ENVIRONMENTAL AND SOCIAL IMPACT STATEMENT FOR THE PROPOSED SINDILA MINI HYDROPOWER STATION IN BUNYAMWERA PARISH, SINDILA SUB-COUNTY, BUNDIBUGYO DISTRICT

UPDATED

Prepared by:

OPEP Consults

Prepared for:

Butama Hydro-Electricity Company Limited
Plot 41, Nakasero Road
P. O. Box 9566
Kampala, Uganda

Following Gap Analysis by Atacama Consulting against IFC PS, identified gaps filled in and ESIA Updated by:

Atacama Consulting
P.O. Box 12130
Kampala, Uganda

VOLUME 2: ANNEXURES

SEPTEMBER 2014

CERTIFICATION

We, the undersigned, certify that we have participated in the update of the Environmental and Social Impact Statement (ESIS) for the proposed Sindila Mini Hydropower Project to be located in Sindila Sub-County, Bundibugyo District, Uganda, whose project ESIS was prepared by OPEP Consult Ltd and submitted to NEMA in 2012 for approval. Although NEMA approved the project on 7th March 2013 (Certificate Number: NEMA/EIA/4395), a potential lender for the project undertook a gap analysis of the ESIA report in line with the lenders environmental and social requirements. The International Finance Corporation (IFC) Performance Standards (PS) were used as the basis for the gap analysis.

Following the gap analysis, the potential lender identified a number of gaps which were presented in an environmental due diligence report dated 9th June, 2014. It is upon this background, that the project proponent, Butama Hydro Electricity Company Limited, contracted Atacama Consulting, to address the gaps that were identified following the analysis.

The focus of the updated ESIA (the current report) therefore, was primarily to address the identified gaps. The integrity of the original ESIA as prepared by OPEP Consult Ltd as submitted to NEMA, remains the same.

Name	Key role	Signature
Mr. Edgar Mugisha	Team Leader	
Miss Juliana Keirungi	Report Review and Quality Control	
Ms Sally Lahm	Terrestrial Ecology	
Ms Rhoda Nankabirwa	Project Coordinator/ Terrestrial Ecology	
Mr. Tonney Ssemmanda	Sociologist	
Miss Eva Joan Namutebi	Backstopping/report production	
Mr. Norman Mushabe	Aquatic Ecology	

Developer's obligation

I certify that I have read and understood the contents of this updated ESIS for the proposed Sindila Mini Hydropower Project in Bundibugyo District. I agree to undertake all the recommended mitigation measures and all aspects of monitoring in order to protect the environment from any form of pollution and degradation.

Signed: Krishnan Raghunathan

_____

For: Butama Hydroelectricity Company

LIST OF ANNEXURES

ANNEXURE 1: ERA PERMIT AND IMPORTANT CORRESPONDENCE

ELECTRICITY REGULATORY AUTHORITY

PERMIT TO UNDERTAKE STUDIES AND OTHER ACTIVITIES

[Under S. 31 Electricity Act, Cap 145, Laws of Uganda]

PERMIT NO: 2011/028

EFFECTIVE DATE: 1ST APRIL 2011

PERMIT ISSUED TO: BUTAMA HYDRO- ELECTRICITY COMPANY LIMITED

Under the Authority granted to it by the Laws of the Republic of Uganda, the Electricity Regulatory Authority grants this permit to the above named permit Holder to carry out the necessary studies and activities in connection with **GENERATION AND SALE OF APPROXIMATELY 7.5 MW OF ELECTRICITY FROM RIVER SINDORO AND NDUGUTU IN BUNDIBUGYO DISTRICT.**

The permit holder shall be required to submit quarterly progress reports to the Authority. This permit shall be subject to the Electricity Act 1999, Regulations and Directives made by the Authority from time to time. This permit will also be subject to further conditions as attached hereto and as may be determined by the Authority.

This permit shall be valid for a duration of twelve (12) consecutive calendar months year unless terminated earlier or renewed for a further period in accordance with terms of this permit and the relevant laws.

IN WITNESS WHEREOF the common seal of the Electricity Regulatory Authority has been affixed hereunto this 11th day of April 2011 in the presence of:-

CHAIRMAN

AUTHORITY MEMBER

AG. CHIEF EXECUTIVE OFFICER

HEMAS

Acting Chief Executive Officer
Electricity regulatory Authority
PO BOX 103332
Kampala

26 June 2011

Dear Sir

BUTAMA HYDROELECTRIC COMPANY LTD (OWNED BY HEMAS POWER PLC)
PERMIT FOR THE APPLICATION TO SETUP 7.5MW HYDROPOWER PROJECT IN BUNDIBUGYO

Reference the Permit issued dated 01 April 2011 for the aforementioned project.

Please find the Progress Review Report for the project attached herewith.

We are pleased to inform you that we have already concluded the detailed engineering surveys at the site and hydrology studies for the proposed project.

Our surveys revealed that if we are to construct the channel on a common contour line to harness the flow of the two rivers - Sindoro and Ndugutu the net head would stand at 307 meters. This is higher than the 290 meter head we proposed in the Notice of Intended Application (NIA). At the same time our hydrology studies reveal that we can consider 2.8 cumecs design flow (as opposed to 2.7 cumecs proposed in the NIA) at a 20% exceedence level on the flow duration curve (FDC). Provided that we use high-end Western European turbines and generators with respective efficiencies at 91% and 95% at the design flow, the proposed project's output would stand at approximately 7.3MW. This is slightly less than 7.5MW we proposed in the NIA. In the meantime, at the time of preparing the NIA proposal we considered releasing the water flow from both rivers into one river off the tailrace a few meters above the point at which both rivers converge. This might mean a trans-basin diversion.

Alternatively, we can develop two projects, in which case we do not have to build the channel on a common contour line. Then we can use the optimum head for two projects independently. Accordingly we find that River Sindira Project can harness a 383 meter gross head (net head – approx. 370 meters) and River Ndugutu Project can harness a 353 meter gross head (net head – approx. 340 meters). This is more than a 15% average head gain and capacity gain. In this case considering the higher cost of developing two different power houses under two separate projects we may consider a lower exceedence say approximtaley 10% on the FDC to optimize energy. Through this we can consider a 5.6MW project on the River Sindira and a 4.5MW project on the River Ndugutu leading to a combine capacity of over 10.0MW. The two projects can be developed simultaneously and will not require a trans-basin diversion. This proposal will not change the project's area marked in our NIA as the two projects have been considered within the coordinates proposed in the NIA.

We presume the proposal to develop two projects is attractive from the Ugandan national perspective as it would give more than 2.5MW additional capacity. We would appreciate to have your views and concurrence on this proposal.

Hemas Power PLC Reg. No. PV 415 PB PQ
Hemas Building, 36, Bristol Street, Colombo 1, Sri Lanka.
[t]: +94 11 4731731 [f]: +94 11 4731555 [e]: info@hemas.com [w]: www.hemas.com

If the latter proposal is acceptable, we assume that it requires for us to have two companies for the two projects and eventually there will be two Generation Licenses and Power Purchase Agreements. Therefore, we seek your advice regarding the following:

(1) Having received the Permit for the project under one company -Butama Hydro-electric Company Ltd (BHECL) can we proceed to apply for Generation License and enter into Power Purchase Agreements under two separate companies?

(2) If the answer to (1) above is yes;
(a) Do we have to incorporate two companies under BHECL to entertain separate Generation Licenses and Power Purchase Agreements; or (b) Can BHECL be one company in which case we have to incorporate one other company?

If we are not able to proceed to the Generation Licenses and Power Purchase Agreements stages under BHECL kindly advice us on the ERA procedures to fast track the application for the Generation License for two independent projects. Your advice is essential for the next stage of the studies. This is particularly relevant to start the Environmental Study which we are now ready for as the scope of it will vary depending on the number of projects to be developed.

Awaiting your early response

Yours Faithfully

Kishan Nanayakkara
MANAGING DIRECTOR

ELECTRICITY REGULATORY AUTHORITY

Regulating the Electricity Industry for Efficient and Reliable Supply at Equitable Prices

Ref:HEMAS/2011/003/dkc-cwn

September 13th 2011

Mr. Kishan Nanayakkara,
Hemas Power Plc,
No. 36, Hemas Building, Bristol Street,
Colombo 1,
Sri Lanka.
Email: Kishan@hemas.com
Fax: +94114731555

Dear Sir,

BUTAMA HYDROELECTRIC COMPANY LIMITED (OWNED BY HEMAS POWER PLC) - PERMIT FOR THE APPLICATION TO SET UP 7.5MW HYDROPOWER PROJECT IN BUNDIBUGYO

We acknowledge receipt of your letter on August 25th 2011 concerning the above subject.

We note that the studies that you have carried out so far point to a number of technically viable project options. We wish to advise that you proceed with evaluation of the various technically feasible project options, with the ultimate intention of selecting the option that will:

- Result in maximum economic benefit to the nation;
- Ensure optimal resource utilization; and,
- Ensure more financial viability.

We hope this response addresses your concerns and that you will now proceed with detailed project feasibility studies so that you can submit a qualifying license application to us by March 31st 2012.

Yours Sincerely,

Patrick Mwesige
FOR: Ag. CHIEF EXECUTIVE OFFICER

Plot 15 Shimoni Road Nakasero, P.O. Box 10332, Kampala
Tel: +256-414-341852 / 341646, +256-312-260166 Fax: +256-414-341624
E-mail: era@africaonline.co.ug, Website: www.era.or.ug

ANNEXURE 2: NEMA TERMS OF REFERENCE APPROVAL

NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

NEMA House
Plot 17,19 & 21, Jinja Road.
P.O.Box 22255, Kampala, UGANDA.

Tel: 256-414- 251064, 251065, 251068
342758, 342759, 342717
Fax: 256-414-257521 / 232680
E-mail: info@nemaug.org
Website: www.nemaug.org

NEMA/4.5

Date: 27th March, 2012

Mr. Krishantha Wimalasiri,
Butama Hydro-Electricity Company Limited,
P. O. Box 9566,
KAMPALA.
Tel: +256 (0)414 344123 / (0)789 430291

RE: REVIEW OF SCOPING REPORT AND TERMS OF REFERENCE (TOR) PERTAINING TO SINDILA MINI–HYDROPOWER PROJECT

This is in reference to your letter, dated 19th February, 2012, submitting the Scoping Report and Terms of Reference (TOR) for carrying out environmental and social impact assessments (ESIA) for the proposed Sindila Mini-Hydropower Project, in Ntuma, Bunyamwera and Kabwe Villages, in Sindila Sub-county, Bundibugyo District, to this Authority for review and consideration for approval. This Authority has finalised the review and grants formal **APPROVAL** of the said Scoping Report and TOR.

In addition, however, there is need to consider further during the conduct of the ESIA and preparation of the ESIA report, certain important aspects of the proposed project activities, as highlighted below.

A. General Comments

(i) Ensure that the ESIA report contains a comprehensive analysis of alternatives, which should include aspects such as design of the dam, location of the dam, height of the dam, etc.

(ii) A brief impact evaluation matrix that illustrates significance of potential environmental impacts (*major, minor, reversible, irreversible, cumulative, direct, indirect, etc)* associated with the proposed project, should have been included in the Scoping Report. There is therefore, need to include such a matrix in the ESIA report.

(iii) The team of consultants that will be contracted to undertake the ESIA, should be registered EIA Practitioners.

(iv) The name of the parish(es) and county the proposed project site is found, should also be provided, respectively.

(v) There is to note that note that other auxiliary infrastructure and related activities – for example, workers' camps, parking/storage yards, burrow-pits/quarries, construction of access roads, electricity transmission line, etc – will require separate environmental impact assessments to be undertaken, and the EIA reports submitted to this Authority for review, before commencing the construction and operational phases of the proposed Project.

(vi) Ensure that comprehensive consultations with all the key stakeholders including the Directorate of Water Resources Management, the Bundibugyo District Local Government Authorities, the Office of the Government Valuer, and the local community in the project area, are undertaken; and that the views/concerns of the stakeholders should be appended to the ESIA report.

(vii) Ensure that matters pertaining to land ownership/acquisition are handled in a proper manner in close liaison with the District Local Government Authorities and Office of the Government Valuer, and that authentic copies of land ownership (acquisition) documents (lease, etc) for the plots of land acquired to accommodate the project infrastructure/components are appended to the EIA report.

(viii) Be mindful of any other critical environmental aspects/concerns which may have not been initially foreseen during the preparation of the Scoping Report and TOR, and include an evaluation of such concerns/environmental aspects in the ESIA report.

(ix) Include in the ESIA report clear/legible and well-labelled location and google map(s), diagrams, and a set photographs of state projects area, as well as GPS coordinates.

(x) Ensure that detailed descriptions of the project components and activities are provided, including the size/categories of the workforce and facilities for use by the work-force.

(xi) Indicate the different sources and names of the places where the different raw materials (water, construction material such as stones, murram, etc), will be obtained from for implementing the proposed project activities.

(xii) Provide a clear and well-labelled site layout plan for the hydropower plan including its boundaries in relation to the surrounding area.

B. Specific Comments

SCOPING REPORT

(a) *Page 5 – Section 3.5*: Under the Water Act, Cap.152, there is need to make reference to the Water Resources Regulations that provides for both the Abstraction and Construction Permits issued by DWRM for hydropower development projects.

(b) *Pages 11 and 12 – Section 4.4.2 (Design Alternatives)*: It is noted that with regard to alternative 1 (one) the combined Ndugutu and Sindila option has a total design discharge of 2.8cumecs; however, with separation and development of Sindilu and Ndugutu mini-hydropower projects, the sum total of their design discharges is 3.3cumecs. This gives an increase of 0.5cumecs. Hence, there is need to account for the excess water and explain why 0.5cumecs could not be used under alternative 1 (one).

(c) *Section 9.2.1, 9.2.2, and 9.2.4:* the following should be considered/addressed and evaluated:

- land-take, including land inundated by the dam, land-take for dam infrastructure, canals (head and tailrace), penstocks, irrigation, access roads, power generation stations, etc;
- people affected by the projects, particularly those that will be displaced and require resettlement, not only due to inundation, but also the need to acquire land for other associated infrastructure works;
- environmental flow in both rivers – for sustaining floral and faunal habitats and ecosystems, as well as allowing flow for downstream users; and, this requires carrying out a comprehensive water assessment that provides for a basis for determination of available water for power generation;
- consider risks in dam/project design, unforeseen environmental, social and health risks.

