Report of Assessment of Land Degradation in Pilot Area

Prepared under the Capacity Development and Mainstreaming for Sustainable Land Management Project

Guyana Lands and Surveys Commission,
United Nations Development Programme
& Global Environment Facility
2008

Table of Contents

Introduction, Background and Aims

This report complements the wider ranging National Assessment of Land Degradation which is a first attempt at the characterisation of land degradation in Guyana and is being undertaken as part of the United Nations Convention to Combat Desertification (UNCCD) process.

The national assessment aims to provide a baseline indication as to the nature and extent of land degradation in Guyana using proven methodology (LADA/WOCAT) and this local assessment aims to do the same at a smaller scale in a particular area.

The ultimate objectives of a local area land degradation assessment are:

- to develop a methodology for conducting land degradation assessments
- to conduct assessments that deliver an understanding of causes and impacts of land degradation, the effectiveness of mitigating land management practices and policies that need to be in place for sustainable land management
- to provide an integrated approach for assessing and monitoring land degradation
- to recommend approaches for extrapolating between local and national level assessments
- to give guidance on the presentation and reporting of results

However at this early stage in the process the aims of the local area land degradation assessment were more diagnostic and aimed to:

- identify '*Hot spots'* - areas of severe land degradation requiring remedial action or vulnerable land threatened by degradation
- identify *'Bright spots'* - areas without significant land degradation, naturally stable or sustainably managed
- characterise status, drivers and impacts of land degradation
- map land degradation
- assess the LADA/WOCAT methodology
- provide policy and practical recommendations

The assessment process was undertaken in 12 days including travel to and from Guyana and included an aerial reconnaissance, two field days with some stakeholder consultations and a workshop presentation.

Methodology

As stated above the methodology used for the local land degradation assessment followed that of LADA (Land Degradation Assessment in

Drylands) and WOCAT (World Overview of Conservation Approaches and Technologies) as outlined in the Manual for Land Degradation Assessment – Training Workshop (Development Policy and Management Consultants/GLSC/GEF/UNDP 2008).

This methodology is largely qualitative rather than quantitative, requiring subjective judgement, and identifies hot spots (most critical areas) and bright spots (stable areas) which are then investigated in more detail involving an analysis of criticality and vulnerability through a transparent and participatory process and resulting in an ad-hoc classification and rating system worked out and used in consultation with local stakeholders.

The methodology used in this diagnostic assessment was also qualitative rather than quantitative and contained the following steps:

- Analysis of existing information
- Overflight
- Field visits
- Stakeholder consultations
- Land cover/land use mapping
- Land degradation mapping

The **analysis of existing information** comprised an assessment of a number of thematic maps (soils, vegetation, minerals and mining and forestry leases) covering the pilot area (see below) and an assessment of comments made and issues raised in public meetings held within the pilot area (at Linden and 47 Mile village) during the course of the Linden-Lethem road corridor planning in 2006 which could help to identify land degradation status and drivers.

The **overflight** lasting 2½ hours took place on Tuesday 30th September with a route across Linden, south to Ituni, west to 47 Mile village and back north to Linden at a flying height of about 1,000 feet. This served as an aerial reconnaissance and identified areas of degradation for further assessment at ground level. Photographs of degradation were taken and are shown in Appendix II.

Two **field visits** were undertaken; on 1st October to Linden, Three Friends and 47 Miles village and on 2nd October south from Linden to Ituni and north to Moblissa. These field visits included a rapid assessment of land degradation status on the ground as well as **stakeholder consultations** with Community Logging and Agricultural Associations based in Linden, Three Friends and Ituni operating within or based within the pilot area.

This resulted in the delineation of a **land cover/land use map** and of a **land degradation map** which was drawn onto a satellite imagery base obtained from Google Earth which was subsequently georeferenced and mapped at 1:100,000 scale onto the pilot area base map.

The Pilot Area

The pilot area is located in Region 10 extending south from the Moblissa river in the north to Ituni at the south-east corner and 47 Mile village in the south-west corner and including Linden. The northern boundary is formed by the Moblissa river and the eastern and western boundaries are defined as being approximately 5 miles east and west of the main roads running to Ituni (and on to Kwakwani) and 47 Mile village (and on to Mabura Hill and Lethem) respectively. The southern boundary is a line between Ituni and 47 Mile village.

Existing information on the area includes data and maps on topography and drainage, soils, natural vegetation, mineral resources and mining and logging leases and concessions. These maps are shown in Appendix I.

The pilot area is characterised by a flat to gently undulating topography bisected by the Demerara River which flows from south to north. The main urban areas are Linden in the north and Ituni in the south-east both of which are surrounded by old (Ituni) and current (Linden) bauxite mining tailings. The only roads are those linking Linden to the coast in the north (the Soesdyke Highway), to Ituni in the south east and to Rockstone, Mabura Hill and Lethem in the west.

The soil information and mapping is derived from FAO mapping in the mid-1960s which produced a soil and land capability map for the whole of Guyana. These maps have been digitised at GLSC and form the basis for the soil data within the area. It is understood that NARI have recently reclassified this mapping and have produced maps under the USDA soil classification albeit with the same soil boundaries as the FAO mapping. For reasons of clarity and ease of understanding the original soil classification names have been retained.

The soil maps show four land units; a small area of the Coastal Plain between the Moblissa River and Linden, the Interior Alluvial Plain close to the Demerara River north and south of Linden, the White Sand Plateau over most of the area and small areas of Highlands, Mountains and Plateaux associated with higher ground in the south west of the area.

The soils have been mapped in six separate categories but are dominated by Regosols (white quartz sand phase) and Red Yellow Latosols (steep phase including red yellow podzolic integrades to red yellow latosols.). The latter soils occur close to the Demerara river with the Regosols occupying the higher land away from the river. A small area of Red Yellow Latosols (light textured phase) occurs to the east of 47 Mile village.

Around Linden the soils are poorly drained Low Humic Gleys of low base status and Groundwater Laterites including alluvial soils with the small coastal plain area having Low Humic Gleys of high base status. The hills of the south west have been mapped as Reddish Brown Lateritic Soils of low base status.

