges by exiting underground beneath the R41 road and changing direction eastward after crossing at-grade through the M77 (Elias Motsoaledi Road). It then shifts to a south-west direction into the Meadowlands East settlement, avoiding the dolomite area, and proceeds beneath the existing PRASA line, running parallel to the line adjacent to the existing Inhlazane Station, connecting to a below-ground Jabulani Station.

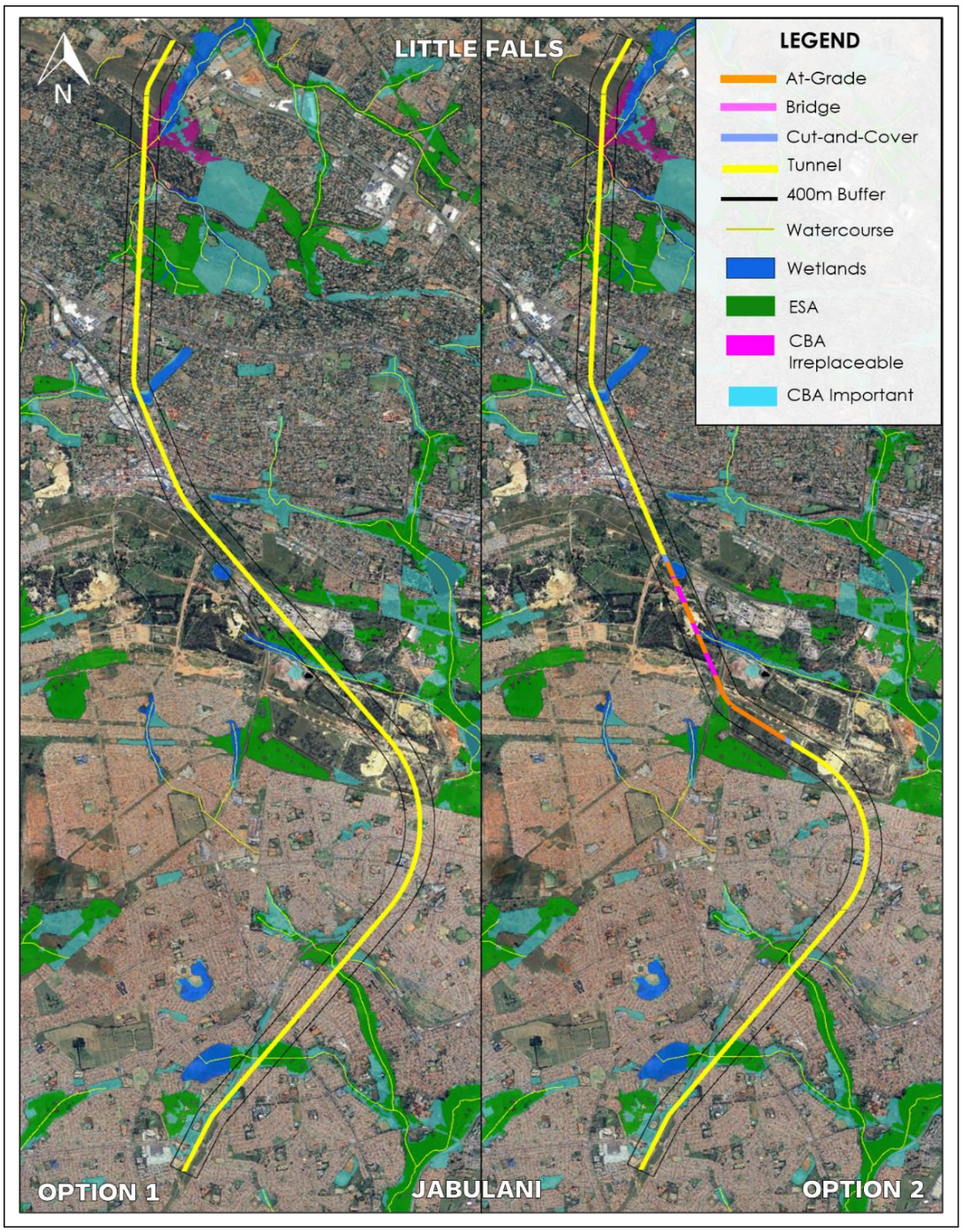


Figure 4-3: Visual Representation of the Vertical Profiles of Option 1 and Option 2 including Biodiversity and Aquatic Sensitivities

From a landcover and landscape perspective, the area is characterised by predominantly urban residential, small holding and township coverage (Appendix D: Figure A - 1). However, the routes traverse through areas of grassland cover and bare / semi-bare mining areas. From a vegetation perspective, Gold Reef Mountain Bushveld is dominant in the Little Falls / Helderkruin area, and along the routes toward Jabulani Station, traversing Soweto Highveld Grassland and Tsakane Clay Grassland vegetation types (Appendix E: Figure A - 4). Across both options, significant development is evident in the form of residential, industrial, and commercial use, with pockets of open greenfield/undeveloped spaces.

The findings of the Screening Tool, sensitivity features, and comparisons from an environmental perspective are summarised in the subsections below.

4.1.1 Screening Findings

The Jabulani Corridor is characterised by a variety of environmental sensitivities across several themes. The Screening Tool highlighted high sensitivity areas for animal species, aquatic biodiversity, and terrestrial biodiversity due to the presence of essential habitats, watercourses, and conservation zones.

Additionally, the corridor traverses regions with medium sensitivity for plant species, indicating the potential presence of vulnerable and critically endangered flora. The corridor's proximity to heritage sites and civil aviation aerodromes further contributes to its sensitivity ratings. Overall, the environmental sensitivities within the Jabulani Corridor require meticulous planning and effective mitigation strategies to minimise impacts, especially in areas of significant ecological and cultural value.

Table 4-2 provides an in-depth comparison of the screening findings for Option 1 and Option 2. The desktop DFFE Screening Tool findings are initially presented, which evaluate the environmental sensitivities associated with each option across the various themes. This section is presented to same way for all three corridors.

These preliminary findings are then adjusted based on ground truthing and the impacts of vertical placement along the routes. By refining the initial sensitivity ratings, Table 4-2 offers a more accurate reflection of the actual environmental sensitivities, enabling a clearer understanding of the potential impacts. This comprehensive approach ensures that all relevant factors are considered, facilitating informed decision-making regarding the preferred route alignment.

The Screening Tool identified varying sensitivity levels across environmental themes. Areas with high sensitivity may require detailed specialist assessments or permits (see Appendix C). In some cases, a 'Specialist Compliance Statement' may suffice. To enhance accuracy, ground truthing and vertical placement considerations have been incorporated. Ground truthing validated the Screening Tool results against current land use, while vertical placement analysis assessed the construction depth. This dual approach refined the sensitivity ratings, providing a more precise assessment of environmental impacts and helping to identify the most sustainable route alignment.

- Option 1, which features a longer deep tunnel section, consistently showed lower sensitivity ratings across most environmental themes. This is due to the reduced surface-level disruption associated with deep tunnelling, which minimises impacts on agricultural land, sensitive animal and plant habitats, heritage sites, as well as terrestrial biodiversity and aquatic ecosystems and other critical areas (Figure 4-3).

The deep tunnel also avoids extensive land acquisition and surface-level construction activities, further reducing the potential for environmental harm

- Option 2, while similar in many respects, includes a 3.39 km section that is above ground. This section increased the potential for surface-level impacts, particularly in areas of high sensitivity, such as the presence of ESAs and wetlands in this portion (Figure 4-3). As a result, Option 2 generally exhibited higher sensitivity ratings compared to Option 1.

In summary, the table highlights the adjusted sensitivity ratings for various environmental themes, demonstrating how the deep tunnel method inherently and significantly mitigates surface-level impacts. Option 1, with its extended deep tunnel section, generally exhibits lower sensitivity ratings across most themes. This makes it the superior choice for minimising environmental disruption and preserving natural resources.

Based on the MCA Option 1 is the optimal route alignment for the Little Falls to Jabulani Corridor and is least environmentally sensitive.

Table 4-2: Screening Tool and Adjusted Sesntivity Findings Considering Vertical Placement Impacts of Option 1 and Option 2 for the Little Falls to Jabulani Corridor

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
Agriculture	The route alignments traverse areas with varying sensitivity levels, from low to high (Figure 4-4), but the overall sensitivity was high for both options. At some point along the routes, the options all cross Urban Development Zone 1 and/or Zone 5 of the GPEMF. Therefore, it is assumed that at these points, the development is appropriately located to not compromise agricultural resources in Gauteng. The development of a railway line is also listed under the land uses that are compatible with the intention of these zones under the GPEMF. Further to this, areas with high potential soils are restricted to isolated areas at various points along the routes with substantial urban sprawl (in all route options). Despite the high rating, it is unlikely to impact on agricultural resources in the province given the surrounding land uses (urban and industrial; Appendix A: Figure A - 1). There is no differentiator between the route options.	For both options, the deep tunnel method significantly reduces surface-level impacts on agricultural land. This minimises the disruption to high potential soils and agricultural productivity. The underground route ensures that areas with high potential soils are not disturbed, preserving the agricultural productivity of these regions. Additionally, the deep tunnel avoids the need for extensive land acquisition and surface-level construction activities, which could otherwise lead to soil compaction, erosion, and loss of arable land. However, in areas where Option 2 exits the ground, there may be localised impacts due to land acquisition and construction activities. Overall, the sensitivity for agriculture is low for both options, with Option 1 being slightly more favourable due to its longer tunnel section.
Animal Species	Both options traverse medium and high sensitivity areas, with a high overall sensitivity rating due to the potential presence of sensitive species such as the Lanner Falcon (*Falco biarmicus*) and Black Stork (*Ciconia nigra*). Approximately 5% of the route alignments cross high sensitivity areas, primarily in the Little Falls area, while the remaining 95% fall within medium sensitivity zones (due to the potential presence of, and adverse impact on eight (8) other animal species). The high sensitivity species are located within the same position for both options from, namely in open green space towards the end of the route in Little Falls (Figure 4-4). This area represents a greenfield site located near a watercourse (Figure 4-1). These route options traverse undeveloped greenfield sites with undulating hills and some rocky areas, with grassland and bushveld vegetation types. Several watercourses (namely wetlands) are also crossed which facilitate the occurrence of these species. Natural vegetation will need to be cleared, thus resulting in loss of habitat for potentially occurring species.	The deep tunnel approach in Option 1 minimises habitat disruption for sensitive animal species. The underground route ensures that surface areas with high sensitivity, such as those near watercourses and greenfield sites, are not disturbed, preserving the habitats of species like the Lanner falcon and Black stork. Additionally, the deep tunnel avoids the need for extensive vegetation clearance and surface-level construction activities, which could otherwise lead to habitat fragmentation and loss. In Option 2, the above-ground sections increase the potential for habitat fragmentation and loss, particularly in greenfield areas. Consequently, the sensitivity rating for animal species is low for Option 1 and medium for Option 2.

<table>
<tr><th>Environmental Theme</th><th>Screening Tool Findings</th><th>Adjusted Sensitivity Considering Vertical Placement and Ground Truthing</th></tr>
<tr><td>Aquatic Biodiversity</td><td>The routes have a very high sensitivity rating due to multiple watercourse crossings (Figure 4-1), which are critical for maintaining aquatic biodiversity. The route alignments traverse both low and very high sensitivity areas in this theme (Figure 4-4), with about 6% to 7% of the alignments crossing very high sensitivity zones. Key features include crossings of the Klip River in Horizon View, Roodepoort, and a tributary of the Crocodile River near Little Falls. The presence of these watercourses necessitates careful consideration to avoid significant impacts on aquatic ecosystems.
While Option 1 crosses a lower number of watercourses, it traverses a longer portion (800 meters) of a Dry Highveld Grassland Bioregion (Valley-bottom) wetland, totalling 1.23 km crossing wetland areas, compared to 1.18 km for Option 2.
Table 4-3: Length (in km) of each route traversing aquatic sensitivity features
<table>
<tr><th>Sensitivity Features</th><th>Option 1</th><th>Option 2</th></tr>
<tr><td>A small Klip River crossing in Horizon View, Roodepoort; and a tributary of the Crocodile River.</td><td>0.05</td><td>0.05</td></tr>
<tr><td>Central Bushveld Bioregion (Valley-bottom)</td><td>0.26</td><td>0.26</td></tr>
<tr><td>Dry Highveld Grassland Bioregion (Valley-bottom)</td><td>0.8</td><td>0.63</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Depression)</td><td>-</td><td>0.12</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Seep)</td><td>0.12</td><td>0.12</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Valley-bottom)</td><td>-</td><td>-</td></tr>
<tr><td>Total</td><td>1.23 km</td><td>1.18 km</td></tr>
</table></td><td>Option 1's deep tunnel alignment avoids direct impacts on watercourses and wetlands, preserving aquatic ecosystems. The underground route ensures that areas with very high sensitivity, such as those near water bodies and wetlands, are not disturbed, preserving the aquatic ecosystems. In contrast, Option 2's above-ground sections pose a higher risk of disrupting aquatic habitats, leading to potential water pollution and changes in hydrology. The above-ground section could result in habitat disruption, water pollution, and changes in hydrology, which are concerns that need to be addressed through careful planning and mitigation measures.
Therefore, the sensitivity rating for aquatic biodiversity is low for Option 1 and medium for Option 2.</td></tr>
<tr><td>Archaeological & Cultural Heritage</td><td>Both options have a very high sensitivity rating because they fall within 5 km of a Grade I Heritage site and 2 km of a Grade II Heritage site. These sites include historical landmarks and areas of cultural importance protected under the South African Heritage Resources Act. Section 38(1) of the Act requires a heritage study for linear developments exceeding 300 meters in length, such as this Project. Detailed assessments are required to identify and mitigate potential impacts on these heritage resources. The proximity to these sites necessitates careful planning to preserve cultural heritage.
Given the high sensitivity rating for both options, implementing a Chance Find Procedure may be essential. This ensures that any unexpected discoveries during the construction of the railway line are managed in accordance with legal</td><td>The deep tunnel method in Option 1 ensures minimal surface-level interactions with heritage sites, preserving their integrity. The underground route ensures that areas with very high sensitivity, are not disturbed, preserving the cultural and historical integrity of these regions. In Option 2, the above-ground sections increase the risk of impacting archaeological and cultural heritage sites, potentially leading to physical damage and loss of historical artifacts. The above-ground section could result in physical damage, loss of historical artifacts, and a negative impact on the cultural landscape, which are concerns that need to be addressed through careful planning and mitigation measures.</td></tr>
</table>

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
	requirements and best practices for heritage conservation. This should be applicable regardless of vertical placement.	Thus, the sensitivity rating is low for Option 1 and medium for Option 2.
Civil Aviation	Both options have a high sensitivity rating due to the proximity of the route alignments to civil aviation aerodromes. Both options are located within 8 km of other civil aviation aerodromes, which raises concerns about potential interference with aviation activities. The proximity to civil aviation aerodromes means that both options could potentially impact aviation safety and operations. Issues such as bird strikes, electromagnetic interference, and physical obstructions could arise from the construction and operation of the railway line. These concerns necessitate careful planning and mitigation measures to ensure that the railway development does not pose risks to aviation safety.	Both options are located within proximity to civil aviation aerodromes. The deep tunnel in Option 1 eliminates surface-level interactions, reducing the risk of interference with aviation activities. The underground route ensures that areas within 8 km of civil aviation aerodromes are not affected by the construction and operation of the railway line. Option 2's above-ground sections could pose potential risks, such as physical obstructions and electromagnetic interference. The above-ground section could result in physical obstructions and electromagnetic interference, which are concerns that need to be addressed through careful planning and mitigation measures. As a result, the sensitivity rating is low for Option 1 and medium for Option 2.
Defence	Both options have a low sensitivity rating due to the absence of specific sensitive features related to defence in the areas traversed by the route alignments. Both options do not intersect with any known defence installations, military bases, or areas of strategic importance for national security. Therefore, no significant defence-related concerns are anticipated for either option.	The deep tunnel method in both options ensures minimal surface-level disruption, maintaining a low sensitivity rating for defence. The underground route avoids any potential interactions with defence installations or areas of strategic importance. There are no significant defence-related concerns anticipated for either option.
Palaeontology	Both options have a low sensitivity rating for due to the route alignments avoiding areas with high palaeontological significance. Both options circumvent regions that are noted for their potential palaeontological importance (Figure 4-4), such as fossil-rich deposits or areas known for significant palaeontological finds. This low sensitivity rating suggests that the development of the railway line is unlikely to disturb important fossil sites or hinder palaeontological research.	Option 1's deep tunnel alignment reduces the likelihood of disturbing fossil-rich deposits (particularly closer to surface-level). However, deep tunnelling involves excavating deeper layers of the earth, which could potentially encounter significant palaeontological resources. The underground route increases the likelihood of encountering fossils, necessitating careful monitoring and management. Option 2's above-ground sections increase the potential for surface-level impacts on palaeontological sites. Consequently, the sensitivity rating is low for both options, with a slightly higher risk for Option 2.
Plant Species	Both options have a medium sensitivity rating due to the route alignments traversing areas with the potential presence of sensitive plant species (Figure 4-4). Both options cross regions that support various vulnerable and critically endangered plant species, such as the *Khadia beswickii* (a small succulent plant listed as a vulnerable species) and the Albertina Sisulu Orchid (critically	The deep tunnel method in Option 1 minimises surface-level disruption to sensitive plant habitats. The underground route ensures that areas with high sensitivity, such as those supporting critically endangered, vulnerable, and endangered ecosystems, and classified as conservation areas, are not disturbed. In Option

<table>
<tr><th>Environmental Theme</th><th>Screening Tool Findings</th><th>Adjusted Sensitivity Considering Vertical Placement and Ground Truthing</th></tr>
<tr><td></td><td>endangered). The length of routes in medium plant sensitivity areas with the potential occurrence of vulnerable species is 9.59km and 10.5km for Option 1 and Option 2, respectively.
There is no difference between the two options in terms of their impact on plant species, as both routes traverse similar types of vegetation and sensitive areas. These areas include grasslands and bushveld vegetation types, which are home to several sensitive plant species. The presence of these species necessitates careful consideration and mitigation measures to protect them during the construction and operation of the railway line. In the case of the presence of vulnerable or threatened species, Search and Rescue Permits and associated plans may also be required prior to the commencement of construction.</td><td>2, the above-ground sections (namely an expanse of open green spaces that may be impacted in the Vogelstruisfontein area) pose a higher risk of habitat disruption and vegetation clearance – particularly vulnerable and critically endangered plant species that may be present. The above-ground section could result in habitat disruption and vegetation clearance, which are concerns that need to be addressed through careful planning and mitigation measures.
Therefore, the sensitivity rating for plant species is low for Option 1 and medium for Option 2.</td></tr>
<tr><td>Terrestrial Biodiversity</td><td>Both options have a very high sensitivity due to the routes crossing CBAs and important conservation areas (Figure 4-4). Both options traverse regions that are essential for maintaining terrestrial biodiversity, providing habitats for a wide range of species and supporting crucial ecological processes. Option 1only crosses approximately 0.76 km shorter distance of conservation area (totalling 6.02 km) compared to Options 2 (6.78 km) (Table 4-4).
Table 4-4: Length (in km) crossing each conservation area
<table>
<tr><th>Sensitivity Features</th><th>Option 1</th><th>Option 2</th></tr>
<tr><td>CBA 1</td><td>1.95</td><td>3.01</td></tr>
<tr><td>CBA 2</td><td>0.13</td><td>0.12</td></tr>
<tr><td>ESA 1</td><td>1.53</td><td>1.5</td></tr>
<tr><td>ESA 2</td><td>0.59</td><td>0.54</td></tr>
<tr><td>NPAES</td><td>1.82</td><td>1.61</td></tr>
<tr><td>Total</td><td>6.02 km</td><td>6.78 km</td></tr>
</table>
In addition to the various conservation areas, these routes also occur within the critically endangered Egoli Granite Grassland Ecosystem, vulnerable Soweto Highveld Grassland Ecosystem, and endangered Tsakane Clay Grassland Ecosystem (Appendix E). The presence of these conservation areas and sensitive ecosystems necessitates careful consideration and mitigation measures to protect them during the construction and operation of the railway line.</td><td>Option 1's deep tunnel alignment avoids direct impacts on critical biodiversity and conservation areas. The underground route ensures that areas with very high sensitivity, such as those supporting critically endangered, vulnerable, and endangered ecosystems, and classified as conservation areas, are not disturbed, preserving the terrestrial biodiversity of these areas. In Option 2, the above-ground sections increase the potential for habitat fragmentation and loss of biodiversity, particularly in areas classified as conservation areas. The above-ground section could result in habitat fragmentation, loss of biodiversity, and disruption of ecological processes, leading to a medium to high sensitivity rating for terrestrial biodiversity (particularly in this area).
As a result, the sensitivity rating for terrestrial biodiversity is low for Option 1 and medium for Option 2.</td></tr>
</table>

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
Social [13]	There are various low to high sensitivities for social impacts for both options. This is due to the potential visual intrusion in the relatively greenfield areas near Little Falls, particularly close to the Little Falls Pleasure Resort. The routes' proximity to residential areas and public amenities raises concerns about noise, air quality, and disruption during construction and operation. Additionally, the need for land acquisition and the potential displacement of residents and businesses further contribute to the high sensitivity rating. Both options follow the same route, thus the initial social impacts identified are the same.	The deep tunnel method in Option 1 significantly reduces surface-level disruptions, lowering the overall social impact. However, visual intrusion remains a concern due to necessary surface infrastructure such as ventilation shafts, emergency exits, and access points, as well as temporary construction impacts. In Option 2, the mixed track types and above-ground sections increase the potential for social disruption, including higher noise levels, impact on air quality, and greater visual impact in residential areas. The need for land acquisition is more pronounced in Option 2, as portions of the route that are built at-grade or cut-and-cover will require purchasing properties and potentially displacing residents and businesses. This could lead to community resistance and increased social tension. Consequently, the sensitivity rating for social impacts is medium for both options, with Option 1 being more favourable due to fewer surface-level interactions.

[13] The Screening Tool does not make provision for 'social' impacts. In this theme, consideration was made for potential adverse impacts to surrounding communities such as displacement (i.e., land acquisition, purchasing and/or expropriation, as a last resort), or from an environmental perspective (i.e., air, noise, vibration, visual, sense of place etc.). These aspects were rated subjectively and are subject to detailed assessment during future Project impact assessment phases

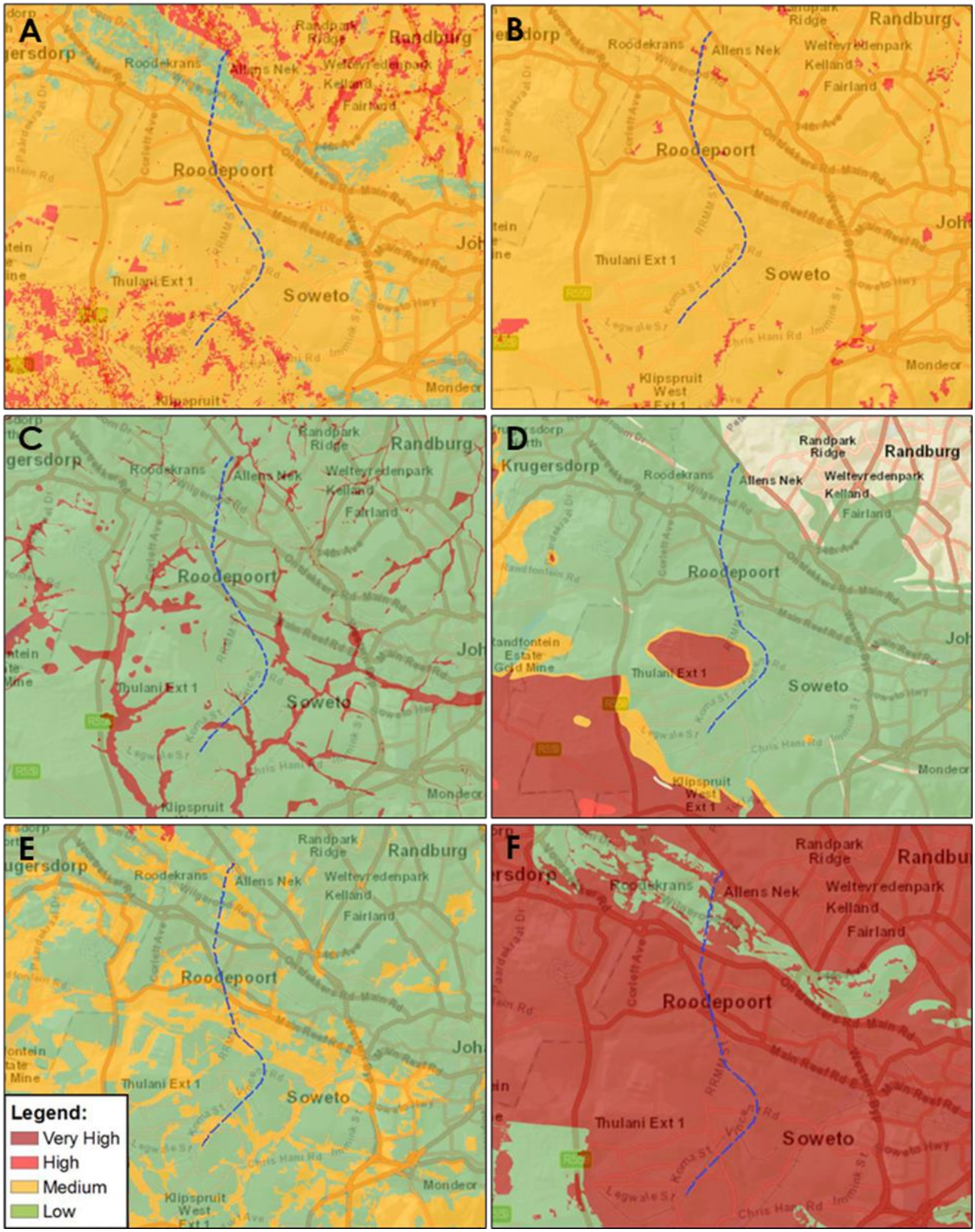


Figure 4-4: Screening Tool findings for Agriculture (A), Animal Species (B), Aquatic Biodiversity (C), Palaeontological (D), Plant Species (E) and Terrestrial Biodiversity (F) for both options [14]

[14] Option 1 and Option 2 follow the same alignment and therefore the Screening Tool figures are representative of the sesntivity of the corridor and precisely for both routes.

4.1.2 Option 0 and Optimal Option 1 Comparison

The Option 0 route spans approximately 18 km and is divided into two main sections: Jabulani to Roodepoort and Roodepoort to Little Falls (July 2016)[15].

The section from Roodepoort to Little Falls is in a tunnel. The tunnel segment spans approximately 7 km, providing a continuous underground route that minimizes ground-level infrastructure disruptions and environmental impacts. The proposed Roodepoort station building including the track and access platforms, will be located on an elevated bridge structure.

The section from Roodepoort to Jabulani comprises of both at-grade and elevated bridge / viaduct route sections. These at-grade sections of the route between Jabulani and Roodepoort would become permanent barriers separating the communities in these areas, once built.

Part of the route also crosses the previous underground mined areas near Roodepoort, presenting potential risks for the route in this region. To address this risk additional supporting infrastructure like long bridges may be required to navigate the terrain and minimize ground-level disruptions.

A significant portion of this route (approximately 3.3 km) runs above the dolomite area identified as part of this study. Construction on dolomite can be extremely complex and expensive and poses a major risk to the stability of the track infrastructure. A dolomitic stability assessment would need to be conducted to assess the depth and extent of the dolomite zone. In addition, a small portion of the route (approximately 1.2km) would need to be constructed in a cut-and-cover structure (shallow tunnel) beneath the existing Mphepheto Street. Construction of this section would be very complex requiring temporary road closures and deviations. This would be very disruptive to the mobility of the surrounding community.

The environmental data and route alignment information for Option 0 (Feasibility Study, 2016) did not enable quantitative assessment and comparison. Nonetheless, considering the screening findings of this Project, the Optimal Option 1 is demonstrably superior to Option 0 due to significantly lower environmental sensitivity. Optimal Option 1 minimises surface-level disruptions, ensuring a more sustainable and feasible route, aligning with environmental sustainability goals and mitigating potential risks associated with surface-level construction and operation impacts. Unlike Option 0, which required several adjustments to navigate surface impacts, Optimal Option 1 was designed to avoid such challenges from the outset.

4.1.3 Refined Optimal Route Alignment

Compared to the Optimal Option 1 (Figure 4-5), several sections of the route were refined, namely:

- **Little Falls and Roodepoort:** since this route is in a tunnel, refinement was done to straighten out the route to reduce route length and improve alignment. This refinement has resulted in the route shifting slightly to the east. The maximum shift of the route in this section is approximately 0 to 450m

[15] Source: Feasibility Study for the possible Gauteng Rapid Rail Extensions - Volume II: Section 4a: Part 4a: Technical Due Diligence: Annexure DD-3: Conceptual Vertical and Horizontal Alignment Drawings (July 2016).