(d) *Section 9.2.3*: There is need to consider issues pertaining safety of hydropower dams; including reference to the World Bank (Ref. WB OP 4.37) on Safety of Dams, and integrating the relevant aspects of latter into the ESIA report.

TERMS OF REFERENCE

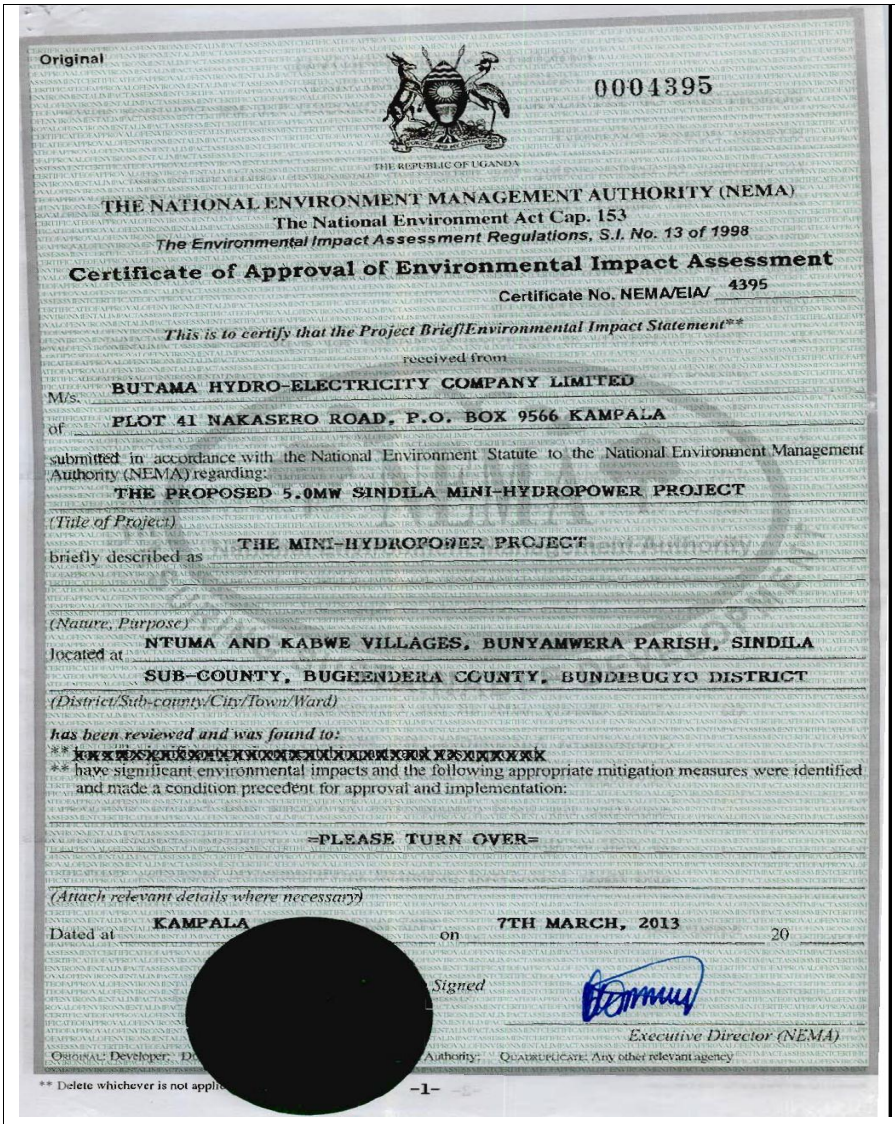
(e) *Sections 2.1 and 2.2 – regarding the TOR*: Existing information on the hydrological situations of the rivers (section 2.1.1) may not be adequate. Therefore, there is need to use appropriate methods to generate fresh/up-to-date information on the hydrology of the two rivers, to determine available water, environmental flows and flood risks.

You may proceed with carrying out the environmental impact study for the proposed project. We look forward to receipt of copies of a comprehensive ESIA report, for our further action.

Dr. Gerald. M. Sawula
FOR: EXECUTIVE DIRECTOR

c.c The Chief Administrative Officer,
Bundibugyo Local Government,
BUNDIBUGYO.

ANNEXURE 3: NEMA ISSUED EIA CERTIFICATE OF APPROVAL



Original

0004395

THE REPUBLIC OF UGANDA

THE NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY (NEMA)

The National Environment Act Cap. 153

The Environmental Impact Assessment Regulations, S.I. No. 13 of 1998

Certificate of Approval of Environmental Impact Assessment

Certificate No. NEMA/EIA/ 4395

*This is to certify that the Project Brief/Environmental Impact Statement***

received from

M/s. BUTAMA HYDRO-ELECTRICITY COMPANY LIMITED

of PLOT 41 NAKASERO ROAD, P.O. BOX 9566 KAMPALA

submitted in accordance with the National Environment Statute to the National Environment Management Authority (NEMA) regarding:

THE PROPOSED 5.0MW SINDILA MINI-HYDROPOWER PROJECT

(Title of Project)

briefly described as THE MINI-HYDROPOWER PROJECT

(Nature, Purpose)

located at NTUMA AND KABWE VILLAGES, BUNYAMWERA PARISH, SINDILA SUB-COUNTY, BUGHENDERA COUNTY, BUNDIBUGYO DISTRICT

(District/Sub-county/City/Town/Ward)

has been reviewed and was found to:

** ~~[illegible]~~

** have significant environmental impacts and the following appropriate mitigation measures were identified and made a condition precedent for approval and implementation:

=PLEASE TURN OVER=

(Attach relevant details where necessary)

Dated at KAMPALA on 7TH MARCH, 2013 20

[redacted] *Signed*

Executive Director (NEMA)

ORIGINAL: Developer; [illegible] Authority; QUADRUPLICATE: Any other relevant agency

** Delete whichever is not appli[illegible]

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CONDITIONS OF APPROVAL
(Additional Information Sheet)

CONDITIONS OF APPROVAL FOR THE PROPOSED 5.0 MW SINDILA MINI-HYDRO POWER PROJECT

In addition to implementing the mitigation measures outlined in the Environmental Impact Statement, this Certificate of EIA approval is granted on condition that the developer – M/S Butama Hydro-Electricity Company Ltd. shall comply with approval conditions stated below:

CONDITIONS OF CERTIFICATE

1. This Certificate of Approval is VALID for a period of 5 YEARS – the period which covers both the construction and operational phases of the project.
2. The Project must commence within the first 24 MONTHS(from the date of approval) of the validity period, failure of which the Certificate may be varied, cancelled or otherwise dealt with by this Authority.
3. The Executive Director should be NOTIFIED of any transfer of ownership, variation/alteration of the project design or components, or surrender of this Certificate of Approval.

I.0 GENERAL CONDITIONS OF APPROVAL

(i) Liaise closely with all the Bundibugyo District Local Government Authorities, the Ministry of Energy and Mineral Development(MEMD), and other relevant Authorities, to sensitise the local communities in Ntuma and Kabwe villages, as well as the work-force, about the proposed project activities and their associated potential environmental impacts, during

Dated at KAMPALA on 7TH MARCH, 2013 20

Signed

Executive Director (NEMA)

Printed by Uganda Printing and Publishing Corporation

CONDITIONS OF APPROVAL FOR THE PROPOSED 5.0MW SINDILA MINI-HYDROPOWER PROJECT, IN NTUMA AND KABWE VILLAGES, BUNYAMWERA PARISH, SINDILA SUB-COUNTY, BUGHENDERA COUNTY, BUNDIBUGYO DISTRICT

GENERAL CONDITIONS (cont.....d)

during both the construction and operational phases of the Project.

(ii) Ensure that thorough consultations are carried out with and approval obtained from the relevant Lead Agencies, respectively, regarding the designs and site lay-out plans for the hydropower generation site, workers' camp, office premises, among other components, before commencement of the project activities.

(iii) Ensure that the proposed project activities are carried out within the approved boundaries (grid coordinates) of the project area that is to accommodate the project infrastructure, as approved by the relevant Authorities.

(iv) Have in place a Grievance and Redress Committee, and liaise closely with the District Local Government Authorities, the Office of the Government Valuer, among others, to ensure that the project-affected persons/households are compensated in a transparent and timely manner, in accordance with the provisions of the Land Act, Cap. 227 and other national laws governing land acquisition and compensation.

(v) Consult closely with the District Local Government Authorities and local leaders to ensure that influx of migrant labour is minimised, and that priority is given to the local communities in the project area to be involved in various project activities.

(vi) Ensure that use of child labour is prohibited during implementation of the proposed project activities, in order to safeguard the rights and welfare of the children.

(vii) Apply for and obtain all the necessary licenses *(including for diversion of River Sindila and for electricity generation/transmission)* and permits, from the Directorate of Water Resources Management (DWRM), Electricity Regulatory Authority (ERA), Ministry of Works and Transport (MoWT), MEMD, among others, to cater for both the construction and operational phases of the Project.

(viii) Ensure that pre-job and induction meetings are conducted for workforce and contractors including, among others, sensitisation on the rules and regulations pertaining to potential occupational safety and health hazards, sound environmental management practices, and restricted access to the Mount Rwenzori National Park, respectively.

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(ix) Ensure that all relevant environmental standards and regulations relating to pollution, and physical, mechanical and ergonomic hazards, are complied with and to ensure that workers are adequately protected from excessive exposure to dust, noise/acoustics, vibrations, heat, and other related occupational hazards.

(x) Ensure that adequate occupational health and safety measures and procedures are put in place, and that appropriate protective gear (helmets, gum-boots, overalls, hand-gloves, ear-muffs, respiratory masks, etc) is provided for use by the work-force; and, sensitise the work-force on matters relating to their safety.

(xi) Obtain proper approval and guidance from the relevant Lead Agencies on use of the appropriate type of explosives and blasting method, for extracting the rock material underlying the sections of the river bank/bed, for purposes of anchoring the weir structure, bridge, and setting the foundation of the canal.

(xii) Ensure that the cable transport system that will be put in place is along the bank of River Sindila, to convey construction materials (in mid-air) to the project sites, is properly planned and should not interfere with activities of and/or access by the local community to their farmland and other shared facilities or resources.

(xiii) Prior approval/clearance should be obtained from the Authorities responsible for construction of access roads, to address aspects of the width and alignment of the two proposed access roads leading to the powerhouse (1,600 metres) and to the fore bay tank (1,000 metres), respectively; and, ensure that fragile areas are avoided.

(xiv) Obtain proper guidance from the relevant Authorities responsible for installation of electricity transmission and distribution lines, in order to properly align and maintain the way-leaves / right-of-way, during the construction and operational phases of the this component of the Project, respectively.

(xv) Consult with the Local Authorities on matters pertaining use of the River by the local community, to ensure that members of the local community are not denied access to the River. Give prior notification to the local leaders and the affected sections of the local community in case there is need to temporarily block access to any section of the River, so that conflict amongst the concerned parties.

(xvi) In accordance with the National Environment (Noise Standards and Control) Regulations, 2003 ensure that noise pollution and acoustics is minimised, by providing adequate sound buffering (acoustic buffering) during use of noise-generating equipment; and, any electricity generators to be used during any phase of the Project should be fitted with silencers.

(xvii) Ensure that the Bundibugyo District Local Government Authorities are involved during selection of sites to accommodate the workers' camp, office premises, storage/parking yards, and for extraction of construction materials, respectively; and, the sites where such materials will be extracted from should be managed in an environmentally-sound manner so that those areas are not degraded or polluted.

(xviii) Ensure the river bed and river-banks (of River Sindila) are not degraded as required under the National Environment (Wetlands, Riverbanks, Lakeshores Management) Regulations, 2000; and that **no construction materials should be extracted from the river bed and the river banks.**

(xix) In accordance with the provisions of the National Environment (Waste Management) Regulations, 1999, ensure that all the solid waste *(including construction and demolition debris, excavated soil, rock debris)* and garbage during implementation of the project activities, is properly collected and disposed of in an environmentally-friendly manner, in a location(s) outside regulated areas that have been approved by the Bundibugyo District Local Authorities.

(xx) Ensure that all hazardous waste (waste-oils, lubricants, spent filters, etc) is properly collected and segregated, and that only hazardous waste handlers licensed by NEMA are contracted to dispose of such hazardous waste, as required under the National Environment (Waste Management) Regulations, 1999.

(xxi) Due to the hilly nature of the terrain in the project area, observe the requirements under the National Environment (Hilly and Mountainous Areas Management) Regulations, 2000, to ensure minimisation of the risks and/or activities that may lead to degradation of hill-slopes in the project area (including inducement of soil erosion, soil slump/collapse, sedimentation process).

(xxii) In accordance with the National Environment (Standards for Discharge of Effluent into Water and Land) Regulations,1999, ensure that appropriate/recommended sanitary facilities are put in place to handle sanitary waste (waste-water/effluent/sewage) generated at the office premises, workers' camp and parking yard, during the construction and operational phase of the Project.

(xxiii) Put in place a comprehensive emergency and monitoring plan to cater for all risk-areas prone to fire, for purposes of averting any undesirable incidents of fire-risk behaviour or actual fire out-break; and have in place appropriate fire-fighting equipment, and train the work-force on basic fire-fighting techniques.

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(xxiv) Liaise with the relevant authorities including the Uganda Police Authorities, to have in place a proper traffic management plan to regulate the volume of traffic in the project area in order to minimize occurrence of accidents; and, install appropriate and illuminated signage along the access roads leading to the project sites to guide the road users.

(xxv) Institute strict environmental management and monitoring as well as sound house-keeping practices, and ensure that these practices become part and parcel of the day-to-day project operations, in order to detect and avert any undesirable environmental pollution incidences, among others.

(xxvi) Ensure that a comprehensive HIV/AIDS and sexually transmitted diseases (STDs) awareness and prevention programme is instituted to sensitize the worker-force, the local communities, etc, with the aim to minimise the spread of HIV/AIDS and STDs in the project area and beyond.

(xxvii) Any concerns raised by the communities relating to the Project, are addressed promptly throughout the life-cycle of the Project, and this should be done in consultation with the District Local Government Authorities, and other relevant lead agencies.