In terms of Land Capability, the most suitable soils for cultivation are the Low Humic Gleys of high base status between Linden and Moblissa which have been mapped as Class I-II, Good to Moderate Agricultural Land. Also mapped as Class I-II but also with areas of IIIf (Poor Agricultural land with low fertility) are the light textured Red Yellow Latosols in the south west and the Low Humic Gleys of low base status around Linden. The Red Yellow Latosols (steep phase) and the Reddish Brown Lateritic soils of the hills in the south west have been mapped as Class III - Poor Agricultural Land while the White Sand Regosols have been mapped as Class IV – Non agricultural land.

The natural vegetation of the area is derived from mapping by the Guyana Forestry Commission and is highly correlated with the soils mapping with a total of seven mapping categories. The low humic gleys with high base status are mapped as Swamp Forest while similar soils with low base status are mapped as Marsh Forest. Dakama Forest is dominant on the white sand regosols with some areas of Muri Scrubland and Wallaba Forest in the west. The central lowlands of the Demerara river with red yellow latosols (steep and light textured phases) and the Reddish Brown Lateritic Soils of the hilly areas are dominated by Mixed Forest.

The main mineral resources are the bauxite belt which covers most of the area apart from the south west corner, aluminous laterite deposits around 42 Miles and glass sand in the north east. There are three mining concession areas; one in the north around Linden and extending south along the main road, one in the south east and one in the south west which are part of the same larger concession area. Bauxite is currently mined in Linden by Omai Bauxite Mining Inc. (OBMI) a company 70% owned by Bosai Minerals of China and 30% by the Government of Guyana. Most of the bauxite mined and exported is Calcined Bauxite rather than Metallurgical Grade bauxite. Further bauxite deposits are known to occur north and east of Linden and south and east of Ituni.

Forestry concessions comprising State Forest Permissions (SFPs), Wood Cutting Leases (WCLs) and Timber Sales Agreements (TSLs) occur in the northwest, the southeast and a small area in the south west part of a larger area extending west and southwards. State Forest Permissions (SFP) are granted by GFC for areas up to 80km^2 (8,000ha or 19,767acres) for a period of one calendar year with an option for renewal. Within the Pilot Area these areas are concentrated in the west between Linden and 47 miles. Wood Cutting Leases (WCL) are issued for areas greater than 80km^2 with a duration of 3 to 15 years and Timber Sales Agreements (TSL) are issued for area greater than 243km^2 (60,000 acres) and are valid for 10 to 25 years. These occur in the Pilot Area as parts of larger areas in the south east and south west.

Findings

The findings of the local land degradation assessment are contained in the current land cover/land use map and the derived land degradation map as shown in Appendix I.

The land cover/land use mapping is composed of six classes as shown below:

Land Cover/Land Use Mapping Classification

U	Urban area	Residential, Commercial and Light Industrial land uses
UA	Village	Cleared land with scattered settlement and some agriculture
Mb	Bauxite mining	Mining, processing and abandoned mine workings.
Ml	Laterite mining	Open cast mining of laterite gravels.
F	Forest	May contain areas of logging but little clear felling.
A	Agriculture	Agricultural land containing productive farms and cleared but abandoned/unproductive land. Occurs as a mosaic with forest.

Land Cover Extent

Land Cover/land use	**Area (ha)**	**%**
U	2,245	1.52
UA	40	0.03
Mb	4,804	3.25
Ml	25	0.02
F	5,758	3.90
A	3,699	2.51
TOTAL AREA OF THE PILOT SITE	**147,602**	

The urban areas (U) cover an area of some 2,245 ha (1.52% of the total area) and are confined to Linden and Ituni while the only village (UA) (40 ha, 0.03%) mapped was around 47 Mile village. The main land uses in these areas are habitation, commercial and industrial with some small-scale agriculture.

Bauxite mining (Mb) was easily discriminated and occurs around Linden and Ituni covering a total area of 4,804 ha (3.25%). The category includes currently mined areas, old tailings and resultant deposition areas from erosion of these as well as some small areas of ponds and wetlands. However they have all been mapped as Mb since it was not possible to discriminate between the different uses. Areas of forest cleared for laterite mining occur close to the main roads with two areas on the Mabura road and one on the Ituni road.

Forest (F) is the most extensive land cover with a total coverage of 5,758 ha or 3.9% of the total area but was not sub-divided into different forest types although it was possible to discriminate Muri scrub from other forest types on the imagery. The degree of forest disturbance by logging was not mappable at this stage or scale.

Agricultural land (A) occurs mainly to the north of Linden, between Linden and Moblissa and along the Demerara river and includes currently productive land, cleared land and abandoned land often in association with forested areas. The area of agricultural land is 3,699 ha and comprising 2.51% of the total area.

These land use classes were then assigned land degradation status as shown below:

Land Degradation Mapping Units

E Extreme degradation (Red)
Degradation 'hotspots'. (Mb)

M Slight to Moderate degradation Areas where (Orange)
the natural vegetation has been cleared but
the degradation is not severe. (UA, Ml & A)

N No degradation (Yellow or blank)
Degradation 'bright spots' (F)

U Urban areas

Land Degradation Extent

Land Degradation Class	**Area (ha)**	**%**
E	4,804	3.25
M	3,764	2.55
N	5,758	3.90
U	2,245	1.52
TOTAL AREA OF THE PILOT SITE	**147,602**	

The Table above shows the relative extent of different degrees of land degradation. The most extensive land degradation class is N – no degradation covering some 3.9% of the total area followed by M – Slight to Moderate degradation (2.55%) with the greatest extent in the agricultural land north of Linden followed by E – Extreme degradation (3.25%) associated with bauxite mining around Linden and Ituni. U- Urban areas occupy 1.52% and are confined to Linden and Ituni.

Areas of extreme degradation ('hot spots') are associated with current and past bauxite mining where the vegetation cover and soil has been stripped and there has been minimal rehabilitation. In places there is further erosion of tailings with severe impacts on surrounding areas. These areas primarily occur around Linden and to a lesser extent around Ituni. The extreme degradation is evidenced by a severely disturbed topography, an almost complete lack of vegetation, the presence of bare soil, rock and tailings on the surface and, in places, further erosion of these tailings with deposition in lower lying areas. Further evidence is the creation of water bodies in lower lying areas and the potential for surface and groundwater contamination and pollution.

There is no evidence of any rehabilitation or revegetation although around Ituni where the tailings are reported to be 25-30 years old there has been some natural revegetation.