- **Roodepoort to Meadowlands East:** due to the refinements of the route between Little Falls and Roodepoort, this section of the route also required refinement to achieve compliance with the design criteria. This refinement has resulted in the route shifting slightly to the south-west. The maximum shift of the route in this section is approximately 0 to 500 m
- **Meadowlands East to Jabulani:** the refinements in this section were due to the need to align with the location of the optimal Jabulani station position and, to allow for the route to be extended to other areas in future, the route direction at the terminal station was changed to face southwards. This refinement has resulted in the route shifting slightly to the west. The maximum shift of the route in this section is approximately 0 to 900m
- **At Jabulani Station:** refinement in this section was to extend the end of the route approximately 350m further, to allow for potential staging of trains overnight.

The final length of the Refined Optimal Little Falls to Jabulani route is 19.9 km, comprising a complete tunnel route.

From an environmental sensitivity perspective, regardless of how the Refined Optimal deviates in alignment or placement from Optimal Option 1, it remains entirely deep tunnel, resulting in minimal surface-level disruptions. The two are therefore essentially the same from an environmental perspective (Figure 4-5).

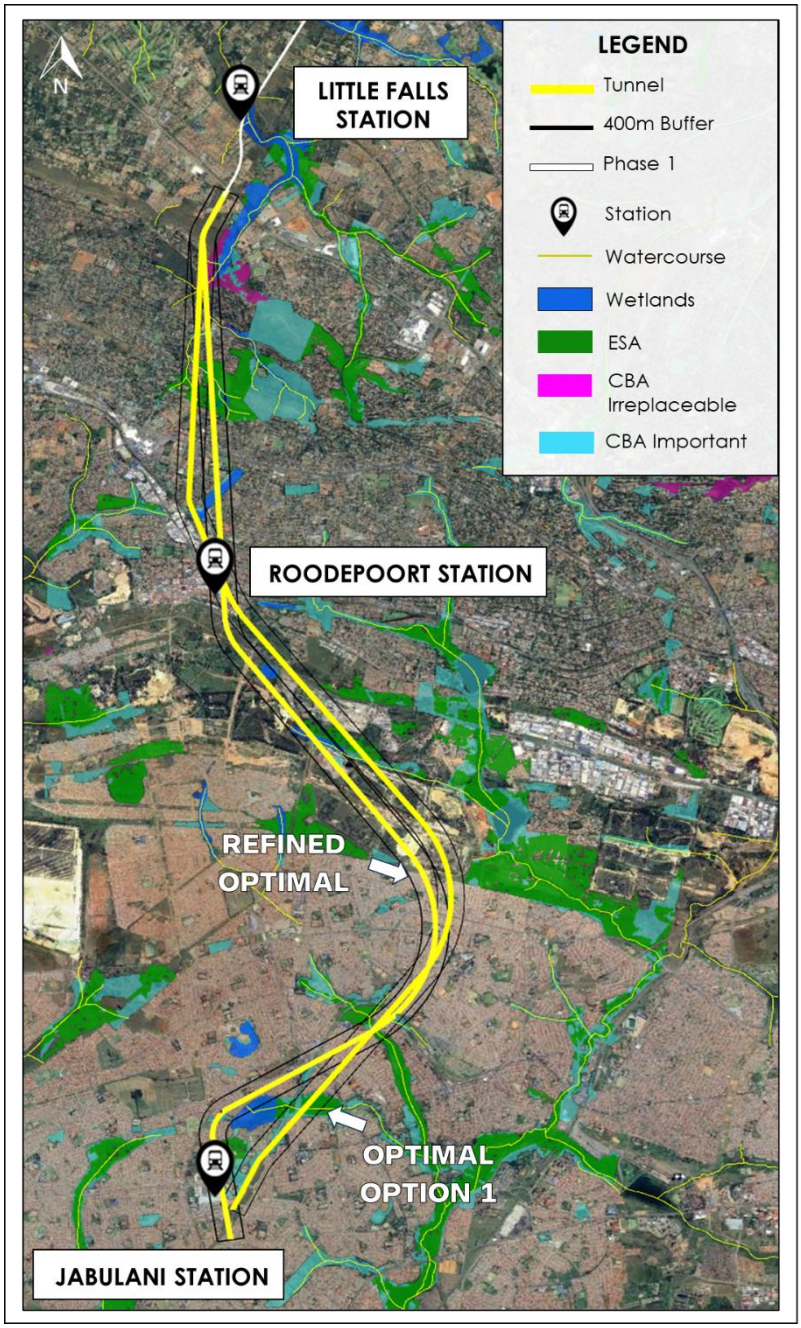
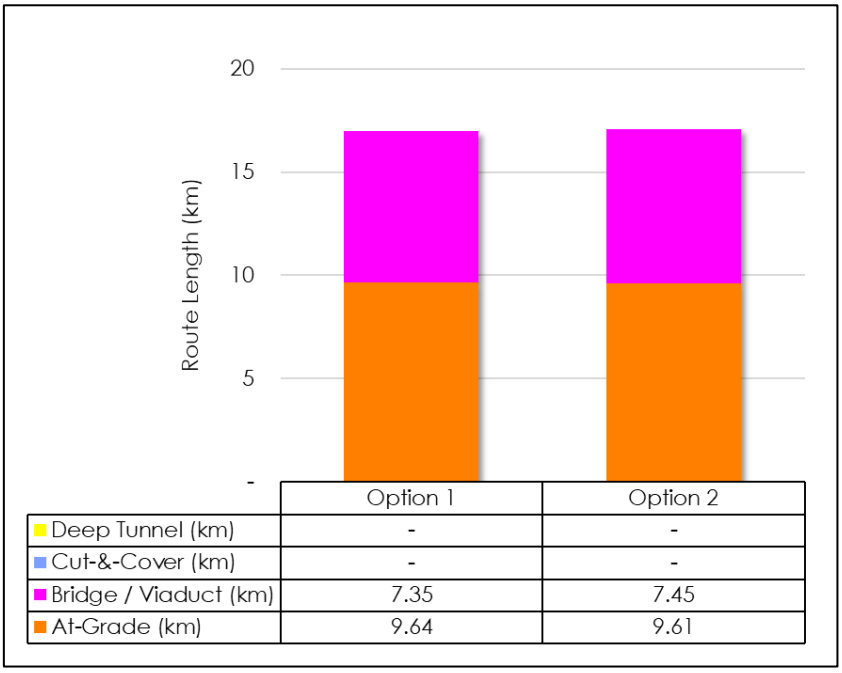


Figure 4-5: Refined Optimal compared to Optimal Option 1

4.2 Cosmo City to Lanseria Corridor

The start point of the route alignment for this corridor is the end of Cosmo City Station Platform as proposed for the GRRIN Phase 1 route alignment. The route is approximately 15.6 km in length and traverses in a northerly direction through to the proposed Cradle Station before proceeding to the Lanseria Station.

Two route options were developed. The Lanseria Airports Company advised that a route running beneath the airport runway will not be permitted, and this was a key factor in the development of options. The route overviews are provided below (Figure 4-6).



	Option 1	Option 2
Deep Tunnel (km)	-	-
Cut-&-Cover (km)	-	-
Bridge / Viaduct (km)	7.35	7.45
At-Grade (km)	9.64	9.61

Figure 4-6: Varying Vertical Alignment Distances for each Cosmo City to Lanseria Option

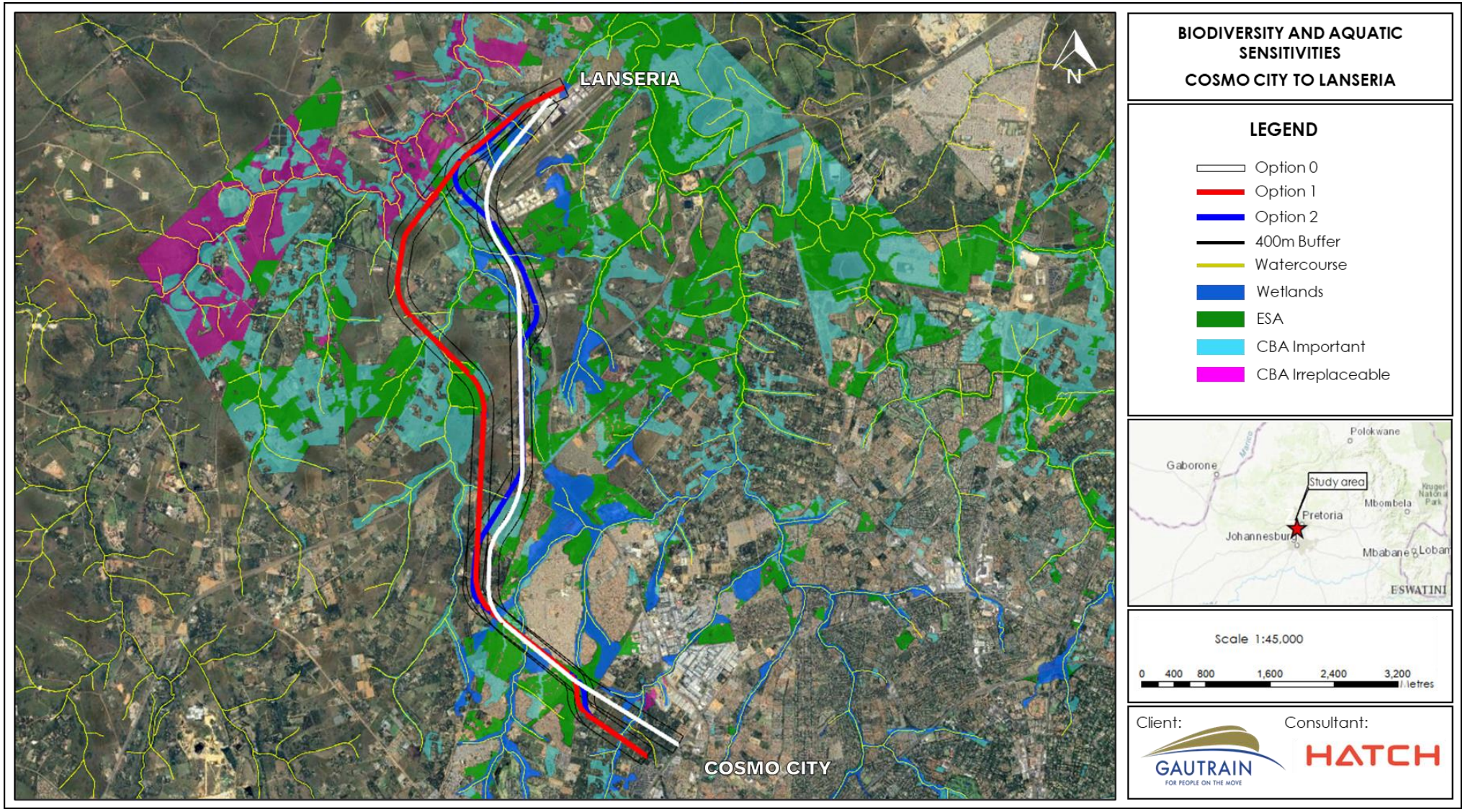


Figure 4-7: Cosmo City to Lanseria Route Alignment Options including Biodiversity and Aquatic Sensitivities

The routes can be described as:

- **Option 1**: The route alignment is 16.98 km in length and consists of a combination of two track types: 57% at-grade and 43% bridge / viaduct. This option does not include any cut-and-cover or deep tunnel track types (Figure 4-8). The route starts at the end of the proposed Cosmo City Station Platform, from the GRRIN Phase 1 route alignment, and traverses in a north-western direction, crossing South Africa Drive through Cosmo City. It then changes direction before Marina Street, proceeding parallel to Marina Street in a northern direction, on the east side of the road but west of the proposed Cradle Depot location. The route continues across the R114 road and the N14 Highway, changing to a north-western direction before aligning north over the R552 (Elandsdrift Road). After crossing the R552, the route heads north-east towards Lanseria International Airport, crossing over the R512 parallel to Ashenti Road. The route terminates at-grade on the north-western side of the existing Lanseria International Airport parking area
- **Option 2:** The route alignment is 17.05km in length and consists of a combination of two track types (56% At-grade, 44% Bridge / Viaduct). This option also does not contain any cut-and-cover or deep tunnel track types (Figure 4-8). It has a marginally longer distance at bridges / viaducts, and slightly shorter at-grade. Similar to Option 1, this route starts at the end of the proposed Cosmo City Station Platform, linked to the GRRIN Phase 1 route alignment, and heads north-west, crossing South Africa Drive through Cosmo City. It also changes direction before Marina Street, but then moves north along the west section of the proposed Cradle Depot location. The alignment crosses the R114 road, the N14 Highway, and the R552 (Elandsdrift Road), similar to Option 1. However, it then follows the R512 (Pelindaba Road / Malibongwe Drive) on the western side. After crossing the R512, the route continues north-east, running parallel to Ashenti Road towards Lanseria International Airport. It concludes at-grade on the north-western side of the existing Lanseria International Airport parking area.

From a landcover and landscape perspective, the area is characterised by predominantly grassland and urban residential, small holding and township coverage (Appendix D: Figure A - 1). However, the various route options traverse through areas of cultivated – commercial and plantation use. From a vegetation perspective, all route options only cross through the Egoli Granite Grassland vegetation type (Appendix E: Figure A - 4). Across both options, the starting point in the Northriding area is more greenfield with interspersed residences. Conversely, significant rural / urban residential development is evident in the Cosmo City area. For all route options north of Cosmo City is characterised by open green spaces (grassland and agricultural lands), interspersed with commercial and residential use.

The findings of the Screening Tool, sensitivity features, and comparisons from an environmental perspective are summarised in the subsections below.

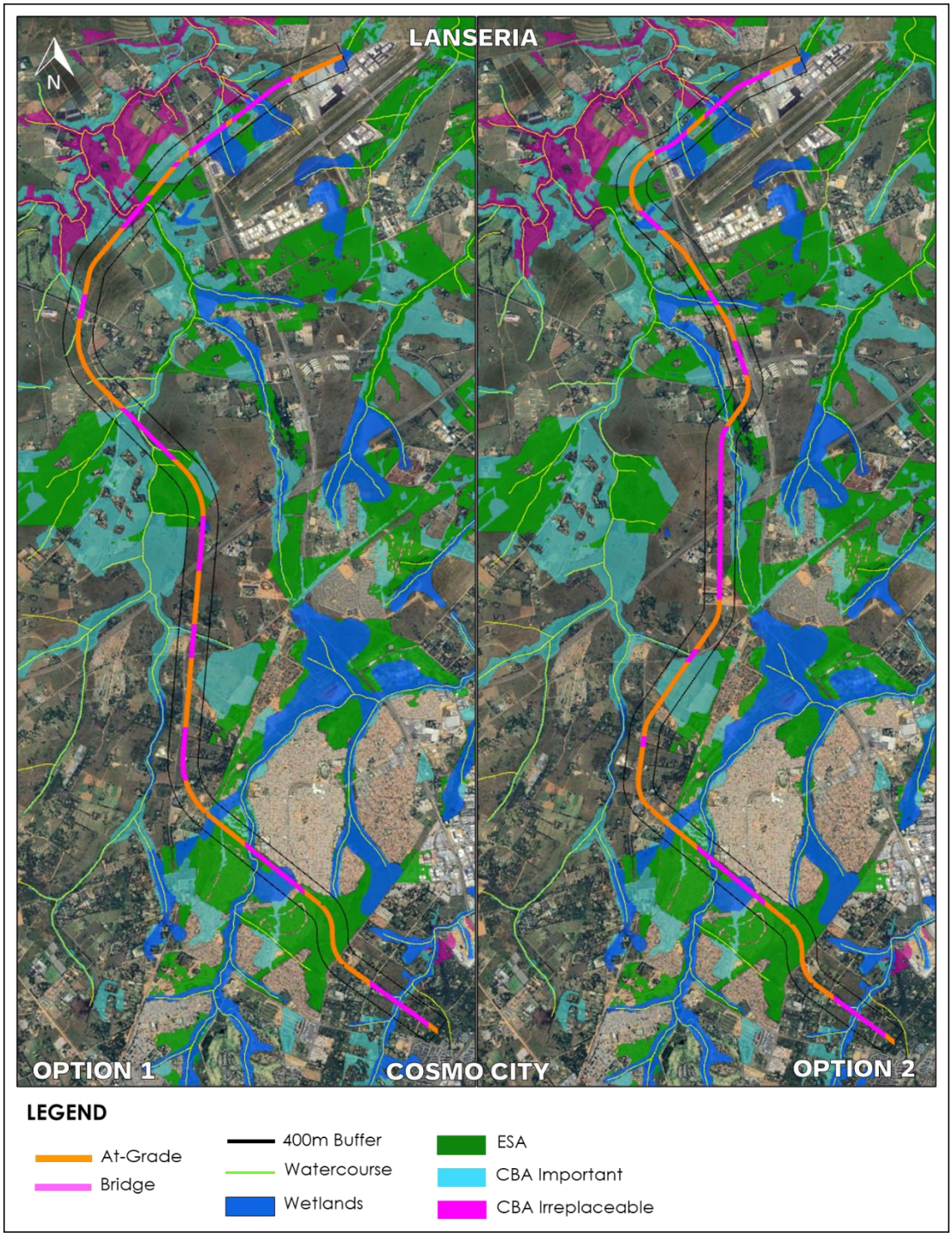


Figure 4-8: Visual Representation of the Vertical Profiles of Option 1 and Option 2 including Biodiversity and Aquatic Sensitivities

4.2.1 Screening Findings

The Cosmo City to Lanseria Corridor exhibits a range of environmental sensitivities across various themes. The Screening Tool identified very high sensitivity areas for agriculture, aquatic biodiversity, and civil aviation due to the presence of critical habitats, watercourses, and proximity to Lanseria International Airport. Additionally, the corridor crosses regions with high sensitivity for animal species and archaeological and cultural heritage, reflecting the potential presence of vulnerable species and heritage sites.

The corridor also shows medium sensitivity for plant species and defence, indicating the presence of sensitive flora and proximity to military sites. Overall, the environmental sensitivities within the Cosmo City to Lanseria Corridor necessitate careful planning and mitigation measures to minimise impacts, particularly in areas of high ecological and cultural importance.

Table 4-5 provides an in-depth comparison of the screening findings for Option 1 and Option 2. The desktop DFFE Screening Tool findings are initially presented, which evaluate the environmental sensitivities associated with each option across the various themes. These preliminary findings are then adjusted based on ground truthing and the impacts of vertical placement along the routes. By refining the initial sensitivity ratings, Table 4-5 offers a more accurate reflection of the actual environmental sensitivities, enabling a clearer understanding of the potential impacts.

The Screening Tool identified varying sensitivity levels across environmental themes. Areas with high sensitivity may require detailed specialist assessments or permits (see Appendix C). In some cases, a 'Specialist Compliance Statement' may suffice. To enhance accuracy, ground truthing and vertical placement considerations were incorporated. Ground truthing validated the Screening Tool results against current land use, while vertical placement analysis assessed the construction depth. This dual approach refined the sensitivity ratings, providing a more precise assessment of environmental impacts and helping to identify the most sustainable route alignment.

- Option 1 shows higher sensitivity ratings across most environmental themes due to its route alignment. This option crosses more sensitive features, such as small holdings and areas of annual crops / cultivation and includes a portion of land with pivot irrigation. The combination of at-grade and bridge sections does not significantly alter the sensitivity rating because of the associated impacts. However, the bridge sections may slightly reduce the impact on agricultural land by allowing for some continued use of the land underneath (if and where applicable). Additionally, Option 1 crosses a longer distance of high sensitivity areas for animal species and aquatic biodiversity, which increases its potential of overall environmental impact. The proximity to heritage sites also contributes to its higher sensitivity rating. Overall, Option 1 is less favourable from an environmental perspective
- Option 2, while similar in many respects, crosses fewer sensitive features compared to Option 1. This option has a shorter distance crossing high sensitivity areas for animal species and aquatic biodiversity. The use of bridges in some sections of both options may reduce the impact on sensitive habitats by allowing for the preservation of natural habitats underneath. However, the at-grade sections will still require significant vegetation clearance, which can disturb habitats. Option 2 generally exhibits lower sensitivity ratings compared to Option 1, making it a more favourable option in terms of minimising environmental impacts making it a more sustainable choice. Additionally, Option 2 avoids proximity to heritage sites, which further reduces its sensitivity rating.

In summary, both routes consist of a similar combination of at-grade and bridge / viaduct sections, limiting the difference in terms of vertical placement. The key differences lie in the alignment and the sensitivities they traverse. Option 2, with its shorter distance crossing high sensitivity areas and fewer sensitive features, generally exhibits lower sensitivity ratings across most themes. This makes it the superior choice for minimising environmental

disruption and preserving natural resources. The reduced need for land acquisition and other social impacts further enhances this.

However, it is important to note that Option 1emerged as the overall optimal option from the MCA. This indicates that while Option 1 may have marginally higher environmental sensitivities, it likely performed better across other criteria considered in the MCA, leading to its selection as the optimal route. While this option presents higher sensitivity, the impacts can be adequately managed and mitigated with careful planning and the implementation of effective management plans and mitigation measures.

Based on the MCA Option 1 is the optimal route alignment for the Cosmo City to Lanseria Corridor and is more environmentally sensitive.

Table 4-5: Screening Tool and Adjusted Sesntivity Findings Considering Vertical Placement Impacts of Option 1 and Option 2 for the Cosmo City to Lanseria Corridor

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
Agriculture	A very high sensitivity was noted in the Screening Tool for Option 1, while Option 2 was rated as high (Figure 4-9). A significant portion of both options (>60% of the lengths) cross Urban Development Zone 1 and Zone 5. Similar to the Little Falls to Jabulani Corridor, this suggests that the development in these areas is appropriately located to avoid compromising agricultural resources. However, the loss of capable land for agricultural purposes remains a risk in portions of the corridor outside these zones. While Gauteng has become highly developed in general, urban expansion decreases towards Lanseria from approximately midway along the route, with substantially more small holdings and greenfield areas compared to the more developed starting point of the routes in Cosmo City. The likelihood of encountering soil with high potential and use for agricultural purposes increases towards the Lanseria area. Based on the findings, Option 1 may be less preferred in this theme as it consists of more sensitivity features not traversed by Option 2, namely small holdings and annual crops / cultivation areas. Option 1 also crosses over a portion of land undertaking pivot irrigation (west of Botesdal Farm, Lanseria), which was not triggered for Option 2 as a sensitivity; this feature was the source of the very high rating in the Screening Tool for Option 1	The adjusted sensitivity for agriculture remains very high for Option 1 and high for Option 2 due to their crossing sensitive features, including small holdings and annual crops/cultivation areas (and a portion of land undertaking pivot irrigation west of Botesdal Farm, Lanseria in Option 1). The combination of at-grade and bridge sections does not significantly alter the sensitivity rating because of the associated impacts. However, the bridge sections may slightly reduce the impact on agricultural land by allowing for some continued use of the land underneath. Regardless of land use and development, given the high sesntivity findings, this aspect may need to be assessed by the requisite Agricultural Impact Assessment specialist because of potential ground-level impacts.
Animal Species	Both options were rated with high sensitivity. The route cross medium and high sensitivity areas, with high sensitivity concentrated north of the N14 between Nietgedacht and Lanseria International Airport (Figure 4-9). Option 1 crosses 4.25 km of high sensitivity areas, while Option 2 crosses a considerably longer 6.39 km. Both options are associated with the potential presence of species such as the African Grass Owl and the White-Bellied Bustard (*Eupodotis senegalensis*). Given the geographic differences, the high sensitivity species are variably located along the routes, primarily in undeveloped greenspaces (Figure 4-7). Option 1 is slightly less sensitive than Option 2 in this theme.	The use of bridges in some sections of both options may reduce the impact on animal species by allowing for the preservation of natural habitats underneath. While the bridge / viaduct sections might slightly reduce impacts, as impacts will be evident at the footprint of the pillars, there are still construction-related impacts to consider. This vertical placement helps mitigate the disturbance to wildlife corridors and habitats compared to at-grade, thereby slightly lowering the overall sensitivity. However, the at-grade sections will still require significant vegetation clearance, which can disturb animal habitats. Option 1 is slightly less sensitive than Option 2 due to its shorter distance crossing high sensitivity areas. The high sensitivity rating remains and should be further evaluated by relevant specialists (it may reduce to medium-high in bridge / viaduct sections).
Archaeological & Cultural Heritage	Option 1 was rated with high sensitivity, while Option 2 was rated low. The alignments for Option 1 are located within 100m of a Grade IIIb Heritage site, whereas Option 2 does not have this proximity (Figure 4-9). Given the proposed	Option 1 remains high due to its proximity to heritage sites. The vertical placement, which includes at-grade and bridge sections, does not significantly alter the sensitivity rating. However, careful

<table>
<tr><th>Environmental Theme</th><th>Screening Tool Findings</th><th>Adjusted Sensitivity Considering Vertical Placement and Ground Truthing</th></tr>
<tr><td></td><td>development exceeds 300 m in length, similarly to the Little Falls to Jabulani Corridor, it is likely that a HIA and Chance Find Procedure will be required. Option 1 is more sensitive in this theme due to its proximity to heritage sites.</td><td>planning and mitigation measures during construction can help minimise the impact on these sensitive areas. The use of bridges may provide some protection to heritage sites by reducing ground-level disturbances.</td></tr>
<tr><td>Aquatic Biodiversity</td><td>A very high sensitivity was noted for both options, with some differentiation. The route alignments traverse low and very high sensitivity areas (Figure 4-9), with the very high sensitivity due to crossing and proximity to watercourses and aquatic sensitivity feature which are critical for maintaining aquatic biodiversity. Option 1 crosses 2.74 km of aquatic features, while Option 2 crosses 1.72 km, making Option 1 less favourable in this theme. None of the route options cross any major rivers, but Option 1 does cross over a small tributary to the Crocodile River, west of Lanseria International Airport (not crossed by Option 2).
Table 4-6: Length (in km) of each route traversing aquatic sensitivity features
<table>
<tr><th>Sensitivity Features</th><th>Option 1</th><th>Option 2</th></tr>
<tr><td>A tributary of the Crocodile River and surrounding wetland area</td><td>0.2</td><td>-</td></tr>
<tr><td>Central Bushveld Bioregion (Valley-bottom)</td><td>0.23</td><td>0.23</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Seep)</td><td>1.18</td><td>0.99</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Valley-bottom)</td><td>1.13</td><td>0.5</td></tr>
<tr><td>Total</td><td>2.74 km</td><td>1.72 km</td></tr>
</table></td><td>The use of bridges in some sections of both options may reduce the impact on aquatic biodiversity by minimising direct disturbance to watercourses. While the bridge/viaduct sections might slightly reduce impacts, as impacts will be evident at the footprint of the pillars, there are still construction-related impacts to consider. This vertical placement helps protect the integrity of aquatic ecosystems and reduces the potential for habitat fragmentation compared to at-grade sections.
However, the at-grade sections will still pose a risk to aquatic habitats if present. It is understood the design took into consideration aquatic features, and the at-grade sections do not cross clearly visible aquatic features, but this will be subject to confirmation by detailed specialist assessments in future phase EIAs, necessitating careful planning and mitigation measures. Option 1 remains more sensitive than Option 2 due to its longer distance crossing sensitive aquatic features. Nonetheless, the very high sensitivity rating remains and should be further evaluated by relevant specialists (it may reduce to medium-high in bridge / viaduct sections).</td></tr>
<tr><td>Civil Aviation</td><td>Both options were rated with very high sensitivity due to their proximity to Lanseria International Airport. Approximately 60% of the lengths of both options are within 8 km of the airport, with the remaining portions within high and medium sensitivity ratings due to proximity to other civil aviation features. There is no distinction between the options in this theme.</td><td>Both options remain very high due to their proximity to Lanseria International Airport. The vertical placement of the routes, whether at-grade or bridge, does not significantly alter the sensitivity rating in this theme.</td></tr>
<tr><td>Defence</td><td>Both options were rated with medium sensitivity due to their proximity to a Military and Defence site, likely triggered by the adjacent Lanseria International Airport. There is no distinction between the options in this theme.</td><td>Both options remain medium due to their proximity to a Military and Defence site. The vertical placement of the routes does not significantly alter the sensitivity rating in this theme.</td></tr>
<tr><td>Palaeontology</td><td>For the Palaeontology theme, both Option 1 and Option 2 were rated with low sensitivity in the Screening Tool. There were no specific sensitive features identified for this theme across either route option. Consequently, there is no difference between options.</td><td>The adjusted sensitivity for palaeontology remains low for both options as there were no specific sensitive features identified for this theme. The vertical placement of the routes does not significantly alter the sensitivity rating in this theme.</td></tr>
</table>

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
Plant Species	Both options have a medium sensitivity rating because the routes cross regions that support various vulnerable and critically endangered plant species, such as Sensitive species No. 1248 and Melolobium subspicatum (Figure 4-9). Both options start in an area adjacent to a high sensitivity location in North Riding. Option 1 crosses a length of 11.32 km in medium plant sensitivity areas with the potential occurrence of vulnerable species, compared to marginally higher 11.61 km for Option 2. These areas include grasslands and bushveld vegetation types, which can support sensitive plant species, necessitating careful consideration and mitigation measures to protect them during the construction and operation of the railway line. There is no significant difference between options. If vulnerable or threatened species are present, a search and rescue operation may be necessary before starting any construction, provided the required permits are obtained.	The use of bridges in some sections of both options may reduce the impact on plant species by allowing for the preservation of natural vegetation underneath. While the bridge / viaduct sections might slightly reduce impacts, as impacts will be evident at the footprint of the pillars, there are still construction-related impacts to consider. This vertical placement helps protect sensitive plant species and their habitats compared to at-grade sections, thereby slightly lowering the overall sensitivity. However, the at-grade sections will still require significant vegetation clearance, which can disturb plant habitats. Both options have similar lengths crossing medium sensitivity areas, with Option 1 being marginally less sensitive than Option 2. The medium sensitivity rating remains and is still subject to detailed specialist site assessments to confirm.
Terrestrial Biodiversity	A very high sensitivity was noted for both options due to them crossing through various conservation areas. The vegetation type crossed by the full lengths of both options is the Critically Endangered Egoli Granite Grassland Ecosystem. These regions are essential for maintaining terrestrial biodiversity, providing habitats for a wide range of species and supporting crucial ecological processes. Option 1 crosses a total of 7.24 km of conservation areas, while Option 2 is only marginally shorter as 7.17 km. Based on the Screening Tool, it is evident that both routes cross conservation areas that may be areas of biodiversity concern, with Option 1 being slightly more sensitive.	The use of bridges in some sections of both options may reduce the impact on terrestrial biodiversity by minimising direct disturbance to conservation areas. While the bridge/viaduct sections might slightly reduce impacts, as impacts will be evident at the footprint of the pillars, there are still construction-related impacts to consider. This vertical placement helps protect critical biodiversity areas and supports ecological processes compared to at-grade sections, thereby slightly lowering the overall sensitivity. However, the at-grade sections will still pose a risk to terrestrial habitats, necessitating careful planning and mitigation measures. The very high sensitivity rating remains and is still subject to detailed specialist site assessments to confirm (it may reduce to medium-high in bridge / viaduct sections).
Social	In consideration of any adverse impacts to surrounding communities or sensitive social receptors, both have a high sensitivity, but Option 1 is more sensitive than Option 2. Visual impact and intrusion are apparent in both options due to the relatively greenfield nature of the greater area the corridors are proposed in. Both options traverse regions that are in close proximity to residential areas and public amenities, raising concerns about noise, air quality, and disruption during construction and operation. Option 1 may have a higher social impact because the railway is in close proximity to settlements around Mogale City and crosses more developed properties in the Nooitgedacht area, including a church (Nederduitche Hervormde Kerk – Noordrand), storage facilities, retail and renovation shopping,	Option 1 remains higher compared to Option 2. The vertical placement, which includes at-grade and bridge sections, does not significantly alter the sensitivity rating. However, the proximity of Option 1 to settlements around Mogale City and more developed properties in the Nooitgedacht area increases its social sensitivity. The use of bridges may help reduce some visual and physical intrusion, but extensive community engagement and mitigation measures will still be required. The at-grade sections will have a

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
	and La Vue Guest Lodge and Function Venue, among others. This makes it more likely to have a negative social impact, predominantly during construction. Further to this, in the same area, the railway will run alongside a graveyard site being (presumably) used by the neighbouring informal settlements. This close proximity may require extensive community engagement and possibly grave relocation. Both options were rated with medium sensitivity, with Option 1 having a slightly higher rating. Visual impact and intrusion are apparent in both options due to the greenfield nature of the area. Option 1 may have a higher social impact due to its proximity to settlements around Mogale City and a graveyard site, which may require extensive community engagement and possibly grave relocation. Both options cross multiple properties that will need to be purchased, with Option 1 traversing more developed properties in the Nooitgedacht area.	more pronounced impact on local communities, necessitating careful planning and mitigation measures. The use of bridges in some sections of both options may help reduce the physical intrusion on local communities by elevating the railway above ground level. However, bridges and viaducts can still have significant visual intrusion, especially in residential and sensitive areas. While the bridge / viaduct sections might slightly reduce impacts, there are still construction-related impacts to consider. This vertical placement helps mitigate the disturbance to residential areas and public amenities compared to at-grade sections, thereby slightly lowering the overall sensitivity. However, the at-grade sections will still have a more pronounced impact on local communities, necessitating careful planning and mitigation measures. Additionally, land acquisition for both at-grade and bridge sections can be significant, thereby maintaining a high sensitivity rating. Option 1 remains more sensitive than Option 2 due to its proximity to settlements around Mogale City and more developed properties in the Nooitgedacht area.