(xxviii) Ensure that this Certificate of Approval is displayed at the Project site and is available at all times.

(xxix) Fulfil any other conditions and requirements as may be prescribed from time to time by Bundibugyo District Local Government Authorities, the National Environment Management Authority (NEMA), Directorate of Water Resources Management (DWRM), Electricity Regulatory Agency (ERA), Ministry of Works and Transport (MoWT), Occupational Safety and Health Department in the Ministry of Gender, Labour and Social Development, among others.

(xxx) Ensure that annual environmental audits are carried out in accordance with the best available practices (taking into account advances in science and technology) in accordance with Section 6 of the National Environment (Audits) Regulations, 2006, and report to this Authority on the environmental performance of the project as required under Sections 77 and 78 of the National Environment Act, Cap 153; and, **submit the first Environmental Audit Report by March, 2014.**

(xxxi) Ensure that the Environment Management and Monitoring Plans contained in the Environmental Impact Statement (EIS) are adhered to and implemented; and ensure record-keeping and transmit the records to this Authority, as required under Section 77 of the National Environment Act (NEA), Cap.153, 1995, and Section 78 of the Act, respectively.

(xxxii) Before commencement of construction activities, ensure that all the baseline data regarding the project area, including water and soil quality data, noise levels, geotechnical investigation results is well-documented, and updated from time to time during project implementation phases, to enable proper monitoring of the project activities and performance of the Project throughout its life-span.

(xxxiii) Fulfil any other conditions and requirements as may be prescribed from time to time by Bundibugyo District Local Authorities, NEMA, Electricity Regulatory Authority (ERA), Directorate of Water Resources Management (DWRM), and any other relevant Lead Agency.

(xxxiv) In accordance with Section 22(4) of the National Environment Act, Cap.153, take all reasonable measures and mitigate any other undesirable environmental impacts that may arise during the implementation of the project, but were not contemplated during the assessment and by the time of issuing this approval, and report on those measures to the relevant Lead Agencies and this Authority.

2.0 CONSTRUCTION PHASE CONDITIONS OF APPROVAL

(xxxv) Ensure that all construction activities are restricted to day time hours only, in order not to inconvenience the local community in the project area and/or cause accidents.

(xxxvi) Construct a proper drainage system of adequate capacity including embankments / stone pitching where required in the project areas, to handle storm-water run-off; and, use appropriate methods to control soil erosion and accumulation of sediments/silt and flooding in the main storm–water drains in the low-lying areas.

(xxxvii) Enforce speed limits on drivers transporting project-related materials and Equipment/machinery and install appropriate road signage at various roads junctions and access roads leading to and from the project sites, in order to minimise accidents, emission dust/dust nuisance in areas traversed by roads leading to the project sites.

(xxxvii) Ensure that the vehicular fleet that is to be used to transport the construction, liquids (fuel, oils, etc) to and from the project site are specially designed to prevent littering, spillage and leakage of such materials, and should bear phrases that convey a message to the general public, among others, that the items being transported can pose a risk to safety and health of people, among others.

(xxxviii) Construct an appropriate perimeter/security fence or any appropriate structure around the hydropower station and other support sites (storage and parking yards) to restrict unauthorised access to the said sites.

(xxxix) Ensure that all machinery/equipment to be installed and used at the project sites are well maintained/services in order to minimize occurrence of accidents.

(xl) Ensure that embankments are constructed around heaps of soil spoil/excavated soil, loose construction materials (sand, murram, gravel, aggregate) to minimize translocation and depositing of such materials in River Sindila.

3.0 OPERATIONAL PHASE CONDITIONS OF APPROVAL

(xli) Ensure that there is close monitoring of the environmental flow of River Sindila, the associated local hydrology, and quality of the River waters, in order to maintain the functionality of the River including sustainable use of the River for various purposes by the local communities found mid-stream and down-stream of the River.

(xlii) Ensure that appropriate measure are put in place for continued monitoring and control of any incidents of sedimentation and siltation along the course of the said River, and in particular down-stream of River.

(xliii) Ensure that any complaints/concerns raised by the local communities in the project area regarding implementation of the Project, are addressed in liaison with the authorities including Directorate of Water Resources Management, NEMA, Ministry Energy and Mineral Development, Bundibugyo District Local Government Authorities, and other relevant Lead Agencies.

4.0 NOTIFICATION CONDITIONS OF APPROVAL

(xliv) Seek written approval from this Authority for any operational changes under this Certificate of Approval.

(xlv) Ensure that this Authority is notified of any malfunction of any system or component(s) of the Mini-Hydropower Project, within 12 hours and mitigation measures put in place.

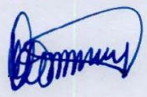
(xlvi) Notify this Authority of the intent to decommission components of the Project (including temporary workers' camp, storage and parking yards, etc) **three (3) months** in advance, in writing.

5.0 DECOMMISSIONING PHASE CONDITIONS OF APPROVAL

(xlvii) Ensure that a decommissioning plan is in place and undertake to decommission the Mini-Hydropower Project when its life-span comes to an end as per the decommissioning plan, or as will be prescribed by the relevant Lead Agencies.

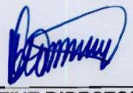
6.0 RESTORATION PHASE CONDITIONS OF APPROVAL

(xlviii) Ensure that all areas laid bare during the construction phase are restored including landscaping and re-vegetating with suitable indigenous plant species, in order to minimise land/soil degradation, degradation of the riverbanks, and to improve aesthetics of the project-affected areas.



(xlix) Upon completion of the construction phase of the Project, ensure that the sites where construction materials (e.g., murram, sand, stones) will have been extracted from for purposes of undertaking the project activities, are re-vegetated, landscaped, and eventually restored to near their original state as possible, to the satisfaction of the Bundibugyo District Local Government Authorities, among others.

DATED AT **KAMPALA ON 7TH MARCH, 2013**

Signed: 

EXECUTIVE DIRECTOR (NEMA)

c.c: The Permanent Secretary,
Ministry of Works and Transport,
ENTEBBE.

Attn: The Engineer in Chief/Director Engineering.

c.c: The Permanent Secretary,
Ministry of Energy and Mineral Development,
KAMPALA.

c.c: The Permanent Secretary,
Ministry of Gender, Labour, and Social Development,
KAMPALA.

c.c: The Executive Director,
Electricity Regulatory Authority,
KAMPALA.

c.c: The Executive Director,
Rural Electrification Agency,
KAMPALA.

c.c: The Executive Director,
Uganda Electricity Transmission Company Limited,
KAMPALA.

c.c: The Director,
Directorate of Water Resources Management,
ENTEBBE.

c.c: The Chairperson LC–V,
Bundibugyo District Local Government,
BUNDIBUGYO.

c.c: The Resident District Administrator,
Bundibugyo District,
BUNDIBUGYO.

c.c: The Chief Administrative Officer,
Bundibugyo District Local Government,
BUNDIBUGYO.

c.c: The District Environment Officer,
Bundibugyo District Local Government,
BUNDIBUGYO.

c.c: The District Engineer,
Bundibugyo District Local Government,
BUNDIBUGYO.

c.c: The Chairperson LC–III,
Sindila Sub-County,
BUNDIBUGYO DISTRICT.

ANNEXURE 4: CONCORDANCE TABLE

	Comment	Status	Update and Location in the ESIA
	Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts		
1.	Is an environmental and social management system (ESMS) established and maintained?	The Applicant (Butama) does not have an explicitly described ESMS. The investor of Butama (Hemas) has a company policy ("The Hemas Way", annexure 2 of the clarifications documents) that refers in very general terms to communities, environment, health and safety. This policy makes no explicit reference to World Bank Group standards. At present there does not appear be any plans for developing a comprehensive project specific ESMS. The strategy seems to be the placement of an environment and social officer on site during construction to follow up such issues. The Applicant has confirmed the commitment to follow IFC Performance Standards and the ESIA claims that it has been prepared in accordance with these standards (chapter 3.5). The Applicant has carried out several studies and prepared plans and documentation, including: - Environmental and Social Impact Assessment (ESIA) undated (most likely prepared in 2012, authors not provided). The ESIA was not updated from GET FiT RFP round 1 in early 2013 to the RFP round 2 in December 2013. The ESIA contains an Environmental and Social Management and Monitoring Plan (chapter 9); - Resettlement and Compensation Action Plan dated 13 December 2013 (by Joseph, Alex Katikiro, LPD Dayananda, Sangeetha and Krishantha) and covering both Sindila and Ndugutu projects (while the front page of the document does not refer to "draft", there is a "draft" watermark throughout the document). These documents also contain elements of grievance mechanisms, a stakeholder / PAP engagement plan and disclosure and dissemination procedures. There are still inadequately developed structures and procedures for implementation, monitoring and evaluation of the environmental and social mitigation and compensation measures, including adaptive management based on monitoring and reviews.	The ESIA has been updated (September 2014). A project phase specific ESMS has been updated in section 8 of the updated ESIA to adequately address the aspect of implementation, monitoring, and evaluation of the environmental and social mitigations during the construction and operation phases. A detailed Stakeholder Engagement Plan (Section 8.11) and disclosure and dissemination procedures section 7 have also been developed. The Resettlement and Compensation Action Plan for the proposed Sindila MHP has been updated.
2.	Has the Applicant conducted an Environmental and Social Impact Assessment (ESIA) of the proposed Project in an integrated manner? Key aspects include: Accurate Project description, including alternatives.	The demand for electricity in Uganda is briefly described in the ESIA and alternative power technologies are briefly mentioned (chapter 1.5). Additional information about alternative power technologies is included in chapter 8 (e.g. biomass, hydropower, solar, wind, geothermal). This chapter also includes a discussion of different project layouts, including a combined power station for Sindila and Ndugutu rivers and various alternative layouts for the Sindila project and its various components. However, the alternatives are considered more with respect to engineering issues rather than the environmental and social aspects associated with the alternatives. This also means that there is no evidence that impacts of land acquisition have been assessed for different alternatives. The 'no-action' alternative (no project) is also described in general terms (chapter 8).	Environmental and social aspects associated with the alternatives have been considered Section 5, the various alternatives considered for project design or implementation, focus on environmental implications. The 'no-action alternative has been specifically described for the proposed Sindila MHP. Additional studies were carried out for the transmission line (Annexure 7, power evacuation report) Location for source points of construction materials has been discussed in Section 2.5.4. Materials such as sand, cement, aggregate metal and reinforcement steel will be obtained locally from existing and approved local suppliers within Bundibugyo district, the project developer will also liaise with the district local governments in the identification of quarry sites for use. The waste and spoils handling facilities have been briefly described in Section 2.5.5. A detailed Waste management plan is given in Section 8.5. Section 1.12 of the updated Re-settlement Action Plan (RAP) presents how the social aspect was

		The ESIA covers the main project components and most associated facilities. A 10-11 km long transmission line (33 kV) is needed to Nyahuke town where the existing line is found. The ESIA states that the line will follow the reservation of the existing district road from Nyahuke town to Butama village, and then along the road reserve for the road connecting Butama and Bunyangule and along the powerhouse access road. The ESIA states that the transmission line neither requires any acquisition of private lands nor will it affect any existing agricultural lands. It is not explicitly clarified whether any additional studies will be carried out for this transmission line or not. The need for and location of spoil areas as well as source points for construction materials are not identified.	considered in selecting the project alternatives. Section 5.2.1 of the updated Re-settlement Action Plan (RAP) and Section 6.3.2 of the updated ESIA present the impacts on land acquisition that have been identified.
3.	Appropriate social and environmental baseline data.	The ESIA includes several types of physical, biological and socio-economic baseline data (chapters 4 and 5). Except for some data on water quality, noise and hydrology, there is limited quantitative baseline data and ecological seasonality is not covered. Environmental baselines are typically general descriptions rather than quantified and site-specific. The Project's area of influence is described in general terms but not defined in detail. Vegetation has been sampled at sites across the project area. Surveys have been carried out for birds, amphibians, reptiles, butterflies and some insect groups. Aquatic studies have also been carried but very little aquatic life appears to have been found and documented. The ESIA states the aquatic surveys did not find any fish species in the river and that this is confirmed by local people. Any explanation of this situation is not provided. The methods applied for aquatic ecology sampling should be documented and an interpretation and explanation of the results elaborated. Sindila River joins Ndugutu River downstream before entering the fish rich Semliki River further downstream. The potential presence of any barriers to fish migration between Semuliki River and the project site is not discussed. No species in the IUCN Red List categories 'near threatened', 'vulnerable', 'endangered' or 'critically endangered' are reported in the ESIA. The ESIA mentions that the Rwenzori Mountains National Park is in the area but minimal reference to the Park is made. The clarifications from the Applicant in February 2014 confirmed that the Park is 250 m from the weir site. The ESIA does not include information regarding the relationships between the proposed project and the National Park (incl. the Park's General Management Plan), the World Heritage Site (incl. the Outstanding Universal Values) and the fact that the Park is also a Ramsar wetland site of international importance is not mentioned. The ESIA contains socio-economic baseline data has been collected from the project area and is informative and useful as it reflects the specific conditions of the project area rather than the district. It is not clear whether cultural issues have been omitted or whether there are no cultural issues of relevance at all. It was expected that the	The project area of influence has been described in detail in Section 1.2. The National park actual distance (boundary) from the weir was confirmed to be 430m during the ESIA update. The Park's significance as a world heritage site has been documented in Section 4.2.2 of the updated ESIA. The methods for aquatic ecology sampling have been documented, interpretation and explanation of the results elaborated in Section 4.2.3.6. Results of the aquatic ecology sampling show that fish (*Labeo forskalii*) is found in R. Sindila (section 4.2.3.6), nullifying the possibility of potential barriers to fish migration. The behaviour ecology of this species is discussed in Section 4.2.3.6 to include ecological seasonality. The potential impact of barriers to fish migration as a result of the project has been discussed as well in Section 6.3.14, the possibility of including a rock ramp fish way made of large rocks and timber to create pools and small falls that mimic natural structures suitable for the species (*Labeo forskalii)* has also been proposed for the design of the intake weir so as to allow the upstream migration of fish. The IUCN conservation status for the various fauna has been reported in the respective sections of the ESIA. The significance of the national park has been documented in Section 4.2.2. An archaeological Cultural property section has been included in Section 4.3.16. Other than the cultural traditions and beliefs of the people in the project area, consultation with the local chairperson (L.C.1) revealed no presence of cultural sites in the project area (Section 4.3.16), Census socio-economic study has been conducted during the updated RAP preparation. Natural hazards common in the area have been discussed under Unplanned (contingency) impacts in the following sections:- • Earthquakes (Section 6.4.1); • Landslides and obstruction of pathways (Section 6.4.2); • Floods (Section 6.4.3); • Failure hazards (Dam break) (Section 6.4.4); • Occupational accidents (Section 6.4.5); and • Susceptibility of the project to climate change (Section 6.4.6). Section 4 of the updated Re-settlement Action Plan (RAP) presents the updated socio economic census survey information of the project area of influence.