Slight to moderate degradation is also associated with the clearance of the natural vegetation but in these areas the soil is generally not exposed for long or the areas are very small. These areas include villages and agricultural lands where the natural vegetation has been cleared but the soil is quickly covered by crops or regrowth with minimal soil erosion although soil fertility may have declined. Exceptions are the laterite mining areas which, even though the areas have been clear felled, are very small in size and can be rehabilitated relatively easily.

The majority of the area as forest is considered to have no degradation (' bright spots') despite some areas having been logged out thus reducing the biodiversity and its economic function but its ecosystem function remains intact and the degree of land degradation is minimal to zero.

Land Degradation Status, Drivers and Impacts

An initial indication of the land degradation status, drivers and impacts has been derived from the field assessments and stakeholder consultations.

Land Degradation - Status

- The overall land degradation status of the Pilot Area is that the vast majority of the area is a forested 'bright spot' with little evidence of land degradation

- Even in forestry concession areas there is little evidence of land degradation with loggers following the GFC code of practice which does not allow clear felling, precludes felling on steep slopes (>40%), promotes forest use zoning, yield regulation and harvest planning
- Discussion with community loggers indicated that while some areas may be logged out of *economically* valuable trees (due to past logging activity) the ecosystem function of these areas is intact and that these areas are not degraded
- Some areas of forest degradation (dead trees) were noted from the air and on the ground and are the result of natural causes, mainly flooding or waterlogging and occasionally fire although this is reportedly rare
- Land degradation 'hotspots', areas with extreme degradation, are confined to areas of bauxite mining and are characterised by severe topographic changes, total vegetation removal with little revegetation, the presence of subsurface materials on the surface and the creation of water bodies in low lying areas
- In places there is evidence of further erosion of mine tailings with impacts on surrounding areas
- The possibility of contamination and pollution of surface and groundwater resources in these areas must be considered and investigated
- Laterite mining areas have been classified as showing moderate degradation due to their small size even though the areas have been stripped of thir vegetation
- Areas cleared for agriculture do not show any physical evidence of further degradation such as soil erosion but discussions with stakeholders indicated that soil fertility declines over time
- Increased land degradation through urban area expansion is largely mitigated by the fact that this expansion is often into already degraded mine areas

Land Degradation – Drivers

- Within the Pilot Area the main driver to land degradation is resource use, primarily by large-scale mining with forestry (including charcoal production) and agriculture secondary
- The dominant causes of land degradation are deforestation for mining and agriculture, overuse of vegetation resources in some forested areas, biological degradation through pollution in mining and chemical (fertility) deterioration in agriculture
- The only evidence of increasing population pressure is on urban growth, a minimal driver to land degradation in the Pilot Area

Land Degradation – Impacts

Mining has the greatest land degradation impact with the greatest disturbance, extent and rehabilitation difficulty. In addition there are potential secondary impacts from mining including surface water and groundwater pollution and off-site impacts through further erosion of mine tailings.

Forestry has minor impacts within the pilot area since there are no areas of clear felling or any evidence of erosion or degradation from forested areas. Logged out areas may have lost biodiversity and their economic value but their ecosystem function remains intact.

Agriculture has a slight to moderate impact through the loss of natural vegetation by clear felling albeit on a small scale but there is little evidence of any further physical degradation through soil erosion although there is anecdotal evidence of chemical degradation through fertility decline.

Land degradation impacts by sector are:

- Mining
    - Clearance of natural vegetation
    - Loss of biodiversity and ecosystem function
    - Interference with surface water flows, possible pollution
    - Potential impact on groundwater
    - Topsoil loss inhibiting re-vegetation
    - Further erosion from spoil impacting surrounding areas

- Forestry
    - Loss of biodiversity with potential for reduction of ecosystem function

- Agriculture
    - Clearance of natural vegetation with reduction in biodiversity
    - Fertility decline (soils are fragile with fertility in topsoil only)

Conclusions and Recommendations

The overall conclusions of the land degradation assessment of the pilot area are:

- The majority of the area is a forested 'bright spot' with little or no land degradation
- Extremely degraded 'hotspots' are confined to areas of bauxite mining which, in places, have further impact on surrounding areas
- There is moderate degradation associated with land clearance for agriculture but little evidence of further degradation
- There is little degradation from urban expansion since this expands into already degraded old mining areas although there is some evidence of further degradation following expansion
- The methodology for assessing land degradation is sound but needs better definition of 'extreme', 'moderate', 'slight' and 'none' with reference to type, extent and ease of rehabilitation
- The usefulness of using imagery as a base for mapping land use and land degradation

Policy Recommendations

Land degradation occurs largely due to indiscriminate resource use, the underlying causes of which are usually due to non existent (or poorly defined) policies and laws, low institutional capacity to implement policy, enforce legislation and monitor compliance and poverty which forces people to exploit natural resources in an unsustainable manner.

The following are policy recommendations that aim to reduce land degradation:

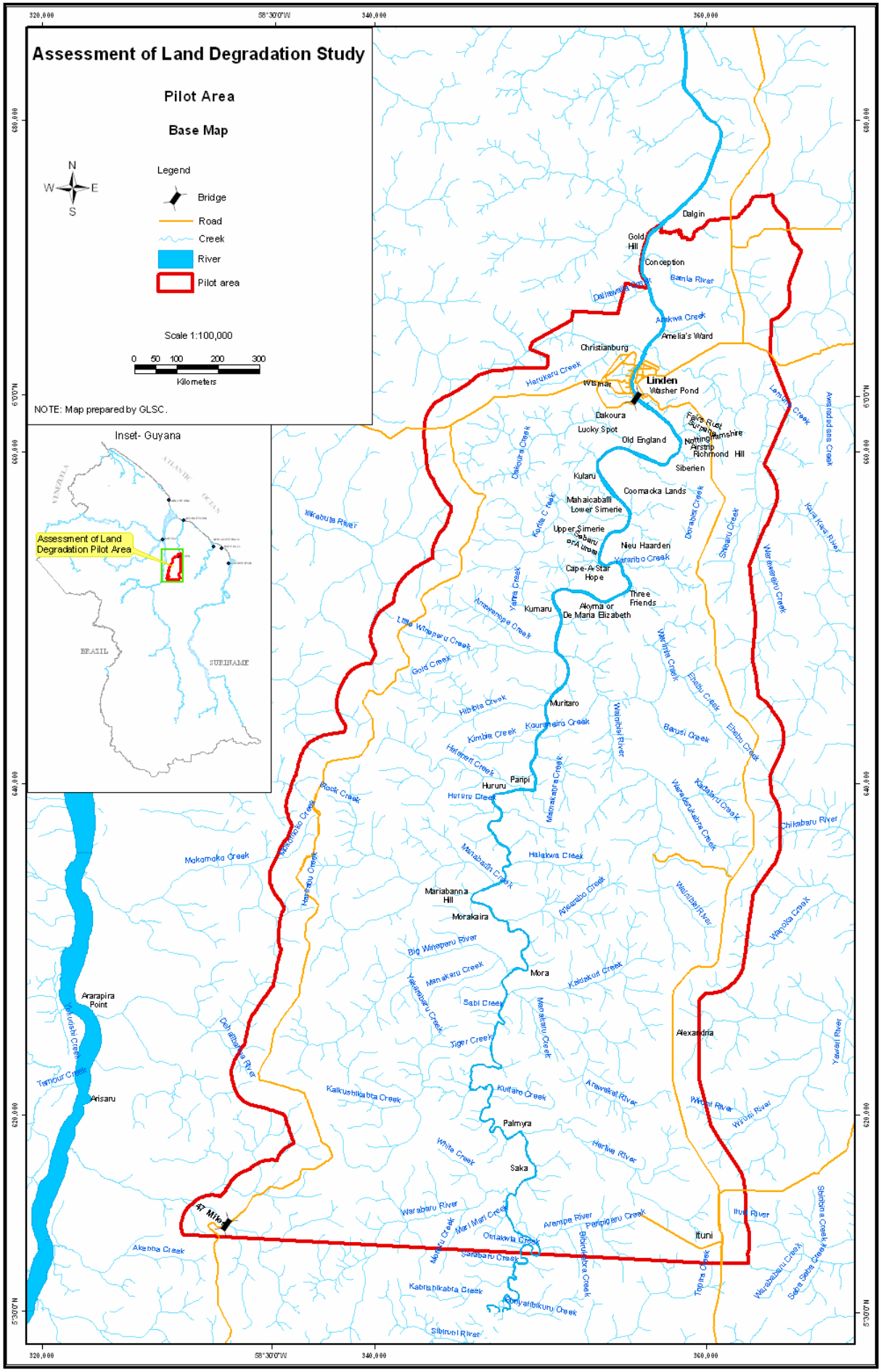
- Enforcement of environmental policies concerning mine waste rehabilitation
- Finalise a National Land Use Policy and develop a National Land Use Plan to guide resource use
- Strengthen institutional arrangements for land planning and management, particularly the relationship between GLSC, GFC, GGMC and CHPA
- Explore the use of MODIS satellite imagery for monitoring land use change

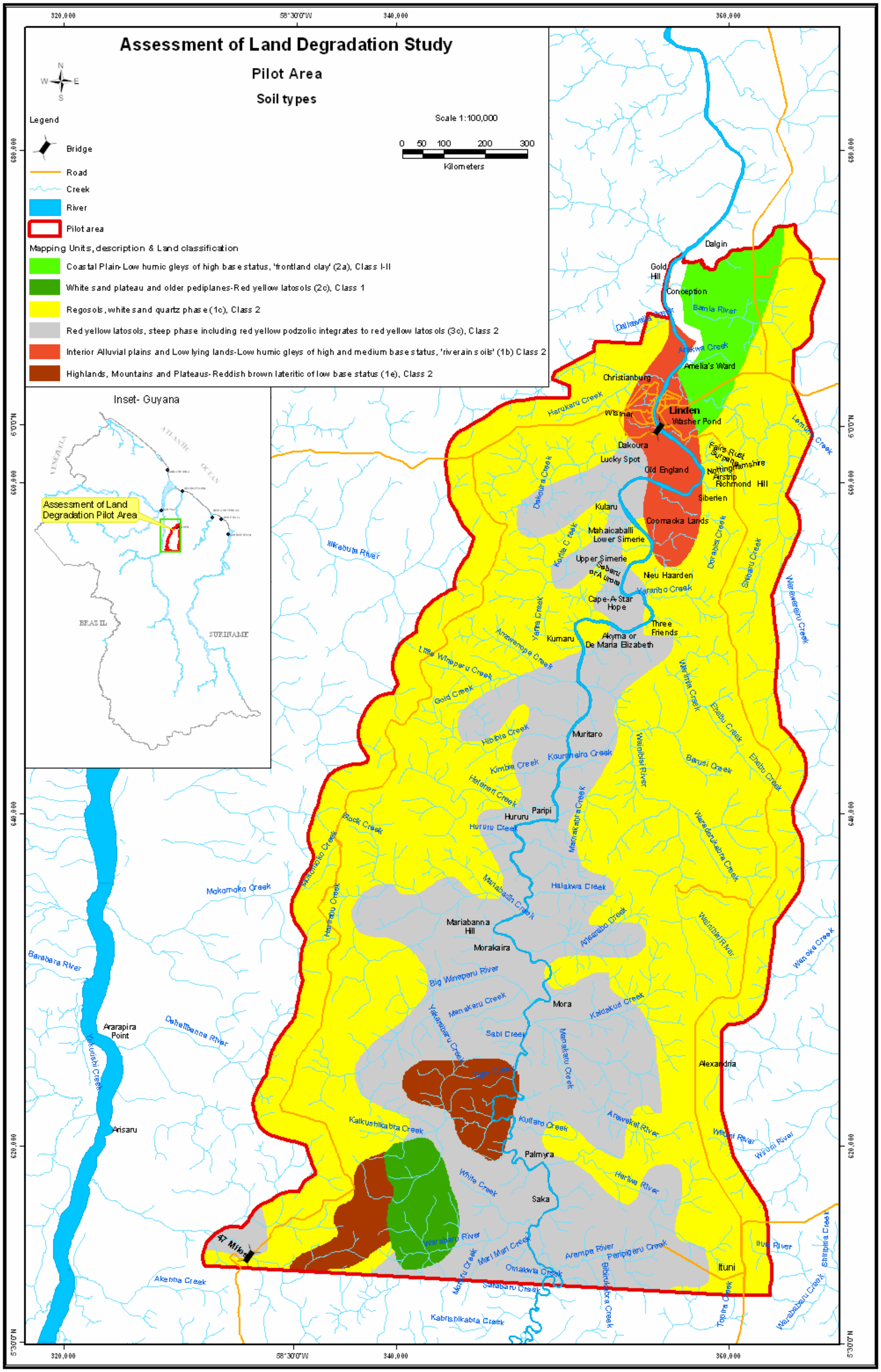
Practical recommendations to mitigate current and future land degradation in the pilot area include:

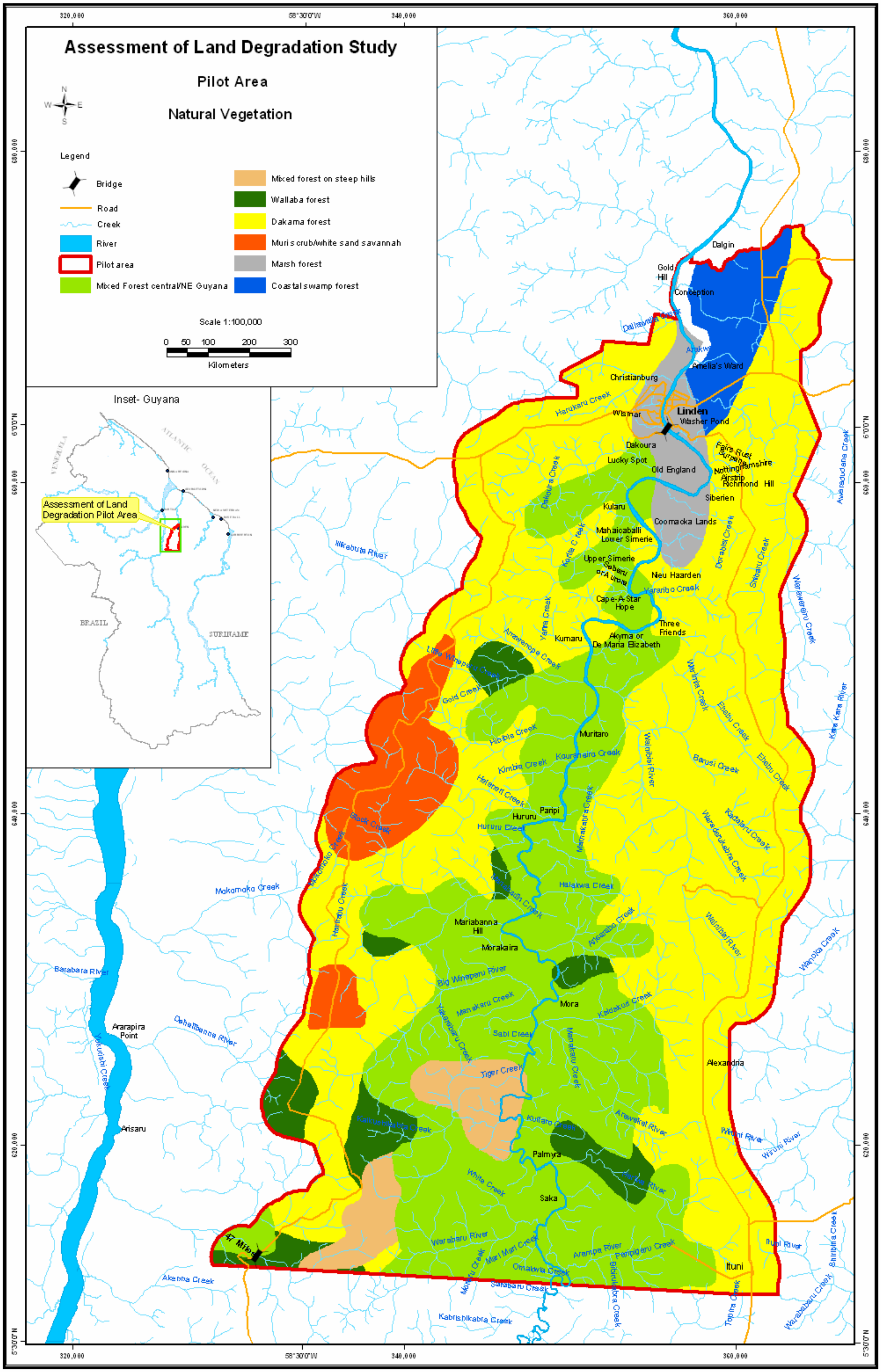
- Explore alternative uses (recreation, landfill, industrial) of extremely degraded mining areas. This will require further study.
- Explore alternatives for the re-vegetation of mine tailings
- Monitor surface and groundwater quality particularly in relation to the degradation hotspots