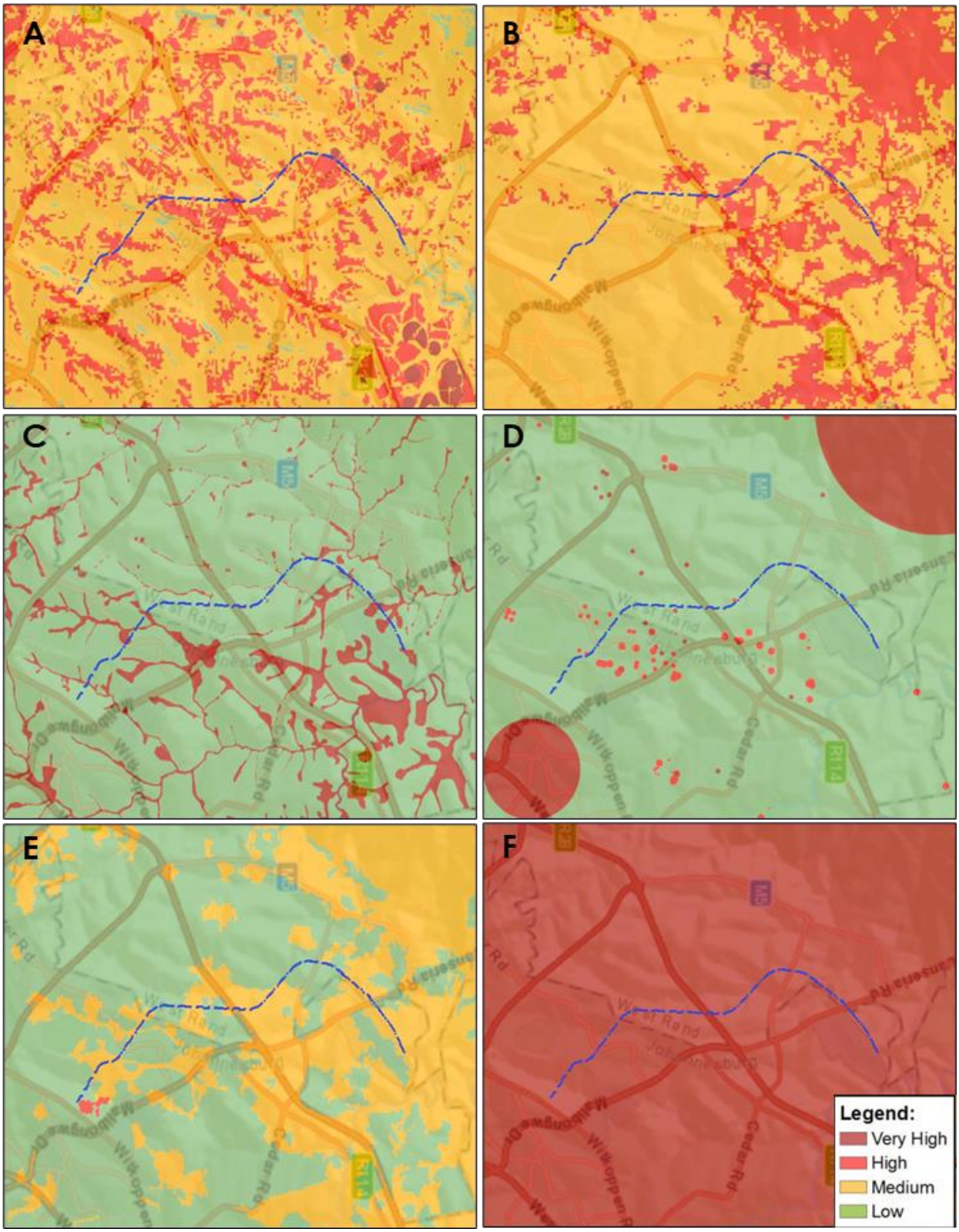


Figure 4-9: Screening Tool findings for Option 1 [16] for Agriculture (A), Animal Species (B), Aquatic Biodiversity (C), Archaeological And Cultural Heritage (D), Plant Species (E) and Terrestrial Biodiversity (F)

[16] Option 2 largely follows the same alignment at Option 1 with variation in sensitivities at the latter end towards Lanseria. Nonetheless, the Screening Tool figures are representative of the sesntivity of the corridor

4.2.2 Option 0 and Optimal Option 1 Comparison

The Option 0 route for the Cosmo City to Lanseria Corridor spans several sections, each with unique characteristics and challenges. The total length of Option 0 is approximately 16 km. This route primarily follows existing road reserves to minimise property expropriation and construction complexity (July 2016)[17].

The section from Cosmo City to the proposed Cradle station primarily comprises of at-grade sections of the route with a few bridges and a tunnel section. The route starts off at-grade at Cosmo City station and goes into an elevated bridge (approximately 800m long) over the Kevin Ridge suburb. In this section over Kevin Ridge, possible relocation of the existing residential houses will be required to enable construction of this section of the route.

After the bridge section, the route runs underground into a tunnel (approximately 1.2km long) through a currently vacant piece of land and continues below South Africa drive, before it exits the tunnel. The route continues onto another bridge (approximately 650m long) to cross the valley through Como City. This section is anticipated to run through a vacant piece of land, between two separate sections of the Cosmo City Suburb. Disruptions to the community can be expected during construction however a complete permanent separation of the community is not expected to be major since majority of the route through this Cosmo City suburb, will be either underground in a tunnel or on the elevated bridge section. This will still allow residents to move between the separated areas of the Como City Suburb.

The remaining section after the bridge runs at-grade through to the Proposed Cradle station. The proposed Cradle station, the railway route and the access platforms will also be at-grade. Through this are, a few existing commercial and residential property, can be expected to be relocated. Disruptions during construction is expected and a permanent barrier will be created through this area of at-grade railway route.

The next section of the route from Cradle station through to Lanseria station, is predominantly at-grade sections with a few bridges to get across major roads and valleys. The possible major roads affected by the route are listed in Table 5 6 below.

Although the areas through which this section of the route runs, are very sparsely populated, there are a still a few commercial and residential developments that will be permanently impacted by the route. Some of these possible affected suburbs and developments are listed in Table 5 6 below. Through this are, existing commercial and residential property, can be expected to be relocated. Disruptions during construction will be present and a permanent barrier will be created through this area of at-grade railway route. However, since this section of the route runs close to the existing R512 Pelindaba Road, the permanent separation of the community will not be as severe, since the R512 already is a barrier.

The railway route, access platforms and the proposed station at the Lanseria airport will be at-grade in the existing parking area of the airport. The parking area will require relocation to accommodate the proposed station and railway route.

[17] *Source:* Feasibility Study for the possible Gauteng Rapid Rail Extensions - Volume II: Section 4a: Part 4a: Technical Due Diligence: Annexure DD-3: Conceptual Vertical and Horizontal Alignment Drawings (July 2016).

The environmental data and route alignment information for Option 0 (Feasibility, 2016) did not enable quantitative assessment and comparison. Nonetheless, qualitatively, Option 0 would have been environmentally preferable due to its tunnel sections, which significantly reduce surface-level disruptions.

While Option 1 is not as environmentally friendly as Option 0, the decision to avoid tunnelling was influenced by practical constraints and stakeholder engagements, particularly with the Lanseria Airport Company, where it was indicated that a tunnel under the existing or planned runways would not be permitted.

4.2.3 Refined Optimal Route Alignment

Compared to the Optimal Option 1 (Figure 4-10, the following sections of the route were refined:

- **Cosmo City Station to "For Afrika" Offices:** the refinement in the section was to straighten out the route to centred it in the vacant land between the West and East parts of Cosmo City Suburb. This resulted in a very minor shifting of the route to the east. The maximum shift of the route in this section is approximately 0 to 40m
- **"For Afrika" Offices to North of N14:** refinements were made to align with the location of the optimal Cradle station position and to allow for the integration with the Cradle Maintenance Depot[18] (see below). This refinement has resulted in the route shifting significantly to the east side of the proposed Cradle Maintenance Depot. The maximum shift of the route in this section is approximately 0 to 900m
- **At Lanseria Station:** a refinement in this section was to extend the end of the route approximately 80m further, to allow for potential staging of trains overnight.

The final route length of the Refined Optimal Cosmo City to Lanseria route is a total of 17.4 km from start to end, comprising of 45% At-grade, 48% Bridge/Viaduct and 7% Cut-and-Cover.

For this corridor, an additional two connecting routes were added to the Refined Optimal alignment for the following reasons:

- To integrate and connect with the proposed Cradle Maintenance Depot (± 2.8 km x 0.2 km). The Cradle depot option[18] was considered the best from an environmental perspective as it had a lower overall environmental impact, most notably, it has minimal impact on aquatic biodiversity and aquatic features. Conversely on the social side, a resettlement plan may be required for a portion of a rural community the proposed layout crosses. The length of the depot access route is approximately 4.5 km long and is a complete at-grade route
- To future-proof the optimal route to align with the future development plans for the Lanseria Smart City and to align with the Gauteng Province's priorities to enable prospective extensions beyond Gauteng to link up with the High Speed Rail.

[18] The Cradle Maintenance Depot options underwent screening in an earlier Project engineering assessment. Proposed locations included Jackal Creek, Little Falls, Sunninghill and Cradle. Considering various criteria, namely proximity to core of the GRRIN extensions, construction costs (topographical challenges), land acquisition (availability of land and ability to accommodate an optimal depot layout within the 400-wide rail reserve boundary) and environmental and social impact, Cradle was selected as the preferred location. This depot assessment did not form part of the MCA process or detailed quantitative assessment. Findings are qualitatively defined.

The length of the Smart City access route is approximately 4.4 km long, comprising 13% At-grade, 3% Cut-and-Cover and 84% Deep Tunnel, terminating at the Smart City Station[19]. The access route and station location were deemed environmentally appropriate. Due to the proposed vertical placement, the access route will have minimal environmental impact, as the tunnel will bypass sensitive areas (Figure 4-10). Future station design and development must consider and appropriately mitigate potential environmental impacts, given the greenfield nature and associated sensitive areas (Figure 3-9).

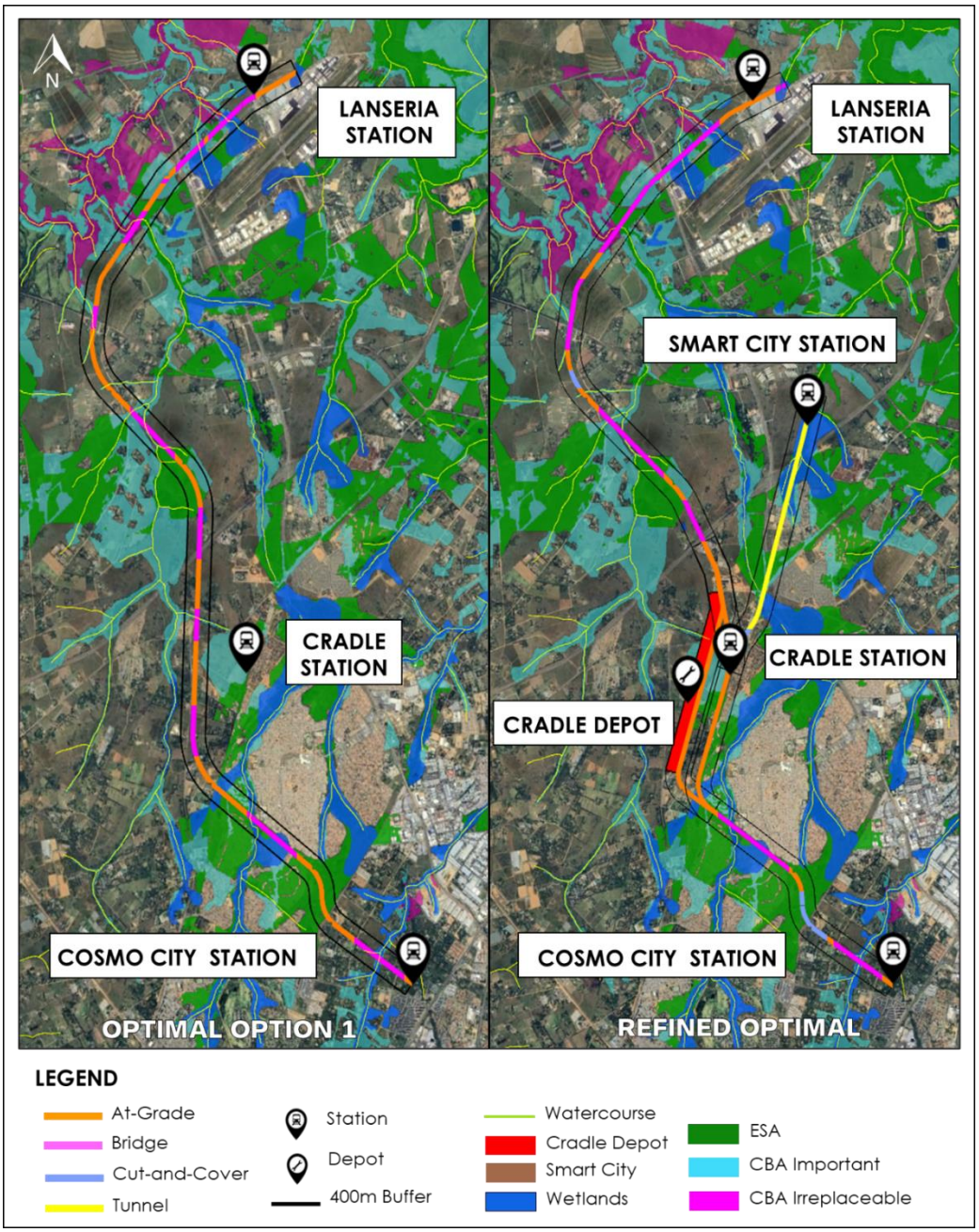


Figure 4-10: Refined Optimal compared to Optimal Option 1

[19] The Smart City access route and station options underwent environmental screening and did not form part of the MCA process or detailed quantitative assessment. The findings were qualitatively assessed to determine likely environmental and social impacts constituting red flags or go / no-go options. The presented options were preferred considering various criteria, including cost, engineering and design, and environmental and social impact.

Compared to the Optional Option 1, the Refined Optimal presents several differences affecting environmental sensitivities (Figure 4-10):

- From Cosmo City towards the Cradle Station, the length of at-grade rail has been reduced, with an increase in cut-and-cover and bridge sections, slightly reducing the environmental impact (Table 2-3)
- The fully at-grade portion near the Cradle Station and Depot location presents higher environmental and social impacts than previously anticipated for Optimal Option 1. This is mainly due to vegetation clearance for the at-grade development accessing the depot and along the Cradle Station, and the social impact of the at-grade development traversing one rural community and being close to another (including a graveyard site near the Cradle Station)
- For the remainder of the route towards Lanseria Airport, the alignment has remained the same, with some changes in the vertical placement. The length of at-grade rail has reduced and increased in cut-and-cover and bridge length, which once again present a slightly lower anticipated environmental impact in this portion of the route (Table 2-3).

The above refinements were necessary to optimise the alignment, specifically to integrate with the Depot and Smart City access routes. The earlier and latter lengths of the routes have slightly reduced impacts due to the proposed changes in vertical placement (a reduction of 12% length at-grade). Nonetheless, from an environmental sensitivity perspective, the Refined Optimal does present greater environmental and social impacts overall.

4.3 Cosmo City to Samrand Corridor

The start point of the route alignment for this corridor is the end of Cosmo City station platform as proposed for the GRRIN Phase 1 project. The route is approximately 31.6 km in length and traverses in a north-easterly direction through to the proposed Fourways, Sunninghill and Olievenhoutbosch stations before proceeding to the future Samrand Station on the existing GRRL (known as existing Gautrain) (Figure 4-11).

Figure 4-12 below illustrates the detailed lengths (in km), including the vertical alignment positions (A, B, C or D), for Optimal Option 1 and Option 2.

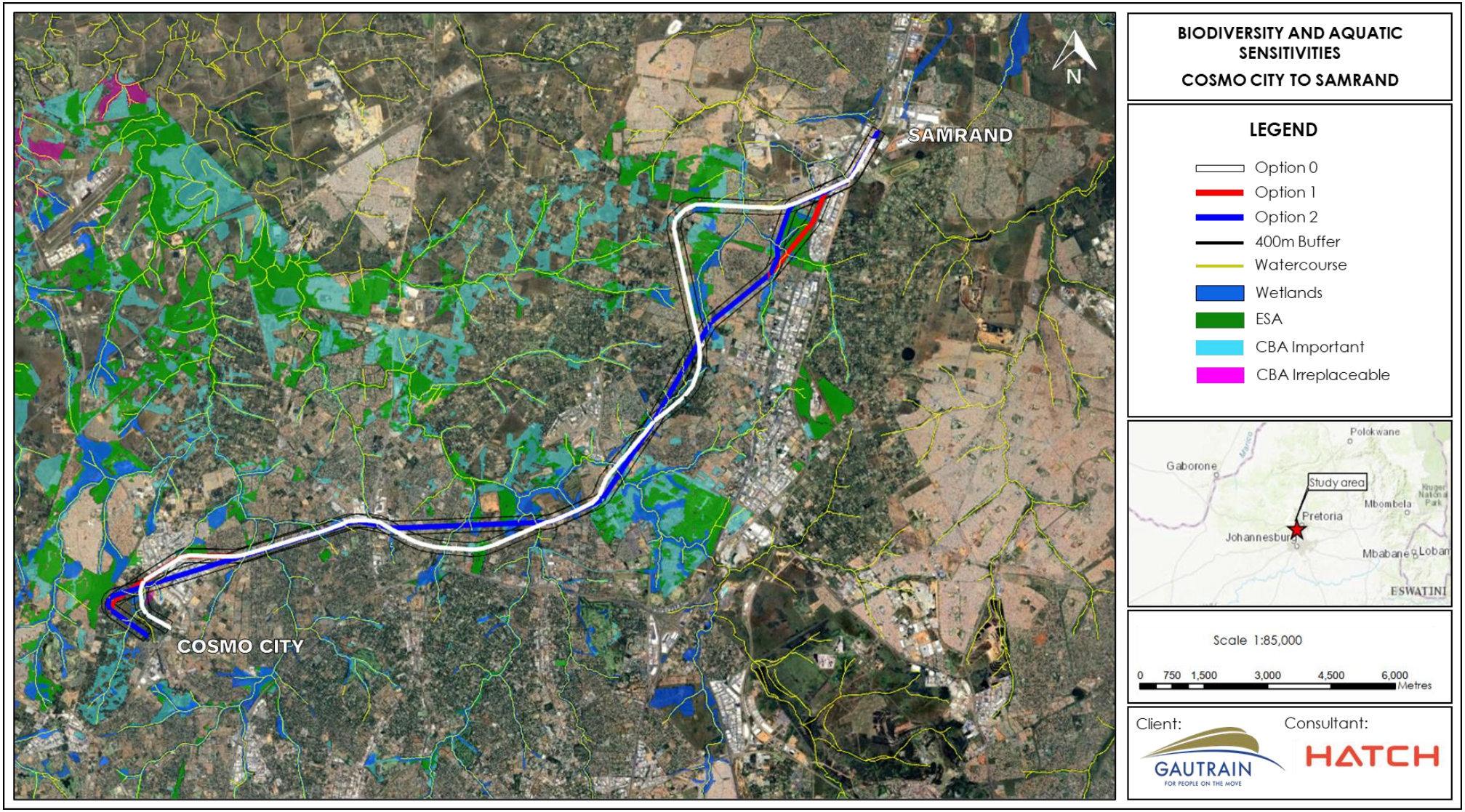
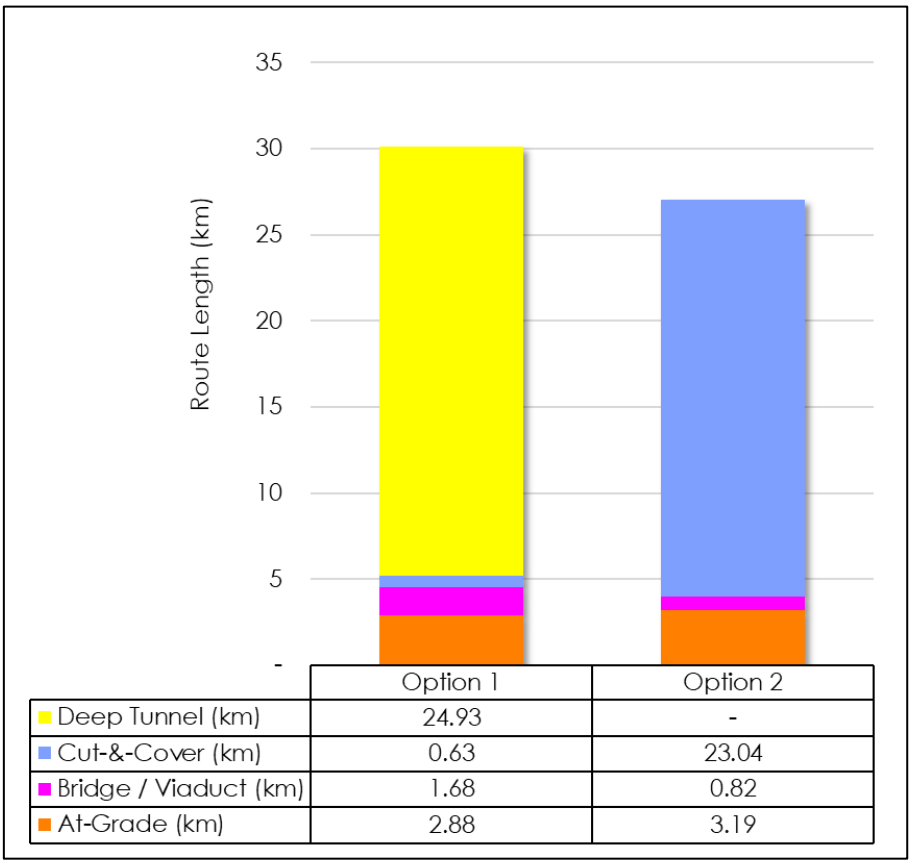


Figure 4-11: Cosmo City to Samrand Route Alignment Options including Biodiversity and Aquatic Sensitivities



	Option 1	Option 2
Deep Tunnel (km)	24.93	-
Cut-&-Cover (km)	0.63	23.04
Bridge / Viaduct (km)	1.68	0.82
At-Grade (km)	2.88	3.19

Figure 4-12: Varying Vertical Alignment Distances for each Cosmo City to Samrand Option

The routes can be described as:

- **Option 1:** The route alignment is 30.11 km in length and consists of a combination of all four track types (10% At-grade, 6% Bridge / Viaduct, 2% Cut-and-cover and 83% Tunnel) (Figure 4-13). This route starts at the end of the proposed Cosmo City station platform, from the GRRIN Phase 1 route alignment, and traverses in a North-western direction before changing direction sharply to go North-eastwards towards Fourways. It passes between the Kya Sands and Hoogland industrial areas, then turns east into a tunnel just before Witkoppen Road. The route runs parallel to Witkoppen Road towards the proposed Fourways station near Monte Casino.

  Continuing east beneath the M71 (Main Road) via Blanford Ridge, it changes direction near the M9, running parallel to the M9 (Leeuwkop Road) on the northern side towards the proposed Sunninghill Station. After Sunninghill, it heads northeast beneath the R55 (Woodmead Drive), the M39 (Allandale Road), and Walton Avenue towards the proposed Olievenhoutbosch Station. The route proceeds underground along Eighth Road, crossing under Lever Road and Olifantsfontein Road, then continues northeast through vacant land.

  The route then changes direction to go North before the Development Bank of South Africa (DBSA) and continues parallel to the N1 highway. It then crosses beneath the N1 Highway and beneath the R101, Olievenhoutbosch Road and the Tlokwa street (parallel to the existing GRRIN) as it exits the tunnel and terminates next to the future Samrand Station at-grade.

- **Option 2:** The route alignment is 30.44 km in length and consists of a combination of all four track types: 11% at-grade, 10% bridge/viaduct, 3% cut-and-cover, and 76% tunnel (Figure 4-13). Similar to Option 1, this route starts at the end of the proposed Cosmo City station platform from the GRRIN Phase 1 route alignment, traversing in a northwestern direction before sharply changing to a northeastern direction towards Fourways. It proceeds beneath the Hoogland industrial area and Witkoppen Road towards the proposed Fourways station near Monte Casino.

  Continuing east beneath the M71 (Main Road) via Blanford Ridge, it changes direction near the M9, running parallel to the M9 (Leeuwkop Road) on the northern side towards the proposed Sunninghill Station. After Sunninghill, it heads northeast beneath the R55 (Woodmead Drive), the M39 (Allandale Road), and Walton Avenue towards the proposed Olievenhoutbosch Station. The route proceeds underground along Eighth Road, crossing under Lever Road and Olifantsfontein Road, then runs parallel to Lever Road near the Country View Residential area.

  The route then changes direction before Blue Valley Golf Estate, going slightly eastwards over the N1 highway and north over the R101, Olievenhoutbosch Road, and Tlokwa Street (parallel to the existing GRRIN), terminating at-grade next to the future Samrand Station.

From a landcover and landscape perspective, the area is characterised by predominantly urban residential, small holding and township coverage (Appendix D – Figure A3). However, the various route options traverse through areas of grassland cover, cultivated / croplands, and urban industrial areas. From a vegetation perspective, all route options only cross through the Egoli Granite Grassland vegetation type (Appendix E). While all routes cross some undeveloped greenspaces, this corridor largely follows Witkoppen Road in the west of the routes, and once passing Fourways Mall, is predominantly higher income residential areas, surrounded by significant complex and commercial development.