<table>
<tr><td></td><td></td><td>baseline studies in the RAP would build on the information from the ESIA but with more focus on the directly impacted households. Unfortunately, this is not the case. Instead, a sampled data from only 36 out of the total 183 affected households has been applied. The Applicant is therefore advised that a census socio-economic study needs to be carried out to capture the key socio-economic indicators for every directly affected household. Among the particularly important data that are relevant to the assessment of the residual impacts is the total landholding per household and the resultant severity of land take in regard to productivity, accessibility (during and after construction), safety (during and after construction) among others. The results will be used for resettlement, livelihood and relocation planning, if necessary, and will further be used in the analysis of impacts per household and also be used as a basis for future monitoring. Socio-economic census studies need to be launched as soon as possible because they might impact the compensation packages proposed. The Applicant is advised to engage the services of a competent sociologist, preferably from the local area but not necessarily a resident of the project area. Natural hazards (e.g. landslides and earthquakes) common in the area are not discussed in the ESIA except floods that are touched upon in the hydrology section (chapter 4.1.3).</td><td></td></tr>
<tr><td>4.</td><td>Consideration of all relevant social and environmental risks and impacts in the Project's area of influence during construction and operation.</td><td>The assessment of environmental and social risks and impacts (chapter 7) covers both the construction and operation phases. Overall, the availability of particularly the social baseline data could have supported a more comprehensive and complete assessment of risks and impacts. It is not always clear how the overall impact assessment scoring is arrived at. Cumulative impacts are not well covered. Anticipated effects of mitigation measures are not clearly described and residual impacts after implementation of mitigation measures are not described. It should also be noted that the impacts listed under the mitigation plan (Table 7.4) is substantially different from impacts described elsewhere in the ESIA. These inconsistencies undermine the credibility of the document. The assessment of environmental impacts is brief and very generic with limited indications of site-specific impacts and impacts on various biodiversity. Aquatic impacts are not considered significant as no fish were identified and it seems that no other significant impacts are expected along the 3.5 km stretch between the weir and the power station.

The Project's potential impacts on the Rwenzori Mountains National Park are not considered in the ESIA. During the clarifications in February 2014, the Applicant confirmed that the park boundary was about 250 m from the weir site. There appears to be a clear risk of impacts by the presence of a work force and in-migration by opportunity seekers resulting in harvesting of resources in the Park. This needs to be analysed along with the potential impacts on the values that constituted the basis for the national and international designations as a protected area (national park, World Heritage Site and Ramsar Site). It is also not clear whether the Project may impact any of the Park-local community collaborative programmes introduced in recent years to improve Park-community relations. This should be confirmed is discussions with UWA.</td><td>Social baseline data was used to complete the assessment of the risks and impacts. The overall impact assessment has been documented in the ESIA. The impact significance was arrived at by evaluating the intensity of impact and the sensitivity of the environmental and social receptors as shown in the table below and was largely subjective but based on the professional judgment of the entire team of specialists section 6,
<table>
<tr><td colspan="3"></td><td colspan="4">Sensitivity of receptor</td></tr>
<tr><td colspan="3"></td><td>Very low</td><td>Low</td><td>Medium</td><td>High</td></tr>
<tr><td colspan="3"></td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td rowspan="4">Intensity of impact</td><td>Very low</td><td>1</td><td>1
Negligible</td><td>2
Minor</td><td>3
Minor</td><td>4
Minor</td></tr>
<tr><td>Low</td><td>2</td><td>2
Minor</td><td>4
Minor</td><td>6
Moderate</td><td>8
Moderate</td></tr>
<tr><td>Medium</td><td>3</td><td>3
Minor</td><td>6
Moderate</td><td>9
Moderate</td><td>12
Major</td></tr>
<tr><td>High</td><td>4</td><td>4
Minor</td><td>8
Moderate</td><td>12
Major</td><td>16
Major</td></tr>
</table>
Note that each numerical descriptor 1, 2, 3, or 4; is defined to equate to very low, low, medium or high. The impact severity is therefore determined as the product of the two numerical descriptors, which is equivalent to negligible, minor, moderate or major as shown in the table above.
Furthermore, mitigation measures have been indicated for all the identified potential impacts to reduce the severity of the impact on the social or environment aspect that may be affected by the project.

The residual impacts severity after implementation of mitigation measures is also given.

The impacts anticipated from Sindila MHP have been thoroughly re-assessed with reference to the baseline information provided in chapter 4, using the methodology described in Section 6.1 of the ESIA (also shown above) and the cumulative impacts have been covered in Section 6.5.

Project potential impacts on Rwenzori National Park are included in Section 6.3.1 and the impact on increased poaching during construction was also included in Section 6.3.10.

Section 5 of the updated Re-settlement Action Plan (RAP) presents the detailed description the positive</td></tr>
</table>

			and negative impacts of the project.
		Some socio-economic impacts are described while others have been left out. A table in the ESIA summarises social impacts and lists three negative impacts and nine positive impacts (Table 7.2), leaving an unrepresentative impression of the overall impacts. Impacts related to land acquisition are particularly poorly analysed and described in the documentation. The ESIA states that about 5.8 acres of land belonging to 100 persons will be acquired. The document states, without a clear justification, that loss of crops is unlikely to significantly affect annual harvest for the affected people. The ESIA also states that no existing houses or other structures will be lost (chapter 6.4). This statement appears unrealistic given the narrow land that will be acquired and where a likely expansion of land take during construction is likely to require the removal of some houses. The ESIA focuses on the narrow corridor earmarked for project activities but has not assessed the residual impact of the project land acquisition on the affected households. Issues such as land severance and the resultant fragmentation as well as future accessibility have not been analysed. In addition, there is no evidence in the RAP that areas for temporal use have been considered. Further, in regard to access roads, the Applicant has only included the new roads and not considered the fact that the existing roads are very narrow and are not likely to be able to handle the planned construction phase traffic in their current state. These road will therefore require upgrading, including widening, which will affect more households in regard to land acquisition. The Applicant has also earmarked a narrow corridor ranging from 4-6 meters for all the project components. Given the steep terrain it is expected that there will be need for more land during the construction phase to allow for construction activities and disposal of excess materials or even provide for access along the construction sites. It is also necessary to have a buffer zone to allow for rolling stones and soil, during excavation without damaging the property of neighbouring households. It is therefore imperative that the Applicant revisits the land requirements properly to avoid conflicts with communities in future and to ensure that there is sufficient and safe working area for the workforce. This issue was also raised by several stakeholders right from national level to the local residents within the project area and requires due attention. The impacts of temporary acquisitions and acquisition of land as a result of auxiliary facilities also need to be analysed in further detail (e.g. land for camp sites, residential facilities, access roads and storage areas for excess materials). The Applicant also needs to revisit the impact assessment for the operation phase to detail impacts on the affected households. Particularly vulnerable groups that may be differentially or disproportionately affected are not clearly identified. Neither the ESIA nor the RAP has demonstrated the consideration of the long term impact of component positioning/placement on affected households in terms of safety, aesthetics, accessibility and practicability of the remaining pieces of land. Hence, the livelihood	All the anticipated socio-economic impacts from Sindila MHP have been thoroughly re-assessed with reference to the baseline information provided in Section 4. These anticipated socio-economic impacts include; increased disease vector populations as a result of changes in water ecology (Section 6.3.6), increased traffic (Section 6.3.7), impact on downstream river flows and community water sources (Section 6.3.13), impacts on cultural resources (Section 6.3.15), segregation and differential rewards (Section 6.3.16), increased spread of sexually transmitted diseases and other communicable diseases (Section 6.3.17), physical resettlement of people and associated impacts (Section 6.3.18), noise effect and vibrations on local communities (Section 6.3.21), poor sanitation due to poor domestic waste management (Section 6.3.22), and the effects of blasting (Section 6.3.23).

		impacts are inadequately considered. The Applicant is also expected to assess the impacts on community facilities (cultural property, water supply, community paths, etc.) in the RAP. Mitigation strategies for these facilities should also be detailed in the RAP or restoration plans.	
5.	Appropriate stakeholder engagement through disclosure of the Project-related information and consultation on matters that directly affect stakeholders.	The Applicant and contracted consultants have engaged with project affected people and identified stakeholders, including local governments, on a number of issues. The consultation process seemed to have been well thought through with focused interviews at all levels. The results offered useful input into the making of both the ESIA and RAP. It seems like it was only one round of consultation. Follow up sessions would have been helpful in the definition of site specific management plans. From the consultation details it is not clear whether all the communities relying on the rivers for their water supply were consulted, neither was the District Water Office Bundibugyo / DWD Mbarara, for purposes of planning strategies for providing alternative water supply. Uganda Wildlife Authority has not been consulted regarding potential impacts on the Rwenzori Mountains National Park. A brief and rather general public consultation and disclosure plan for stakeholder engagement has been developed (chapter 6 in ESIA). This needs to be implemented consistently and continuously to ensure that all PAPs fully understand the issues at hand. Given their levels of literacy, a more illustrative approach should be adopted in relation to the PAPs. Efforts should be made to critically analyse and address the individual concerns. The Applicant will benefit from the employment of a competent sociologist, preferably from the local area and not necessarily a resident in the project direct impact zone. A person of considerable neutrality, with an ability to understand tribal dynamics and ability to communicate directly in the local languages to avoid translation errors. During the field visit, it was evident that there is a communication gap between the developer and the communities, especially in regard to giving feedback on submitted complaints or even handling complaints. This could be a result of the lack of the Applicant's presence in the project area or over-reliance on locals who are not in position to ably clarify all issues to the affected households. The Developer appears to have adopted a selective disclosure strategy, where the disclosed information is to the developer's benefit and limited information is disclosed to the people to help them plan or move on with their productive lives. This mainly applies to the inadequate response given to households that are worried of their safety as a result of their proximity to the project components (access roads and penstock). Segments of the population are also unsure of the project plans in regard to the widening of the existing roads, and they fear land grabbing particularly in regard to temporally work areas and widening of existing and narrow community roads. During the site visit it was evident that certain segments of the population in the project area had been subjected to long periods of anxiety and stress, as a result of the alignment of the access road, residential premises sandwiched between project components and	Consultations with communities that use River Sindila for their water supply were undertaken and details were included in Section 7 and Annexure 5. For the purposes of planning strategies for providing alternative water supply to the Sindila community, the Water and Sanitation CDO, Bundibugyo district, Mr. Olegasiza Tevin was consulted and details of this consultation are included in Annexure 5. Mr. Joseph R. Matte, UWA park ranger stationed at Harugali ranger station in Bundibugyo district was consulted in regards to the potential impacts on the Rwenzori Mountains National Park Annexure 5. Section 6 of the updated RAP presents the public consultation and disclosure plan and how it was used.

		not considered as affected by the project team as well as subdivided pieces of land which render parts of the land useless. This is caused by having multiple project components on the same piece of land. This mainly affects the areas earmarked for the penstock and one of the access roads. Employment benefits have already started to trickle down to the local communities. However, the Applicant should desist from overly delegating and relying on local resources even for tasks they cannot fully understand. A case in point is where a local person employed by the Developer was expected to clarify on all issues related to survey and valuation in the community. His participation as a casual labourer in these activities does not make him responsible or an appropriate communication person on behalf of the Developer. This renders him quite vulnerable to the anger of his neighbours. This could also be an avenue for distortion of project facts. The Applicant needs to have a better communication strategy with a clear roles and responsibilities between company staff. The Developer also needs a strategy for managing expectations by being more transparent and willing to share relevant information. A case in point is the confusion within the district leadership that the Developer has the capacity to electrify the neighbouring communities, yet the developer's license is only for generation and not distribution.	
6.	Consideration of all applicable Ugandan laws and regulations.	A scoping report and proposed terms of reference for the environmental impact assessment was submitted by the Applicant 19 February 2012 and approved by NEMA 27 March 2012. The ESIA was approved 7 March 2013 for a period of five years (certificate no. NEMA/EIA/4395). The Applicant has obtained a five year surface water abstraction permit (no. BUN501010/1SWMDW 2013) and a one year construction permit (BUN501208/1CPHDW 2013) from the Directorate of Water Resources Management (DWRM), both dated 10 December 2013. The above mentioned certificate and permits contain a range of conditions and also references to other regulations. The transmission line is not properly covered in the ESIA. It is not clear whether this will be subject to separate assessments for approval by NEMA. The Applicant will be obliged to process residual land certificates for all the affected households who prior to project land acquisition had processed or were in the process of registering their land. This will apply to leasehold, freehold and customary certificates. Even though applicable laws have been reviewed in the ESIA and the RAP, it is advisable that the Applicant familiarises himself with the land acquisition processes and requirements as stipulated in both the Land Act, 1998 and the Land Acquisition Act, 1965. The Applicant will then realise that the national regulations on compensation do not achieve full replacement cost as expected by the IFC Performance Standards and these also require that severance on land be assessed and compensation offered if necessary. The national law also has provisions on acquisition of land for temporal use and compensation for partial effects on buildings. During the round of clarifications, the Applicant informed that a	A separate study (Annexure 7) for the evacuation of power has been carried out covering power lines, support structures, interconnection switchgear, voltages, size of conductors, short circuit levels etc. The Wetlands, River Banks and Lake Shores Management Permit (NEMA/RB/LS/WT/328) to carry out activities in the river bank was obtained. The compensation figures for Bundibugyo district have also been updated to the latest 2013/2014 financial year. The key Ugandan policies relevant to the proposed project Section 3.1 (National (Ugandan) Policies). Framework have been updated to include the Land Amendment Act (2010) (Table 3.2) Section 8.11 and 8.12 of the updated Re-settlement Action Plan includes the land acquisition and security o of tenure.