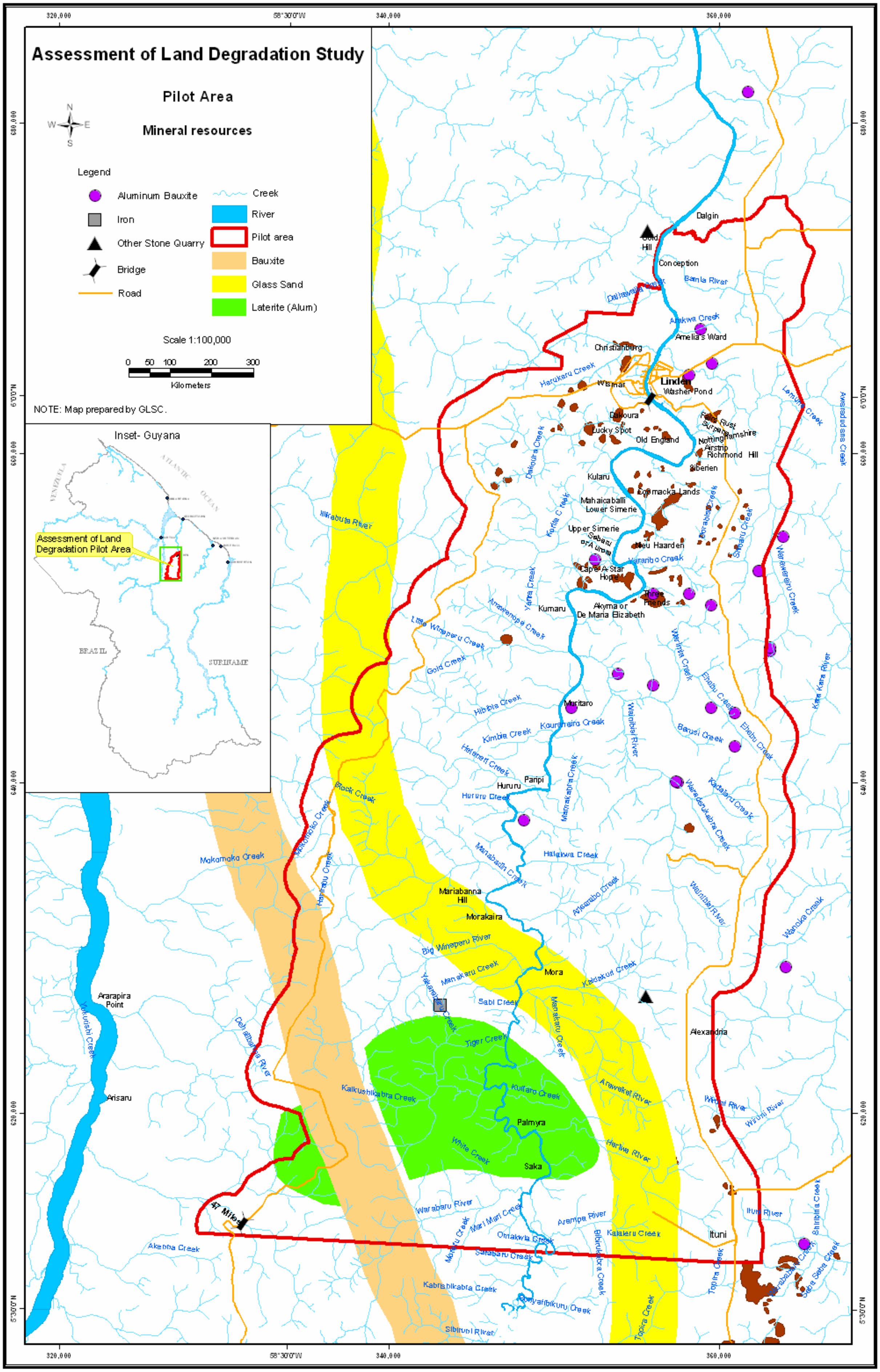
- Collect baseline soil fertility data and monitor cleared agricultural areas against the baseline
- Assess the degree to which logged out forest areas still perform their ecological function (these areas have been mapped as non degraded but further study may enable mapping of logged out versus virgin forest and how these affect land degradation)
- Assess the effect of urban expansion on the stability and erodibility of former mine tailings around Linden
- Assess the need for road maintenance to reduce road induced soil erosion and land degradation

