FIELD SURVEY REPORT

TRINITY METALS

FINAL

GroundTruth

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GroundTruth
PO Box 916
9 Quarry Road, Hilton
KwaZulu-Natal, South Africa
+27 33 343 2229
admin@groundtruth.co.za

www.groundtruth.co.za

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Prepared by	GroundTruth environment & engineering
Author(s)	Fiona Eggers (Pr.Sci.Nat – Ecology)
	Gary de Winnaar (Pr.Sci.Nat – Ecology)
Document Reviewer	Craig Cowden (Pr.Sci.Nat – Ecology)
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1. INTRODUCTION

GroundTruth were appointed by Trinity Metals to undertake a broad range of ecological, social and engineering studies across their mining concession areas in Rwanda, to contribute towards Phase 1 of Trinity Metal's Legacy Tailings Management and River Rehabilitation Programme.

This report provides an overview of the field survey undertaken from the 11th – 19th November 2025. It provides information about the freshwater ecosystem assessments associated with Phase 1 of the project, that are being undertaken for the four (4) Trinity mines including Rutongo, Nyakabingo, Musha and Ntunga.

The objective of the site visit was to verify and evaluate the freshwater ecosystems, distinguishing between riverine and wetland ecosystems, and recognising their landscape linkages. Baseline information was collected to enable the assessment of ecosystem functioning and integrity, as well as to develop an understanding of the ecosystem goods and services provided by these freshwater habitats. This information, together with the results of the floodline and sediment modelling, will inform impact mitigation measures and guide sustainable rehabilitation planning during Phase 2 of the project.

2. METHODOLOGY

The following section provides an overview of the methodology adopted for the freshwater ecosystem assessments.

2.1 Riverine assessments

Sampling and assessments took place at a total of 27 sites covering the river systems traversing the four mines, including: the Gisanse, Nyiramududu, Rusine, Nyirabukingure, Sanzare, Mulindi, and Nyacyonga Rivers draining the Rutongo Concession; the Nyakabingo River draining the Nyakabingo Concession; the Nyirabigaji River draining the Musha Concession; and Gashahi draining the Ntunga Concession.

The following assessments were conducted, based on the availability of riverine habitat:

- *Water clarity* – Measured at 25 sites using a clarity tube to obtain a relative measure of suspended sediments and turbidity.
- *Benthic diatoms* – Diatoms are useful indicators of the effect of the water quality conditions on in-stream biota, especially where habitats are limited. A representative diatom sample was collected at 15 of the river sites – seven from Rutongo, five from Nyikabingo, and three from Musha. Diatom sampling was performed according to the standardised protocols of Taylor *et al*. (2005). The samples will be sent to a specialist diatom laboratory, Diamon, to be process and analysed. Results will then be interpreted according to Harding and Taylor, (2011).
- *Aquatic macroinvertebrates* – Where suitable habitat prevailed, an assessment was conducted using the South African Scoring System version 5 (SASS5), accredited to ISO 17025 standards, carried out by a Department of Water Affairs accredited SASS5 practitioner at 11 sites. These results will be interpreted according to the SASS5 metrices (i.e. SASS Score, Average Score per Taxon, and Number of Families) to derive ecological / river health categories based on the macroinvertebrate community of the river systems.
- *Index of Habitat Integrity (IHI)* – The assessment of identified river habitats was undertaken at 19 sites using the Index of Habitat Integrity (IHI) updated rapid model to establish the Present Ecological State (PES) of riparian and instream habitat.

2.2 Wetland assessments

The wetland assessments involved the following infield verification and assessments:

- *Habitat extent* - Verify the extent of the wetland habitat, where applicable, based on site conditions including inter alia, soil properties, landscape position, and vegetative indicators.
- *Functionality assessment and integrity* – to assess and quantify the ecosystem functionality of the wetlands and understand their importance in providing goods and services at the landscape scale. These services were assessed in terms of direct and indirect benefits to society and the surrounding landscape.
- *Integrity assessment* - The assessment evaluated deviations from natural reference conditions across four biophysical drivers: hydrology, water quality, geomorphology, and

vegetation. Observed deviations from the benchmark state provide an indication of the extent to which anthropogenic activities have modified the condition of the wetlands.

2.3 Site Visit

The field survey was conducted from 11th – 19th November 2025 to assess the freshwater ecosystems at the four Trinity Metals mines. Table 2-1 below shows the field survey programme which was followed for the riverine assessments.

Table 2-1 Field survey programme for the riverine assessments.