The findings of the Screening Tool, sensitivity features, and comparisons from an environmental perspective are summarised in the subsections below.

4.3.1 Screening Findings

The Cosmo City to Samrand Corridor exhibits a range of environmental sensitivities across various themes. The Screening Tool identified high sensitivity areas for animal species, aquatic biodiversity, and terrestrial biodiversity due to the presence of critical habitats, watercourses, and conservation areas. Additionally, the corridor crosses regions with medium sensitivity for plant species, reflecting the potential presence of vulnerable and critically endangered flora. The proximity to heritage sites and civil aviation aerodromes also contributes to the sensitivity ratings. Overall, the corridor's environmental sensitivities necessitate careful planning and mitigation measures to minimise impacts, particularly in areas of high ecological and cultural importance.

Table 4-7 provides an in-depth comparison of the screening findings for Option 1 and Option 2. Initially, we present the desktop DFFE Screening Tool findings, which evaluate the environmental sensitivities associated with each option across the various themes. These preliminary findings are then adjusted based on ground truthing and the impacts of vertical placement along the routes. By refining the initial sensitivity ratings, Table 4-7 offers a more accurate reflection of the actual environmental sensitivities, enabling a clearer understanding of the potential impacts.

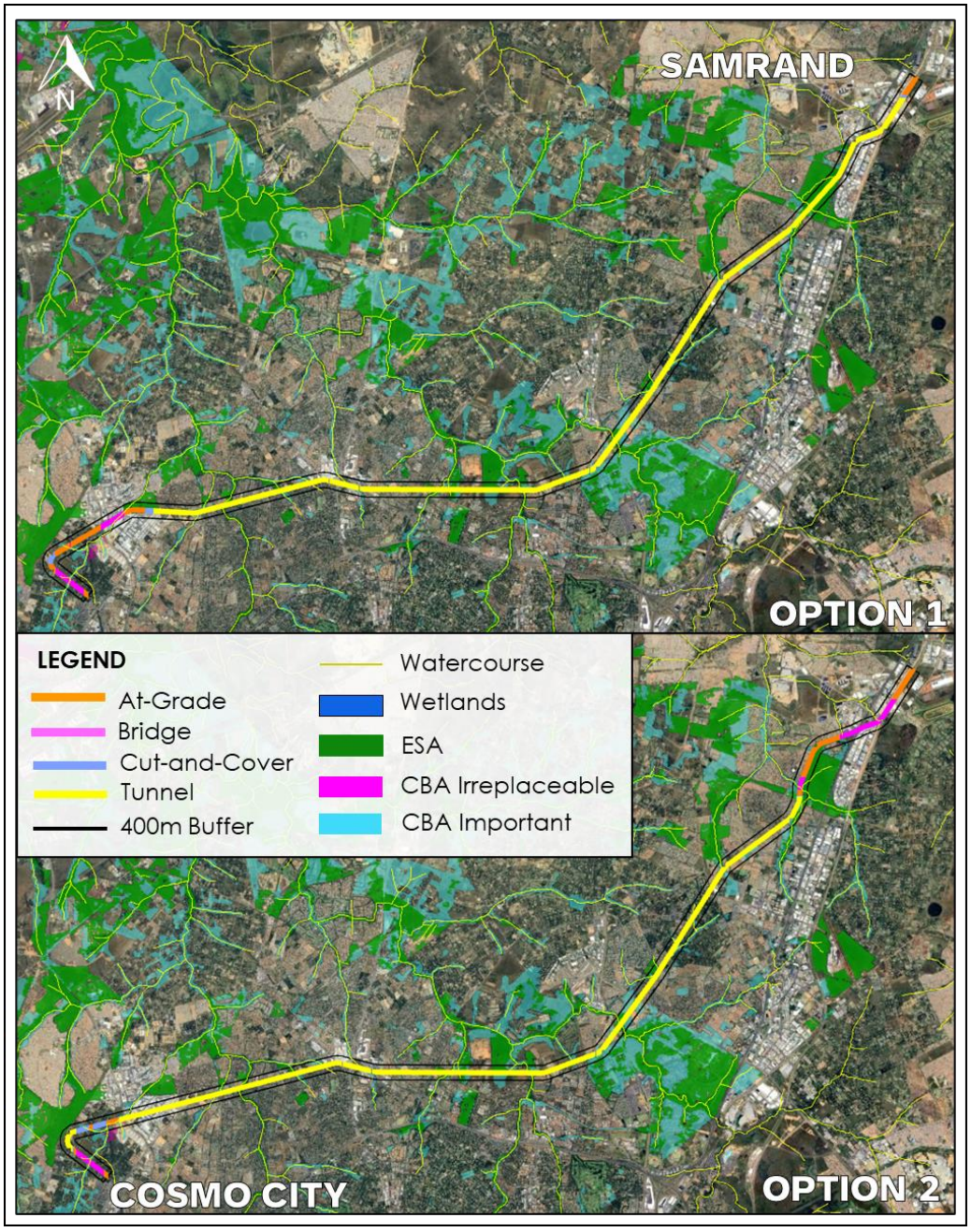


Figure 4-13: Visual Representation of the Vertical Profiles of Option 1 and Option 2 including Biodiversity and Aquatic Sensitivities

The Screening Tool identified varying sensitivity levels across environmental themes. Areas with high sensitivity may require detailed specialist assessments or permits (see Appendix C). In some cases, a 'Specialist Compliance Statement' may suffice. To enhance accuracy, we incorporated ground truthing and vertical placement considerations. Ground truthing validated the Screening Tool results against current land use, while vertical placement analysis assessed the construction depth. This dual approach refined the sensitivity ratings, providing a more precise assessment of environmental impacts and helping to identify the most sustainable route alignment.

- Option 1, which features a longer deep tunnel section, consistently shows lower sensitivity ratings across most environmental themes. This is due to the reduced surface-level disruption associated with deep tunnelling, which minimises impacts on

agricultural land, sensitive animal and plant habitats, heritage sites, and terrestrial biodiversity and aquatic ecosystems and other critical areas (Figure 4-13). The deep tunnel method also avoids extensive land acquisition and surface-level construction activities, further reducing the potential for environmental harm. The longer underground alignment ensures that sensitive areas are preserved, making it an environmentally sustainable option

- Option 2, while similar in many respects, includes a 7.30 km section that is above ground. Albeit only 1.89 km longer above ground than Option 1, this section increases the potential for surface-level impacts, particularly in areas of high sensitivity, such as the presence of ESAs and wetlands in this portion (Figure 4-13). The above-ground sections in Option 2 are more likely to disrupt sensitive habitats and require more extensive land acquisition, leading to higher social and environmental impacts. As a result, Option 2 generally exhibits higher sensitivity ratings compared to Option 1.

In summary, the table highlights the adjusted sensitivity ratings for various environmental themes, demonstrating how the deep tunnel method significantly mitigates surface-level impacts. Option 1, with its extended deep tunnel section, generally exhibits lower sensitivity ratings across most themes. This makes it the superior choice for minimising environmental disruption and preserving natural resources. The reduced need for land acquisition and the minimised surface-level construction activities further enhances its suitability as the optimal route alignment.

Based on the MCA, Option 1 is the optimal route alignment for the Cosmo City to Samrand Corridor and is the least environmentally sensitive.

Table 4-7: Screening Tool and Adjusted Sensitivity Findings Considering Vertical Placement Impacts of Option 1 and Option 2 for the Cosmo City to Samrand Corridor

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
Agriculture	Both options traverse areas with varying levels of agricultural sensitivity, ranging from low to high (Figure 4-14). The routes cross Urban Development Zone 5 of the Gauteng EMF in the Fourways area. Similarly to the Little Falls to Jabulani corridor, despite the high sensitivity rating, the impact on agricultural resources is expected to be minimal due to existing land use. In this corridor, it is predominantly urban and industrial land uses surrounding the routes (Appendix D – Figure A3). Therefore, there is no significant difference between the two options in terms of their impact on agricultural resources.	The deep tunnel method in both options significantly reduces surface-level impacts on agricultural land. This approach minimises disruption to high potential soils and maintains agricultural productivity. By ensuring that areas with high potential soils remain undisturbed, the underground route helps preserve the productivity of these regions. Additionally, the deep tunnel avoids extensive land acquisition and surface-level construction activities, which could otherwise lead to soil compaction, erosion, and loss of arable land. Therefore, the sensitivity for agriculture is low for both options, with no significant difference between them.
Animal Species	The Screening Tool indicates high sensitivity for both options due to the presence of sensitive animal species. The routes traverse medium and high sensitivity areas, with approximately 15% to 18% of the alignments crossing high sensitivity zones, particularly between Kyalami and Carlswald, Midrand (Figure 4-14). Option 1 crosses a length of 3.01 km in high sensitivity, while Option 2 is slightly shorter, at 2.54 km. Species of concern that may be present include the African grass owl and Yellow-billed stork (*Mycteria ibis*) (among others). The remaining ± 60 - 80% of the routes fall within a medium sensitivity, on the southern end of the routes towards Cosmo City. Both options have similar impacts on animal species, with no significant differentiation. Vast portions of land along these routes consists of greenfield sites, and several watercourses (namely wetlands), which facilitate the occurrence of these species, are also crossed (Figure 4-11). In these areas, natural vegetation will need to be cleared, thus resulting in loss of habitat for potentially occurring species.	Both options employ a deep tunnel approach that minimises habitat disruption for sensitive animal species. The underground route ensures that high sensitivity areas, such as those near watercourses and greenfield sites, remain undisturbed, preserving the habitats of potentially occurring sensitive species. In Option 1, the above-ground section at the start of the route crosses sensitive areas, while in Option 2, the above-ground section at the Samrand end of the route also crosses sensitive areas. Despite this, the above-ground sections in both options pose a higher risk of habitat disruption. As a result, the sensitivity rating is medium for both options; Option 2 may be marginally more impactful given the slightly longer above-ground placement.
Archaeological & Cultural Heritage	Both options have a very high sensitivity rating because they fall within 5 km of a Grade I Heritage site (likely the Liliesleaf Farm) from the map provided in the Screening Tool (Figure 4-14). Similarly to the Little Falls to Jabulani corridor, it is likely that a HIA and chance find procedure will be required for both options. There is no difference between options.	The deep tunnel method in both options ensures minimal surface-level interactions with heritage sites, preserving their integrity. The underground route ensures that areas with very high sensitivity are not disturbed, preserving cultural and historical integrity of these regions. In both options the above ground sections increase the risk of impacting archaeological and cultural heritage sites, potentially leading to physical damage and loss of historical

<table>
<tr><th>Environmental Theme</th><th>Screening Tool Findings</th><th>Adjusted Sensitivity Considering Vertical Placement and Ground Truthing</th></tr>
<tr><td></td><td></td><td>artifacts. This needs to be addressed through an HIA and mitigation measures if required. There is no material difference between the options and sensitivity is considered low.</td></tr>
<tr><td>Aquatic Biodiversity</td><td>Both options show very high sensitivity due to their proximity to important watercourses such as the Kleinjukskeirivier, Jukskei River, and Rietspruit River (Figure 4-11), which are critical for maintaining aquatic biodiversity. The routes traverse both low and very high sensitivity areas, with the high sensitivity attributed to the potential impacts on these aquatic ecosystems. The routes have a very high sensitivity rating due to multiple watercourse crossings (Figure 4-11), which are critical for maintaining aquatic biodiversity. Approximately 25-35% of the length of the alignments cross sensitive areas (Figure 4-14). The presence of these watercourses and wetlands necessitates careful consideration to avoid significant impacts on aquatic ecosystems.
Option 1 crosses a marginally longer distance of sensitive aquatic features compared to Option 2 (Table 4-8).
Table 4-8: Length (in km) of each route traversing aquatic sensitivity features
<table>
<tr><th>Sensitivity Features</th><th>Option 1</th><th>Option 2</th></tr>
<tr><td>The Kleinjukskeirivier adjacent to Witkoppen Road, Fourways, Jukskei River east of Woodmead Drive, and Rietspruit River (small tributary).</td><td>0.13</td><td>0.13</td></tr>
<tr><td>Central Bushveld Bioregion (Valley-bottom)</td><td>0.87</td><td>0.78</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Seep)</td><td>2.18</td><td>2.05</td></tr>
<tr><td>Mesic Highveld Grassland Bioregion (Valley-bottom)</td><td>2.55</td><td>2.14</td></tr>
<tr><td>Total</td><td>5.73 km</td><td>5.1 km</td></tr>
</table></td><td>The deep tunnel approach in both options helps to minimise disruption to aquatic ecosystems. The underground route ensures that areas with very high sensitivity, such as those near watercourses and wetlands, remain undisturbed, preserving aquatic biodiversity. The above-ground sections in both options, however, pose a higher risk of disrupting aquatic habitats. In Option 1, the above-ground section at the start of the route crosses sensitive aquatic areas, while in Option 2, the above-ground section at the Samrand end of the route also crosses sensitive aquatic areas. Consequently, the sensitivity rating for aquatic biodiversity is medium for both options, with Option 2 being slightly more impactful due to the marginally longer distance of sensitive aquatic features crossed above ground (Figure 4-13).</td></tr>
<tr><td>Civil Aviation</td><td>Both options have a high sensitivity rating due to their proximity to civil aviation aerodromes (within 8 km), which could impact aviation safety and operations. Potential issues include bird strikes, electromagnetic interference, and physical obstructions. Careful planning and mitigation measures are necessary to address these concerns. There is no difference between options.</td><td>The deep tunnel in both options eliminates surface-level interactions, reducing the risk of interference with aviation activities. In contrast, the above-ground sections could pose potential risks, such as physical obstructions and electromagnetic interference. Interference in the above ground sections will need</td></tr>
</table>

Environmental Theme	Screening Tool Findings	Adjusted Sensitivity Considering Vertical Placement and Ground Truthing
		to be assessed. Nonetheless, for both, the sensitivity is considered low.
Defence	Both options have a medium sensitivity rating due to their proximity to a Military and Defence Site. This proximity necessitates careful consideration to avoid any potential impacts on defence operations. There is no difference between options.	The deep tunnel method reduces the sensitivity rating to low. In both options it ensures minimal surface-level disruption, maintaining a low sensitivity rating for defence. The underground placement (for the majority of both routes) avoids any potential interactions with defence installations or areas of strategic importance. There are no significant defence-related concerns anticipated for either option.
Palaeontology	Both options show no sensitivity (not even 'low') in the Screening Tool for palaeontology, meaning they do not intersect areas known for significant fossil deposits or palaeontological importance. This indicates that the construction and operation of the railway lines are unlikely to disturb any important fossil sites or hinder palaeontological research.	The sensitivity rating remains none / very low for both options.
Plant Species	Both options have a medium sensitivity rating because the routes cross regions that support various vulnerable and critically endangered plant species, such as Sensitive species No. 1248 and *Melolobium subspicatum* (Figure 4-14). Option 1 crosses a length of 10.54km in medium plant sensitivity areas with the potential occurrence of vulnerable species, compared to marginally lower 9.13 km for Option 2. These areas include grasslands and bushveld vegetation types, which are home to several sensitive plant species. The presence of these species necessitates careful consideration and mitigation measures to protect them during the construction and operation of the railway line. There is no significant difference between options. If vulnerable or threatened species are present, a search and rescue operation may be necessary before starting any construction, provided the required permits are obtained.	Both options have a medium sensitivity rating because they traverse regions that could support various vulnerable and critically endangered species, which are present in both options' above-ground sections. The deep tunnel method in both options minimises surface-level disruption to sensitive plant habitats. However, the above-ground sections in both options pose a higher risk of habitat disruption and vegetation clearance. In Option 1, the above-ground section at the start of the route crosses sensitive areas, while in Option 2, the above-ground section at the Samrand end of the route also crosses sensitive areas. Therefore, the sensitivity rating for plant species is medium for both options. As with the Animals theme, Option may be marginally more sensitive.
Terrestrial Biodiversity	Both options have a very high sensitivity due to the routes crossing CBAs and important conservation areas (Figure 4-14). Both options traverse regions that are essential for maintaining terrestrial biodiversity, providing habitats for a wide range of species and supporting crucial ecological processes. Option 1 crosses a	The deep tunnel alignment in both options avoids direct impacts on critical biodiversity and conservation areas. However, the above-ground sections in both options increase the potential for habitat fragmentation and loss of biodiversity. In Option 1, the above-ground section at the start of the route crosses sensitive areas, while in Option 2, the above-ground section at the

<table>
<tr><th>Environmental Theme</th><th>Screening Tool Findings</th><th>Adjusted Sensitivity Considering Vertical Placement and Ground Truthing</th></tr>
<tr><td></td><td>considerably shorter distance of 10.7 km's of conservation areas, compared to 12.11 km for Options 2 (Table 4-9).

Table 4-9: Length (in km) crossing each conservation area
<table><tr><th>Sensitivity Features</th><th>Option 1</th><th>Option 2</th></tr><tr><td>CBA 1</td><td>3.68</td><td>3.34</td></tr><tr><td>CBA 2</td><td>0.4</td><td>0.3</td></tr><tr><td>ESA 1</td><td>2.47</td><td>2.97</td></tr><tr><td>ESA 2</td><td>2.72</td><td>2.72</td></tr><tr><td>NPAES</td><td>1.43</td><td>2.78</td></tr><tr><td>Total</td><td>10.7</td><td>12.11</td></tr></table>
In addition to the various conservation areas, these routes also occur wholly within the CR Egoli Granite Grassland Ecosystem (Appendix E), which is characterised by its unique biodiversity and the potential presence of several vulnerable and endangered species. The presence of the various conservation areas and sensitive ecosystems necessitates careful consideration and mitigation measures to protect them during the construction and operation of the railway line.</td><td>Samrand end of the route also crosses sensitive areas. Therefore, the sensitivity rating for terrestrial biodiversity is medium for both options, with Option 1 being slightly more favourable due to the shorter length of conservation areas crossed.</td></tr>
<tr><td>Social</td><td>Both options have medium sensitivity due to their proximity to residential areas and public amenities, raising concerns about visual intrusion, noise, air quality, and disruption during construction and operation. The routes also require land acquisition, potentially displacing residents and businesses. The routes traverse the grounds of the Leeuwkop Prison in Sunninghill, including smallholdings and agricultural areas, and pass near the Leeuwkop Asidlale Adventure Park, necessitating careful planning to minimise disruption and ensure safety. Passing through or near several residential estates and higher-income areas around Fourways, Sunninghill, and Olievenhoutbosch, the routes raise concerns about social impacts. The need for land acquisition and potential displacement further adds to the socio-economic sensitivity.

Both options follow similar routes, with visual impact and intrusion being significant concerns due to the lack of existing transport infrastructure. In the Kyalami to Midrand area, the routes traverse underdeveloped greenspaces, increasing sensitivities.</td><td>The deep tunnel method in both options significantly reduces surface-level disruptions, lowering the overall social impact. However, the above-ground sections still pose notable social impacts. These sections will likely result in higher noise levels, visual intrusion, and greater disruption in residential areas, as well as the need for land acquisition. Therefore, while both options maintain a medium social sensitivity, Option 2 is somewhat more sensitive due to the extended length of the above-ground sections and the associated land acquisition requirements.</td></tr>
</table>

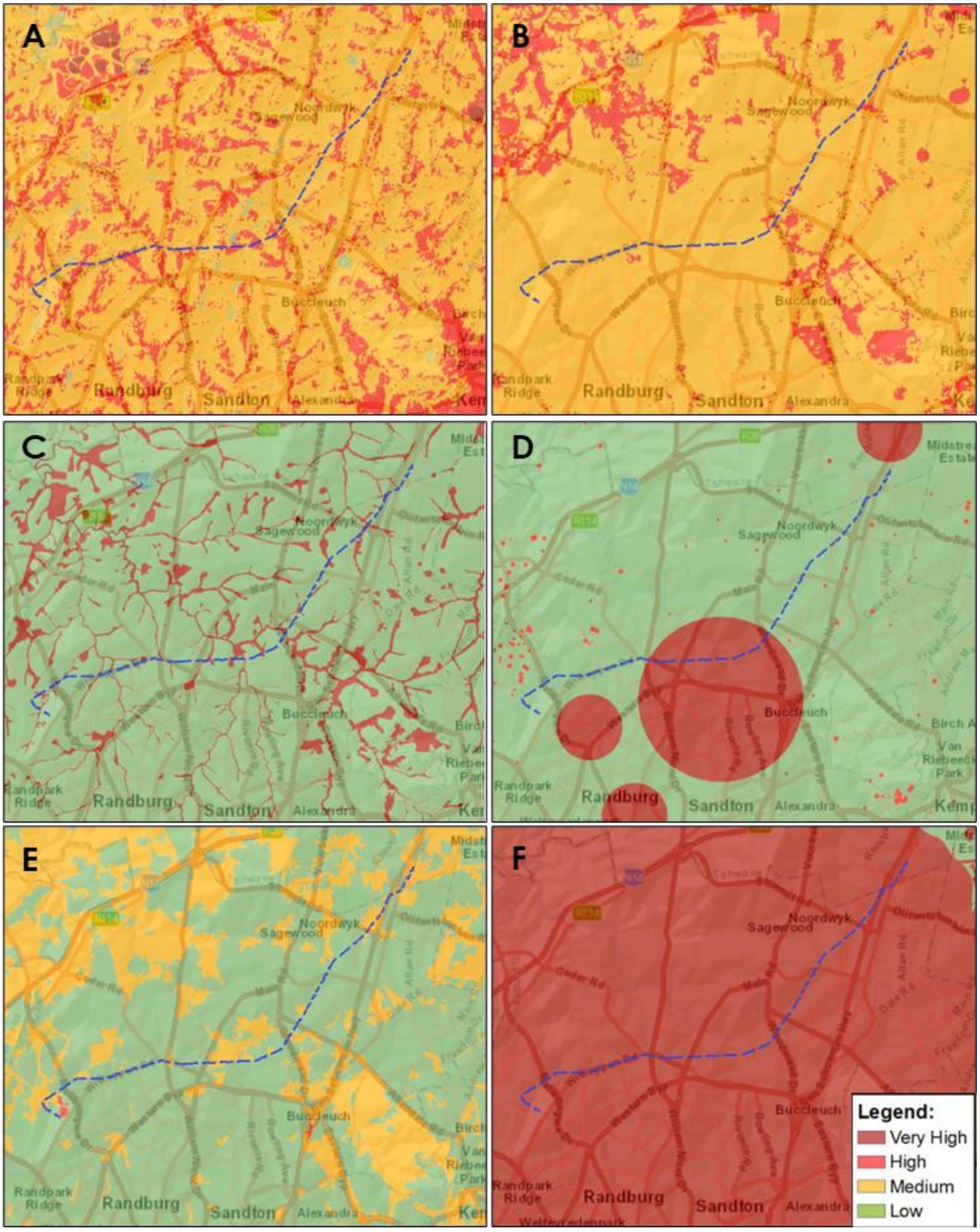


Figure 4-14: Screening Tool findings for Option 2 Agriculture (A), Animal Species (B), Aquatic Biodiversity (C), Archaeology and Cultural Heritage (D), Plant Species (E) and Terrestrial Biodiversity (F)[20].

[20] Option 1 largely follows the same alignment with slight variation at the start and end of the route. Nonetheless, the Screening Tool figures are representative of the sesntivity of the corridor.

4.3.1 Option 0 and Optimal Option 1 Comparison

The Option 0 route for the Samrand Corridor spans several sections, each with unique characteristics and challenges (July 2016)[21]:

The section from Cosmo City to the proposed Fourways station comprises of all types of track routes i.e. At-grade, Elevated Bridges / Viaducts, Cut-and-cover and Tunnel sections. The route starts off at-grade at Cosmo City station and goes into an elevated bridge (approximately 800m long) between the Kya Sands and Hoogland Industrial areas. The route then proceeds at-grade through the vacant land and the Bloubosrand suburb before going onto an elevated bridge / viaduct over the Witkoppen road. After the Klein Jukskei River the route goes into a cut-and-cover section (shallow tunnel) underneath the Witkoppen Road.

In this section described above, relocation of some existing residential houses and perhaps commercial businesses will be required to enable construction. Due to the at-grade sections of the route, disruptions to community during construction are expected and a permanent barrier will be created through the areas with at-grade railway routes. At the point where the route goes over the Witkoppen road, and then under it in a shallow tunnel, temporary road closures and road deviations will be required during construction.

After the Klein Jukskei River, the route remains in the cut-and-cover (shallow tunnel) beneath the Witkoppen road, until Fourways mall where the route would be completely in a deep tunnel until the proposed Fourways station, located near Monte Casino.

This short section where the route is underground (approximately 3km), ground-level infrastructure disruptions are expected since the Witkoppen road would require temporary closure and road deviations to enable construction. The proposed Fourways station building will be located above ground however the rail route and station platforms will remain below ground in a tunnel, directly beneath the station building.

After the Fourways station, the route remains in a shallow tunnel beneath the Witkoppen road and changes to at-grade then eventually an elevated bridge / viaduct just after M71 (Main Road). Near Paulshof, the route goes into a cut-and-cover (shallow tunnel) then continues at-grade through vacant land next to Paulshof Suburb before going over the Jukskei river on an elevated bridge. There is another cut-and-cover section of the route shortly after the Jukskei river, before finally reaching the proposed Sunninghill station. The proposed Sunninghill station, the railway route and the access platforms will all be at-grade.

In this section, disruptions are expected since the Witkoppen road would require temporary closure and road deviations to enable construction. Near Paulshof, relocation of homes will be required to enable construction. Since this section of the route runs at the end of the Paulshof Suburb, the route is not separating any communities.

After the proposed Sunninghill Station, the route goes through a short cut-and-cover section beneath the newly constructed M9 Main Road before moving onto an elevated bridge over the R55 Woodmead Drive and the Jukskei River.

[21] Source: Feasibility Study for the possible Gauteng Rapid Rail Extensions - Volume II: Section 4a: Part 4a: Technical Due Diligence: Annexure DD-3: Conceptual Vertical and Horizontal Alignment Drawings (July 2016).

Thereafter the route remains at-grade through Kyalami hills and Carlswald residential area. Near Walton Road, the route goes underground into a tunnel beneath Walton Road and exits the tunnel shortly after Adcock Ingram offices along garden Road. After this, the route remains at-grade up to the proposed Olievenhoutbosch Station. The proposed Olievenhoutbosch station, the railway route and the access platforms will all be at-grade.

In this section, disruptions are expected since the newly constructed M9 road would require temporary closure and road deviations to enable construction. Near Kyalami hills and Carslwald, relocation of homes will be required to enable construction. The last section of at-grade route just before the proposed Olievenhoutbosch station, will require relocation of residential estates and road closures or road deviations for Garden Road, leading to severe community disruptions and creating a permanent barrier in the community in future.

In the last section of the route between the proposed Olievenhoutbosch and future Samrand stations, the route continues at-grade curving through Olifantsfontein Road where it then moves onto an elevated bridge / viaduct over the Blue Valley Golf Estate. The route then continues at-grade alongside the Blue Valley Golf Estate, and crosses over the N1 Ben Schoeman Highway and R101 old Johannesburg Road on elevated bridges, before it reaches the Future Samrand station which will be situated on the existing GRRL network. The future Samrand station, the railway route and the access platforms will all be at-grade.

In this last section, a few residential developments will require relocation through the Blue Hills area, and closer to Samrand station, a few industrial developments may require relocation to enable construction. The at-grade section of the route through the Blue Hills and Blue Valley Golf Estate will create a permanent barrier through the area, separating communities in future.

Optimal Option 1 for the Samrand Corridor features a longer proportion of deep tunnel which significantly reduces surface-level impacts across most environmental themes. It is unclear from the available information what the comparisons of environmental sensitivities are between these two options.

The environmental data and route alignment information for Option 0 (Feasibility Study, 2016) did not enable quantitative assessment and comparison. Nonetheless, Optimal Option 1 may be considered superior to Option 0 due to its design, which inherently minimises surface-level disruptions and aligns better with environmental sustainability goals. While detailed sensitivity findings for Option 0 are not as comprehensively defined as those for Optimal Option 1, the latter's extended deep tunnel section generally exhibits lower sensitivity ratings across most themes. This makes Optimal Option 1 the preferred choice for minimising environmental disruption, preserving natural resources, and addressing other technical and engineering aspects.

4.3.2 Refined Optimal Route Alignment

Compared to the Optimal Option 1 (Figure 4-15), the following sections of the route were refined:

- **Cosmo City to Boundary Park:** At the sharp curve just north-west of Cosmo City station, refinement was done to achieve compliance with the design criteria. The refinement in this section has resulted in a very minor shifting of the route to the east. The maximum shift of the route in this section is approximately 0 to 20m

- **Noordwyk to Samrand:** Since this section of the route is in a tunnel, the refinement was done to straighten out the route to reduce route length and improve alignment. The refinement in this section has resulted in the route shifting slightly to the east. The maximum shift of the route in this section is approximately 0 to 450m
- **At Samrand Station:** Refinement in this section was to extend the end of the route approximately 250m further, to allow for potential staging of trains overnight.

The final route length of the Refined Optimal Cosmo City to Samrand route is 30.3 km from start to end, consisting of 5% at-grade, 10% bridge/viaduct, 2% cut-and-cover, and 83% deep tunnel.