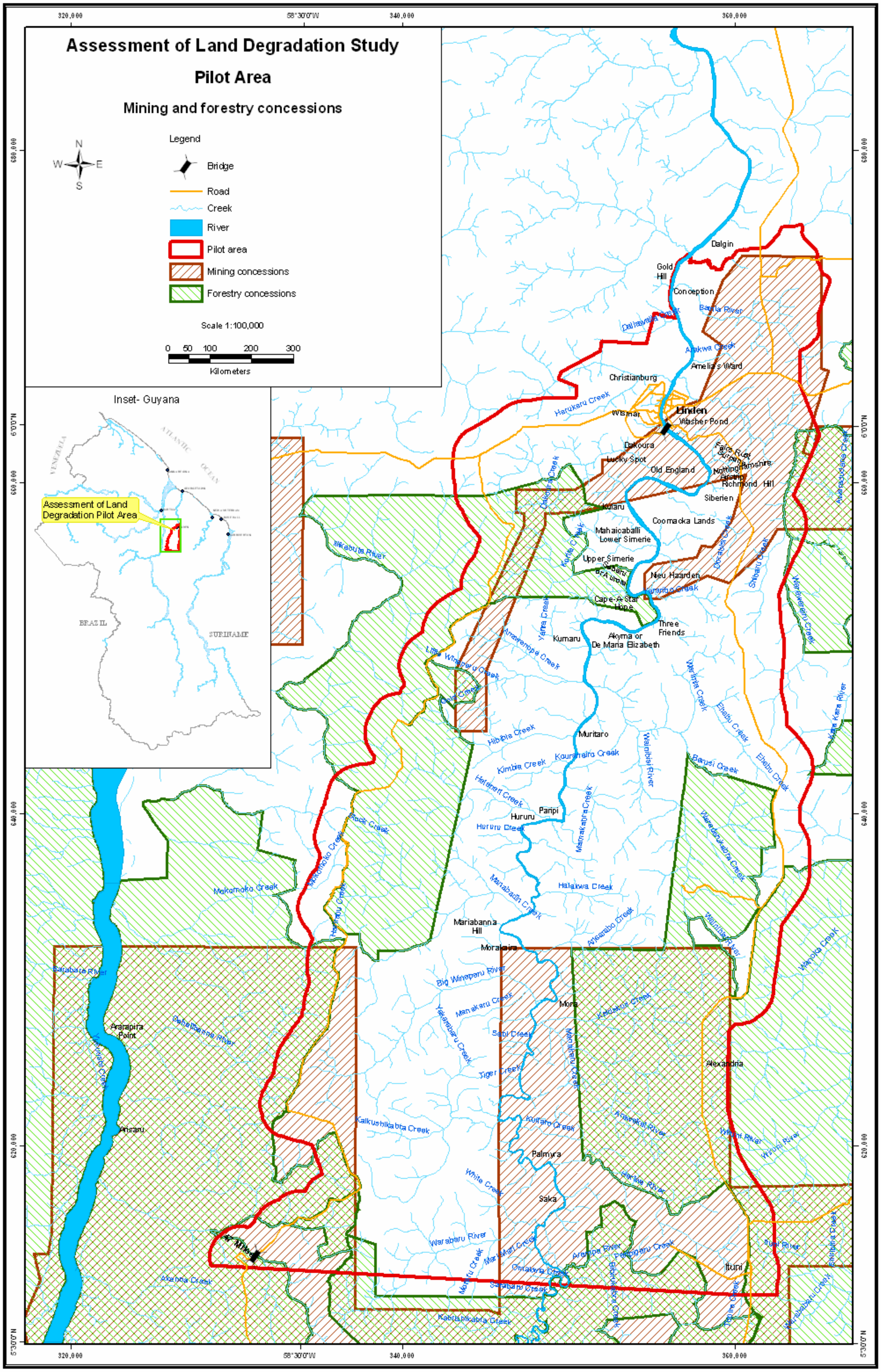
APPENDIX 1- Maps

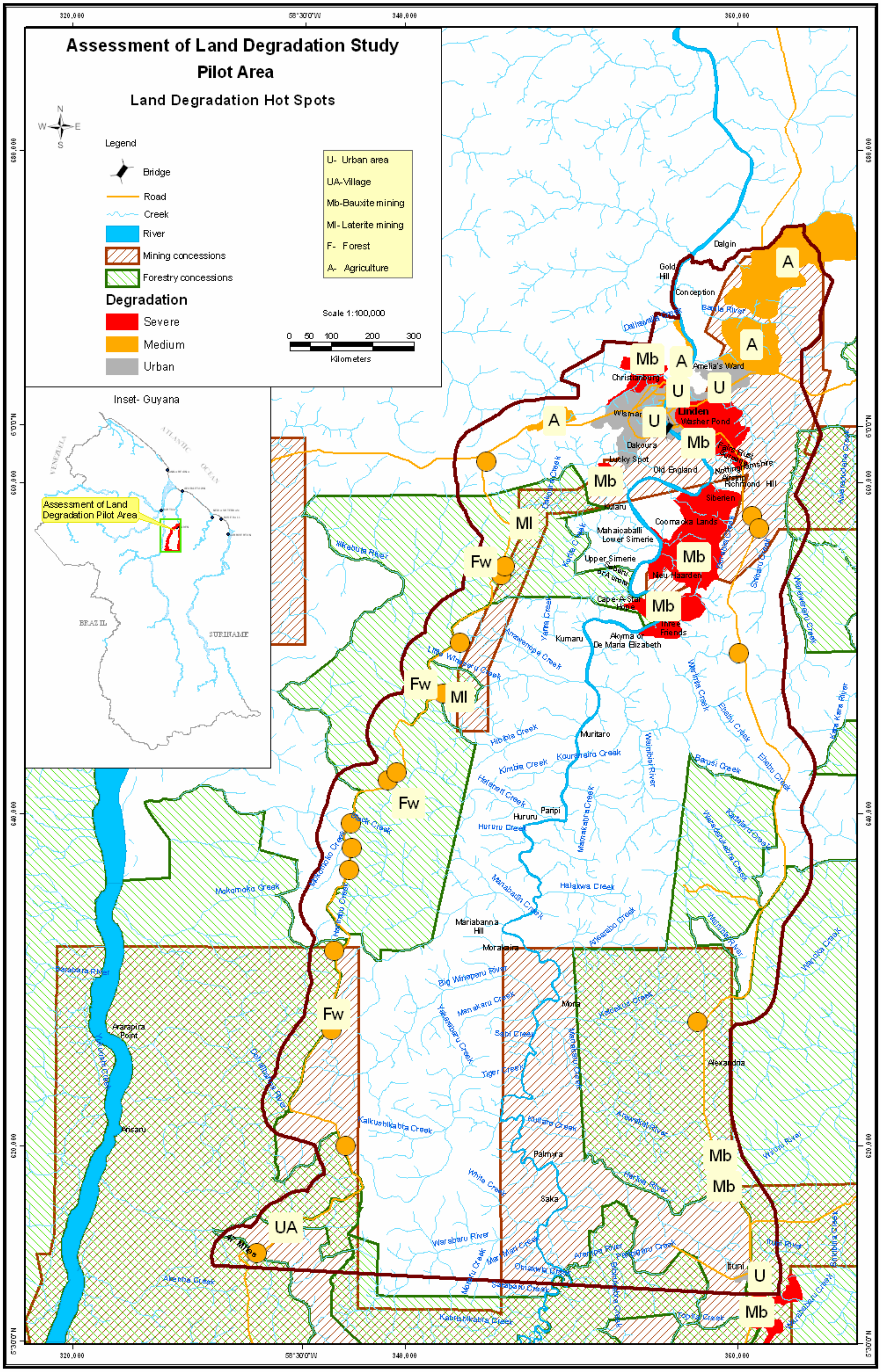



Assessment of Land Degradation Study
Pilot Area
Soil types
Legend
Bridge
Road
Creek
River
Pilot area
Mapping Units, description & Land classification
Coastal Plain-Low humic gleys of high base status, 'frontland clay' (2a), Class I-II
White sand plateau and older pediplanes-Red yellow latosols (2c), Class 1
Regosols, white sand quartz phase (1c), Class 2
Red yellow latosols, steep phase including red yellow podzolic integrates to red yellow latosols (3c), Class 2
Interior Alluvial plains and Low lying lands-Low humic gleys of high and medium base status, 'riverain soils' (1b) Class 2
Highlands, Mountains and Plateaus-Reddish brown lateritic of low base status (1e), Class 2
Scale 1:100,000
0 50 100 200 300
Kilometers
Inset- Guyana
Assessment of Land Degradation Pilot Area
BRAZIL
SURINAME
320,000
58°30'0"W
340,000
360,000
6°0'0"N
5°30'0"N
Dalgin
Gold Hill
Conception
Christianburg
Amelia's Ward
Linden
Wismar
Washer Pond
Dakoura
Lucky Spot
Old England
Siberien
Richmond Hill
Kularu
Coomacka Lands
Mahaicaballi
Lower Simerie
Upper Simerie
Neu Haarden
Cape-A-Star Hope
Three Friends
Kumaru
Akyma or De Maria Elizabeth
Muritaro
Paripi
Hururu
Mariabanna Hill
Morakaira
Mora
Alexandria
Palmyra
Saka
Ituni
47 Miles
Ararapira Point
Arisaru
Big Wineperu River
Mokamoko Creek
Barabara River
Demerara River
Ituni River
Akabha Creek
Kabrabikabra Creek