Day	Date	Site
Tuesday	11/11/2025	Rutongo Mine (three sites)
Wednesday	12/11/2025	Rutongo Mine (three sites)
Thursday	13/11/2025	Rutongo Mine (three sites)
Friday	14/11/2025	Rutongo Mine (five sites)
Saturday	15/11/2025	Off Day
Sunday	16/11/2025	Off Day
Monday	17/11/2025	Musha and Ntunga Mine (four sites)
Tuesday	18/11/2025	Nyakabingo Mine (five sites)
Wednesday	19/11/2025	Not applicable (site visit completed)

Table 2-1 below shows the field survey programme which was followed for the wetland habitat assessment component of the study.

Table 2-2 Field Survey Programme for wetland habitat assessment.

Day	Date	Site
Tuesday	11/11/2025	Rutongo Mine
Wednesday	12/11/2025	Rutongo Mine
Thursday	13/11/2025	Rutongo Mine
Friday	14/11/2025	Rutongo Mine
Saturday	15/11/2025	Off Day
Sunday	16/11/2025	Off Day
Monday	17/11/2025	Musha and Ntunga Mine
Tuesday	18/11/2025	Musha Mine
Wednesday	19/11/2025	Nyakabingo Mine

3. FIELD SURVEY TEAM

Table 3-1 below includes the list of specialists which conducted the field survey.

Table 3-1 Field Survey Team.

Member	Component	Role
Gary de Winnaar	Riverine	Aquatic/biodiversity specialist
Fiona Eggers	Wetland	Wetland ecologist
Steven Ellery	Wetland/sediment	Specialist geomorphologist/wetland ecologist

4. SITE OVERVEW – MINING CONCESSION AREAS

The following maps provide an overview of the sites surveyed within the four Trinity Metals Mining Concession Areas.