Compared to the Optional Option 1, the Refined Optimal presents the following differences affecting environmental sensitivities (Figure 4-15):

- The Cosmo City end of the route is primarily Bridge, compared to the more mixed placement in Optimal Option1. The Bridge placement exhibits slightly reduced impacts compared to at-grade in Optimal Option 1
- There is slight deviation in the Refined Optimal route near the DBSA at the Samrand end of the route. Since this section is also deep tunnel, the deviation makes no difference to the sensitivity findings
- There is a change to a cut-and-cover section at the Samrand end of the route that is tunnel in Optimal option 1; this area however is not an environmentally sensitive area.

The above refinements were necessary to optimise the alignment. From an environmental sensitivity perspective, the Refined Optimal and Optimal Option 1 are similar. This similarity arises primarily from the extensive use of deep tunnel design, which minimizes surface disruption and environmental impact.

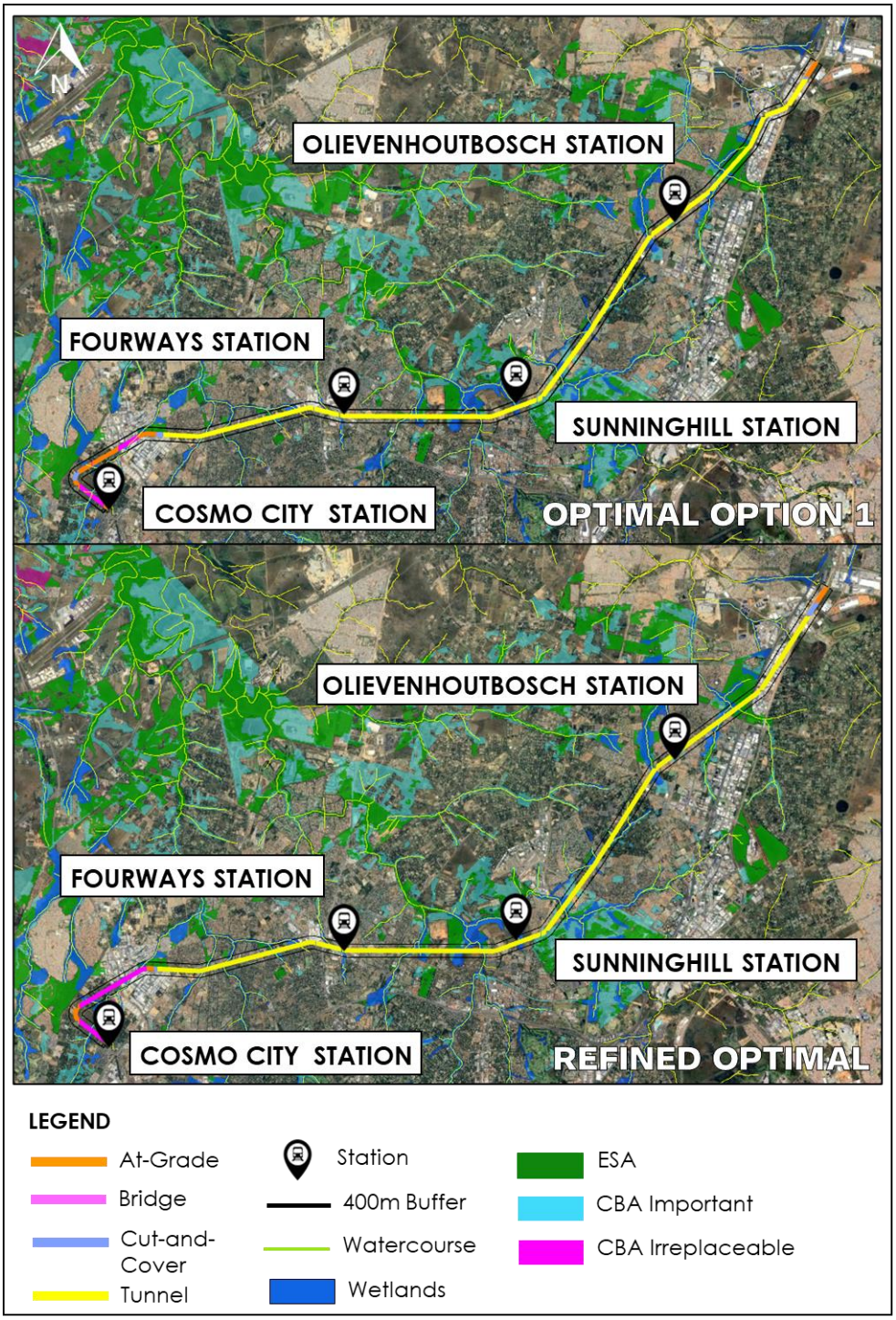


Figure 4-15: Refined Optimal compared to Optimal Option 1

5. ENVIRONMENTAL AND SOCIAL RISKS AND OPPORTUNITIES

5.1 Potential Risks and Impacts

The development of the Project will result in various environmental and social impacts, the severity of which is largely associated with the specific location and site sensitivity. Understanding how, when, and where such developments will affect the environment, and whether it will be possible to mitigate future impacts through careful planning and siting decisions, is crucial. This section identifies the potential impacts and benefits associated with the Project based on desktop level evaluation and previous experience with similar development projects.

Environmental impacts of the proposed railway line and its associated infrastructure are expected to occur during the construction, operation, and decommissioning phases. The Project is intended to be a long-term infrastructure investment, with no immediate plans for decommissioning. Therefore, the focus of this section is on the construction and operational phases, which are more relevant to the current planning and screening assessment. Additionally, the decommissioning phase may be considered speculative at this stage, as it would depend on future decisions and conditions that are not yet foreseeable.

- The majority of environmental impacts may likely arise during the construction phase, which includes activities such as land clearing, transportation of materials and equipment, construction of foundations, and installation of infrastructure. These activities can lead to significant environmental disturbances, requiring diligent management and mitigation to limit their significance, footprint and ensure responsible construction practices. Environmental and social issues associated with these construction activities are generally temporary and may include impacts on surface water bodies and groundwater, threats to biodiversity and ecological processes, impacts on sites of heritage value, land acquisition, and nuisance noise and air quality issues
- During the operational phase, continuous use of the railway line can lead to ongoing environmental and social impacts, such as noise pollution, visual impacts, and potential disruptions to local communities. These operational impacts necessitate careful management to minimise their environmental footprint and ensure the sustainable operation of the railway line.

The potential environmental and social impacts associated with the Project are presented in the detailed table below. For each identified negative impact, corresponding mitigation measures have been suggested to avoid or minimise these impacts. It is important to note that these findings are based on preliminary assessments and do not include specific specialist input. Consequently, this is not an exhaustive list of impacts and mitigation measures. More detailed and comprehensive findings, including additional impacts and mitigation measures, will be identified during the future EIA phase and specialist assessments.

Table 5-1: Anticipated Impacts during Project Construction and Operation Phases, and Proposed Mitigation Measures

Aspect	Construction Phase		Operations Phase	
	Potential Impact	Mitigation Measures	Potential Impact	Mitigation Measures
Air Quality	Dust and emissions from construction activities and machinery.	• Use dust suppression techniques, such as wetting unpaved roads or spraying of dust suppression/ dust-binding lignosulphonate material. • Limit the speed of construction vehicles on unpaved roads. • Cover stockpiles and transport vehicles to prevent dust emissions. • Regular maintenance of machinery to reduce emissions. • Develop an Air Quality Management Plan for construction activities.	Dust emissions resulting from the operation of trains, and Volatile Organic Compound emissions associated with the operation of maintenance vehicles.	• Use of electric trains to reduce emissions. • Promote the use of green spaces around stations to improve air quality. • All maintenance vehicles, equipment and machinery must be appropriately maintained to minimise exhaust emissions. • Implement a grievance procedure, where complaints can be received, recorded and responded to appropriately.
Noise	Increased noise levels from construction equipment.	• Implement noise attenuation barriers and soundproofing. • Schedule construction activities during daytime hours. • Adhere to local authority bylaws relating to noise control. • Mechanical equipment with lower sound power levels will be selected, where possible, to ensure that the permissible occupational noise is not exceeded. • Equipment will be fitted with silencers as far as possible to reduce noise. • All equipment will be adequately maintained and kept in good working order to reduce noise.	Noise from train operations and station activities.	• Use noise attenuation barriers and soundproofing at sensitive locations. • Implement quiet zones near residential areas. • Regularly maintain tracks and trains to minimise noise.
Vibration	Vibration from construction equipment affecting nearby structures.	• Use vibration dampening techniques. • Monitor vibration levels and adjust construction methods accordingly. • Inform nearby residents about potential vibration impacts. • Ensure blasting activities occur during day-time hours.	Vibration from train operations affecting nearby structures.	• Implement track vibration isolation measures. • Regular maintenance of tracks and trains. • Monitor vibration impacts on sensitive structures.

Aspect	Construction Phase		Operations Phase	
	Potential Impact	Mitigation Measures	Potential Impact	Mitigation Measures
Visual	Visual intrusion from construction sites and equipment.	• Use sustainably sourced and aesthetically pleasing materials. • Minimise the footprint of construction sites. • Implement temporary landscaping where possible. • Measures to control wastes and litter should be included in the contract specification documents. • Wind-blown dust from soil stockpiles and construction activities, should be controlled.	Visual impact of railway infrastructure and stations.	• Design aesthetically pleasing structures. • Use landscaping to blend infrastructure with surroundings. • Implement green roofs and walls on station buildings.
Terrestrial Biodiversity and Ecology	Habitat destruction and disturbance to wildlife and plant/vegetation communities.	• Develop a Biodiversity Management Plan during construction activities. • Conduct pre-construction biodiversity assessments. • Minimise habitat clearance and disturbance. • Implement habitat restoration and conservation plans. • Relocate affected species where necessary. • Establish any biodiversity offsetting requirements.	Disturbance to wildlife from train operations.	• Implement wildlife crossings and barriers. • Develop a Biodiversity Management Plan during operational activities. Monitor and manage wildlife interactions. • Maintain green corridors along the railway line. • Implement and monitor performance of any offsetting plans (if required).
Surface Water	Contamination from construction runoff and spills.	• Temporary stockpiles should be located away from stormwater drains. • Implement sediment and erosion control measures. • Use spill containment systems. • Regularly monitor water quality in nearby water bodies. • Drip trays are to be utilised to catch incidental spills and pollutants from vehicles, machinery and equipment. • Spill kits must be kept onsite and any spills or leaks must be cleaned up immediately and disposed of at a licensed disposal facility. • All onsite employees involved with daily operation onsite must undergo appropriate training which must include prevention of	Potential contamination from maintenance activities.	• Implement proper waste disposal and spill response plans. • Regular monitoring of water quality. • Use environmentally friendly cleaning agents. • Hazardous/ dangerous goods offloading areas and fuel dispenser pumps must be located on a hardened and curbed surface to contain spillages. • Develop a Water Management Plan during operational activities.

Aspect	Construction Phase		Operations Phase	
	Potential Impact	Mitigation Measures	Potential Impact	Mitigation Measures
		spillages of chemicals and hydrocarbons and be versed in how to manage a spillage. • An Emergency Response Plan must be in place for the site, this must clearly describe emergency procedures and include emergency contact numbers. • Develop a Water Management Plan during construction activities.		
Groundwater	Potential contamination from construction activities.	• Monitor groundwater quality against baseline conditions and notify the necessary Regulators should a substantial change in quality be identified. • Cement mixing must be confined to a designated area and must be done on an impervious surface. • All construction vehicles, machinery and equipment will be properly maintained to prevent leaks. This must be done at appropriate workshop facility and not at the construction sites. • Drip trays are to be utilised to catch incidental spills and pollutants from vehicles, machinery and equipment. • All waste generated at construction areas will be adequately stored and collected and disposed of by a reputable waste management contractor. No waste is to be burned or disposed of onsite. • All chemicals used during the construction phase must be located within an access controlled designated area and protected from the elements. • Implement groundwater recharge areas.	Contamination from maintenance activities.	• Develop a Groundwater Management Plan during the operational phase. • Implement groundwater protection measures. • Regular monitoring and maintenance of containment systems. • Use sustainable drainage systems.
Soil	Soil erosion and compaction from construction activities.	• Contractors operating onsite are to at construction sites must provide a method statement before site clearance commences. The method statement will clearly indicate all	Soil contamination from hydrocarbon spillages of maintenance activities.	• Implement proper waste disposal and spill response plans. • If any minor spillage or leakage occurs, the spillage will be cleaned immediately and the

Aspect	Construction Phase		Operations Phase	
	Potential Impact	Mitigation Measures	Potential Impact	Mitigation Measures
		material storage areas, offices and other site infrastructure, waste disposal/ storage areas etc., designed to minimise removal of vegetation, damage to surrounding areas and impact to soils. • Large areas of soil excavation should be phased to limit the erosion potential during rainfall events. • Implement soil stabilisation techniques. • Minimise soil disturbance and use erosion control measures. • Topsoil should be removed and stockpiled separately from subsoil horizons. Stockpiles should be revegetated when required to minimise erosion and loss of soil. • Stockpiles shall be located away from seepage zones, floodline, water courses and other ecological sensitive areas. Sustainable erosion control measures (for wind and water erosion) will be implemented and maintained where necessary in areas disturbed by construction (and operation) activities. Erosion control measures include, but are not limited to swales, sandbags, planting of vegetation, hydroseeding of topsoil and subsoil stockpiles and retention of vegetation. • Rehabilitate disturbed areas post-construction.		contaminated area will be rehabilitated, as appropriate. • If a major spillage or leakage occurs the contractor will be called out to clean the spillage as required. • Any significant spills or leak incidents must be reported in terms of the National Environmental Management Act and the National Water Act.
Agriculture	Loss of agricultural land and impact on local farming activities.	• Develop a Resettlement Action Plan or Livelihood Restoration Plan to adequately compensate affected farming communities	Ongoing impact on agricultural activities near railway lines.	• Implement buffer zones and barriers. • Engage with local farmers to manage impacts
Cultural Heritage	Potential damage to cultural and historical sites.	• Develop a Chance Finds Procedure for construction activities. • Engage with heritage authorities and local communities for knowledge and locations of potential of cultural heritage sites.	Ongoing risk to heritage sites from vibrations and operations.	• Regular monitoring and maintenance of protective measures. • Engage with heritage authorities. • Implement educational programs about heritage conservation.

Aspect	Construction Phase		Operations Phase	
	Potential Impact	Mitigation Measures	Potential Impact	Mitigation Measures
Palaeontology	Potential disturbance or destruction of fossil sites.	• Develop a Chance Finds Procedure for construction activities. Engage with palaeontologists for monitoring during excavation.	No significant impacts expected.	N/A
Socio-Economic and other Social Impacts	Displacement of communities and businesses.	• Provide fair compensation and relocation assistance. • Engage with affected communities throughout the Project. • Implement community development programs.	Changes in local economy and community dynamics.	• Promote local employment and business opportunities. • Monitor and manage socio-economic impacts. • Support local businesses through procurement policies.
	Increased traffic and disruption to local transport.	• Develop and implement a Traffic Management Plan during construction activities. • Provide alternative routes and signage. • Engage with local authorities and communities about route disruptions and length of construction.	Disruption to existing public transport systems - predominantly impacting on the Taxi Industry: • Loss of income for taxi operators. • Disruption to the livelihoods of taxi drivers and their families. • Changes in taxi routes and schedules to accommodate the new rail service.	• Enhance public transport integration. • Monitor and manage transport-related impacts. • Integrate taxi services with Gautrain stations to ensure a complementary relationship (e.g. taxi associations to provide feeder and distribution services). • Implement joint ticketing systems to encourage the use of both transport modes. • Provide retraining and upskilling programs for taxi drivers to transition into other roles within the transport sector. • Engage with taxi associations to develop mutually beneficial solutions. • Conduct thorough route planning and consultations with taxi operators to minimise disruptions. • Implement flexible scheduling to allow taxis to serve areas not covered by the Gautrain.

5.2 Potential Benefits and Opportunities

Conversely to the potential impacts identified above, the development of the Project is expected to bring a range of social and economic benefits to the respective municipalities, and the Gauteng Province as a whole. These benefits extend beyond the immediate provision of a reliable transport, encompassing positive impacts on local communities, economic development, and technological advancement:

- **Economic Growth:** During the construction phase of the Project, there will be a substantial creation of jobs, which will significantly boost local employment. This availability of job opportunities will not only provide income for many families but also stimulate the local economy. Additionally, the construction phase will provide / create numerous opportunities for local businesses and suppliers to engage with the Project. This engagement will foster economic growth within the community as businesses benefit from increased demand for their products and services. Once operational, it will act as a catalyst for economic stimulation by enhancing connectivity between key areas. This improved connectivity will make it easier for businesses to operate and expand, attracting new businesses and investments along the rail corridor. The presence of a reliable and efficient transportation system will make the region more attractive to investors, further contributing to economic development and prosperity
- **Transportation:** The operation of the Project will revolutionise public transportation in the region by providing a fast, reliable, and efficient mode of transport between major areas. This improvement will be particularly beneficial for daily commuters, who will experience reduced travel times and increased convenience. By offering an attractive alternative to driving or road-based public transport, the extended GRRIN will help alleviate traffic congestion on major highways, leading to smoother and more efficient commutes. This reduction in traffic congestion will also have positive ripple effects, such as decreased stress for drivers, lower vehicle maintenance costs and reduced carbon emissions
- **Environmental:** From an environmental standpoint, the operation of the trains as part will lead to a reduction in the carbon footprint compared to traditional cars and buses. The trains produce fewer emissions, contributing to cleaner air and a healthier environment. By encouraging more people to use public transport, the extended GRRIN will help reduce the overall number of vehicles on the road, further lowering vehicle emissions. This shift towards sustainable transportation will play a crucial role in combating climate change and promoting environmental sustainability
- **Social:** During the construction phase, the Project will actively involve local communities and stakeholders, fostering a sense of community development. This engagement will ensure that the Project aligns with the needs and aspirations of the local population. Local businesses will have the opportunity to participate in the Project, either through direct involvement in construction or by providing goods and services. Furthermore, local employment could lead to the growth in the multiplier factor as the impact will extend to family members and other supporting services (businesses). This participation will strengthen the local economy and create a sense of ownership and pride within the community. Once operational, the extended GRRIN will enhance the quality of life for residents by improving accessibility to key areas and significantly reducing travel time. The increased safety and convenience offered will make commuting a more pleasant experience, contributing to a better

overall living standard. The reliable transportation system will also provide greater mobility for individuals, enabling them to access employment, education, and recreational opportunities more easily

- **Urban Development:** The operation of the Project is expected to stimulate urban renewal and development around its stations. This development would include both commercial and residential land uses, transforming the areas surrounding the stations into vibrant hubs of activity. The presence of the GRRIN may attract businesses, retailers, and residents, leading to the revitalisation of these areas. This urban renewal will not only enhance the aesthetic appeal of the region but also create new economic opportunities and improve the overall quality of life for residents
- **Education and Skills Development:** During the construction phase, the Project should offer comprehensive training programs for construction workers and engineers. These programs will focus on developing local expertise in rail construction and maintenance, equipping individuals with valuable skills that can be applied to other future projects. This emphasis on education and skills development will create a skilled workforce capable of supporting the region's infrastructure needs. The focus on education and skills development should continue into the operational phase, with ongoing training for operational staff. This continuous training will ensure that the workforce remains proficient in the latest rail technology and operational practices. Additionally, the extended GRRIN project can provide opportunities for research and development in rail technology, fostering a culture of innovation and continuous improvement
- **Accessibility:** The extended GRRIN will significantly improve accessibility for all individuals, including those with disabilities. The design of the rail system will incorporate features that enhance access for people with disabilities, ensuring that everyone can benefit from the improved transportation options. The enhanced connectivity between major urban centres will make travel more convenient and efficient for all passengers, promoting greater mobility and inclusivity
- **Safety:** The operation of the extended GRRIN will increase transport safety by reducing the number of cars on the road, thereby contributing to the decreased likelihood of road accidents. The rail system should adhere to high safety standards, ensuring that passengers can travel with confidence. The implementation of advanced safety measures and protocols will further enhance the security of the rail system, providing a safe and reliable mode of transport for all users
- **Tourism:** The extended GRRIN should provide a significant boost to tourism by offering easier access to tourist destinations within the region. The improved transportation options will make Gauteng a more attractive destination for tourists, contributing to the region's economic and cultural vitality. The presence of a reliable and efficient rail system will enhance the overall travel experience for tourists, encouraging them to explore more of what the region has to offer.

6. LEGISLATIVE FRAMEWORK AND PERMITTING STRATEGY

A desktop-level analysis of current legislation in the South African environmental legislative framework was done to identify and review relevant and applicable legislation that may inform the Project. This review contributed to developing an environmental approval or permitting strategy to be used to determine the environmental assessment process required for the authorisation of the Project. This involved identifying all applicable environmental permits, licenses, and other authorisations that would possibly be required for the various Project activities. The permitting strategy aims to:

- Identify applicable environmental permits, licenses, and other authorisations required for the specified Project activities. This was to reduce any delays that might occur in the future
- Describe the administrative processes required to be followed for each permit, license, and authorisation, including the likely associated timeframes of these processes. This enables integrating the permitting schedule with the Project schedule, reducing the risk of delays and additional costs
- Identify which authorisations, permits, or licenses should be prioritised for the Project. The purpose of this was to identify the level of effort needed for each authorisation, permit, and license and which process to prioritise
- Determine which Competent Authorities will be responsible for issuing the various authorisations, permits, and licenses. The benefit of this was to highlight required communication with the different governmental departments
- List the outcomes to be expected through the implementation of this strategy
- Identify the key permitting risks to the Project and the proposed means of mitigating these risks.

In summary, this review identified possible environmental triggers and outlined expected timeframes associated with the environmental aspects of this Project.

6.1 Legislative Framework

The Project is required to be carried out in compliance with the South African environmental regulatory framework, which establishes well-defined requirements and standards for environmental and social management of industrial and civil infrastructure developments. A review of the legislative framework was done to develop an environmental approval or permitting strategy for the various components of the route alignment. An overview of potentially applicable South African legislation is contained in

Table 6-1. Key legislation and regulations are described in more detail in Table 6-2.

Table 6-1: Overview of Applicable Legislation

Category	Legislation
Overarching	• The Constitution of the Republic of South Africa (Act no. 108 of 1996) (the Constitution) • National Environmental Management Act (Act 107 of 1998), as amended (NEMA) • NEMA: Environmental Impact Assessment (EIA) Regulations, 2014 (Government Notice Regulation [GNR] 982) • Listing Notice 1 of 2014 (GNR 983) • Listing Notice 2 of 2014 (GNR 984) • Listing Notice 3 of 2014(GNR 985)
Air	• National Environmental Management: Air Quality Act (Act 39 of 2004), as amended (NEM:AQA). • NEM:AQA: Listed Activities and associated Minimum Emission Standards, GNR 893 (12 June 2015) • NEM:AQA: National Dust Control Regulations, GNR 827 (1 November 2013) • NEM:AQA: National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5micron meters (PM2.5), GNR 486 (29 June 2012) • NEM:AQA: National Ambient Air Quality Standards, GNR 1210 (24 December 2009). • Climate Change Bill, GN 580 (2018)
Waste	• National Environmental Management: Waste Act (Act 59 of 2008), as amended (NEM:WA). • NEM:WA: List of Waste Management Activities that have, or are likely to have, a Detrimental Effect on the Environment, GNR 921 (29 November 2013) • NEM:WA: National Norms and Standards for the Storage of Waste, GNR 926 (29 November 2013) • NEM:WA: Waste Classification and Management Regulations, GNR 634 (23 August 2013) • NEM:WA: National Norms and Standards for the Assessment of Waste for Landfill Disposal, GNR 635 (23 August 2013) • NEM:WA: National Norms and Standards for Disposal of Waste to Landfill, GNR 636 (23 August 2013).
Water	• National Water Act (Act 36 of 1998), as amended (NWA). • NWA: Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals, GNR 267 (24 March 2017) • NWA: General Authorisation in terms of Section 39 of the NWA for Water Uses as defined in section 21(c) or section 21(i), GNR 509 (26 August 2016) • NWA: Revision of General Authorisations in terms of Section 29 of the NWA, GNR 665 (6 September 2013).
Biodiversity	• National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA). • National Forests Act (No. 84 of 1998) • National Environmental Management: Protected Areas Act (Act 57 of 2003) (NEM:PA). • NEMA: Draft National Biodiversity Offset Policy, GNR 276 (31 March 2017) • NEM:BA: Alien and Invasive Species Regulations, GNR 598 (1 August 2014) • NEM:BA: Alien and Invasive Species List, GNR 599 (1 August 2014) • NEM:BA: Publication of Prohibited Alien Species, GNR 508 (19 July 2013) • NEM:BA: Publication of Exempted Alien Species, GNR 509 (19 July 2013) • Biodiversity Policy and Strategy for South Africa: Strategy on Buffer Zones for National Parks (8 February 2012) (GNR 106 of 2012)
Heritage	• National Heritage Resources Act (Act 25 of 1999) (NHRA)
Noise	• Noise Control Regulations in terms of Section 25 of the Environment Conservation Act (Act No. 73 of 1989), GNR 154 (10 January 1992).
Other	• Gauteng Transport Infrastructure Act (Act 8 of 2001) (GTIA). • Gauteng Provincial Environmental Management Framework (GPEMF) • Various Municipal by-laws

6.2 Applicable Environmental Legal Requirements

The Project requires various authorisations under multiple pieces of legislation, such as NEMA, NWA, NHRA, and potentially others, which are crucial for integrated environmental management. These Acts set forth criteria that must be satisfied before any construction can commence, or clearing of land can begin. This section outlines the environmental legislation requirements likely applicable to the Project activities (Table 6-2). It is crucial to note that as the Project scope becomes clearer in future stages, a more detailed review of the specific permitting and licensing requirements will be necessary (which is also further refined by consultation with the relevant authorities during the environmental authorisation process). This will ensure that all legal obligations are met and that the Project proceeds in compliance with all relevant (i.e. amended, newly promulgated, etc.) environmental laws and standards.

Table 6-2: Potential Environmental Legal and Permitting Requirements for the Project

Legislation	Potential Legislation Trigger/Activity	Applicability
The Constitution of the Republic of South Africa, Section 24 (Environmental Right)	Everyone has the right: **(a)** To an environment that is not harmful to their health or well-being; and (b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that: **(i)** Prevent pollution and ecological degradation; **(ii)** Promote conservation; and **(iii)** Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.	Given the development and its potential environmental impacts, it is essential to uphold the provisions of the Constitution. By applying the principles of Duty of Care and conducting a comprehensive EIA for the Project, these constitutional provisions will be effectively addressed.
National Environmental Management Act (NEMA)	The NEMA provides for the overarching environmental legislative framework for South Africa. It provides a framework for cooperative environmental governance, aiming to ensure that environmental management is integrated and coordinated across different sectors and levels of government. It establishes principles for decision-making on matters affecting the environment, promotes public participation, and sets out procedures for coordinating environmental functions exercised by various state organs, enforcing Section 24 of the South African Constitution (above). Section 24(2) and 24D of NEMA requires Environmental Authorisation (EA) to be obtained for certain activities identified in GNR 983 (GNR 984 (Listing Notice 2) and GNR 985 (Listing Notice 3). The procedure for obtaining EA for a Listing Notice 1 and 3 activities will require a Basic Assessment (BA) process (approximately one year) to inform the application for authorisation whereas the procedure for obtaining EA for a Listing Notice 2 activities will require a Scoping and Environmental Impact Reporting (S&EIR) process (approximately 18 months). The NEMA EIA Regulations (GNR 982) detail the process to be followed. It should be noted that if any Listing Notice 2 activities are triggered, as well as Listing Notice 1 and 3 activities, an S&EIR process will be required, and all activities will be included in the application.	Given the nature of the project and the activities triggered (see below), a formal S&EIR process is required for the Project to obtain EA. The Department of Forestry, Fisheries and Environment (DFFE) will be the Competent Authority (CA) responsible for granting the EA.
	EIA Regulations Listing Notice 1 Activities (GN 983, as amended 7 April 2017) requiring a Basic Assessment	
	Activity 11: The development of facilities or infrastructure for the transmission and distribution of electricity- **(i)** outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or **(ii)** inside urban areas or industrial complexes with a capacity of 275 kilovolts or more; excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is - **(a)** temporarily required to allow for maintenance of existing infrastructure; **(b**) 2 kilometres or shorter in length; **(c)** within an existing transmission line servitude; and **(d)** will be removed within 18 months of the commencement of development.	This activity may be triggered should any substations and transmission lines with a distribute capacity of 275 kilovolts or more be developed as part of the Project (cognisance should be taken of the activity exemptions in terms of the GPEMF).
	Activity 12 (ii): The development of infrastructure or structure with a physical footprint of 100 square metres or more; where such development occurs – **(a)** within a watercourse **(b)** in front of a development setback; or **(c)** if no development setback exists, within 32m of a watercourse.	This activity may be triggered should infrastructure or structures exceeding 100 square metres be developed within 32 metres of a water course.