		permit to carry out activities in river banks had been applied for and that compensation figures had to be updated with Bundibugyo district values (not updated since 2008).	
	Has the Applicant identified specific measures to avoid, minimise, mitigate, or compensate / offset impacts during all Project stages (environmental and social action plan, ESAP)?	Mitigation measures for specific impacts are listed in chapter 7 of the ESIA. An environmental mitigation plan (table 7.4) covers both environmental and social mitigation measures. The RAP also contains such measures. An environmental and social management and monitoring plan is also included in the ESIA (chapter 9). This plan includes a range of management plans which cover areas such as environmental and social monitoring; health, safety and environmental management; traffic management; waste management; labour force management; pollutant spill contingency; hazardous materials management and emergency responses. During the clarifications round the Developer also stated that during the design stage the proposed mitigation measures will be incorporated in the designs and bidding documents and relevant sections of the environmental mitigation plan and the environment and social management and monitoring plan will be incorporated into the contractual agreements with construction contractors. The relationships between the contents and implementation structures of all these different plans remain unclear. Also, there is no explicit assessment of the expected results from implementing mitigation and compensation. Therefore, the residual impacts are not established. The mitigation hierarchy (avoid–minimise– mitigate–restore–offset) is not explicitly applied. In practice, however, elements of the hierarchy appear to have been used. Several of these plans are in their current form rather general and not adapted specifically to the project. The plans will have to be adapted to the project and its context in order to become operational in an effective manner. Costs are in most instances not reflected and it is not clear whether these activities are budgeted for or whether the responsible implementation entity has the required capacity. Much of the responsibility for environmental mitigation seems to be handed over to the Contractor and hence there are several specific measures not clearly defined at this stage. As potential impacts on the Rwenzori Mountains National Park have not been analysed, there are no mitigation measures proposed specifically with respect to the Park (e.g. to avoid work force or population influx to increase illegal harvesting of park resources). The RAP states that the project will not result into any physical displacement. A closer look at the project cadastral map and discussions on site indicate that several houses are quite close or partly within the corridor. The site visit also revealed a number of households sandwiched in project components or quite close to the proposed access roads. In addition, the valuer's observations in the RAP report mention eight homes within the corridor, but this has not been reflected in the RAP report. This results into the questioning of the impact analysis and the adequacy of the proposed mitigation and compensation measures. A review of the projects cadastral map also indicates that a quite narrow corridor has been acquired. It is assumed that the Applicant's intention was to avoid physical displacement. However,	The baseline section (Section 4) has been updated with the significance of Mount Rwenzori National Park (RMNP) (Section 4.2.2) clearly describing the importance of RMNP to the project. More ecosystems in the project area of influence and their importance to the project are described under Section 4.2.1. The impact section (Section 6) has also been updated with an assessment of the impact on Rwenzori Mountain National Park, World Heritage Site and Ramsar Site (Section 6.3.1) and mitigation measures with respect to the park have been proposed. The impacts on surface water have been clearly assessed and appropriate mitigations for surface water quality (Section 6.3.11) and Sedimentation and siltation of downstream water sources (Section 6.3.12) have also been documented. Ecological flow/Environmental flow Assessment has been determined in Section 4.1.3.4 of the ESIA. This together with the construction permit (BUN501208/ 1CPHDW 2013) issued by the Directorate of Water Resources Management, adequately cover the environmental flow aspect.

		this strategy makes households and communities more vulnerable to construction phase risks. Therefore, this has to be reviewed prior to commencement of the construction activities. An environmental flow of 40 l/s to be released from the weir has been set by DWRM. There is no seasonal variation in the environmental flow to mimic natural variation in the flow regime. A justification for the level of 40 l/s has not been provided. The ESIA states that a number of tributaries join the river between the weir and the tailrace but no indications are provided on the volumes of these tributaries. The site visit indicated that many of these tributaries are seasonal and hence may not contribute water during the dry season when the environmental flow may be most crucial. The ESIA also concludes that these tributaries together with an environmental flow released from the weir will ensure there is adequate flow in the river. No further justification or rationale is provided. The ESIA also states that there will be established pools in the river in addition to having the environmental flow. Based on the documentation provided it is not adequately clear that water quantity and quality will be mitigated satisfactorily for those using the river as their water source	
8.		Decommissioning and associated demobilisation and restoration measures not discussed.	Decommissioning and associated demobilisation and restoration measures have been discussed in Section 2.7.
9.	Are roles, responsibilities and authority to implement ESAP and its measures identified?	The responsibilities for environmental and social management, mitigation and monitoring measures are mainly placed on the Applicant or the Contractors but they are poorly defined in terms of the operational details. Central and local government departments are poorly reflected even though one would expect them to be involved in and also to some extent carry out independent monitoring. The implementation structures and coordination mechanisms for the numerous measures, plans and stakeholders involved are not clear, including how the Project will avoid omissions, overlaps and conflicts between different plans, measures and those responsible. The overall organisational structure provided during the clarifications in February 2014 is useful to indicate the general approach by the Applicant but not specific roles and responsibilities. Improved integration of efforts by the Applicant, contractors, government agencies and consultants are required to ensure cost-effective use of mitigation and monitoring resources. Roles and responsibilities as well as lines of decision-making, communication and reporting must be further clarified. The ESIA and RAP do not include analysis of the capacities of the various parties involved. Experience and capacity need to be assessed and plans for filling important capacity gaps must be developed.	The project construction and operation phases Environmental and Social Monitoring Plans section 8 have been updated to include lines of decision making, communication and reporting. This plan has also been updated to properly address mitigation and monitoring measures. The various plans included in the ESIA have been defined in terms of implementation and operational details. The roles and responsibilities as well as lines of decision-making, communication and reporting have been further clarified. The Central and local government departments have been involved in the pre-project implementation (consultations - Section 7) and during monitoring (updated ESMP - Section 8).
9.	Have procedures to monitor and measure the compliance of ESAP with its environmental and social provisions including establishment of a grievance mechanism been established?	Procedures for monitoring, monitoring indicators and performance targets have been proposed in the ESIA (chapter 9) and cover several of the thematic areas, including in the environmental and social monitoring plan (table 9.1). The RAP contains a monitoring and reporting plan. The monitoring plans cover a range of relevant issues but they have not been detailed to a level where they will be operationally effective. These plans in their current form are in many, if not most, cases not well suited to monitor the performance of the Project and its mitigation measures as the plans tend to focus on whether	An overall coordination mechanism for monitoring activities is required but has been clearly articulated in Section 8 of the updated ESIA

		activities have been implemented (or not) rather than to focus on the results or impacts caused by mitigation measures and whether these are sufficient. There is a lack of sound performance indicators that can be verified. The lack of quantified and site-specific baseline data (see item 2 above) hampers the development of a specific monitoring plan that is appropriate to monitor and measure compliance with the ESIA and RAP, evaluation of actual impacts, effects of mitigation and identification of unexpected impacts. Costs are in most instances not reflected and it is not clear whether these activities are budgeted for or whether the responsible implementation entity has the required capacity. The Applicant appears to a large extent to rely on an environmental and social officer on-site to do much of the work but appears to underestimate the associated costs as these will not only be staff costs. It seems like the Applicant will take overall responsibility for monitoring with some tasks given to the contractors and other to consultants. Other entities, such as central and local government agencies, are also likely to participate. There is limited information on whether these entities involved in monitoring have the capacity to implement the monitoring measures. Regarding grievances, the ESIA states that a grievance redress committee will be established with representatives from local governments (LC I and LC III), the PAPs and the Developer (chapter 6.4). An overall coordination mechanism for monitoring activities is required but has not been clearly articulated.	
10.		It is unclear to what extent independent monitoring or inspections will take place. Under any GET FiT support there will be semi-annual reviews during construction	The project construction and operation phase Environmental and Social Monitoring Plans Section 8 have been updated to include the frequency of monitoring or inspection of the different social and environmental aspects.
	Performance Standard 2: Labour and Working Conditions		
11.	Has a human resources policy that sets out its approach to managing workers consistent with the requirements of this performance standard been established?	The Applicant's specific human resource policy was not seen, but may be Hemas code of ethics ('The Hemas Way'). This document, however, does not say much about the specific human resource management function. The Applicant has also developed a labour force management plan as part of the environmental and social management plan (chapter 9.3.4), in which measures for labour management have been prescribed to contractors. The labour force management plan has been prepared in consideration of the Ugandan relevant labour laws and the requirements of the International Labour Organisation (ILO) thereby contributing to consistency with the requirements of this performance standard.	A Labour Force Management Plan has also been included in Section 8.6 of the updated ESIA.
12.	Will the Project comply with national laws, principles and standards embodied in the ILO conventions (related to e.g. child labour, non-discrimination, forced labour)?	The labour force management plan included in the ESIA seems to have considered the applicable national laws and international labour standards and seeks to comply with these.	Legislation pertaining to workers has been included in Section 3 of the updated ESIA including but not limited to the:- Employment Act 2006, Workers Compensation Act Cap 225, Labour Unions Act 2006, Occupational Safety and Health Act 2006 (Table 3.2). A Labour Force Management Plan has also been included in Section 8.6 of the updated ESIA.
13.	Are wages, benefits and conditions of work for the Project on par with those offered by similar employers in the relevant region?	The documents submitted to date cannot be used to conclude on whether the Applicant's wages, benefits and conditions of work will be comparable to those offered by equivalent employers in the region. However, the labour force management plan in principle prescribes adequate measures to ensure that these items are	See response in 12 above.

		handled adequately.	
14.	Will the Applicant provide workers with safe and healthy work environment compliant with relevant World Bank Group Environmental, Health and Safety (EHS) Guidelines?	The labour management plan, advocates for a healthy and safe working environment for workers. In addition, a health, safety and environment (HSE) plan, a hazardous materials management plan and an emergency response plan have been developed as part of the environmental and social management plan. All these seek to ensure the safety of the project workforce. The HSE plan has covered most of the requirements of the World Bank Group EHS guidelines even if in general terms at times. The clarifications in February 2014 confirmed that the Developer intends to comply with these EHS guidelines.	See response in 12 above.
15.	Will the Applicant provide a grievance mechanism for workers?	The labour force management plan advocates for the setup of a grievance mechanism for workers by the contractors. The overall policy called 'The Hemas Way' implies and refers to several functions that the employees can use in case of non-compliance to the code of ethics, but this document rather general and without details and precise procedures.	A grievance mechanism procedure was included in the Labour force management plan (Section 8.1.1.4).
	Performance Standard 3:Resource Efficiency and Pollution Prevention		
16.	Will the Project comply with national environmental laws related to pollution, wastes, hazardous materials, resource use and greenhouse gas (GHG) emissions (see also 1.2 above re. applicable laws and regulations)?	The Project received NEMA approval for the EIA ToR and later the EIA certificate as approval of the ESIA. The Project has also received the DWRM surface water abstraction and construction permits (see item 2 above). The certificate and permits contain a range of conditions the Project must adhere to. The ESIA refers to compliance with various national legislations and contains an environmental and social management and monitoring plan (chapter 9) which again includes management plans for areas such as environmental and social monitoring; health, safety and environmental management; waste management; pollutant spill contingency; hazardous materials management and emergency responses. During the clarifications round the Developer also stated that during the design stage the proposed mitigation measures will be incorporated in the designs and bidding documents and relevant sections of the environmental mitigation plan and the environment and social management and monitoring plan will be incorporated in to the contractual agreements with construction contractors. The relationships between the contents and implementation structures of all these different plans remain unclear. Greenhouse gases (GHG) are addressed briefly in the ESIA by stating that the proposed project will result in a reduction of anthropogenic emissions of greenhouse gases by displacing an equivalent amount of electricity that would otherwise be generated by thermal power plants (chapter 1.5). The ESIA has also estimated that the 26 GWh expected to be produced by the Sindila SHP annually will result in emission reductions estimated at 17,110 tonnes CO_2 equivalents (chapter 7.3.2). Some ambient conditions (noise, hydrology and water quality) are included in the ESIA (chapter 4), though the baseline data quality is	Legislation pertaining to national environmental laws related to pollution, wastes, hazardous materials, resource use and greenhouse gas (GHG) emissions has been included in Section 3 of the updated ESIA. Section 2.2 of the updated ESIA also indicates the permits and approvals required by the project including the status of acquisition of each of these at the time of preparation of the updated ESIA. The emission of Greenhouse gases as a result of the proposed project has been addressed in Section 6.3.24. The baseline sections on noise and hydrology have been further expanded as included in Section 4.1.2 and Section 4.1.3 respectively of the updated ESIA in order to allow for adequate monitoring. A section on wastes and spoils handling facilities has been included in Section 2.5.5 of the updated ESIA. The ambient conditions in the project area have been reassessed and updated in the ESIA (Section 4.1. physical environment, Section 4.2, biological environment and Section 4.3, Socio-economic environment). The sources of waste have been identified (Section 2.5.5) and the management of such waste will be according to the Waste management plan in 8.1.1.3. A construction permit (BUN501208/1CPHDW2013) and a surface water abstraction permit (BUN501010/1SWMDW2013) have been obtained for this project, clearly stating the project water requirements and environmental flow for the project – however during the ESIA update, the EF for the project was still calculated as included in Section 4.1.3.4 and Annexure 10 (hydrological report). Project impacts on downstream river flows and community water sources and the proposed mitigation measures have been discussed in Section 6.3.13 of the ESIA. Monitoring indicators have been provided in the ESMP (Table 8.1, Section 8)