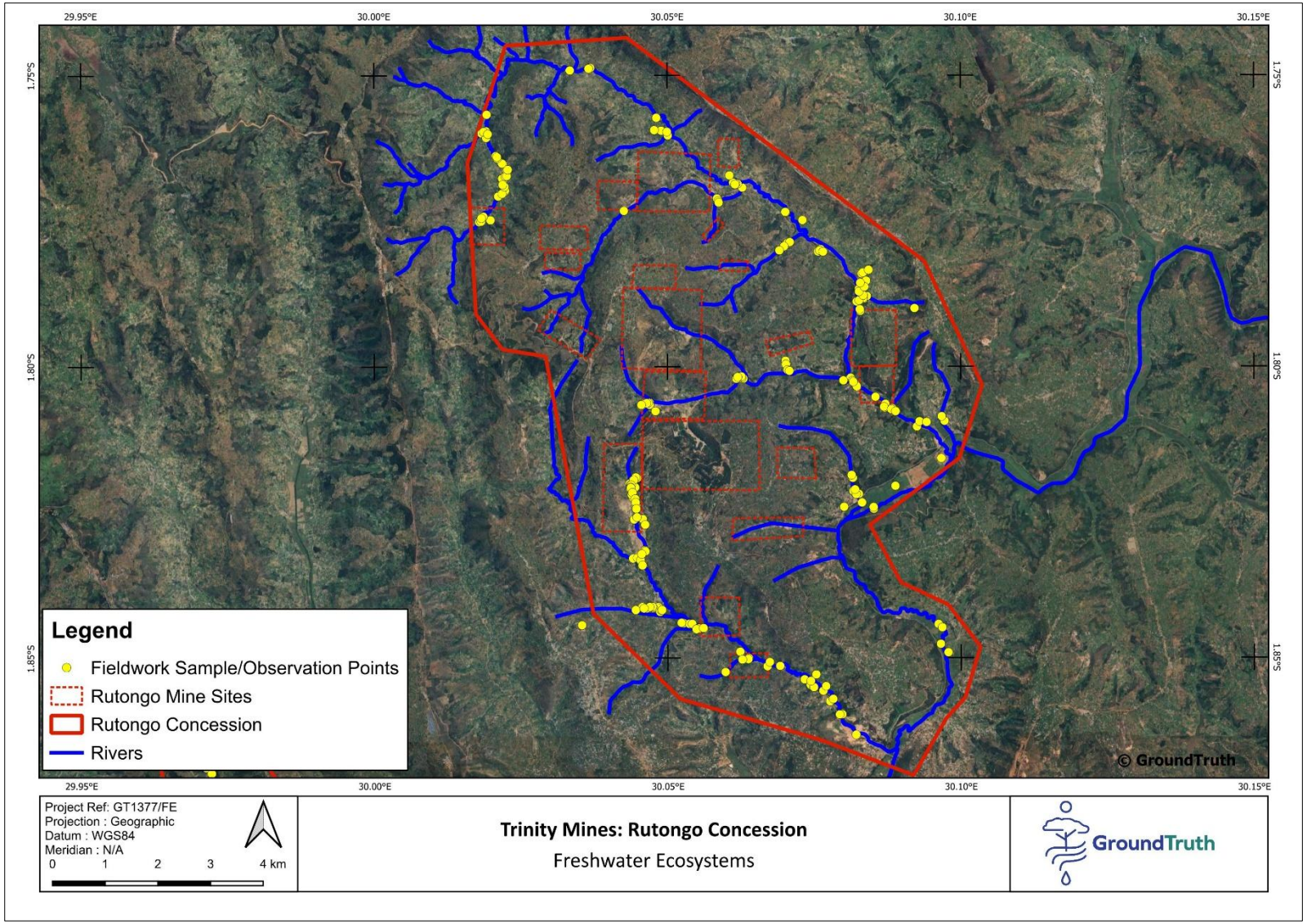

Figure 4-1 Map illustrating the various sites for the field survey within the Rutongo Mining Concession.