Legislation	Potential Legislation Trigger/Activity	Applicability
	Activity 14: The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80m^3 or more but not exceeding 500m^3.	This activity may be triggered should there be storage of dangerous goods such as fuel/diesel with a combined capacity of 80m^3 to 500m^3 (cognisance should be taken of the activity exemptions in terms of the GPEMF).
	Activity 19: The infilling or depositing of any material of more than 10 m^3 into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving -**(c)** falls within the ambit of Activity 21 in this Notice, in which case that activity applies;	This activity may not be triggered in Activity 21 is triggered. If Activity 21 I not triggered, then this activity will likely be triggered.
	Activity 21: Any activity including the operation of that activity which requires a mining permit in terms of section 27 of the MPRDA, as well as any other applicable activity as contained in this LN or LN 3, required to exercise the mining permit.	This activity will may be triggered as borrow pits are likely to be required during the construction phase.
	Activity 27: The clearance of 1 - 20 hectares (ha) of indigenous vegetation	This activity will be triggered as more than 1ha of indigenous vegetation will be cleared for the development of the Project.
	Activity 30: Any process or activity identified in terms of section 53(1) of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).	This activity may be triggered and will be determined by the relevant specialist assessments during the EIA process.
	Activity 34: The expansion of existing facilities or infrastructure for any process or activity where such expansion will result in the need for a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the release of emissions, effluent or pollution.	This activity may be triggered if an AEL is required.
	Activity 64: The expansion of railway lines, stations or shunting yards where there will be an increased development footprint, excluding- **(i)** railway lines, shunting yards and railway stations in industrial complexes or zones; **(ii)** underground railway lines in mines; or **(iii)** additional railway lines within the railway line reserve.	This activity will be triggered as the Project ties into existing stations and railway lines (and is considered an expansion of the existing Gautrain railway project. Additional components of this Activity may also be triggered (cognisance should be taken of the activity exemptions in terms of the GPEMF).
	EIA Regulations Listing Notice 2 Activities (GN 984, as amended 7 April 2017) requiring an Environmental Impact Assessment	
	Activity 6: The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent.	This activity may be triggered if an AEL is required.

Legislation	Potential Legislation Trigger/Activity	Applicability
	Activity 12: The development of railway lines, stations or shunting yards excluding - **(i)** railway lines, shunting yards and railway stations in industrial complexes or zones; **(ii)** underground railway lines in a mining area; or **(iii)** additional railway lines within the railway line reserve.	This activity will be triggered as new railway lines are being developed.
	Activity 15: The clearance of an area of 20 ha or more of indigenous vegetation.	This activity may be triggered if more than 20ha of indigenous vegetation will be cleared for the development of the Project.
	Activity 24: The extraction or removal of peat or peat soils, including the disturbance of vegetation or soils in anticipation of the extraction or removal of peat or peat soils, but excluding where such extraction or removal is for the rehabilitation of wetlands in accordance with a maintenance management plan.	This activity may be triggered in areas where the railway lines cross watercourses.
	EIA Regulations Listing Notice 3 Activities (GN 985, as amended 7 April 2017) requiring a Basic Assessment	
	Activity 8: The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 m^3 **c. Gauteng – (applicable subsections)** **(ii)** National Protected Area Expansion Strategy Focus Areas; **(iii)** Gauteng Protected Area Expansion Priority Areas; **(iv)** Sites identified as Critical Biodiversity Areas (CBAs) or Ecological Support Areas (ESAs) in the Gauteng Conservation Plan or in bioregional plans**; (v)** Sites identified within threatened ecosystems listed in terms of the NEM:BA; **(vi)** Sensitive areas identified in an environmental management framework adopted by the relevant environmental authority; **(vii)** Sites identified as high potential agricultural land in terms of Gauteng Agricultural Potential Atlas; **(ix)** Sites managed as protected areas by provincial authorities, or declared as nature reserves; **(x)** Sites designated as nature reserves in terms of municipal Spatial Development Frameworks; **(xi)** Sites zoned for conservation use or public open space or equivalent zoning.	This activity may be triggered should there be storage of dangerous goods such as fuel/diesel with a combined capacity of 30 m^3 to 80 m^3.
	Activity 12: The clearance of an area of 300 m^2 or more of indigenous vegetation - **c. Gauteng - (applicable subsections)** **(i)** Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; **(ii)** Within Critical Biodiversity Areas or Ecological Support Areas identified in the Gauteng Conservation Plan or bioregional plans; or **(iii)** On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.	This activity is likely to be triggered due to the presence of CBAs and ESAs and will be determined by the relevant specialist assessments during the EIA process.
	Activity 14: The development of— (ii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs **(a)** within a watercourse; **(b)** in front of a development setback; or **(c)** if no	This activity will be triggered as the infrastructure or structures will exceed a physical footprint of 10 m^2 or more, and in

Legislation	Potential Legislation Trigger/Activity	Applicability
	development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse. **c. Gauteng – (applicable subsections)** **(ii)** National Protected Area Expansion Strategy Focus Areas; **(iii)** Gauteng Protected Area Expansion Priority Areas; **(iv)** Sites identified as Critical Biodiversity Areas (CBAs) or Ecological Support Areas (ESAs) in the Gauteng Conservation Plan or in bioregional plans; **(v)** Sites identified within threatened ecosystems listed in terms of the NEM:BA; **(vi)** Sensitive areas identified in an environmental management framework adopted by the relevant environmental authority; **(vii)** Sites or areas identified in terms of an international convention; **(viii)** Sites managed as protected areas by provincial authorities, or declared as nature reserves in terms of the Nature Conservation Ordinance (Ordinance 12 of 1983) or the NEMPAA; **(ix)** Sites designated as nature reserves in terms of municipal Spatial Development Frameworks; or **(x)** Sites zoned for conservation use or public open space or equivalent zoning.	some instances will be developed within 32 metres of a water course.
Air Quality Act (NEM:AQA)	The NEM:AQA is the main legislature for the management of air pollution and related activities. Section 21 of the NEM:AQA requires persons conducting certain activities (referred to as listed activities) to apply for an atmospheric emission licence (AEL) to ensure that emissions are controlled and monitored. It is unlikely that any listed activity will be triggered by the Project, and therefore it is not anticipated that an AEL will be required. However, if emergency power generators are included in the project, and these generators are larger than 10 MW energy input (Category 1 – Subcategory 1.5: Reciprocating Engines), an AEL would be required for these power generating units. While an AEL may not be required, the Project must remain within acceptable ambient air quality limits and adhere to the associated air quality standards, namely: • National Ambient Air Quality Standards in terms of section 9(1) of the NEM:AQA (24 December 2009). • National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5-micron metres (PM2.5) in terms of section 9(1) of the NEM:AQA (29 June 2012). • National Dust Control Regulations (GNR 827 of 2013).	At this stage, an AEL is not anticipated; however, once the final Project description is available in future phases, the need for an AEL can be confirmed. It is essential to remain vigilant and consult with relevant authorities throughout the environmental authorization process. This ensures that any additional criteria or unexpected requirements are quickly identified and addressed, ensuring full compliance with all applicable environmental regulations. During future phases, Environmental Design Criteria will be developed which will illustrate the relevant standards that are to be adhered to for ambient air quality and dustfall, particularly during construction.
National Water Act (NWA)	The NWA guides the management of water in South Africa as a common resource. Water use permitting forms an integral part of the NWA. In terms of Section 22 of the NWA, no person may undertake a water use as set out in Section 21 of the NWA (water use) without obtaining a Water Use License (WUL). The Department of Water and Sanitation (DWS) is the authority mandated to manage South Africa's water resources and watercourses. The NWA identifies eleven (11) water use activities that require regulatory approval or registration from the Department of Water and Sanitation. In terms of the NWA, "water resource" includes a watercourse, surface water, estuary, or aquifer.	WUL for various water uses will be required for this Project. The National DWS will be responsible for awarding the WUL in terms of the NWA. The potential listed water uses have been identified in the rows below. In addition to obtaining WUL for certain activities, GA may also be applicable to the

Legislation	Potential Legislation Trigger/Activity	Applicability
	Further to the WUL, a General Authorisation (GA) under NWA allows individuals or entities to use water without needing a specific licence, provided the water use falls within certain limits and conditions set out in the authorisation. GA's require registration with DWS before the water use can commence. This ensures that the water use is monitored and managed effectively to prevent overuse and protect water resources.	Project. This can be confirmed once the formal Project description has been developed in future phases.
	Section 21 Water Uses in terms of the NWA	
	(c) impeding or diverting the flow of water in a watercourse	These water uses will likely be triggered due to watercourses and wetlands (within 500 m) present in the Project area which may be impacted upon by Project activities.
	(i) altering the bed, banks, course or characteristics of a watercourse	
	(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	This water use may be triggered, particularly for cut and cover and underground tunnel construction and operation.
Mineral and Petroleum Resources Development Act (MPRDA)	The purpose of the MPRDA is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources; and to provide for matters connected therewith. This Act falls under the Department of Mineral Resources and Energy (DMRE). The relevance of this Act includes, amongst others, the possible sourcing of construction material (e.g., borrow pits). A borrow pit requires a mining permit, which is provided for in Section 27 of the MPRDA. The holder of a mining permit is authorised to access the land specified in the permit, bringing along any necessary equipment and constructing required surface or underground infrastructure for mining activities. Additionally, the permit holder can utilise water from natural sources on or flowing through the land, or create wells or boreholes, to support their mining operations (subject to the NWA). A borrow pit permit ensures that the borrow pit operations comply with environmental management plans and other regulatory requirements to minimise environmental impact. It also involves public participation and consultation with affected parties to address any concerns related to the proposed borrow pit. The DFFE has taken on a more significant role in overseeing environmental aspects of mining activities under the NEMA. Mining permits required for borrow pits are included in Activity 21 of Listing Notice 1 of the EIA Regulations for which a BA process is required to be followed to obtain Environmental Authorisation.	Borrow pits are likely to be required for the construction phase and therefore borrow pit permits will likely be required. However, Activity 21 of Listing Notice 1 of the NEMA EIA Regulations mandates the Competent Authority (the DFFE) to grant an Environmental Authorisation for mining related activities previously under the umbrella of the MPRDA.
National Heritage Resources (NHRA)	The NHRA aims to promote good management of the national estate, and to enable and encourage communities to nurture and conserve their legacy so that it may be bequeathed to future generations. In terms of the NHRA, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit. Section 34, 35, 36, 37 and 38 of the NHRA provides a list of development activities that require a HIA and associated approval from the South African Heritage Resources Agency (SAHRA). A Phase 1 HIA will need to be undertaken to determine whether a heritage resource will be impacted upon by the proposed	A comprehensive HIA will be required under Section 38(1) of the Heritage Act, including heritage structure evaluations and assessments. Heritage permits may also be required from SAHRA if heritage resources are to be affected (Section 34-37). A Chance Find Procedure will need to be developed.

Legislation	Potential Legislation Trigger/Activity	Applicability
	development. Approval will then be required from the SAHRA should a heritage resource be discovered. • Section 34 protects structures older than 60 years. Any alterations or demolitions require a permit from the relevant heritage authority. • Section 35: Addresses the protection of archaeological and palaeontological sites, as well as meteorites. Excavation or removal of these resources also requires a permit. • Section 36: Focuses on graves and burial grounds, including those of cultural significance. It mandates permits for any disturbance or relocation. • Section 37: Deals with public monuments and memorials, ensuring their protection and proper management. • As per Section 38 (1) Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as **(a)** the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.	
National Environmental Management: Biodiversity (NEM:BA)	The NEM:BA provides for the management and conservation of South Africa's biodiversity within the framework of the NEMA as well as the protection of species and ecosystems that warrant national protection. Within the framework of this act, various regulations are promulgated which provide specific requirements and management measures relating to protecting threatened ecosystems, threatened or protected species as well as the control of alien and invasive species. Ecosystems that are threatened and in need of protection are defined in NEM:BA Government Notice 2747 of 2022. Threatened and protected terrestrial species and freshwater species are included in NEM:BA Government Notice 3009 of 2023, which provide for the management of threatened and protected species. Similarly, NEM:BA Government Notice 3012 of 2023 provides for the list of terrestrial species and freshwater species that are threatened or protected, restricted activities that are prohibited, and restricted activities that are exempted. The potential restrictive activities that may apply for the Project under this Act includes Section 57 **(1):** A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.	Permits and rescue and relocation plans may be required should a specimen of a listed threatened or protected species be identified in the Project area.
National Forest Act (NFA)	The NFA emphasises sustainable forest management and highlights how communities can utilise forests sustainably without destroying them. The Act sets out rules for protecting indigenous forests, as well as listing specific tree species that require protection. The Minister, under Section 15(3), is required to publish a list a list of all species protected declared under Section 12. The potential restrictive activities that may apply for the Project under this Act includes Section 15 **(1):** No person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected	A permit may be required from the DFFE for the cutting, disturbing, damaging or destruction of any Protected Tree or the removal and relocation of any Projected Tree should these be identified in the Project area.

Legislation	Potential Legislation Trigger/Activity	Applicability
	tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated.	
National Biodiversity Offset Guidelines (BOG)	The National Biodiversity Offset Guideline (BOG) was officially published under section 24J of the NEMA on 23 June 2023. The BOG provides a framework for implementing biodiversity offsets in South Africa, ensuring that significant residual impacts on biodiversity are counterbalanced after all efforts to avoid, minimise, and rehabilitate those impacts have been exhausted. It outlines principles such as the mitigation hierarchy, which emphasises that offsetting should only be considered after all other mitigation measures have been applied. It provides procedures for assessing residual impacts, conducting biodiversity surveys, and securing suitable offset sites for long-term conservation. Legal mechanisms include the declaration of protected areas, conservation servitudes, and purchasing credits from a recognised biodiversity offsets bank. For the Project, restrictive activities under this guideline include identifying significant residual impacts and ensuring they are appropriately offset through calculated measures and secured sites, supported by a Biodiversity Offset Management Plan.	Biodiversity offsets may be required if significant residual impacts on biodiversity are identified in the Project area. This involves conducting biodiversity assessments, calculating necessary offsets, and securing suitable offset sites for long-term conservation.
National Environmental Management: Waste (NEM:WA)	The aim of the NEM:WA, is to reform the law regulating waste management in South Africa, and to provide reasonable measures for pollution prevention resulting from waste activities. In terms of section 19(1) of the NEM:WA, the Minister, in GNR 921, published a list of waste management activities that have, or are likely to have a detrimental effect on the environment. In terms of section 20(b) of the NEM:WA no person may commence, undertake or conduct a waste management activity, except in accordance with a Waste Management License (WML) issued in respect of that activity, if a license is required. GNR 921 differentiates between Category A, Category B and Category C waste management activities. Category A waste management activities are those which require the conducting of a BA process as stipulated in the GNR 982 to obtain a WML. Category B waste management activities are those that require the conducting of an S&EIR process stipulated in the GNR 982 of 2013 as part of the WML application. Category C waste management activities require that specific National Norms and Standards be applied and complied with, without the need to undertake an EA (BA or S&EIR) process. It is unlikely that any waste will be recycled, recovered, treated or incinerated at a GMA-owned facility; it is likely that the wastes generated during either construction or operation will be temporarily stored before being removed by a waste contractor for further management (i.e. recycling, disposal, incineration, etc.). However, cognisance must be taken of the final management of the Tunnel Boring Machine , as it is understood that the machine remains underground following construction activities. This could be defined as a waste and disposal of waste to ground, which may trigger the requirement for a WML.	A Category A WML will likely be required for the Project; however, if the volume or nature of the waste exceeds certain thresholds, it may trigger Category B activities, necessitating a more stringent WML administration process (i.e. S&EIR as opposed to a BA process).
	Category A Activities (GNR 921 of 2013, amended in 2022) requiring a Basic Assessment Process	
	Activity 10: The disposal of general waste to land covering an area of more than 50m^2 but less than 200m^2 and with a total capacity not exceeding 25 000 tons.	The classification of the Tunnel Boring Machine will need to be confirmed. If

Legislation	Potential Legislation Trigger/Activity	Applicability
		deemed a waste, and if the activity of abandoning the machine should be deemed as disposal, this activity will be triggered requiring a WML.
	Category C Activities (GNR 921 of 2013, amended in 2022) requiring compliance with the National Norms and Standards	
	Activity 1: The storage of general waste at a facility that has the capacity to store in excess of 100 m^3 of general waste at any one time, excluding the storage of waste in lagoons or temporary storage of such waste.	Should any facility be constructed that has the capacity to store more than 100 m^3 of general waste or more than 80 m^3 of hazardous waste, the Norms and Standards for the Storage of Waste (GNR 926 of 2013) must be complied with.
	Activity 2: The storage of hazardous waste at a facility that has the capacity to store in excess of 80 m^3 of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons or temporary storage of such waste.	
	Category C Activities (GNR 921 of 2013, amended in 2022) requiring compliance with the National Norms and Standards	
	Activity 1: The storage of general waste at a facility that has the capacity to store in excess of 100 m^3 of general waste at any one time, excluding the storage of waste in lagoons or temporary storage of such waste.	Should any facility be constructed that has the capacity to store more than 100 m^3 of general waste or more than 80 m^3 of hazardous waste, the Norms and Standards for the Storage of Waste (GNR 926 of 2013) must be complied with.
	Activity 2: The storage of hazardous waste at a facility that has the capacity to store in excess of 80 m^3 of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons or temporary storage of such waste.	
	Activity 6: The sorting, shredding, grinding, crushing, screening or baling of general waste at a waste facility that has an operational area that is 1,000 m^2 and more.	Should any facility be constructed for the sorting, screening or bailing of general waste in an area exceeding 1,000 m^2 the Norms and Standards for the Sorting, Shredding, Grinding, Crushing, Screening or Baling of General Waste (GN 1094 of 2017) must be complied with.
Gauteng Transport Infrastructure Act (GTIA)	The GTIA aims to provide a comprehensive framework for the planning, development, and management of transport infrastructure in Gauteng, South Africa. Its primary objectives include ensuring efficient and effective transport infrastructure to support economic growth, promoting sustainable development by integrating environmental considerations, facilitating public participation in decision-making processes, and regulating the construction and maintenance of provincial roads, railway lines, and other transport infrastructure to ensure safety and reliability. Part 2, Section 6 of the Act outlines the procedures for determining the routes of provincial roads and railway lines. The MEC (Member of the Executive Council) requires a preliminary route alignment report, which includes recommendations for the route. This report must follow a prescribed format and contain specific details about the proposed route. Before finalising the route, the GMA must conduct an	The nature of the Project triggers this requirement. The Environmental Investigation and Report (EIR – this Report) is a crucial component of the route determination process, which aims to ensure that environmental considerations are integrated into the planning and development of transport infrastructure, promoting sustainable development and minimising negative environmental impacts.

Legislation	Potential Legislation Trigger/Activity	Applicability
	environmental investigation and prepare a report. This investigation must comply with the relevant environmental requirements. A notice containing a broad description of the route, details on where the preliminary route and environmental reports can be inspected, and an invitation for public comments must be posted.	
Gauteng Environmental Management Framework	The Gauteng Provincial Environmental Management Framework (GPEMF) is a strategic tool designed to provide a framework in which sustainable development and environmental management in the Gauteng Province is guided. Commissioned by the Gauteng Department of Agriculture and Rural Development (GDARD), it provides a structured approach to managing land use and environmental resources, helping to maintain ecological balance while supporting economic growth. In terms of the GPRMF, the province is divided into different zones, each with specific guidelines for development, which include: • Zone 1: Urban Development Zone, to support high-density residential, commercial and industrial development • Zone 2: Agricultural Zone, to protect agricultural land and promote sustainable farming practices • Zone 3: Conservation Zone, to preserve natural habitats, biodiversity and ecological processes • Zone 4: Mixed-use Zone, to allow a combination of residential, commercial and light industrial activities • Zone 5: Industrial Zone, to support heavy industrial activities while managing environmental impacts • Zone 6: Rural Development Zone, to support low-density residential and small-scale commercial activities in rural area • Zone 7: Special Management Zone, to address areas with unique environmental or cultural significance. Section 13 of the GPEMF pertains to the GPEMF Standard which was developed in terms of Section 24(2)(d) of the NEMA and contain a total of 30 activities which have been excluded from obtaining Environmental Authorisation in terms of the NEMA EIA Regulations (26 activities from Listing Notice 1 and four from Listing Notice 2), when developing in Zone 1 and Zone 5. This is as a result of the environmental impacts of the excluded activities being relatively well known and understood and can be adequately mitigated through compliance with the Standard and Environmental Management Specifications (EMS), enabling and building a more efficient, effective and proactive environmental management regime in Gauteng. The listed activities excluded from Environmental Authorisation are defined in the "Adoption of Gauteng Provincial Environmental Management Framework Standard and exclusion of associated activities from the requirement to obtain environmental authorisation in terms of sections 24(2)(d) and 24(10) read with section 24(10)(d) of the National Environmental Management Act, for the implementation of the Gauteng Provincial Environmental Management Framework", gazetted in March of 2018. The gazette also includes specific EMS that need to be complied with when developing in Zone 1 and Zone 5. The following listed activities are excluded from Zone 1:	The GPEMF is essential for guiding the sustainable development of the Project. By aligning with the GPEMF, the GRRIN Project aims to provide efficient, low-carbon, and climate-resilient transport infrastructure while protecting Gauteng's environmental and cultural heritage. The applicability of the GPEMF to the GRRIN Project is underscored by the Screening Tool findings, which identified various environmental sensitivities across the proposed route alignments and station locations. The Project falls largely within Zone 1 and Zone 5 of the GPEMF. These zones support urban development and promote densification, making them ideal for the GRRIN Project's stations and rail lines. Certain EIA listing notice activities identified under the NEMA section above for the Project may be exempt from the requirement to obtain Environmental Authorisation within Zones 1 and 5. These exemptions, as outlined in the GPEMF, can streamline the approval process for specific activities, ensuring timely implementation while maintaining high environmental standards. By identifying appropriate, inappropriate, and conditionally compatible activities in these zones, the GPEMF helps the GRRIN Project navigate regulatory requirements efficiently. Nonetheless, any excluded activity must adhere to the applicable minimum standards. These standards are designed to ensure that even excluded activities adhere

Legislation	Potential Legislation Trigger/Activity	Applicability
	• **Listing Notice 1:** Activity 6, Activity 9, Activity 10 (only relating to bulk transportation of sewage in Zone 1), Activity 11, Activity 13, Activity 27, Activity 28(i), Activity 44, Activity 45, Activity 46 (only relating to bulk transportation of sewage in Zone 1), Activity 47, Activity 50, Activity 56, Activity 57, Activity 63, Activity 64 and Activity 66. • **Listing Notice 2:** Activity 9 and Activity 11. The following listed activities are excluded from Zone 5: • **Listing Notice 1:** Activity 6, Activity 9, Activity 10, Activity 11, Activity 13, Activity 14, Activity 25, Activity 27, Activity 28(i), Activity 36, Activity 38, Activity 39, Activity 40, Activity 41, Activity 43, Activity 44, Activity 45, Activity 46, Activity 47, Activity 50, Activity 51, Activity 56, Activity 57, Activity 63, Activity 64 and Activity 66. • **Listing Notice 2:** Activity 4, Activity 7, Activity 9 and Activity 11. It must be noted that although no Environmental Authorisation in terms of the NEMA may be required, a Registration Form must still be submitted to the Competent Authority as well as the DFFE Screening Tool. The Competent Authority will review the submission and either approve or reject the application,	to principles of environmental protection and sustainable development.
Green Transport Strategy	According to South Africa's 2018 Low Emission Development Strategy, the focus in the transport sector has been more on mitigating climate change impacts rather than on adaptation and resilience. The sector's vulnerability is tied to physical infrastructure like buildings, pipelines, roads, and railways. Future measures are needed to enhance the resilience of this infrastructure. To address this, the Department of Transport launched the Green Transport Strategy (GTS) in 2018. This strategy aims to create an environmentally friendly transport system that supports economic growth and job creation. The transport sector is the fastest-growing source of greenhouse gas emissions in South Africa, contributing 10.8% of the country's total emissions, with road transport responsible for 91.2% of that. The GTS aims to reduce greenhouse gas emissions and other environmental impacts from transportation by 5% by 2050. It also seeks to support the transport sector's contribution to social and economic development while promoting green alternatives to reduce harmful emissions. The GTS proposes constructing low-carbon and climate-resilient transport infrastructure, developing strategies for climate resilience in urban and rural transit planning, and creating standards for climate-resilient construction materials.	The Project contributes to this strategy as it aims to shift passenger transport from private cars to public and eco-mobility options, contributing to low-carbon and climate-resilient infrastructure.
Climate Change Bill	The Climate Change Bill aims to establish an effective climate change response and ensure a just transition to a climate-resilient and lower-carbon economy and society. This will be achieved within the framework of sustainable development, addressing all matters related to climate change. The Bill recognises that anthropogenic climate change poses a critical threat to society and the environment, necessitating a well-coordinated and comprehensive response. It highlights the potential destabilising effects of local climate change impacts on the country's development goals and underscores the need for a legislative framework to implement the national climate change response. The Bill also addresses institutional and coordination arrangements across national, provincial, and local government levels. It emphasises the importance of responses from all spheres of government, entities, sectors, and businesses to tackle climate change challenges. Additionally, it covers national	The Project implementation requires the GMA to collaborate with all levels of government to deliver a unified response to climate change. This entails addressing climate impacts associated with the Project to improve adaptive capacity, bolster resilience, and reduce vulnerability at every stage. Adhering to the Bill will ensure the project supports South Africa's climate

<table>
<tr><th>Legislation</th><th colspan="3">Potential Legislation Trigger/Activity</th><th>Applicability</th></tr>
<tr><td></td><td colspan="3">adaptation to climate change impacts, greenhouse gas emissions and removals, and policy alignment and institutional arrangements.
The objectives of the Bill include providing a coordinated and integrated response to climate change and its impacts by all spheres of government, in line with cooperative governance principles; effectively managing inevitable climate change impacts by enhancing adaptive capacity, strengthening resilience, and reducing vulnerability, thereby building social, economic, and environmental resilience and ensuring an adequate national adaptation response; and contributing fairly to the global effort to stabilise greenhouse gas concentrations in the atmosphere, avoiding dangerous anthropogenic interference with the climate system, while enabling sustainable economic, employment, social, and environmental development.</td><td>objectives and fosters sustainable development.</td></tr>
<tr><td>Municipal By-laws</td><td colspan="3">It is important to note that various by-laws of the municipalities within the Project areas may be applicable to this Project. While we will not delve into the specific requirements at this stage, it is essential to acknowledge their relevance. These by-laws are designed to regulate and manage various aspects of municipal governance and public welfare, ensuring that development projects align with local standards and contribute positively to the community. Understanding and complying with these by-laws will be critical as the Project progresses in future phases. They will help ensure that the development is sustainable, minimises environmental impact, and meets the needs of the local population. As GMA moves forward with the future EA process, and as the Project description becomes more defined, a thorough review of these by-laws should be conducted to identify specific requirements and ensure that all necessary authorisations and compliance measures are considered.
The by-laws of the City of Johannesburg, City of Tshwane, and Mogale City Local Municipality that could directly and/or indirectly impact this Project include, but may not be limited to those for:</td><td>Various by-laws of the City of Johannesburg, City of Tshwane, and Mogale City Local Municipality will be applicable to the Project.</td></tr>
<tr><td></td><td>• Air Pollution Control
• Bioregional Plans
• Environmental Health
• Nuisances, like noise control</td><td>• Parking Grounds
• Solid Waste Management
• Spatial planning and Land Use
• Storm Water Management</td><td>• Urban Greening and Biodiversity
• Water Services</td><td></td></tr>
</table>

6.3 Environmental Authorisation for the Project

6.3.1 Integrated Environmental Approvals Process

In accordance with the NEMA, EIA Regulations and Listing Notices, the triggering of Listing Notice 2 activities necessitates a comprehensive Scoping and Environmental Impact Report (S&EIR) process to obtain Environmental Authorisation. In summary, the S&EIR process to authorise this Project includes:

- **Application Submission:** The process starts with submitting an application for environmental authorisation (EA), including a description of the Project and its potential impacts (Chapter 4, Part 1 of EIA Regulations)
- **Scoping Report:** A Scoping Report is prepared to identify key environmental issues and potential impacts. This report outlines the scope of the EIA and includes a plan of study for the EIA (Chapter 4, Part 3, and Appendix 3)
- **Public Participation:** Public participation is conducted to gather input from interested and affected parties, ensuring transparency, and considering public concerns and suggestions (Chapter 6)
- **Specialist Reports:** Specialist reports are prepared to provide detailed assessments on specific environmental aspects. These reports are crucial for understanding the potential impacts and proposing mitigation measures (Appendix 6)
- **Environmental Impact Assessment Report:** The EIA Report is developed based on the findings from the scoping phase and specialist reports. It includes detailed assessments of the potential environmental impacts, proposed mitigation measures, and alternatives to the Project (Appendix 3), including an Environmental Management Programme (EMPr) (Appendix 4)
- **Review and Decision:** The competent authority reviews the EIA Report and other submitted documents. They may request additional information or revisions. A decision is then made to either grant or refuse EA (Chapter 4, Part 3)
- **Environmental Authorisation:** If the Project is approved, an EA is issued, outlining the conditions under which the Project can proceed (Chapter 4, Part 3).

In addition to the S&EIR process, additional specific permits and licenses are likely to be required. Based on the findings of the legislative review in Table 6-2, the table below provides a summary of the various permits, licenses, and authorisations that may be required for the Project (Table 6-3).

It includes information on the relevant licensing authority, process required, and the anticipated timeframes for completing the application process. This summary is intended to facilitate an understanding of the regulatory requirements and timelines involved, promoting for necessary approvals to be obtained in a timely and efficient manner.