Assessment of Land Degradation Study
Pilot Area
Natural Vegetation
N
W
E
S
Legend
Bridge
Road
Creek
River
Pilot area
Mixed Forest central/NE Guyana
Mixed forest on steep hills
Wallaba forest
Dakama forest
Muri scrub/white sand savannah
Marsh forest
Coastal swamp forest
Scale 1:100,000
0 50 100 200 300
Kilometers
Inset- Guyana
Assessment of Land Degradation Pilot Area
BRAZIL
SURINAME
320,000
58°30'0"W
340,000
360,000
6°0'0"N
5°30'0"N
640,000
620,000
Dalgin
Gold Hill
Conception
Christianburg
Amelia's Ward
Linden
Wismar
Washer Pond
Dakoura
Lucky Spot
Old England
Richmond Hill
Siberien
Kularu
Coomacka Lands
Mahaicaballi
Lower Simerie
Upper Simerie
Nieu Haarden
Cape-A-Star Hope
Three Friends
Kumaru
Akyma or De Maria Elizabeth
Muritaro
Paripi
Hururu
Mariabanna Hill
Morakaira
Mora
Alexandria
Palmyra
Saka
47 Miles
Ituni
Ararapira Point
Arisaru
Harukaru Creek
Iliirabuta River
Makamaka Creek
Barabara River
Big Wineparu River
Tiger Creek
Warabaru River
Akenna Creek
Kabrabikabra Creek
Awaraduaina Creek


Assessment of Land Degradation Study
Pilot Area
Mineral resources
N
S
W
E
Legend
Aluminum Bauxite
Iron
Other Stone Quarry
Bridge
Road
Creek
River
Pilot area
Bauxite
Glass Sand
Laterite (Alum)
Scale 1:100,000
0 50 100 200 300
Kilometers
NOTE: Map prepared by GLSC.
Inset- Guyana
Assessment of Land Degradation Pilot Area
BRASIL
SURINAME
320,000
58°30'0"W
340,000
360,000
680,000
660,000
640,000
620,000
6°0'0"N
5°30'0"N
Dalgin
Gold Hill
Conception
Bamia River
Christianburg
Amelia's Ward
Linden
Wismar
Washer Pond
Dakoura
Lucky Spot
Old England
Richmond Hill
Siberien
Kularu
Mahaicaballi
Lower Simerie
Upper Simerie
Neu Haarden
Three Friends
Kumaru
De Maria Elizabeth
Muritaro
Paripi
Hururu
Mariabanna Hill
Morakaira
Mora
Alexandria
Palmyra
Saka
Ituni
Ararapira Point
Arisaru
47 Miles
Harukaru Creek
Dakoura Creek
Korite Creek
Yarra Creek
Little Wineperu Creek
Gold Creek
Hibbia Creek
Kimbia Creek
Kouranairo Creek
Hururu Creek
Mamakabra Creek
Halakwa Creek
Big Wineperu River
Manakaru Creek
Sabi Creek
Tiger Creek
Kuliaro Creek
White Creek
Kaikushikabra Creek
Warabaru River
Mari Mari Creek
Omakwia Creek
Kabiashikabra Creek
Sibiruni River
Akenna Creek
Makomako Creek
Dehattaballi River
Kaikabru Creek
Arawekai River
Harlwa River
Ituni River
Topira Creek
Kalakaru Creek
Arampa River
Waiabisi River
Wainibisi River
Lamuna Creek
Waruni River
Kara Kara River
Wanaka Creek
Wariwaru Creek
Makabarai Creek
Kadakaru Creek
Barusi Creek
Ehebu Creek
Warabudukabra Creek
Sebai Creek
Sibaru Creek
Wariwapiru Creek
Ituriashi Creek


Assessment of Land Degradation Study
Pilot Area
Mining and forestry concessions
N
W
E
S
Legend
Bridge
Road
Creek
River
Pilot area
Mining concessions
Forestry concessions
Scale 1:100,000
0 50 100 200 300
Kilometers
Inset- Guyana
Assessment of Land Degradation Pilot Area
BRASIL
SURINAME
320,000
58°30'0"W
340,000
360,000
680,000
660,000
640,000
620,000
6°0'0"N
5°30'0"N
Dalgin
Gold Hill
Conception
Christianburg
Amelia's Ward
Linden
Wismar
Washer Pond
Dakoura
Lucky Spot
Old England
Richmond Hill
Siberien
Kularu
Coomacka Lands
Mahaicaballi
Lower Simerie
Upper Simerie
Nieu Haarden
Cape-A-Star
Hope
Three Friends
Kumaru
Akyma or
De Maria Elizabeth
Muritaro
Paripi
Hururu
Mariabanna Hill
Morakaira
Mora
Araripira Point
Arisaru
Alexandria
Palmyra
Saka
Ituni
Harukaru Creek
Dalliavalli Creek
Kimbia Creek
Hururu Creek
Halakwa Creek
Mokamoko Creek
Big Wineperu River
Tiger Creek
Kaikushikabra Creek
White Creek
Warabaru River
Akaboa Creek
Kabiabikabra Creek


Assessment of Land Degradation Study
Pilot Area
Land Degradation Hot Spots
Legend
Bridge
Road
Creek
River
Mining concessions
Forestry concessions
Degradation
Severe
Medium
Urban
U- Urban area
UA-Village
Mb-Bauxite mining
Ml- Laterite mining
F- Forest
A- Agriculture
Scale 1:100,000
0 50 100 200 300
Kilometers
Inset- Guyana
Assessment of Land Degradation Pilot Area
BRASIL
SURINAME
320,000
58°30'0"W
340,000
360,000
680,000
660,000
640,000
620,000
6°0'0"N
5°30'0"N
Dalgin
Gold Hill
Conception
Amelia's Ward
Christianburg
Linden
Wismar
Washer Pond
Dakoura
Lucky Spot
Old England
Richmond Hill
Siberien
Coomacka Lands
Mahaicaballi
Lower Simerie
Upper Simerie
Neu Haarden
Cape-A-Star
Three Friends
Kumaru
De Maria Elizabeth
Muritaro
Paripi
Hururu
Mariabanna Hill
Moraballi
Mora
Alexandria
Palmyra
Saka
Araripira Point
Frisaru
Ituni
47 Miles
A
Mb
U
Ml
Fw
UA

APPENDIX 2- Photographs

Mark Hopkins presentation on the findings of land degradation in the Pilot Area at the Stakeholder Consultation Workshop held at Hotel Tower

Fly-over of Linden, a major mining (bauxite) operation in the Pilot Site

Fly-over to view vegetation along the Trail

Fly-over to view land uses and activities along the Demerara River