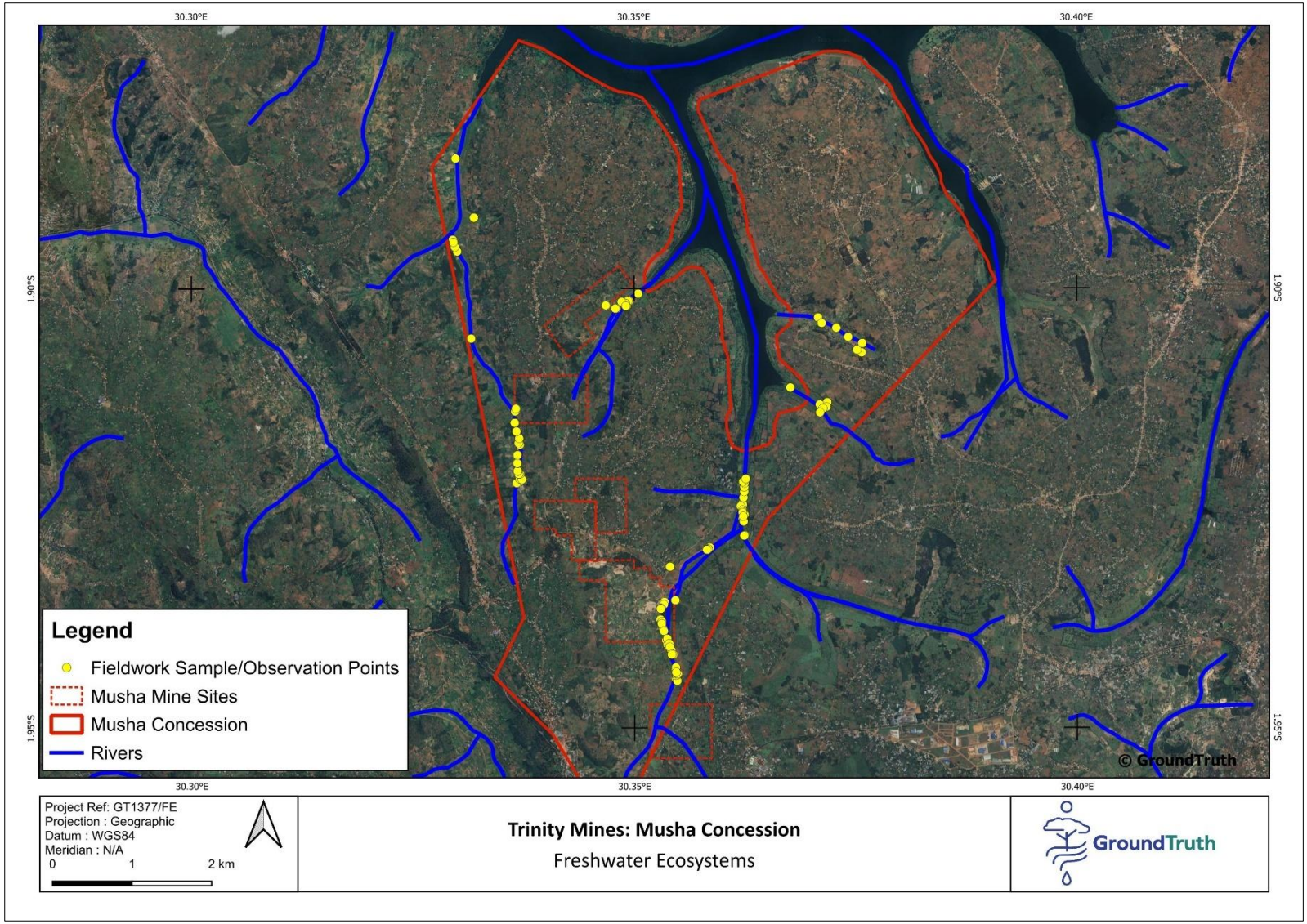

Figure 4-2 Map illustrating the various sites for the field survey within the Musha Mining Concession.

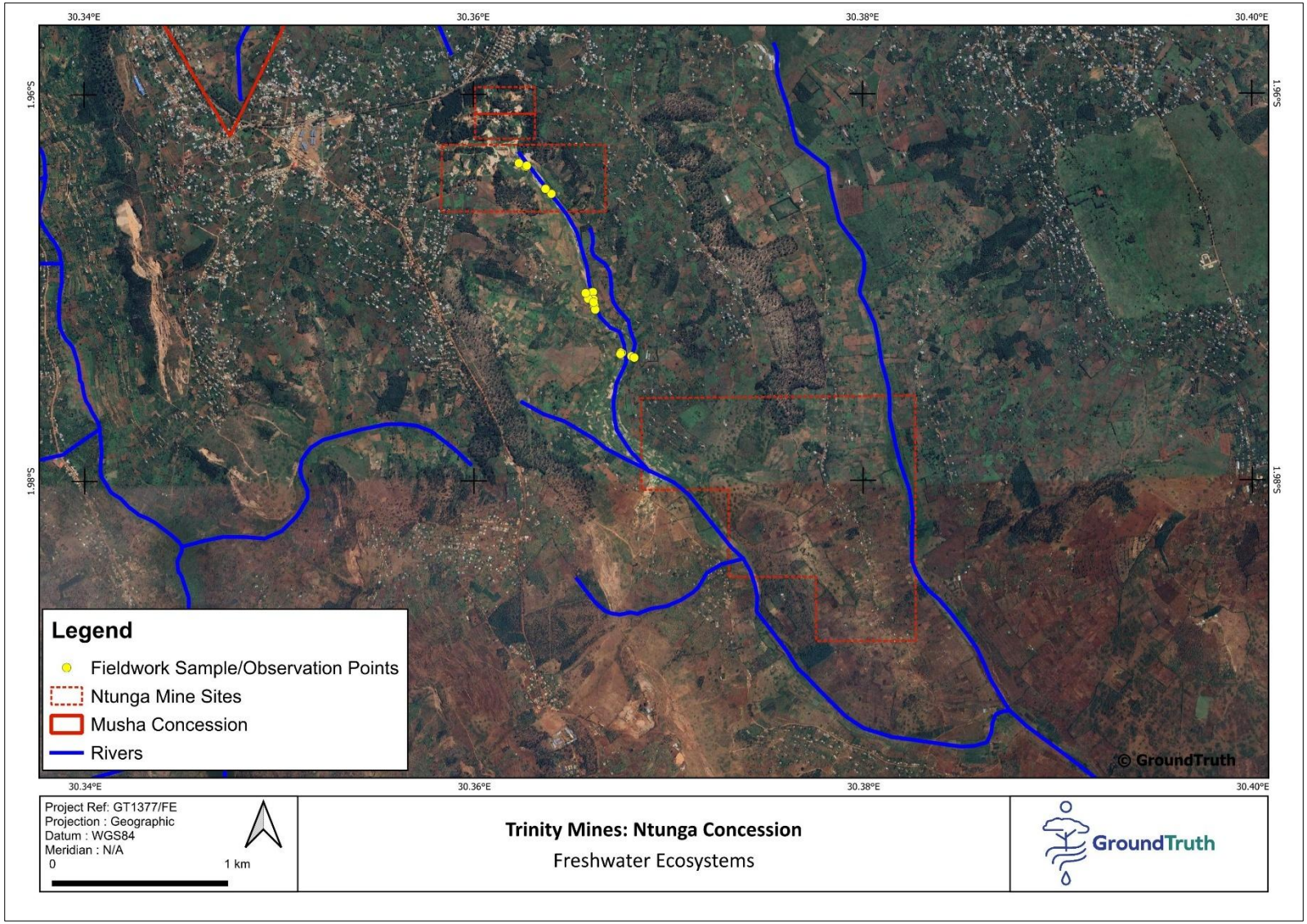

Figure 4-3 Map illustrating the various sites for the field survey within the Ntunga Mining Concession.