Table 6-3: List of Applicable Environmental Permits and Licenses[22]

Aspect/Trigger		Approval Required	Process	Competent Authority(s)	Timeframe (minimum)
1	Triggering NEMA EIA Listing notice 2 activities.	Environmental Authorisation in terms of the NEMA	S&EIR	• DFFE • GDARD	18 months
2	Inclusion of emergency power generators that are larger than 10 MW energy input.	AEL in terms of NEM:AQA	• AEL Application • Air Quality Impact Assessment as part of the S&EIR	• DFFE • City of Johannesburg • City of Tshwane • Mogale City Local Municipality	18 months (90 days following receipt of the EA from DFFE)
3	General Air Quality	No permit required, but require compliance in terms of the National Dust Control Regulations and National Ambient Air Quality Standards	Adherence to regulatory limits	• Provincial and Local Municipalities	N/A
4	Triggering water uses 21 c and i (and possibly j)	WUL in terms of the NWA	WUL Application (WULA)	Department of Water and Sanitation	12 months
5	General Authorisations of Water Uses	GA in terms of the NWA	GA Application	Department of Water and Sanitation	6 months
6	Extracting soil for construction purposes and borrow pits (likely) required during the construction phase.	Environmental Authorisation in terms of the NEMA	BA Process (included in the S&EIR Process)	DFFE (Department of Minerals, Resources and Energy being a Commenting Authority)	18 months
7	Waste disposal associated with the abandonment of the Tunnel Boring Machine	WML in terms of NEM:WA	• WML Application • Basic Assessment (Cat A) • S&EIR (Cat B)	DFFE (as a combined S&EIR process will be proposed)	18 months
8	Waste storage or bailing / sorting / screening of general waste	Compliance with the National Norms and Standards in terms of the NEM:WA	• National Norms and Standards	GDARD	Within 90 days prior to commencing the activity
9	If any species listed under the	• Threatened or Protected	• Relevant biodiversity	• DFFE	6 months

[22] Please note that compliance to by-laws were not assessed as the level of detail to confirm applicability is not available at this stage.

Aspect/Trigger		Approval Required	Process	Competent Authority(s)	Timeframe (minimum)
	NEMBA or the NFA are impacted, or need to be removed or moved	Species (TOPS) permit • Permits for removal or destruction of SCCs • Removal of protected trees permit	permit applications • Relevant biodiversity specialist assessments as part of the S&EIR		
10	Impact on Heritage Resources	Approval in terms of the NHRA	• Heritage Permit application • HIA as part of the S&EIR	• Provincial Heritage Resources Authority – Gauteng (PHRA-G) or SAHRA (depending on significance)	Obtained as part of S&EIR
11	Noise	No permit	Adherence to regulatory and municipal noise level requirements	Metropolitan and Local Municipalities	N/A

Given that, as a minimum, a S&EIR process and a WUL are required[23], an integrated environmental approvals process is suggested, aligning with the cooperative governance framework established by South African legislation. This integrated process will streamline the timeframes and public participation procedures, as illustrated in Figure 6-1 below.

GMA will have to appoint an independent EAP, registered with EAPASA, to undertake the integrated environmental approvals process in accordance with Section 24(5)(e) of the NEMA. The detailed process, as stipulated by the relevant legislation is elaborated on in Appendix D. This provides an overview of each step involved in the S&EIR process, including the initial application, scoping, public participation, impact assessment, and the final decision-making stages. It outlines the specific requirements and procedural guidelines that must be followed to ensure compliance with South African environmental legislation.

[23] Once a Project description has been developed, it is to be confirmed whether an AEL, WML and borrow pit permits are required for the Project. Further, the need for heritage and/or biodiversity permits are ascertained once the EA process is in progress and relevant specialist assessments undertaken. Nonetheless, these applications and the associated assessment requirements would all run concurrently with the S&EIR process as an integrated approvals process.

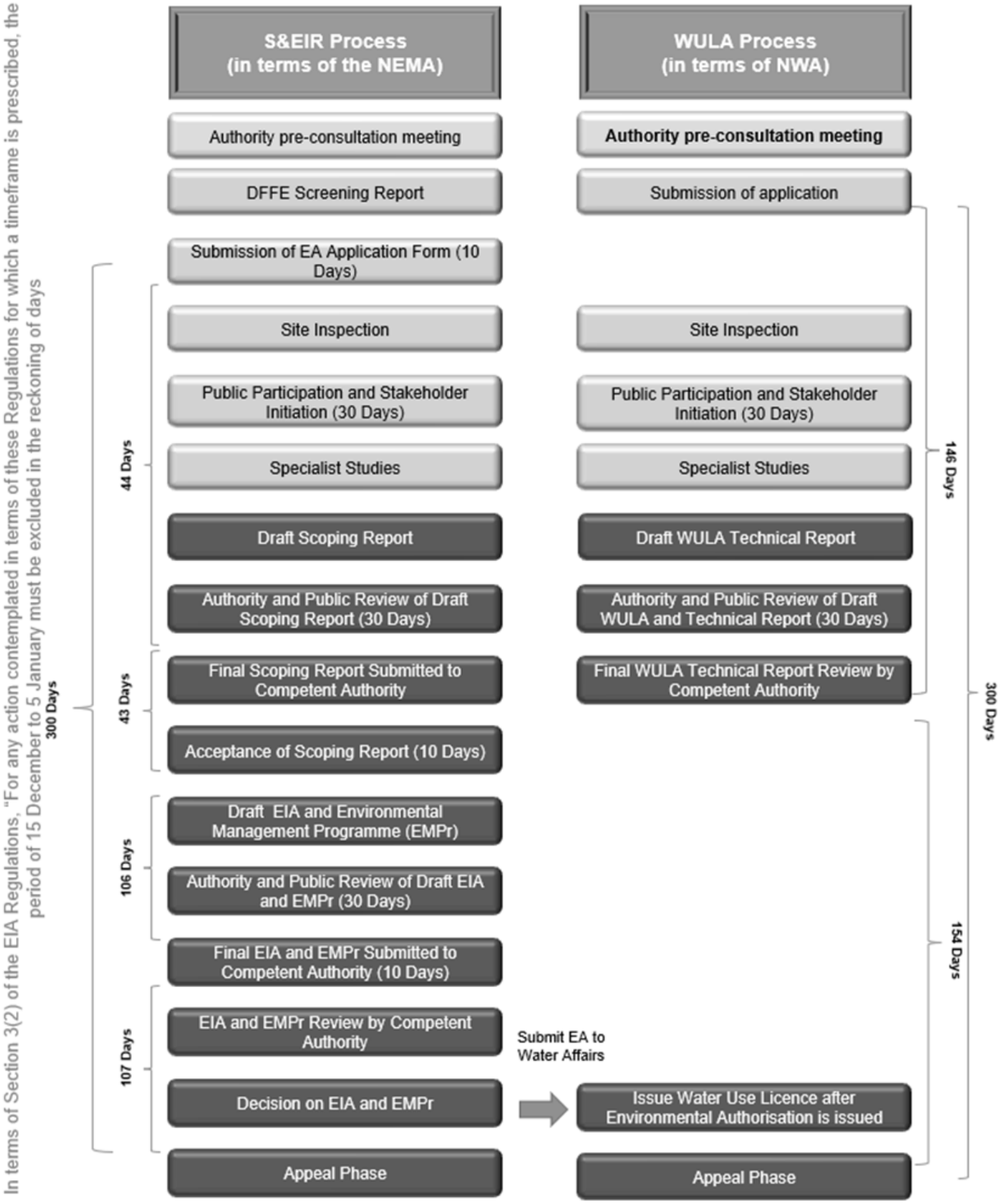


Figure 6-1: Integrated Environmental Approvals Process

6.3.2 Specialist Studies Required

The initial screening undertaken as part of this Report has identified the following environmental specialist studies that are likely to be required for comprehensive investigation as part of the S&EIR process:

- Agricultural Impact Assessment by a qualified Horticulturist or Agricultural Scientist
- Avifaunal Impact Assessment by a qualified Avifaunal Ecologist
- Civil Aviation Compliance Statement prepared by an EAP or a specialist with expertise in radar
- Climate Impact Assessment by a qualified specialist
- Defence Compliance Statement prepared by an EAP or a specialist with expertise in radar
- Faunal Impact Assessment by a qualified Zoologist or Ecologist
- Geohydrological Assessment by a qualified specialist
- Geotechnical Assessment by a qualified specialist
- Heritage and Paleontological Impact Assessment by a qualified Archaeologist
- Noise Impact Assessment by a qualified specialist
- Search, Rescue, and Relocation Management Plan for any red data, protected and endangered species, medicinal plants, heritage resources, and graves
- Socio-economic Impact Assessment by a qualified Socio-economist and Anthropologist
- Terrestrial Vegetation/Habitat Impact Assessment by a qualified Terrestrial Ecologist familiar with the region's vegetation
- Traffic Impact Assessment by a qualified specialist
- Visual Impact Assessment by a qualified specialist
- Wetland Delineation and Functional Assessment and Aquatic Habitat/Sensitivity Impact Assessment by a qualified Wetland and Aquatic Ecologist familiar with the region's wetlands and vegetation.

6.3.3 Approach to Environmental Authorisation

6.3.3.1 Lessons from existing Gautrain Rapid Rail Link System

The Gautrain Rapid Rail Link Project (GRRL – i.e. the existing Gautrain system) was a significant infrastructure initiative aimed at improving public transportation in Gauteng. The EIA for the project, commencing in 2001, was a comprehensive and complex process that spanned nine years, highlighting several critical aspects and challenges that are essential for successful planning of future phases of the GRRIN extensions. The EIA process was initially planned to take four years but extended to nine years due to the project's complexity and evolving legislative requirements. This underscores the need for realistic timelines and flexibility in project planning.

Navigating newly emerging environmental legislation posed significant challenges. The project had to address various biophysical and socio-economic impacts, including the displacement of flora, fauna, and local communities. Effective public participation was crucial. The involvement of senior provincial leadership and robust relationship management strategies were key to successfully engaging stakeholders and obtaining the necessary environmental authorisations. Detailed planning and proactive stakeholder engagement were identified as critical components for managing the environmental impacts of large infrastructure projects. These lessons are invaluable for future extensions of the GRRIN and similar projects. Important to note is:

- Despite challenges, the project obtained the necessary environmental authorisations, providing insights to streamline future EIA processes. Future phases should incorporate realistic timelines and flexibility to accommodate legislative changes and unforeseen delays. Early and continuous stakeholder engagement is crucial for mitigating conflicts and building trust
- Thorough biophysical and socio-economic impact assessments are essential to address potential issues early. Developing adaptive management strategies and regular monitoring ensures compliance and addresses emerging issues promptly. Investing in capacity building and training for project teams is vital to handle EIA complexities
- Maintaining comprehensive documentation of the EIA process and lessons learned can improve future projects' efficiency and effectiveness. Emphasising sustainable practices throughout the project lifecycle is important for minimising environmental impacts and promoting biodiversity.

The EIA process for the Gautrain (GRRL) project provided critical insights for future phases, enabling progress towards a more efficient, effective, and sustainable outcome.

6.3.3.2 Approach to the Next Phase

Based on the lessons learnt from the GRRL, the approach to the EIA process (i.e. the S&EIR) for the GRRIN extensions can vary based on several factors, including the scale of the project, the specific environmental impacts, and regulatory requirements.

As per the Economic Analysis of the 2016 Feasibility Study [24], the GRINN Extensions Project is planned to be rolled out in five phases over a 24-year period. As noted in Section 1.1, this Project encompasses several of the GRRIN phases:

- Little Falls – Roodepoort – Soweto (Phase 2 Extension) of which the Little Falls station forms part of the GRRIN Phase 1 Extension
- Cosmo City – Fourways – Sunninghill (Portion of Phase 3 Extension)
- Sunninghill – Samrand (Portion of Phase 5 Extension)
- Cosmo City – Cradle - Lanseria (Portion of Phase 5 Extension), of which the Little Falls station forms part of the GRRIN Phase 1 Extension.

[24] *Source:* Feasibility Study for the Possible Gauteng Rapid Rail Extensions - Volume I: Section 6: Economic Analysis Part 2: BBBEE & SED Due Diligence Report (August 2016).

Normally, a project of this magnitude would benefit from a single, comprehensive EIA, while also preparing supplementary focused assessments for particularly sensitive corridors.

However, this approach is not viable for the Project due to its phased implementation over a 24-year period. The extended timeline means that the necessary preliminary designs for all corridors will not be available simultaneously, leading to significant delays and inefficiencies. Additionally, the financial burden of conducting a comprehensive EIA upfront would be immense, potentially straining the Project's budget and delaying progress. Furthermore, there are legislated timeframes associated with the commencement of construction works when a project is authorised. This approach also complicates stakeholder engagement, as maintaining focused and effective communication across such an extended timeline and diverse geographic areas would be challenging. Therefore, a phased EIA process is more practical, allowing for detailed, focused assessments and approvals that align with the project's staggered rollout, including the stations and route alignments associated with each. This ensures both financial prudence and timely execution.

To address the environmental authorisation requirements effectively, a hybrid approach is recommended. This approach combines phase-specific EIA with a supplementary cumulative impact assessment. This strategy ensures detailed and focused assessments for each phase while providing a comprehensive understanding of the overall environmental impacts. Below are the benefits associated with the hybrid approach:

- Phase-Specific EIAs:
    - **Detailed Assessments:** Tailored evaluations for each corridor/associated phase, considering unique environmental conditions and regulatory requirements
    - **Cost Efficiency:** Manages costs effectively by aligning assessments with the phased implementation plan, avoiding the significant expense of upfront comprehensive design
    - **Phased Approvals:** Enables construction to begin in segments that have obtained environmental authorisation, keeping the project on schedule
    - **Focused Stakeholder Engagement:** Enhances participation and support from local communities through targeted engagement strategies
    - **Adaptive Management:** Allows for regular monitoring and adaptive management strategies specific to each phase, ensuring compliance and prompt issue resolution.
- Supplementary Cumulative Impact Assessment:
    - **Holistic View:** Provides a comprehensive understanding of the overall environmental impacts by integrating findings from each phase-specific EIA
    - **Cumulative Effects Management:** Identifies and addresses cumulative impacts that might not be apparent in individual phase assessments
    - **Enhanced Mitigation Strategies:** Develops more effective mitigation measures by considering the overall environmental footprint of the entire project
    - **Regulatory Compliance:** Ensures adherence to environmental regulations that require consideration of cumulative impacts

- **Informed Decision-Making:** Supports adaptive management and informed decision-making by providing a complete picture of the project's environmental impacts.

Adopting this hybrid approach ensures that the EA process is both cost-effective and comprehensive, supporting the successful and sustainable development of the GRRIN Extension Project. Conducting phase-specific EIAs allows for detailed and focused assessments for each corridor and its associated stations, addressing unique environmental conditions and regulatory requirements. This phased strategy enables timely approvals and the commencement of construction in segments that are ready, while managing costs effectively. Additionally, the supplementary cumulative impact assessment integrates findings from each phase, offering a holistic view of the overall environmental impacts. This combined approach ensures that both the routes and stations are thoroughly evaluated and managed, facilitating informed decision-making and robust mitigation strategies throughout the project's 24-year rollout.

Early consultation with relevant authorities is strongly advised to ensure a smooth and efficient environmental authorisation process. Engaging with regulatory bodies at the outset allows for the identification and resolution of potential issues before they become significant obstacles. Early consultation helps in understanding specific regulatory requirements and expectations, facilitating compliance and reducing the risk of delays. It also provides an opportunity to incorporate feedback from authorities into the EIA process, enhancing the quality and acceptability of the assessments. By fostering a collaborative relationship with regulatory agencies, the project team at the time can navigate the approval process more effectively, ensuring that both the routes and stations are developed in accordance with environmental regulations and best practices. This proactive approach not only supports timely project execution but also builds trust and transparency with stakeholders, contributing to the overall success of the GRRIN Extension Project.

The appointment of an experienced EAP at the commencement of the EIA process for each phase, and ongoing consultation with relevant authorities, will ultimately determine the best approach. It is essential to remain flexible and adaptive, as new information and changing circumstances may influence the EIA strategy. Continuous engagement with all stakeholders, including local communities, environmental groups, and regulatory bodies, will be crucial to ensure that the chosen approach is both effective and sustainable. By maintaining open communication and being responsive to feedback, the Project can navigate potential challenges and achieve its environmental and developmental goals.

7. CONCLUSION AND RECOMMENDATIONS

The GRRIN Extensions Project represents a significant step towards enhancing public transportation, reducing traffic congestion, and promoting sustainable development in the Gauteng Province and aligning with the NDP. This Report provided a comprehensive assessment of the proposed route alignments and station positions, ensuring that the Project aligns with national and international sustainability goals. The Project focused on three main corridors: Little Falls to Jabulani, Cosmo City to Lanseria, Smart City, and Cosmo City to Samrand.

This Report advocated for compliance with environmental legislation, including the GTIA, the requirements of the GDARD, and sustainable development goals. The assessment identified potential environmental impacts and proposed mitigations, promoting responsible development practices and safeguarding the natural environment.

The environmental screening exercise investigated the interaction of the proposed station and route alternatives with various aspects of the receiving environment to identify areas of impact. The aspects considered were agriculture, biodiversity (including plants, animals, watercourses, and wetland aquatic systems, threatened ecosystems, conversation areas), civil aviation and defence, archaeological and cultural heritage, palaeontology, landcover and land use, and various social aspects (including land acquisition, noise, air quality and visual intrusion among others). To enhance the accuracy of the environmental screening, the DFFE Screening Tool findings were validated the against current land use and environmental conditions, as well as considering the vertical placement in sensitive areas. This assessment informed the selection of sustainable and optimal route alignments and station positions.

The evaluation of station positions and route alignments for the GRRIN Extensions highlights a strategic approach to balancing environmental sensitivities with developmental needs. For route alignments, the importance of minimising disruptions to critical habitats, watercourses, and conservation zones was emphasised. The optimal routes, such as the deep tunnel from Little Falls to Jabulani, were chosen to preserve sensitive areas and reduce potential social disruptions. The comprehensive evaluation process, including MCA, ensured that the final selections not only addressed environmental concerns but also met practical and developmental requirements. These findings underscore a commitment to sustainable development and responsible environmental stewardship. The Refined Optimal routes were developed to align with the optimal station positions.

The proposed Optimal Stations and Refined Optimal Routes for the applicable GRRIN Extensions included (Figure 7-1):

Optimal Stations

- **Jabulani Station (Position 1 - Deep Tunnel):** Strategically located for passenger access to key landmarks such as Bheki Mlangeni Hospital, Jabulani Mall, and Soweto Theatre
- **Roodepoort Station (Position 1 - Deep Tunnel):** Positioned on the western side of the existing PRASA rail line, closer to the CBD area, this station benefits from deep tunnel placement, which minimises surface-level disruptions

- **Cradle Station (Position 1 - Bridge):** Located closer to existing residential areas and new planned developments, enhancing accessibility and potential ridership.
- **Lanseria Station (Position 1 - At-Grade):** Strategically located for passenger access to Lanseria International Airport, this station supports connectivity and development potential.
- **Future Smart City Station (Deep Tunnel):** Included to maintain flexibility and futureproof the Cosmo City to Lanseria Route to allow for future integration of the route with the Lanseria Smart City. The position also allows the Smart City residents convenient access to the station and enables prospective extensions beyond Gauteng to link up with the High-Speed Rail
- **Fourways Station (Position 1 - Bridge):** Positioned closer to vacant land and commercial activities around the major road intersection at Fourways, enhancing accessibility and potential ridership
- **Sunninghill Station (Position 0 - At-Grade):** Located in a predominantly greenfield area adjacent to the Leeuwkop Prison Grounds, this station supports connectivity and development potential
- **Olievenhoutbosch Station (Position 1 - Cut-and-Cover):** Positioned in a more densified residential area and closer to the Midrand industrial area, enhancing accessibility and potential ridership.

Refined Optimal Routes

- **Little Falls to Jabulani Corridor (Option 1 - Deep Tunnel)**: This 19.9 km route, entirely in a deep tunnel, minimised surface-level disruptions, making it the optimal option for reducing impacts on agricultural land, sensitive habitats, heritage sites, and aquatic ecosystems. The deep tunnel ensures lower sensitivity ratings across most environmental themes. From an environmental perspective, the Refined Optimal route was essentially the same as the Optimal Option 1
- **Cosmo City to Lanseria Corridor (Option 1 - At-Grade, Bridge/Viaduct, and Cut-and-Cover):** Spanning 17.4 km from start to end, with 45% At-grade, 48% Bridge/Viaduct and 7% Cut-and-Cover, this route crossed more sensitive features such as small holdings and areas of annual crops/cultivation. The bridge sections may slightly reduce the impact on agricultural land and biodiversity sensitivities by allowing for some continued use of the land underneath. Compared to the Optimal Option 1, the Refined Optimal route does present greater environmental and social impacts overall, but this is primarily focussed on the proximity of the Depot and Cradle Station locations. The Smart City access route included to future-proof the optimal route, spans 4.4 km, comprising 13% At-grade, 3% Cut-and-Cover and 84% Deep Tunnel, terminating at the Smart City Station. Due to the proposed vertical placement, the access route will have minimal environmental impact, as the tunnel will bypass sensitive areas
- **Cosmo City to Samrand Corridor (Option 1 - Deep Tunnel)**: This 30.3 km route, with 83% deep tunnel, 5% at-grade, 10% bridge / viaduct, and 2% cut-and-cover, minimised surface-level disruptions. The deep tunnel ensured lower sensitivity ratings across most environmental themes, making it the superior choice for minimising environmental disruption and preserving natural resources. From an environmental sensitivity perspective, the Refined Optimal route and Optimal Option 1 are similar.

The desktop-level analysis determined that none of the options considered for all corridors presented any fatal flaws but will require extensive impact assessment studies. While the Screening Tool did identify areas of 'very high' sensitivity in some instances, the potential impacts of the proposed development can be effectively mitigated (if not already mitigated by vertical placement) to prevent harm to the environment, particularly in areas of medium to very high sensitivity. The analysis suggested that, with the implementation of appropriate mitigation measures, environmental impacts can be managed effectively.

These measures include detailed planning, adherence to best practices during construction, and continuous monitoring to ensure compliance with environmental standards. For example, in areas of high sensitivity, specific strategies such as habitat restoration, noise reduction techniques, and comprehensive water management plans should be employed to minimize the impact. More specifically for biodiversity related impacts, offsetting might be required if the EIA identifies significant residual impacts on biodiversity (in terms of the National BOG).

It is crucial to note that while the desktop-level analysis provided a preliminary understanding, the confirmation of these findings will require a formal impact assessment process in the later stages of the Project. These processes will involve detailed field studies, expert input, and extensive public participation to ensure potential impacts are thoroughly assessed and addressed.

While not fatally flawed from a desktop perspective, the Project will have various environmental and social impacts, including air quality issues, noise, vibration, habitat destruction, and land acquisition (some of which can be considered significant). Mitigation measures proposed included dust suppression, noise barriers, habitat restoration, offsetting, and a Resettlement Action Plan should be developed for affected parties, respectively. The Project is expected to bring significant benefits, such as job creation, improved connectivity, reduced traffic congestion, and enhanced quality of life through better accessibility and community development. In summary:

- The stations are expected to have high environmental and social impacts, particularly during construction. These impacts include, in summary, significant vegetation clearance (with associated species impact and habitat destruction), noise, dust emissions, and potential disruptions to local communities
- Conversely, the route alignments for the Jabulani and Samrand corridors will have lower impacts due to the extensive use of tunnelling, which minimizes surface-level disruptions. However, the Lanseria corridor will have a substantial impact on the receiving environment, particularly on biodiversity and social aspects. This is due to the generally greenfield nature of some parts of the corridor, which includes sensitive habitats and ecosystems. Additionally, social impacts will be pronounced due to the proximity to a graveyard and residential areas, necessitating careful planning and extensive community engagement to mitigate these effects.

The Project will need to conform with a wide range of South African environmental legislation, including the NEMA, NWA, and several other SEMAs. The Gauteng Provincial Environmental Management Framework also plays a crucial role in guiding sustainable development within the province. Given the scale and nature of this Project, a formal S&EIR process will be required for each corridor / associated phase, including various specialist assessments and several permits and licence requirements. An integrated environmental approvals process is proposed to streamline the timeframes and public

participation procedures. This approach will consolidate the various permitting and licensing requirements into a cohesive framework, ensuring that all necessary approvals are obtained efficiently. By coordinating the different environmental assessments and stakeholder engagements, the integrated process can reduce duplication of efforts, enhance transparency, and facilitate timely decision-making.

The existing Gautrain Rapid Rail Link System project (known as the existing Gautrain) provided valuable lessons, highlighting the importance of realistic timelines, flexibility, and thorough planning in managing large-scale infrastructure projects. Key challenges included navigating newly emerging environmental legislation, addressing biophysical and socioeconomic impacts, and ensuring effective public participation. The involvement of senior management and robust relationship management strategies were crucial for successfully engaging stakeholders and obtaining the necessary environmental authorisations. Based on these lessons, the report recommended adopting a hybrid approach for the EA process for each corridor / phase.

For each phase as and when implemented, a hybrid approach for the EA process was advised in order to be both cost-effective and comprehensive. By conducting phase-specific EIAs, the Project can address unique environmental conditions and regulatory requirements for each corridor and station. This phased strategy allows for timely approvals and construction commencement in ready segments, while managing costs effectively. During each EIA process, a cumulative impact assessment was recommended which serves to integrate findings from each phase, providing a holistic view of the overall environmental impacts. Early consultation with relevant authorities was recommended to ensure a smooth and efficient environmental authorisation process. Engaging with regulatory bodies early helps identify and resolve potential issues, understand regulatory requirements, and incorporate feedback into the EIA process, enhancing the quality and acceptability of the assessments. Nonetheless, the appointment of an experienced EAP and ongoing consultation with authorities will determine the best approach. Flexibility and adaptability are essential, as new information and changing circumstances may influence the EIA strategy.

The proposed development aims to extend GRRIN and its associated urban development in the Gauteng Province. In this context, this Environmental Investigation aimed to investigate the interaction of the proposed route alternatives with various aspects of the receiving environment and identify areas of impact. The findings of the environmental screening were crucial in identifying potential impacts and informing the selection of sustainable and optimal route alignments and station positions. The permitting strategy developed provides that all necessary environmental approvals and licenses can be obtained efficiently, facilitating compliance with South African environmental legislation. By adhering to the provisions of the GTIA and working closely with the GDARD, the GRRIN Extensions can achieve a balance between infrastructure development and environmental conservation. This balance is crucial for the overall sustainability and resilience of the Gauteng Province, aligning with the NDP.

Overall, the GRRIN Extensions Project encompasses a comprehensive approach to sustainable development, balancing economic growth, environmental stewardship, and social well-being. By addressing immediate transportation needs and laying the groundwork for future urban development, the Project will contribute to the long-term prosperity and resilience of the region, while ensuring integration of environmental considerations.