		often not adequate for the purpose of sound monitoring (see items 2 and 5 above). Waste generation (hazardous and non-hazardous) is not mapped. As mentioned above, the environmental and social management and monitoring plan (chapter 9) includes a waste management plan and a hazardous materials management plan. These are in general terms based on the hierarchical approach of avoidance, minimisation, reuse and environmentally sound disposal. The mitigation measures proposed are general in nature and not yet tailored well to the Project. Large but unspecified volumes of rocks and spoil will be generated. The need for and location of spoil sites are not clarified. The Applicant plans to address this during construction in dialogue with the environmental authorities. However, this needs to be clarified prior to construction start to a larger extent as the impacts may be substantial both in environmental and social terms. Data on water resource use efficiency is not available. Impacts on water users between the weir and the tailrace are described though the mitigation and monitoring have not been adequately dealt with.	
17.	Will the Applicant consider the performance levels and measures in relevant technical guidance in the World Bank Group EHS Guidelines?	The ESIA refers to the World Bank Group EHS Guidelines in general terms. The clarifications in February 2014 confirmed that the Developer intends to comply with the EHS guidelines. The specific implications of following these guidelines are generally not discussed in any detail. The lack of specific baseline data will complicate monitoring and documentation in relation to the EHS guidelines.	The EHS guidelines have been discussed in detail in Section 3.5(c) – the World Bank Group EHS Guidelines of 2007. The baseline data in order to allow for monitoring and documentation in relation to the EHS guidelines has been expanded as included in Section 4 of the updated ESIA. A Health, Safety and Environmental Management Plan has been included in the updated ESIA (Section 8.3) to guide the monitoring and documentation.
	Performance Standard 4: Community Health, Safety, and Security		
18.	Has the Applicant evaluated risks and impacts to the health, safety and resources of the affected communities during all Project stages and established appropriate measures favouring prevention and avoidance (see also 2 and 12 above)?	The Applicant has assessed several risks and impacts to the health, safety and resources of the affected communities in the ESIA. However, the assessment is not exhaustive as evidenced in the Developers incapacity to appreciate the risks that some of the component placements will pose on the neighbouring households and communities, even where these are located very close to the narrow corridor the Developer intends to acquire. A case in point is the access road and penstock's proximity to people's residential facilities in such steep terrain and the Developer appears not to have considered the possibility of changing the alignment or relocating them despite what appears to be obvious risks that are creating anxiety among the PAPs. The Applicant needs to undertake an in-depth analysis of the impacts of project component placement so close to households both during construction and operation phases. The Applicant has also acquired a rather narrow corridor (4-6m) given the steep terrain. This corridor does not provide sufficient	Section 5 of the updated Re-settlement Action Plan presents the detailed description the positive and negative impacts of the project on the socio-environment. The number of villages directly impacted by the proposed project are three (Ntuma, Kabwe and Kyebumba) while the indirectly affected villages are four including Mutiti, Kakuka, Buboni and Bihya all relying on River Sindila as the main source water. The points at which the community draws water together with the amount of water they draw have been included and were considered during the calculations of the EF (Section 4.1.3.4) of the updated ESIA. Strategies for mitigating project related impacts on downstream river flows have been proposed in Section 6.3.13, (Impact on downstream river flows and community water sources). Furthermore, strategies to ensure and improve community water supplies have been included in Section 8.10 of the updated RAP (social and community programmes). The impact of increased traffic has been reassessed (Section 6.3.7) and a traffic management plan included in Section 8.4.

		space for construction activities without interfering with the property adjacent to the acquired corridor. The Applicant needs to bear in mind that the safety of those adjacent to the worksite is also paramount and there is need to minimise inconveniences and interferences with their livelihoods during construction phase. The Applicant should develop a system for handling and monitoring unexpected damages in the future. The ESIA identifies up to six directly impacted villages and eleven indirectly affected, all relying on Sindila river as their main source of water supply (chapter 5.3). The Applicant is expected to exhaustively and accurately identify all the villages whose water supply is likely to be impacted by the project activities. Strategies for supplying alternative water supply should be developed. The ESIA mentions providing water fetching points along the headrace canal, but this will be a solution for only the villages through which the headrace canal is located, which is one village out of the 17 (the number 17 appears large and it remains unclear how so many villages can be impacted). Even this strategy is not confirmed as it appears not to be described in the feasibility report. The ESIA identifies five points along the river likely to be affected by the project activities. Strategies for mitigating this impact both during and after construction are not adequately identified in explicit terms. Resources also appear not to have been allocated towards the provision of alternative water supply, whether during construction or operation phases. In an effort to minimise impact of project traffic and equipment on communities the Applicant has developed a traffic management plan. However, it is not explicit on the regulations to follow when using shared roads particularly by heavy trucks and equipment.	
19.	Has the Applicant disclosed, informed and consulted affected communities and relevant government agencies (see also 2 above regarding stakeholder consultation)?	Communities and government agencies have been informed and consulted about the Project by the Applicant. By the time of the site visits it was clear that disclosures had not yet been adequately done, as the community had quite a lot of questions that deserved attention and clarification, many of which were concerned with safety during and after construction. The Applicant should prioritise information sharing and also be more conscious of the people's concerns early in project planning phase. This situation could be a result of the poor communication methods between the Applicant and the communities. The Applicant needs to engage competent community relations personnel. It remains unclear whether all the communities relying on the rivers for their water supply were consulted and whether the District Water Office Bundibugyo / DWD Mbarara have been involved for the purpose of planning strategies for providing alternative water supply. Implementation of the traffic management plan and the emergency response plan will involve several stakeholders (e.g. police, Ministry of disaster preparedness, Uganda Defence Force). This requires	Consultations with communities that use River Sindila for their water supply were undertaken and details are included in Section 7 and Annexure 5 of the updated ESIA. For the purposes of planning strategies for providing alternative water supply to the Sindila community, the Water and Sanitation CDO, Bundibugyo district, Mr. Olegasiza Tevin was consulted and details of this consultation are also included in Annexure 5.

		participation in the implementation of these plans. It is not clear whether this has taken place.	
20.	Does the design, construction and operations of key Project components follow good international industry practice and consider exposure to natural hazards and exposure to disease?	Natural hazards (e.g. landslides and earthquakes) common in the area are not discussed in the ESIA. The area is known for being seismically active but this is not reflected. Floods are touched upon in the hydrology section (chapter 4.1.3). However, the Applicant's management of these risks and responses to such hazards are not clearly described. Health and security risks, and increased pressure on social services, caused by population influx need to be assessed in more detail.	The potential health risks associated with the project have been assessed in detail and mitigation measures provided in Section 6.3.6 (Increased disease vector populations as a result of changes in water ecology), Section 6.3.17 (Increased spread of sexually transmitted diseases and other communicable diseases) Section 6.3.2.6. (Increased pressure on the social service sector) of the updated ESIA. Earth quakes have been discussed in Section 4.1.4.4 (seismic analysis) and the impact section (Section 6) has been updated to include unplanned (contingency) impacts of the proposed Sindila MHP (Section 6.4) including the following assessment of impacts; • Earthquakes (Section 6.4.1); • Landslides (Section 6.4.2); • Floods (Section 6.4.3); • Failure hazards (Dam break) (Section 6.4.4); • Accidents (Section 6.4.5); and • Susceptibility of the project to climate change (Section 6.4.6). The management of such natural hazards has been considered in project design (Section 2) and the mitigation measures against such have been provided in the respective impact sections. Also included in the project ESMP as is relevant to this gap is a Dam Breakdown Analysis and Action Plan (Section 8.12), Emergency Response Plan (Section 8.10), Health, Safety and Environment management plan (Section 8.3), Traffic Management Plan (Section 8.4), HIV/AIDS Policy (Section 8.7), Hazardous Materials Management Plan (Section 8.9).
21.	Have necessary measures to prevent major accidents and limit their consequences in major accident prevention / emergency preparedness policy and management system including internal and external emergency plan been identified?	The ESIA and the Environmental and Social Monitoring Plan have identified measures to prevent major accidents and limit their consequences including an emergency response plan. However, with the gaps in risk and impact identification, the adequacy of the proposed measures is doubtable. During the site visit, it was surprising to discover that the Developer did not intend to improve the existing narrow and winding access road leading to the site located in a quite steep terrain, a road that was already posing safety challenges during the planning phase. Safety risks for the communities need to be assessed for all project phases. The ESIA does not adequately address emergencies. A general and brief Emergency Response Plan is included in the ESMS (chapter 9.3.7). However, the plan has no detailed information in regard to the following issues: administration of the emergency preparedness plan; identification of service providers during an emergency; definition of roles and responsibilities of the service providers, communication strategies for notifying service providers, workers, communities and the government; company emergency response procedures; training of workers and community representatives; reporting; emergency response financing/resources; and contact list for service providers. Coordination with potential external stakeholders in the implementation of the traffic management plan and the emergency response plan need to be initiated prior to the commencement of the construction phase.	The Emergency Response Plan (Section 8.10) has been updated to include; administration of the emergency preparedness plan; service providers during an emergency; roles and responsibilities of the service providers, communication strategies for notifying service providers, workers, communities and the government; reporting; emergency response financing/resources; and contact list for service providers.
22.	Has the Applicant assessed the risks to those within and outside the Project site posed by the Project's security arrangements, including from the use of government security personnel? Has appropriate training	The Applicant has attempted to identify risks but more effort is required to achieve a comprehensive analysis of risks and impacts for those outside the project site critically during construction phase, but also during operation. In regard to security, other than numbers of security personnel	The Emergency Response Plan (Section 8.10) has been updated to include possible security risks and a list of service providers including the security service providers.

	been provided? (see also 5 on grievance mechanism)	provided in the ESIA, there is limited detail on the planned security arrangements. In all the documents reviewed, there is no evidence that the Applicant has assessed risks to those within and outside the project site posed by the Project's security arrangements	
	Performance Standard 5:Land Acquisition and Involuntary Resettlement		
23.	Has the Project avoided, and when avoidance is not possible, minimised physical and economic displacement (see also 2 above re. alternatives)?	The ESIA identifies alternatives but these appear not to have been analysed in terms their respective social impacts such as displacement. The RAP has only analysed social Impacts of the selected alternative. However, during the site visit it was clear that an attempt had been made to try and avoid impacting houses though it has almost resulted into increasing the safety risk of the communities during the construction phase. This is the result of the Applicant's very narrow corridor (4-6 m) which does not provide sufficient working space during construction.	Refer to the response to this in the RAP concordance table (Annexure 1 of the updated RAP)
24.	Has the applicant disclosed all relevant information, consulted end ensured informed participation of those affected (see also 2 above re. stakeholder engagement)?	Based on the documents reviewed and the verifications during the site visit it seems like the Applicant has shared most of the relevant information with several stakeholders. However, it is not clear whether the results of the studies have been disclosed yet. There is need for a disclosure plan with suitable methodologies for the different categories of stakeholders, including appropriate methods for the local communities. Given the peoples' levels of understanding of key issues, there should have been an avenue which facilitates the continuous contact with the PAPs. This avenue would provide the PAPs with an opportunity to seek clarifications even on an individual basis. The Applicant attempted to do this through their local representatives and the grievance committee but unfortunately the committee has not been given sufficient information to help the PAPs satisfactorily. In addition, there was a tendency by the Applicant to only disclose the project component alignment but not the extent of land to be acquired from the different households. This needs to be physically illustrated to ensure that there is joint agreement and consensus on land to be acquired to avoid disagreements after compensation payments and eventual delays in land release by the affected households.	Refer to the response to this in the RAP concordance table (Annexure 1 of the updated RAP)
25.	Has the Project got a livelihood restoration framework / plan for economically displaced persons that among other things, includes compensation at full replacement cost (see also 2-5 above)?	The ESIA states that about 5.8 acres of land belonging to 100 persons will be acquired. The RAP had not fully analysed the impacts on livelihoods, but the Applicant has clarified that the livelihood restoration plan will be prepared by April 2014. It is expected that the new submission will reflect the eligibility criteria for livelihood restoration, will explicitly identify the vulnerable households and will have clear strategies, activities, implementation schedules, baseline data and measurable monitoring indicators. The Applicant has to institute measures to close the gap between the national requirements upon which compensation is being based and the IFC requirements for full replacement cost. It is hoped that with the inclusion of a livelihood restoration plan, replacement housing and in-kind compensation for land, compensation at full	Refer to the response to this in the RAP concordance table (Annexure 1 of the updated RAP)

		replacement cost will be achieved.	
26.	Has the Project got a resettlement action framework / plan for physically displaced persons that, among other things, provides adequate housing and security of tenure (see also 2-5 above)?	The Project has a Resettlement Action Plan (joint for Sindila and Ndugutu projects), in which the impacts on people's homes has not been analysed adequately. In addition, the Applicant claims that the PAPs prefer cash and has therefore not planned for any other form of compensation. The Applicant has also concluded that there will be no physical displacement. However, from the cadastral map it seems like several houses are very close to the narrow corridor acquired. It is recommended that the Applicant cautiously rethinks the land requirements and ensures that the land acquisition process is accurate and well timed to avoid potential expensive delays during construction and unacceptable impacts on the PAPs. The Applicant also needs to ensure that PAPs are not worse off (landless and homeless) after the Project, therefore the choice of compensation needs to be well managed. Should any physical displacement be required, the RAP should include detailed plans for housing or security of tenure. The Applicant has also ensured that the Project will assist the PAPs acquire legal ownership over the current and new property whichever will be applicable. The Applicant is however advised to ensure that distortion of land tenure systems is avoided. Therefore there is a need to maintain the customary practices. The best support in this regard would be to support the PAPs in the processing of their customary certificates.	Refer to the response to this in the RAP concordance table (Annexure 1 of the updated RAP)
	Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources		
27.	Has the Applicant evaluated risks and impacts to biodiversity, ecosystem services and sustainable management of living natural resources during all Project stages and established measures as part of an appropriate mitigation hierarchy (see also 2-5 above)?	Various groups of plants and animals have been mapped during baseline studies. The majority of the area of influence consists of modified habitats (cultivated areas and fallow plots). There are some areas with more natural riverine forest along the river, particularly towards the weir site. However, these forests are also disappearing as evidenced during the site visit in January 2014. Aquatic biodiversity appears very limited, even if possibly inadequately studied this far. The Rwenzori Mountains National Park, also a World Heritage Site and a Ramsar Site, has not been considered even if only located 250 m from the weir site. Potential impacts on the Park need to be assessed, including impacts associated with unplanned (but expected) in-migration to the project area. Overall, the negative impacts on biodiversity are expected to medium, small or insignificant, with the possible exception of impacts on the National Park which requires further clarification. The riverine forest and forest patches in the steep areas towards the weir are probably the most valuable within the direct impact zone from a biodiversity point of view. However, these forests are likely to be severely impacted even without the Project due to the local needs for additional agricultural land, grazing areas and timber and fuel wood. Ecosystem services are not considered and the potential impacts on the ecosystem services of the National Park are therefore not	The baseline (Section 4) has been updated to include the significance of Mount Rwenzori National Park (RMNP) (Section 4.2.2) clearly describing the importance of RMNP to the project. More ecosystems in the project area of influence and their importance to the project are described under Section 4.2.1. In addition to the above, the resources obtained from the RMNP in terms of cultural heritage including but not limited to; smilax and acalypha (for basket making), medicinal plants, mushrooms, water, honey, fibres from tree bark, bamboo stems and sheath, have been discussed under archaeological and cultural resources (Section 4.3.16). The impact section (Section 6) has also been updated with an assessment of the impact on Rwenzori Mountain National Park, World Heritage Site and Ramsar Site (Section 6.3.1) and mitigation measures have been proposed with respect to the park.