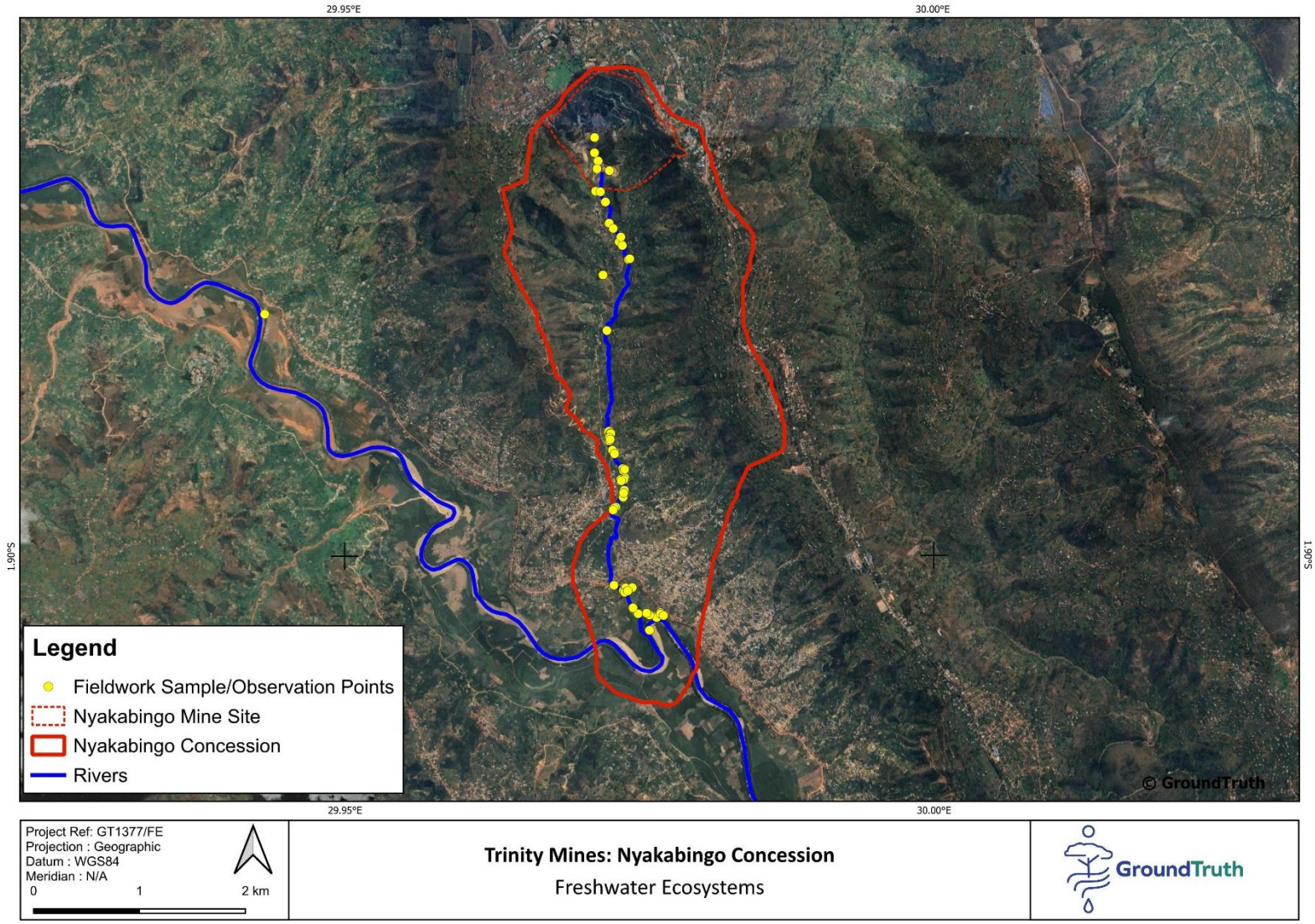

Figure 4-4 Map illustrating the various sites for the field survey within the Nyakabingo Mining Concession.

5. FIELD SURVEY DETAILS – RUTONGO CONCESSION AREA

The following section provides an overview and broad summery of some of the sites visited at Rutongo Concession.