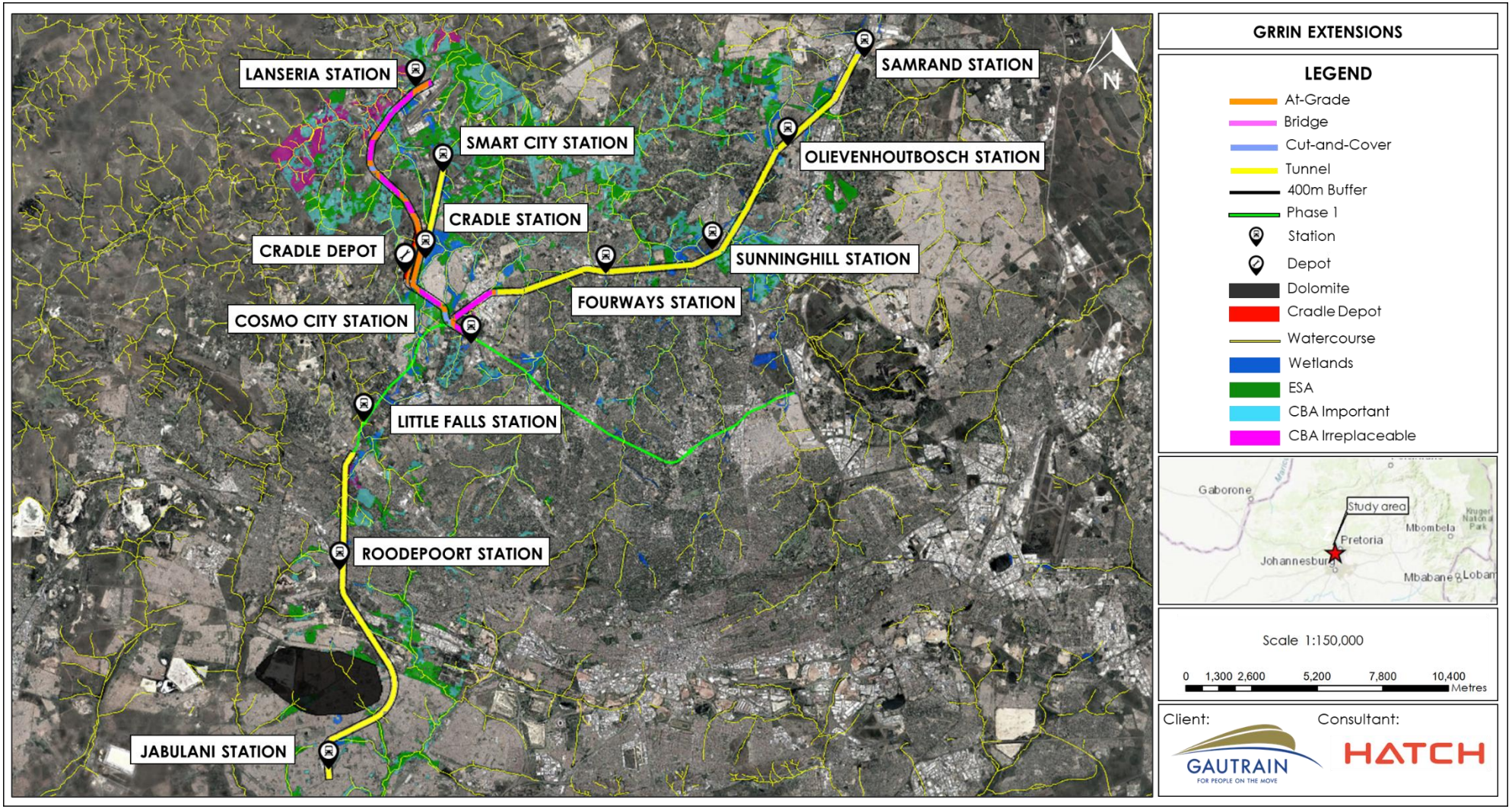


Figure 7-1: Optimal Stations and Routes, including Biodiversity and Aquatic Sensitivities

Recommendations:

Based on this assessment the following recommendations are proposed (for each phase, subject to commencement of implementation per phase):

- Undertake the next step in the GTIA process by conducting the preliminary design and further developing the route alignments and Project description. This will provide a better understanding of the specific activities involved and their potential environmental impacts. An elaborated Project description will provide a clear basis for engaging with stakeholders and the public. This transparency is crucial for building trust and ensuring that the concerns and suggestions of interested and affected parties are considered in the planning process
- A registered EAP must be appointed to undertake a comprehensive S&EIR process in accordance with NEMA to obtain EA. As part of the S&EIR, specialists must be appointed as per Section 6.3.2. Additional specialist studies may be necessary based on feedback from the competent authorities, stakeholder engagement and/or the public participation process
- Engagement should be done early with regulatory authorities to understand their preferences and requirements for the environmental authorisation process. This will help determine the appropriate process, considering the complexity and scale of the Project. Early engagement will also facilitate the identification of environmental sensitivities and ensure that an effective approach is adopted for managing environmental impacts and Project logistics
- Specialist studies must include comprehensive fieldwork assessments (including seasonal assessments where required) to identify any intersections with wetlands or water sources, or to establish the presence of any potentially sensitive or protected species. These assessments should include steps to mitigate impacts on these areas and species. In the case of species presence, they should be avoided where possible. If avoidance is not possible, the species should be relocated outside the development footprint with the appropriate permits for disturbing or relocating them. As per the National Biodiversity Offset Guideline, if these measures cannot adequately mitigate the impacts, biodiversity offsets will need to be investigated as a last resort
- Any additional necessary permits or licenses must be identifies and obtained, including WUL, AEL, WML, and other relevant authorisations, to ensure comprehensive regulatory compliance
- To promote thorough environmental sustainability and safety, it is essential to establish a comprehensive Environmental Design Criteria. The criteria should provide, as a minimum, guidelines for climate change mitigation, energy efficiency, the use of sustainable materials, means to accommodate geotechnical properties, water conservation, waste management, air quality control, biodiversity protection, noise control, community integration, health and safety, and continuous environmental monitoring and reporting. This will ensure full regulatory compliance and long-term sustainability
- As an outcome of the S&EIR process, detailed management and monitoring plans would be developed and implemented to ensure effective mitigation of identified impacts and ongoing compliance with environmental regulations.

- As various phases progress, a supplementary cumulative impact assessment should be continuously developed to track, manage and/mitigate potential impacts
- Upon the implementation of the first phase of this Project, the lessons learnt must be leveraged for subsequent phases, to mitigate challenges or concerns.

By following these recommendations, the GRRIN Extensions Project can achieve a balance between infrastructure development and environmental conservation, contributing to the overall sustainability and resilience of the Gauteng Province.

Appendix A: Summary of the Screening Tool Findings of the Station Location Options

Table A - 1: Summary of the Screening Tool findings of all Environmental Sensitivity Ratings and the Associated Sensitivity Scores for each Environmental Theme for All Station Position Options

Environmental Theme	Jabulani			Roodepoort		Cradle			Lanseria		Fourways		Sunninghill	Olievenhoutbosch	
	J-0	J-1	J-2	R-0	R-1	C-0	C-1	C-2	L-0	L-1	F-0	F-1	S-0	O-0	0-1
Agriculture	7	7	4	7	7	4	4	4	7	7	7	7	4	4	4
Animal Species	7	7	7	7	7	7	6	6	7	4	7	7	8	7	7
Aquatic Biodiversity	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	1	1	9.5	9.5
Archaeological and Cultural Heritage	1	1	1	1	1	9.5	9.5	9.5	9.5	9.5	9.5	1	1	9.5	9.5
Civil Aviation	7	7	7	7	7	1	1	1	1	1	4	4	4	4	4
Defence	9.5	9.5	9.5	9.5	9.5	9.5	9.5	9.5	7	7	7	7	7	7	7
Palaeontology	9.5	9.5	9.5	9.5	9.5	9.5	10	10	10	10	10	10	10	10	10
Plant Species	6	6	6	9.5	9.5	7	7	7	7	6	9.5	7	8	7	7
Terrestrial Biodiversity	1	1	0	0	0	1	0	2	1	1	1	0	1	1	1
Socio-Economic (noise, air, etc.)	9.5	9	9.5	9.5	9.5	9.5	7	9.5	9.5	9	9.5	9	9.5	9.5	9.5
Total	**67**	**66.5**	**63**	**69.5**	**69.5**	**67.5**	**63.5**	**68**	**68.5**	**64**	**74**	**53**	**53.5**	**67**	**71**

Key:

Sensitivity Rating	Score Scale	Median Score
Very High	0 - 2	1
High	3-5	4
Medium	6-8	7
Low	9 - 10	9.5
None	-	10

Appendix B: Land Cover and Land Use of the Three Corridors

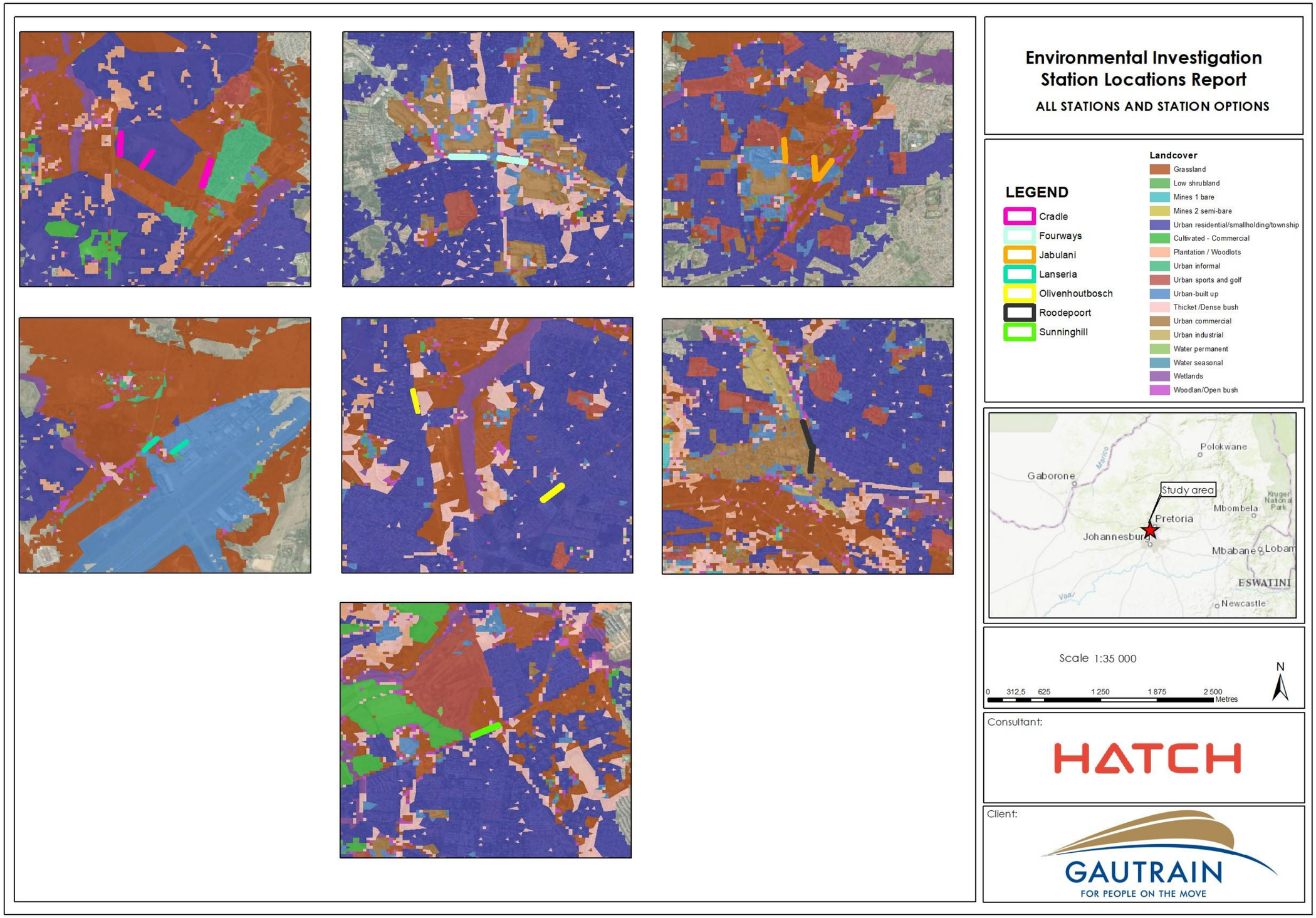


Figure A - 1: Land Cover and Land Use Maps for all Station Project Areas

Appendix C: Specialist Assessments that may be required based on Screening Tool Findings

Table A - 2: Level of Specialist Assessments that may be Required Based on the Findings of the Screening Tool

Specialist impact Assessments *	Sensitivity Rating			
	Low	Medium	High	Very High
Agriculture	Agricultural Compliance Statement must be prepared by a soil scientist or agricultural specialist registered with the SACNASP.		- Must submit an Agricultural Agro-Ecosystem Specialist Assessment. - If information gathered from the site sensitivity verification differs from the designation of "very high" or "high" and it is found to be of a "medium" or "low" sensitivity, then an Agricultural Compliance Statement must be submitted.	
Archaeological and Cultural Heritage / Palaeontology	- No specific assessment protocol has been prescribed in the EIA Regulations for these two themes. - A site sensitivity verification must be undertaken by an EAP or a specialist to confirm if such impact assessment is required. Where a specialist assessment is required and no specific environmental theme protocol has been prescribed, the required level of assessment must be based on the findings of the site sensitivity verification and must comply with Appendix 6 of the EIA Regulations. - Section 38 of the National Heritage Resources Act (Act 25 of 1999) sets out guidelines for Heritage Resources Management and the conditions under which heritage (or paleontological) impact assessments are required when developments impact upon heritage resources.			
Aquatic Biodiversity	An Aquatic Biodiversity Compliance Statement must be prepared by a specialist registered with the SACNASP and having expertise in the field of aquatic sciences.		- Must submit an Aquatic Biodiversity Specialist Assessment. - If information gathered from the site sensitivity verification differs from the designation of "very high" and it is found to be of "low" sensitivity, then an Aquatic Biodiversity Compliance Statement must be submitted.	
Civil Aviation	No requirement identified	- Must submit a Civil Aviation Compliance Statement prepared by an EAP or a specialist with expertise in radar. - If information gathered from the site sensitivity verification differs from the designation of "very high", "high" or "medium", and it is found to be "low" sensitivity, then no further assessment requirements are identified.		
Defence	No requirement identified	- Must submit a Defence Compliance Statement prepared by an EAP or a specialist with expertise in radar. - If information gathered from the site sensitivity verification differs from the designation of "very high", "high" or "medium", and it is found to be "low" sensitivity, then no further assessment requirements are identified.		
Plant / Animal Species	- A Terrestrial Plant / Animal Species Compliance Statement must be prepared by a specialist registered with the SACNASP within a field of practice relevant to the taxonomic groups ("taxa") for	- Must submit either a Terrestrial Plant / Animal Species Specialist Assessment Report or a Terrestrial Plant / Animal Species Compliance Statement, depending on the outcome of a site inspection.	- Must submit a Terrestrial Plant / Animal Species Specialist Assessment. - If information gathered from the site sensitivity verification differs from the designation of "very high" or "high" and it is found to be "low" sensitivity, then a Terrestrial Plant / Animal Species Compliance Statement must be submitted.	

	which the assessment is being undertaken. - If information gathered from the site sensitivity verification differs from the designation of "low" and it is found to be "very high" or "high" sensitivity, then a Terrestrial Plant/Animal Species Specialist Assessment must be conducted.	- Where SCC are found on site or have been confirmed to be likely present, a Terrestrial Plant/Animal Species Specialist Assessment must be submitted in accordance with the requirements specified for "very high" and "high". - Similarly, where no SCC are found on site during the site inspection or the presence is confirmed to be unlikely, a Terrestrial Animal/Animal Species Compliance Statement must be submitted.	
Terrestrial Biodiversity	A Terrestrial Biodiversity Compliance Statement must be prepared by a specialist registered with the SACNASP and having expertise in the field of ecological sciences.		- Must submit a Terrestrial Biodiversity Specialist Assessment. - If information gathered from the site sensitivity verification differs from the designation of "very high" and it is found to be of "low" sensitivity, then a Terrestrial Biodiversity Compliance Statement must be submitted.

* Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration, identified by the Screening Tool, must be confirmed by undertaking a site sensitivity verification. The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist.

Appendix D: Land Cover and Land Use of the Three Corridors

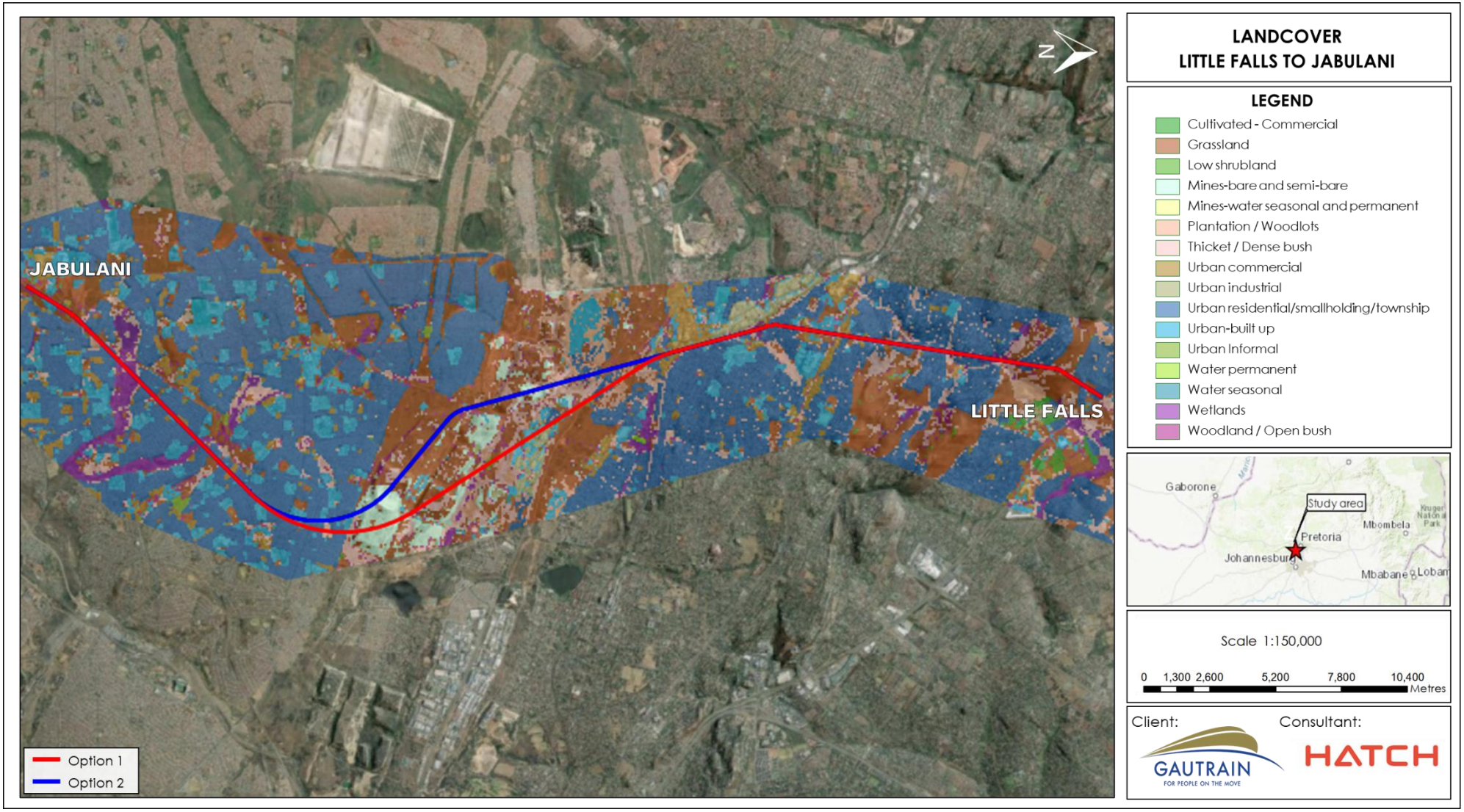


Figure A - 1: Land Cover and Land Use Maps for the Little Falls to Jabulani Corridor

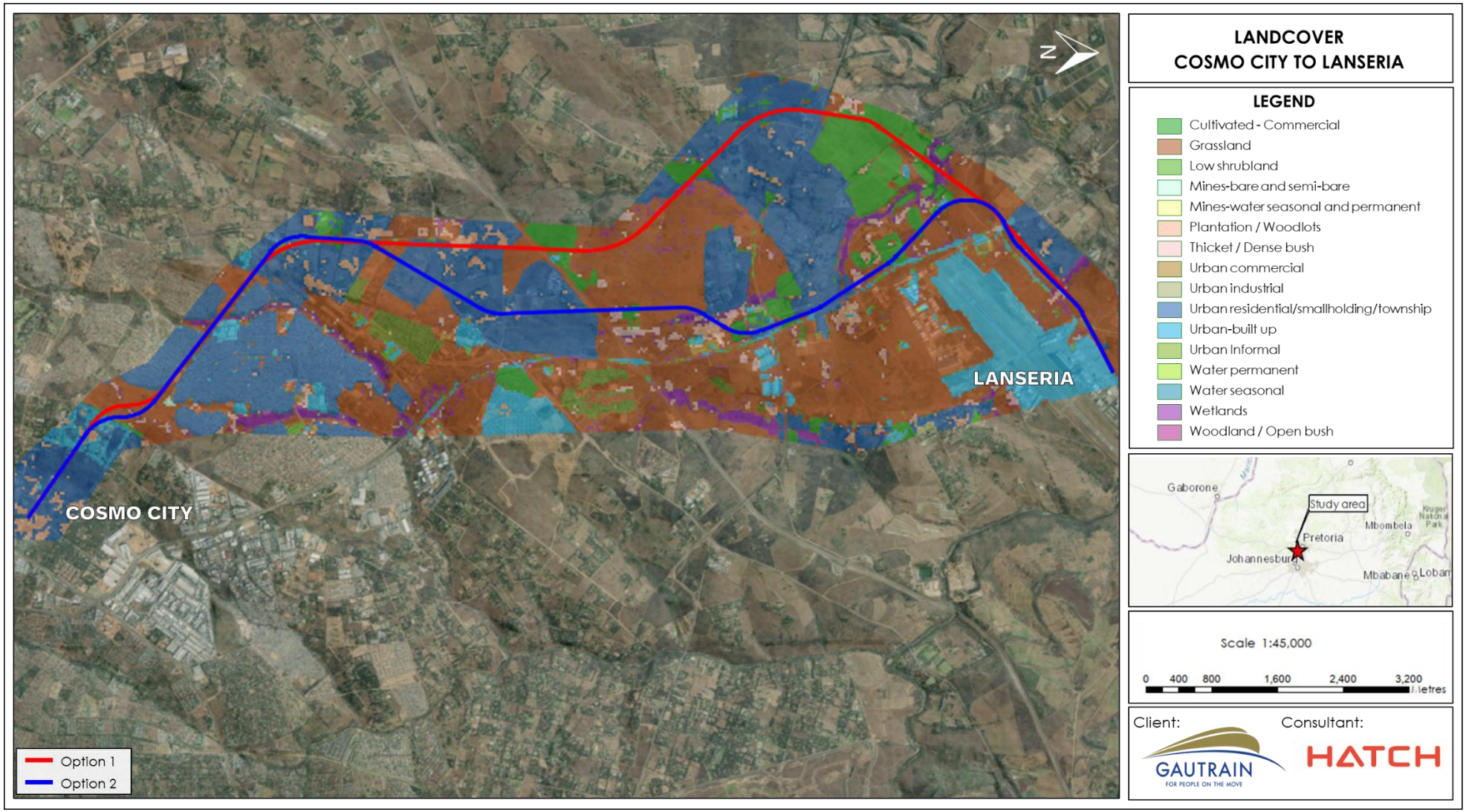


Figure A - 2: Land Cover and Land Use Maps for the Cosmo City to Lanseria Corridor

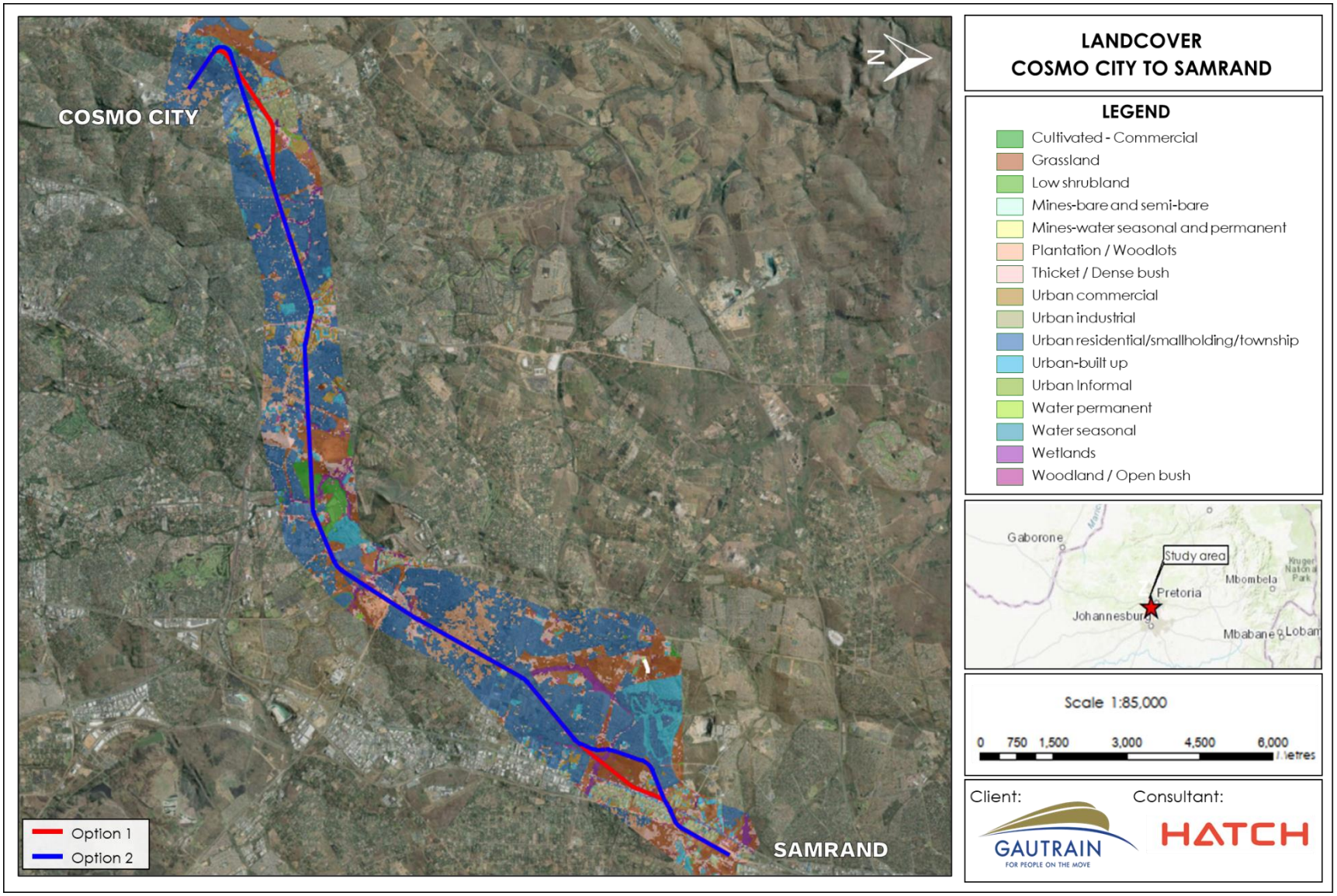


Figure A - 3: Land Cover and Land Use Maps for the Little Falls to Samrand Corridor

Appendix E: Primary Vegetation Types and Threatened Ecosystems Across All Corridors

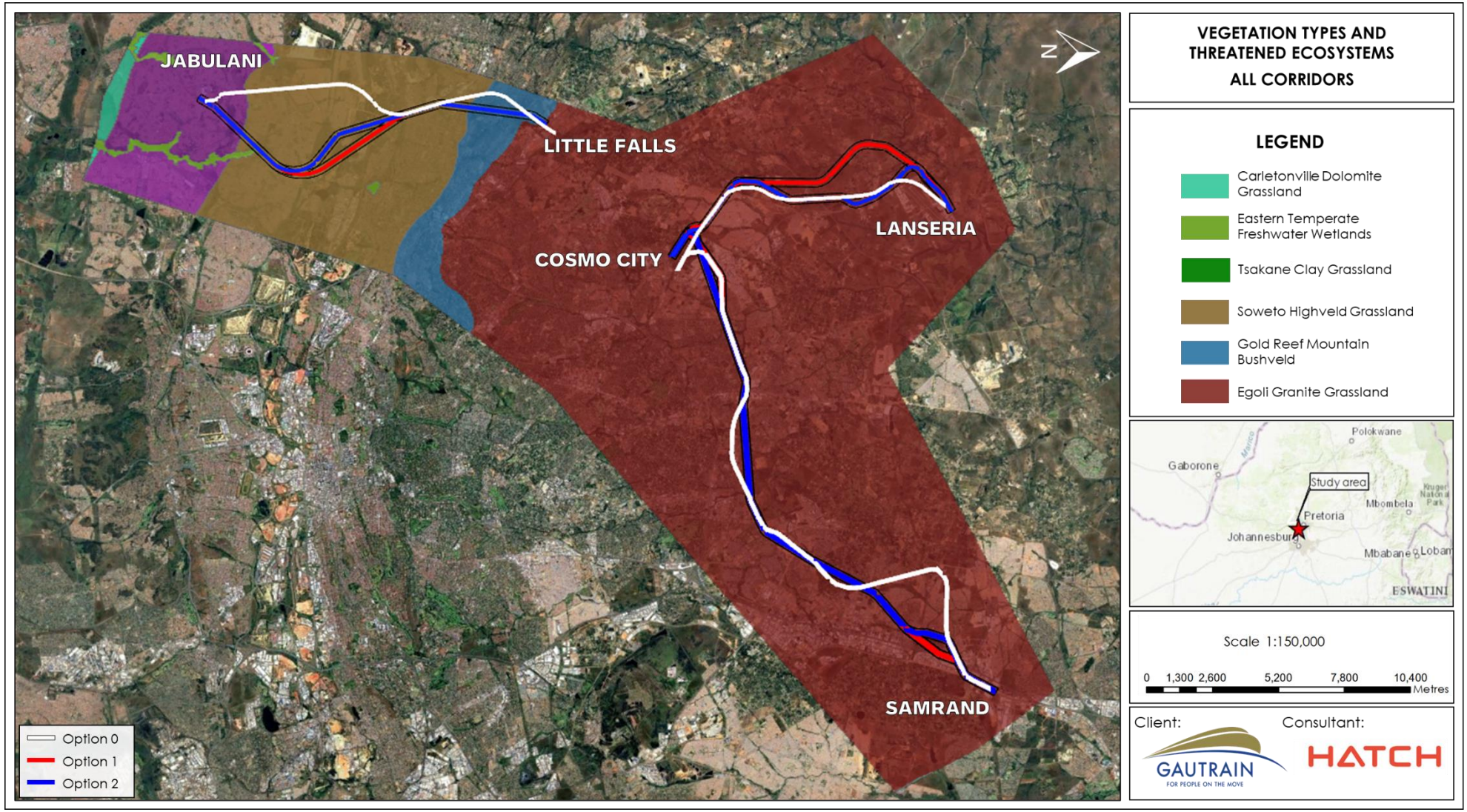


Figure A - 4: Primary Vegetation Types and Threatened Ecosystems Associated with the Three Corridor