		assessed. This should also be considered in the context of potential impacts of the Park. The main concerns of project affected people in terms of ecosystem services (even if not expressed in term 'ecosystem service') are related to water for domestic use rather than fish resources in the Sindila River. The Applicant does not appear to have planned any payments for the ecosystem services provided by the National Park which is the water catchment for the hydropower project. Sustainable management of living natural resources in the context of the IFC Performance Standards is not relevant in this Project.	
28.	Has due diligence regarding natural habitats, critical habitats, legally protected and internationally recognised areas and invasive alien species, including establishment of measures as part of an appropriate mitigation hierarchy been carried out? Has special consideration been given to critical habitats (see also 2-5 above)?	The ESIA makes no explicit reference to 'critical habitats' as per IFC Performance Standards. The Rwenzori Mountains National Park (RMNP) is such a critical habitat. The RMNP is also designated as a World Heritage Site under the UNESCO World Heritage Convention and as a wetland of international importance under the Ramsar Convention. The relationships between the proposed project and the RMNP and UWA's General Management Plan for the Park, the Outstanding Universal Values that was basis for World Heritage designation (criteria viii and x) and the values that was basis for the Ramsar designation as a wetland of international importance on the other side (criteria 1, 2, 3 and 7) should be analysed explicitly as part of assessment potential impacts on the Park. The ESIA does not document that the mitigation hierarchy (avoid-minimise-mitigate-restore-offset) has been followed. There are no assessments of environmental impacts from various alternative project locations. There is no clear rationale for the level of the environmental flow of 40 l / s and no assessment of residual impacts by releasing this flow from the weir site. Invasive alien species are not considered but several introduced species used in agricultural production are listed.	Significance of Mount Rwenzori National Park in relation to the proposed project has been included in Section 4.2.2. Potential impacts on the RMNP are assessed in Section 6.3.1 and 6.3.10. Alternatives have been discussed in Section 5 of the report, with the fundamental alternative on a different location for the project discussed under Section 5.1.3. The aquatic biodiversity baseline information in Section 4.2.3.6 (Aquatic biodiversity of the project area) and the downstream water users have been the basis to justify environmental flow. Ecological flow/Environmental flow Assessment determined in Section 4.1.3.4 of the updated ESIA. The impact of introduction of invasive plant species has been included in Section 6.3.25 of the updated ESIA.
	Performance Standard 7: Indigenous Peoples		
29	Has the Applicant determined and / or identified all affected communities of Indigenous Peoples within the Project area of influence, as well as the nature and extent of the potential direct and indirect economic, social, cultural and environmental impacts during Project construction and implementation? Did the engagement process include stakeholder analysis and engagement planning, disclosure of information, consultation, and participation in a culturally	There are no indigenous peoples in the project area. Therefore, issues under performance standard 7 are not applicable for this project.	N/A

	appropriate manner (see also 2-5 above)?		
30.	Have adverse impacts on affected communities of Indigenous Peoples been avoided, and when avoidance is not possible, have impacts have been minimised and/or compensated in a culturally appropriate manner commensurate with the vulnerability of the affected communities? Has the Applicant proposed actions that were developed with the informed consultation and participation of the affected communities Indigenous Peoples?	Not applicable.	N/A
31.	Has the Applicant obtained the Free, Prior, and Informed Consent (FPIC) of the affected communities of Indigenous Peoples, including in relation to lands and natural resources subject to traditional ownership or under customary use, any relocation of communities of Indigenous Peoples as well as in relation to critical cultural heritage (see also 18-21 and 28)?	Not applicable.	N/A
32.	Has the Applicant and the affected communities of Indigenous Peoples identified opportunities for culturally appropriate and sustainable dev. benefits? Will the Applicant ensure timely and equitable delivery of agreed measures to the affected communities?	Not applicable.	N/A
	Performance Standard 8: Cultural Heritage		
33.	Has the Applicant evaluated cultural heritage as part of the ESIA process? Have affected communities been consulted regarding any significant impacts to cultural heritage (see also 2 above)? Have all assessments and implementation of measures been conducted by or with supervision from qualified specialists? Are mitigation measures implemented in accordance with national regulations and good international practice (see also 3 above)?	The methods section of the ESIA (chapter 1.9) indicates that cultural heritage has been covered. Table 7.4 refers in very general terms to potential impacts on cultural heritage and general mitigation measures. However, there is no evidence of cultural heritage studies undertaken or even explicit consultations on the issue in the baseline data or analysis of impacts, neither in the ESIA nor the RAP. This issue should be further assessed in the ongoing studies.	Consultations with Uganda museums were undertaken and the minutes from this consultation are included in Annexure 5. The archaeological and cultural resources section was also included in the baseline (Section 4.3.16) while the project impact on culture resources has been assessed in Section 6.3.15.

ANNEXURE 5: DETAILS OF STAKEHOLDER CONSULTATIONS

Annexure 5.1: Minutes for consultation with Bundibugyo district officials

Minutes for the Consultative Meeting with Bundibugyo District Officials and other Stakeholders about the proposed Sindila and Ndugutu Mini Hydropower Stations

Venue :Bundibugyo District Headquarters (District conference hall)
Date : 27/02/2012
Participants : (List attached)

Agenda / programme

1. Opening prayer
2. Remarks from Ass. LC V Chairperson
3. Introduction of the project by Project Manager– Butama Hydro Electricity Company Ltd.
4. Agenda 4: Communication from the ESIA team leader – From OPEP Consult Ltd
5. Communication from representatives / Advisors of Butama Hydro Electricity Company Ltd
6. Open discussion
7. Closing remarks from Asst. Chairman LCV Chairperson

Minute 1: Opening prayer
An opening prayer was led by one of the members and he requested the guidance of the almighty God throughout the entire meeting.

Minute 2: Communication from Ass. Chairman LCV
The Chairman LC V recognized the presence of officials from Butama Hydro-Electricity Company Ltd, HEMAS Power, ESIA team members from Uganda (OPEP Consult Ltd in Particular), other stakeholders, colleagues from Bundibugyo district and everybody present. Officially and he welcomed Butama Hydro-Electricity Company Ltd to Bundibugyo District. He informed the members present that this project is on demand in many parts of the country, therefore they should count themselves among blessed people. He thanked Butama Hydro-Electricity Company Ltd & HEMAS Power for having come up to put such a big investment in Bundibugyo District. He also urged the local people to be positive towards the project because there are many benefits that will come as a result of this project. He highlighted that this project will create jobs for the local people especially the youths.

Minute 3: Communication from Project Manager (Butama Hydro Electricity Company Ltd) – Krishantha Wimalasiri
He started by welcoming all the government officials of Bundibugyo district, and everybody present at the meeting. He then gave a brief background about the company / developer and their intended activities in Bundibugyo District. He ended his remarks by giving a brief presentation of what the same company has accomplished in the hydro electricity sector in other countries.

Minute 4: Communication from the ESIA team leader (OPEP Consult Ltd) – Tumusiime Alfred
The team leader started by explaining the purpose of the meeting and presented a brief description of the processes involved in the preliminary studies before any project commences with emphasis on the ESIA process according to the regulations set by NEMA.

He urged the people present to listen carefully and present all their concerns in respect of the two proposed mini hydropower stations.

Minute 5: Communication from a representative / Advisor (Sociologist) from Butama Hydro Electricity Company Ltd - Professor Shantha Hennayake

Professor Shantha started by thanking the government officials of Bundibugyo district for the good welcome given to them. He said the main aim of the meeting was to explain the significant environmental and social impacts (both positive and negative) of the project and get views and concerns of the surrounding communities / stakeholders to input into the final ESIA report. He informed the people that they are at the stage of carrying an ESIA to get approval from NEMA. He said that according to the existing regulations, NEMA has to first approve the report before the project can commences.

He said that, the major impact area will mainly be Sindila sub-county because both Sindila and Ndugutu projects will entirely be located in Sindila sub-county. He explained the components of the project to the people which include: the weir, Intake, Headrace channel / steel pipes, Forebay tank, Power house and Tailrace and the same designs will be used for the two projects. He elucidated that, as the water will be diverted to the canal, the volume of the water in the river will be reduced. However, a certain amount of water (environmental flow) must remain in the river for human use as per the recommendations by project approving agencies such as NEMA and DWRM

.

He informed the people that the ESIA team surveyed the whole project area to find out the impacts of the project on environment and the local communities. He demonstrated (power point) how the ESIA team moved around the project area and some of the issues they encountered in the process. He added that no houses will be affected by this project (according to baseline results); the diversion canal and the access road will go through vegetation and gardens only. He explained the expected positive and negative impacts of the projects and their mitigation measures to the people. Some of positive impacts include: Employment opportunities to the locals (about 100-150 people for each project), addition of 22GWh to the national grid, making an investment worth US$25 million in Bundibugyo district, indirect income 5.5 billion for both projects, infusion of about 180 million to the affected people around Ndugutu and Sindila as compensation payment, increased demand of local products and many others.

He added that the negative impacts will include reduction in water level along the river between the weir and power house before it is released back to the river, acquisition of land for the canal and road, increased soil erosion and turbidity of the R. Ndugutu and Sindila especially during construction. The proposed mitigation measures include; Maintenance of environmental flow and establishing pools along the rivers, relocation of gravity flow scheme, adequately compensation for all land acquired and implementing acceptable and effective soil retention techniques.He concluded by inviting the people to take active interest in this project as it benefits Bundibugyo and the entire region. He requested them to contact them for further information or any queries. He said that the aim of the company is to provide much benefit to the community from the project and he requested for their fullness cooperation during the approval process as well as the construction and implementation stages.

Minute 6: Open discussion (Mainly Verbatim)

(Question): For the project costs you have shown us, do they include both social and environmental costs?

(Answer): As fore mentioned, some mitigation measures against significant environmental and social impacts will be put in place and these costs are all incorporated in the project costs. However, these are just estimates.

(Question): We want you to give us an assurance that the water quality for the two rivers will not be affected?

(Answer): One of the ESIA team member responded to the question with the experience and knowledge from other existing small hydro power stations in the neighbouring district Kasese, it was noted that the water quality cannot be affected except during construction. However, during the ESIA process, water samples are taken to get the base line quality for future reference.

(Question): Our soils here in Bundibugyo are prone to landslides, how will you respond to such a problem?

(Answer): After construction, trees will be planted along the canal to stabilize the soils and where possible, retaining walls will be constructed.

(Question): What plan do you have for the people who have been utilizing the river between the weir and the power / tailrace?

(Answer): We are already aware that the Gravity Flow Scheme (GFS) water has its source between the weir and the power house of Ndugutu Mini Hydropower Station and as noted in our mitigation measures, we shall make an extension of the pipes up to the weir.

In addition, as recommended by NEMA, we shall leave an environmental flow in the river to maintain some of its importance.

(Request): We have a problem of water in Bundibugyo district, so I request that in your corporate social responsibility you consider extending piped water to the surrounding communities.

Minute7: Closing remarks from Chairman LCV

The assistant LC V Chairperson Bundibugyo District concluded the meeting by thanking the ESIA team for involving the stakeholders in the early stages of the project and he officially closed the meeting.

STAKEHOLDER MEETING
NDUGUTU AND SINDILA MHPs
BUNDIBUGIO DISTRICT OFFICE - February 27, 2012

SN	NAME	POSITION	TEL NUMBER	SIGNATURE
1	NSUBUGA HOOD	Ag DCAO	0779481133	[illegible]
2	KAHIISA STEPHEN	Statistician	0782-574526	[illegible]
3	NDAYONDI . A	CFO	0772491979	[illegible]
4	AGABA CHARLES	PROCUREMENT OFFICER	0791531126	Agaba
5	AHEEBWA JUSTINE	Natural Resources officer	0782446231	Aheebwa
6	MAATE JOCKUS	Senior Environment Officer	0774281622 0701151575	[illegible]
7	BASIIME MUGANDA ROBERT	SENIOR FISHERIES OFFICER	0772882232	[illegible]
8	BISHAKA EDMUND	DISTRICT AGRICULTURAL OFFICER	0772514818	[illegible]
9	ISAAC KAPIPA	SFO	0772980585	[illegible]
10	BAMURORO MONDAY	DEO	0772996515	[illegible]

STAKEHOLDER MEETING
NDUGUTU AND SINDILA MHPs
BUNDIBUGIO DISTRICT OFFICE - February 27, 2012

SN	NAME	POSITION	TEL NUMBER	SIGNATURE
1	MBALIBULHA GODFREY	LCS V/C/MAN	0753255799	[illegible]
2	Nanfuka Esther K	Sociologist	0772484265	[illegible]
3	Babriha William	Sec. Finance	0772578131	[illegible]
4	Masereka Julius	Sen. Records Officer, Bgyo	0782234240	[illegible]
5	Dr. Maato Martin	Vet Doctor	0782-478923	[illegible]
6	MBUSA DANIEL	LC III C/P SINDILA	0782899322	MDaniel
7	TIBESIGWA RAJAB	UBC RADIO - B'GYO	0785372829	[illegible]
8	MUTESIGE BENI HASHIM	DIST. SPEAKER	0772358560	[illegible]
9	BALYEBULYA RICHARD	SCDO	0774974861	[illegible]
10	BAKAMANYAKI K. VERONICA	SEC. GENDER & CBS	0787219281	[illegible]

STAKEHOLDER MEETING
NDUGUTU AND SINDILA MHPs
BUNDIBUGIO DISTRICT OFFICE - February 27, 2012

SN	NAME	POSITION	TEL NUMBER	SIGNATURE
1	OREGA CAESAR TEVIN	DFC/ACDO	0772874423	[illegible]
2	Kaliisa Herbert	S.A.S/ACA.O	0772358541	[illegible]
3	KISUNGU ZAKAYO	ACAO	0777388093	[illegible]
4	SENGI SEMU	ASST. ENG. Electrical	0773114032	[illegible]
5	KULE JUSTUS	Biostatistician	0782542690	[illegible]
6	RWAKIPAMBA EZIRON	AGRICULTURE Officer	0782310055	[illegible]
7	Sabiiti Charles	ESIA TEAM MEMBER	0775232361	[illegible]
8	Rwaburindore Protase	ESIA TEAM MEMBER	0772521086	[illegible]
9	TUMUSIIME ALFRED	ESIA Team Leader	0782335405	[illegible]
10	TWESIIME BRIAN	ESIA TEAM MEMBER	0712 243040	[illegible]

STAKEHOLDER MEETING
NDUGUTU AND SINDILA MHPs
BUNDIBUGIO DISTRICT OFFICE - February 27, 2012

SN	NAME	POSITION	TEL NUMBER	SIGNATURE
1	MUGWANI TABUO	Sec. WORKS S/ROAD.	0772919959	[illegible]
2	BALINYHUKA TIBBS	DPC	0788659625	[illegible]
3	Pr. BAMUTIREBYE PETER	SENIOR EDUC OFFICER	0779788057	[illegible]
4				
5				
6				
7				
8				
9				
10				

Annexure 5.2. Minutes of the Community Consultation Meeting

Community Consultative Meeting held at Kaghughu Primary School in Sindila Sub-County

Venue :Kagugu primary school
Date : 28/02/2012
Participants : (List attached)

Agenda / programme
Opening prayer
Remarks from LC II Chairperson
Remarks from LC III Chairperson
Communication from the project manager – Butama Hydro Electricity Company Ltd
Communication from a representative / Advisorfrom Butama Hydro Electricity Company Ltd
Communication from the ESIA team leader – From OPEP Consult Ltd
Open discussion
Closing remarks from Chairman LC III

Agenda 1: Opening prayer
The meeting started with an opening prayer which was led by one of the members who thanked God for the bright day and requested for his guidance throughout the meeting.