5.1 Riverine assessment

Survey Dates: 11 – 14 November 2025
Number of Sites Surveyed: 14
Components surveyed: Water clarity, diatoms, aquatic invertebrates, riparian/instream habitat.
Site Photos:

Most of the Sanzari River is mined for sand and stone by RBSS activities, supported by local community members. Material is worked and sorted into stockpiles placed throughout the river channel and onto the banks. RBSS trucks are constantly loading and transporting the material out from the catchments, and use the river channel to gain access.


Illegal mining along the Gisanse River, tributary of the upper Rusine River, which adds to the disturbance and alteration of river habitats (left). Impacts from mining (both illegal mining and Trinity operations) and RBSS activities extend down the length of the Rusine River (right).

Few rivers, such as the Nyiramududu River (tributary of the Rusine River), are in a noticeably better condition, and supported a significantly higher number of aquatic macroinvertebrates, providing a useful benchmark to compare other systems in terms of desired river health.

The Nyirabukingure River system upstream of the Rutongo Mine Karambo Site is also impacted by illegal mining activities (left). Immediately downstream of Karambo mining operations, the system is heavily impacted by RBSS activities, which extend all the way to the Rusine River confluence (Right).

The upper Mulindi River, just downstream of the Rutongo Mine Masoro Site, is also extensively mined by RBSS, with impact extending down the lower parts of the system (i.e. the Nyacyonga River) before entering the Nyabugogo River. As with all the other mined systems, extreme suspended sediments result in severe impacts to aquatic biota that would be expected to occur within the rivers under improved clarity conditions.

5.2 Wetland assessment

Survey Dates: 11 – 14 November 2025
Number of Sites Surveyed: +-30
Components surveyed: Wetland functionality and integrity assessments
Site Photos:


One of the headwaters of the Sanzari River. This area is heavily utilized for subsistence agricultural activities, along with being a source of water for the Rutongo Mine headquarters. Evidence of historical wetland habitat is present in the remaining vegetative communities e.g. *Leersia hexandra, Fimbristylis dichotoma*. Historical wetland habitat (extensive organic layer and soil indicators) buried under 0.5m of sediment.


Pockets of wetland habitat adjacent to the Sanzari River just above the confluence with the Kivomo River. Signs of historical disturbance in this area were present which is likely associated with the harvesting of clay material for brick making. However, vegetative and soil indicators present. Current impacts include the *Eucalyptus* sp. within the wetland habitat.


The valley-bottom wetland associated with the Upper Rusine River has been extensively cultivated with a variety of subsistence crops. Sedimentation of the channel and directly adjacent habitat is mostly associated with the illegal mining along the river.


Extensive valley-bottom wetland systems downstream along the Rusine River (but upstream of the Nyiramududu tributary). Large portions of the systems have been extensively cultivated with limited wetland vegetation remaining – predominantly in the extensive drainage network. Portions of the valley-bottom has been subject to sedimentation in which portions of the cultivated areas are buried in +-5cm of soil. The lower portion of the valley-bottom is uncultivated however, Cyperus sp. (local name Urukangaga) is maintained and harvested for mat making.

Rusine River upstream of the confluence with the Kilimbi Stream. Pockets of wetland habitat along the flood terraces adjacent to the Rusine River. Similar to other wetlands, these have been modified through the harvesting of clay material.
The large wetland, which was historically linked to the Rusine River and maintained through overbank topping and lateral seepage inputs is currently only maintained via lateral inputs due to incised nature of the River (+-7m below original ground level). Wetland has been extensively modified through agricultural production – commercial and subsistence.

5.3 Overall site description and impacts

The Rutongo concession area is characterised by steep, rocky terrain which contributes to the large volumes of water, carrying large quantities of stone and sediment, entering the downstream freshwater ecosystems. The catchment has been extensively altered including extensive cultivation, homesteads, Eucalyptus plantations/woodlots, roads networks, erosion gullies (often linked to the road network), and illegal mining. These modifications have resulted in the

additional mobilisation of sediments and increased flood peaks into the downstream freshwater ecosystems fundamentally altering their overall functionality and integrity.

The freshwater ecosystems have also been significantly modified through both subsistence and commercial agricultural activities. As part of these practices, extensive drainage networks have been included across the systems to suitably direct flows away from the crops towards the mainstream or river system. Pockets of wetland vegetation can be found in some drains, but these are often cleared to ensure the free movement of flows through the system. Riparian zones through the concession are heavily impacted by bank erosion, channel incision and exotic vegetation.

Generally, the main rivers are extensively mined for aggregate – both fine and course material – by RBSS, which is further altering the hydrology and geomorphology of the freshwater ecosystems (e.g. altering/redirecting of flow paths), which in turn is having a significant impact on instream substrates and habitats, and thus riverine biota.

The cumulative catchment and in-system impact on the freshwater ecosystems have led to changes in all of the biophysical drivers of these systems, with very limited areas of intact habitat remaining. These changes undermine the systems' ecological integrity, reducing habitat quality for aquatic and semi-aquatic species, and weakening their role in nutrient cycling and flood mitigation.

6. FIELD SURVEY DETAILS – MUSHA CONCESSION AREA

The following section provides an overview and broad summery of some of the sites visited at Musha Concession.

6.1 Riverine assessment

Survey Dates: 17 November 2025
Number of Sites Surveyed: 4
Components surveyed: Water clarity, diatoms, aquatic invertebrates.
Site Photos: 
Upper portion of the Musha system closest to the mine. Characterised more by channelled valley bottom wetlands than river. Impacts include channel modification (straightening) and extensive drainage networks to support the subsistence agricultural activities.


Withing the lower portion of the system, in which the impacts have remained relatively unchanged from the upper reaches other than that there are some intact portions of wetland habitat upstream which may contribute towards improving the integrity and functionality of the system.

6.2 Wetland assessment

Survey Dates: 17-18 November 2025

Number of Sites Surveyed: 7

Components surveyed: Wetland functionality and integrity assessments

Site Photos:

The wetland habitat has been substantially modified through the construction of the Bisinia Dam, and the extensive drainage network associated with the subsistence agricultural activities.

The lower portion of the Musha wetland (upstream of the backwaters of Lake Muhazi) is less impacted than upstream, as a large area remains uncultivated.


The wetland habitat associated with the Rwakiramba valley has been substantially modified through both subsistence and commercial (co-operative) agricultural activities. An extensive drainage existing throughout the length of the system to allow for the cultivation of crops.


The wetland habitat associated with the Nyabigugu valley has been substantially modified through subsistence agricultural activities. Along with the others, this includes extensive drainage networks and loss of wetland vegetation, among others.


The Rubonobono and Rukombe valleys have the same characteristics to the Nyabigugu valley system and have been significantly modified through subsistence agricultural activities.

6.3 Overall site description and impacts

The greater mining concession area is comparatively less steep and erosive than the other concessions, reducing the among of sediment mobilised into the wetland systems from the surrounding land uses including *inter alia* cultivation, Eucalyptus woodlots, and homesteads.

The impacts on the downstream freshwater ecosystems associated with the Musha mining activities, are less severe than the other concession areas due to the existing management practices i.e. sediment-trapping within the mining area.

What most distinguishes this concession, however, is the character of its valley-bottom wetlands. Unlike the narrower, channelled wetlands found in other concessions, these valley-bottom areas are broad, flat, and historically would have been dominated by a discontinuously channelled wetland habitat. Some areas of wetland habitat still remain within the valley associated with the Musha mine, which is uncharacteristic for these areas due to the heavy reliance of the communities on the land for subsistence agriculture. Although much of this wetland is currently under cultivation, its geomorphic setting makes it less effective at

transporting sediment and less erosive, and as such the functionality of the overall systems is slightly higher than the wetlands in the other concessions.

7. FIELD SURVEY DETAILS – NTUNGA CONCESSION AREA

The following section provides an overview and broad summery of some of the sites visited at Ntunga Concession.

7.1 Riverine assessment

Survey Dates: 17 November 2025
Number of Sites Surveyed: 1
Components surveyed: IHI
Site Photos: 
Headcut erosion within the upper reaches of the system, followed by a large sediment deposit within the gully, filling the gully. From here there is no defined channel.

7.2 Wetland assessment

Survey Dates: 17 November 2025
Number of Sites Surveyed: 1
Components surveyed: Wetland functionality and integrity assessments
Site Photos:  

The valley-bottom wetland is sustained by lateral inputs and seepage within the channel. The wetland has been significantly modified through subsistence agricultural practices, including crops, drainage networks etc. Sediment inputs into the system are predominantly from the upstream catchment resulting in the burying of crops in fine sediments. Soil indicators are present within the soil but limited vegetative indictors due to the modifications.

7.3 Overall site description and impacts

The Ntunga mining concession is situated within a moderately steep valley, with the mine located at its headwaters. Historically, the system would have supported more wetland habitat, confined to a narrow strip down the valley. The drainage line down the valley has since become incised, and has formed into a "river" channel that constantly erodes and shifts across the lateral extent of the valley, causing the valley to become much wider over time. As a result the system supports a highly altered upper reach with very limited instream and riparian habitat. Water flows down the system is also limited to seepage water that is mostly contained and carried underground within the substrates. Most of the flows are linked to stormwater runoff following rainfall events.

The valley-bottom wetland starts about 900m downstream of the mine. The flows maintaining the wetland are a combination of lateral inputs from the adjacent catchment and the seepage that emerges within the channel. The wetland and biophysical drivers have been significantly modified through the subsistence agricultural practices. The gentler slopes of the adjacent catchment area are having less of an impact on the freshwater ecosystems in comparison to Rutongo however, the modified nature nonetheless is still a contributing factor to the overall integrity of the systems.

Unlike other concessions, there are negligible signs of illegal mining or direct sand and aggregate extraction from the freshwater ecosystems. As a result, the majority of fine and coarse sediment entering the wetlands originates from mining activities at the valley head. The continuous influx of material disrupts the wetlands' natural sediment balance, which is evident in the subsistence crops buried in sediments

Overall, the cumulative impacts on the systems particularly linked with the hydrological and geomorphology of the wetland is reducing the system's ability to regulate water flow, trap sediments, and sustain diverse ecological communities.

8. FIELD SURVEY DETAILS – NYAKABINGO CONCESSION AREA

The following section provides an overview and broad summery of some of the sites visited at Nyakabingo Concession.

8.1 Riverine assessment

Survey Dates: 18 November 2025
Number of Sites Surveyed: 8
Components surveyed: Water clarity, pH (in-situ), diatoms, aquatic invertebrates, riparian/instream habitat.
Site Photos: 
Evidence of deposits of rock within the channel from the upstream mining activities i.e. lots of mining aggregate/rocks but limited fines/sand. The change in sediment loads and flows have contributed to the incision of the channel. Extensive colonisation of alien invasive vegetation along the channel banks.


Within the mid-reach of the Nyakabingo River, where more fines/sand/small aggregate have been deposited. The width and depth of channel incision is variable between the upper and mid-reaches of the system. The overall PES of the system has been influenced by the constant movement and deposition of stone and sediments, as well as bank erosion and presence of exotic vegetation.

In the lower reaches of the Nyakabingo river near the town of Amajyaruguru town, the impacts on the system are largely associated with upstream mining activities with additional impacts from the surrounding urban landscape, e.g. incised channel, litter, infrastructure crossings such as bridges and pipelines.

8.2 Wetland assessment

Survey Dates: 19 November 2025

Number of Sites Surveyed: +-10

Components surveyed: Wetland functionality and integrity assessments

Site Photos:


The Nyakabingo valley has very limited wetland habitat along the lengths of the valley. This is linked to the fact that the valley is very narrow with limited opportunity for the formation of wetland. There are a series of wetland habitat pockets along the fringes of the channel. Some of these pockets have become desiccated and/or smothered in sediments, whilst others are increasingly becoming more cultivated.


Possible origin of the wetland is a levy along the Nyakabingo River which is preventing the flows from the surrounding town from decanting into the river, and therefore, is collecting it in a small basin-type feature in the lower reaches of the town. This area has been substantially cultivated.

8.3 Overall site description and impacts

The concession area represents one of the steepest valley-head settings, creating particularly challenging mining conditions and unique sediment dynamics. This has greatly influenced the nature of the downstream freshwater ecosystems, which have become incised often resulting in a disconnect between the riverine and wetland habitat.

As with the other concession areas, the catchment has been extensively modified through subsistence agricultural practices, woodlots, illegal mining, and erosion. Similar to Rutongo, the mining of coarse and finer sediments/materials from the river is an authorised activity, which is seen to be impacting on the ecosystems. Due to the steep nature of the valley, the mining of sediments is only occurring in the accessible areas, leaving stretches of river untouched from these activities.

The water quality of the main system is a concern due to it being acidic which is a result of the upstream mining activities. There are, however, a number of tributaries that decant into the main Nyakabingo system which are serving as sources of relatively unpolluted waters for the adjacent communities.

The lower reaches of the Nyakabingo system are largely impacted by the surrounding community. Some of the impacts include the disposal of litter within the river system. The system here is also incised with flows being restricted to the channel.