Agenda 2: Communication from LC II Chairperson
The chairperson LC II was represented by the parish youth leader who welcomed the ESIA team members and requested the community members to gladly receive the development which has been brought to us.

Agenda 3: Communication from LC III Chairperson
The Chairman LC III (Mr.Mbusa Daniel) started by welcoming all the people for having come in large numbers. He requested them to continue with such kind of spirit in order to develop their sub-county. He tried to highlight a number of the benefits from the project and a few challenges which the sub-county is facing. He concluded his remarks by saying that the people of Sindila are very happy and they promise to continue working with the developer hoping that they shall we shall have power after construction.

Agenda 4: Communication from Project Manager (Butama Hydro Electricity Company Ltd) – Krishantha Wimalasiri
He started by welcoming everybody present at the meeting. He then gave a brief background about the company / developer and their intended activities in Bundibugyo district specifically in Ndugutu and Sindila sub-county. He ended his remarks by giving a brief presentation of what the same company has accomplished in the hydro electricity sector in other countries.
Agenda 5: Communication from a representative / Advisor (Sociologist) from Butama Hydro Electricity Company Ltd - Professor Shantha Hennayake
Professor Shantha started by welcoming the local people and thanked them for having come to attend the meeting which is important to them. He explained to the members that main aim of the meeting was to elaborate the significant environmental and social impacts (both

positive and negative) of the project and get views and concerns of the affected communities / stakeholders to input into the final ESIA report. He informed the people that they are at the stage of carrying an ESIA to get approval from NEMA. He said that NEMA has to first approve the report before the project can commence.

He said that, the major impact area will mainly be Sindila sub-county because both Sindila and Ndugutu projects will entirely be located in Sindila sub-county. He explained the components of the project to the people which include: the weir, Intake, Headrace channel/steel pipes, GRP Pipes, Surge Fore tank, Power house and Tailrace and the same designs will be used for the two projects. He explained that, as the water will be diverted to the canal, the volume of the water in the river will be reduced. However, a certain amount of water (environmental flow) must remain in the river for human use as per the recommendations by project approving agencies such as NEMA and DWRM.

He informed the people that the ESIA team surveyed the whole project area to find out the impacts of the project on environment and the local communities. He demonstrated (power point) how the ESIA team moved around the project area and some of the issues they encountered in the process. He added that no houses will be affected by this project (according to baseline survey results); the diversion canal and the access road will go through vegetation and gardens only which will be compensated accordingly.

He then briefly explained the expected positive and negative impacts of the projects and their mitigation measures to the people. Some of positive impacts include: Employment opportunities to the locals (about 100-150 people), addition of 26GWh to the national grid, making an investment worth US$11 million in Bundibugyo district, indirect income 3 billion for Sindila project, infusion of about100 million to the affected people around Sindila Sub-county as compensation payment, increased demand of local products, training opportunities for university and senior school students and many others.

He added that the negative impacts will include reduction in water level along the river between the weir and power house before it is released back to the river, acquisition of land for the canal and road, increased soil erosion and turbidity of the R. Sindila especially during construction. The proposed mitigation measures include; Maintenance of environmental flow and establishing pools along the rivers, relocation of gravity flow scheme, adequately compensation for all land acquired and implementing acceptable and effective soil retention techniques.

He finished the presentation by calling upon the community members to take active interest in this project as it benefits Bundibugyo and the entire region. He requested them to contact them for further information or any queries. He said that the aim of the company is to provide much benefit to the community from the project and he requested for their fullest cooperation during the approval process as well as the construction and implementation stages.

Agenda 6: Communication from the ESIA team leader (OPEP Consult Ltd) – Tumusiime Alfred

The team leader started by thanking the members for having come to attend the meeting and explained that its purpose was mainly to get the issues and concerns of the people that

are likely to be affected by the Sindila small hydro power project. He also gave a brief description of the processes involved in the preliminary studies before any project commences with emphasis on the ESIA process according to the regulations set by NEMA. He also requested the members to raise their views and concerns without fear.

Agenda 7: Open discussion (Mainly Verbatim)
(Question): Am called James Basangayo and my main question is, shall we be able to access power since it going to be produced from our area?

(Answer): The ESIA team leader (Tumusiime Alfred) explained to the members that the company is licensed to generate power and feed it into the national grid. He advised them that if they are to access electricity, through their leaders they should make their requests known to REA a government institution responsible for giving electricity to rural areas in Uganda.

(Comment): Am called Matebele John LC I Masiri and I would like to thank the project developers for the development they are bringing in to our sub-county and am so grateful.

(Question): Some of our crops were destroyed during the process of other preliminary surveys, so do you have any program for us?

(Answer): The project manager responded by saying that they will visit those sites and see what to do for the according to the intensity of the damage.

(Question): Now the season is about to begin, and some of us just have small pieces of land. Suppose the canal passes through that piece of land, should we use it or we wait?

(Answer): Everybody is expected to continue using his or her land until they have been told stop and appropriately compensated

(Question): We have seen that some access roads will be opened up; is their going to be compensation for those houses which will be affected?

(Answer): As we mentioned earlier, there will be appropriate compensation of all the property affected by the project activities. The ESIA team leader added that another study called RAP will be carried out to value the affected property in order to do appropriate compensations.

(Question): We have heard that there will be some jobs, when will they be available?

(Answer): The project manger responded by saying that currently management is undertaking all the necessary feasibility studies as they wait for NEMA to approve some of these reports especially the ESIA report and thereafter, the project will commence. However, we anticipate to begin at the end of 2012.

(Question): Is it true that the volumes of water in the Rivers of Ndugutu and Sindila will be greatly reduced and even the remaining water will be contaminated?

(Answer): Project adviser responded that a certain amount of water (environmental flow) must remain in the river for human use as per the recommendations by project approving agencies such as NEMA and DWRM and it will not be contaminated in any way.

(Question): On Sunday we had a meeting at Busyangura Village and one of the residents of Sindila raised an issue that they are scared of strangers who are writing people who fetch water from Sindila River.

(Answer): The project manager said that it was purposed to establish the number of people who utilize the two rivers of Ndugutu and Sindila for proper planning.

(Question): How will the company solve the problem of rolling stones during construction since our area is hilly? Also I have had that you will open up some new roads, what will be the width?

(Answer): The contractor will always make sure that before any kind of excavaton is done, the people downhill will be informed in advance and if the situation is serious they will be relocated until construction is finished with adequate compensation.

Consultant: Tumusiime Alfred explained to people who are worried about their property. He said that, more studies are going to be carried out in this project area and these include the RAP which will come in conjunction with the Survey team and Valuation team to note down all the houses, land crops and other properties that will be used by the hydro power activities. These reports will then be taken to various authorities for consideration and approval after which the affected people will be compensated accordingly for properties lost including a disturbance allowance.

Agenda 8:Closing remarks from Chairman LC III
The LC III Chairperson Mr. Mbusa Daniel thanked the ESIA team for having opened up their eyes in line with what is going to take place in their sub county. He requested the people of Sindila sub-county to cooperate with the developer in all ways. He officially closed the meeting.

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Grace Biira	Ntuma	—	Biira
2	Kule Justus	Bunyamwera	0775477262	[illegible]
3	Yeko Nyamasyabo	Musalaghu	—	Y.N.
4	Bwambale Charles	Bunyamwera	0778315521	[illegible]
5	Bwambale Ezironi	Bunyamwera	0789104931	Bzini
6	Kisembo Ben	Nkuranga	0788917757	[illegible]
7	Baluku musa	Bunyamwera		Mu. M.B.
8	KALINDA PHILEMON.	BUNYAMWERA.	0772455849	Fkalinda.
9	KASUNDI WALIGO	KABWE LCI		[illegible]waligo
10	Faisi Kiiza	KABWE		F.K.

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Mbatebya Benefasio	Bunyamwera	0788182130	M.B
2	Blasio Heliki	MUSALAU	0781691944	B.H
3	Bulimbenda Fred	Ntuma	0785485424	JBFred
4	Muhindo Zakaliya	Bunyamwera	0783356039	[illegible]
5	Mbambu Paghane	"	—	M. Paghane.
6	Yokoniya mbugheki	"	—	M.Y.
7	Musoki Jolsi	Kabwe	—	M.J.
8	Biira Zipora	Bunyamwera	—	B.Z.
9	Sidoya Kyaeimwa	Buyamwera	—	S.K.
10	Mukire Edison	Bunyamwera	—	[illegible]

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	AINEA MULYANCASU D	KABWE LCI	0782310555	
2	Mumbere Abel	Bunyamwera	—	Mumbere
3	PANDAMWEYO JOPHES	KARUKA PARISH	0778351883	
4	BALINSANGAYO JAMES	NKURANGA-MUSALA	0701168296	
5	Mbabu Zeterena	Bunyamwera	—	
6	Mbabu Sujani	Bunyamwera	—	
7	Julius Kasumdi	Bunyamwera	—	
8	Thembo bulasiya	Bunyamwera	—	
9	Mutegeke moses	MUSALAWU	—	
10	Walemba Esther	Kobe	—	Walemba

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	AINEA MULYANCASU D	KABWE LCI	0782310555	
2	Mumbere Abel	Bunyamwera	—	Mumbere
3	PANDAMWEYO JOPHES	KARUKA PARISH	0778351883	
4	BALINSANGAYO JAMES	NKURANGA-MUSALA	0701168296	
5	Mbabu Zeterena	Bunyamwera	—	
6	Mbabu Sujani	Bunyamwera	—	
7	Julius Kasumdi	Bunyamwera	—	
8	Thembo bulasiya	Bunyamwera	—	
9	Mutegeke moses	MUSALAWU	—	
10	Walemba Esther	Kobe	—	Walemba

COMMUNITY MEETING

SINDILA MHP

SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Masika Yoneki	Kabwe	—	M.Y
2	Mukudali Johnson	Bunyamwera	—	M.J
3	KARUSOKE Roberti	Mutiti II	0785469886	[illegible]
4	Bwenge Mustafa	Mutiti	— —	B.
5	Biira Annet	Kabwe	—	BA-
6	Kabugho John	Kabwe	—	K.J
7	Yeresi Isoke	Kaghughu	—	[illegible]
8	Hakali Mbabu	Kaghughu	—	H-m
9	MASIKA ROSEI	Kabwe	—	[illegible]
10	Bwambale Jonasan	Mtuma	—	Bm

COMMUNITY MEETING

SINDILA MHP

SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Grace Mvrose	Bunyamwera	—	G.m
2	Edrenda Kasumali	Kabwe	—	E.K
3	Kabugho Joice	Bunyamwera	—	K.J
4	Mumbere Erafazi	Buhu Mtuma	—	M.E
5	SEREKA Misaki	Mtuma	—	S.m
6	Kule Sikamubera	Mtuma	—	K.s
7	Ngulyanatho Josifasi			
8	Tadeo Kiyaya	Bunyangule I	0775460616	[illegible]
9	Joseph Byaruhanga	"		[illegible]
10	Masika Olive	Musalala	0785109378	M.O

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Biira Joice	MUSILI	—	J.J
2	mbambu Orita	Bunyamwera	—	m.o
3	Biira Juliet	Bunyamwera	—	BJ
4	Mwinda Rejiya	Bunyamwera	—	M.R
5	ITENGURA-Semiti	Kagugu	0789131757	
6	Bwambele Bwakirwe	Musili		B.
7	Mumbere Hadaara	musili		m.h.
8	NGURE-Rutema	Kagugu		R.
9	Kabugho-JESIKA	Kabwe		K J
10	Simoni-Mbusa	Musili		S.mb.

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	BABUYA CHARLES	KAGUGU P.S.	0787835750	
2	BWAMBALE WESLEY	BUNYAMWERA LC	0775417854	
3	Monday Saimon	Kabwe	0789131780	
4	Monday MULYangasu	Kabwe	—	M.M
5	MAATE KARASAN.	KABWE	—	
6	KILAHO, MBUSA	BUNYAMWERA	—	
7	KAISOWA JOLAM	BUNYAMWERA	—	
8	EJJA GREYA KALAS	BUNYAMWERA	—	
9	Yodesi Biira	Kabwe	—	Biira
10	Biira Mary	Bunyamwera	—	Mary

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Samwiri-Murabtswa	Bunyamwera		S.M
2	Tembo Nehemiya	Kagugu		T.N
3	Isebayanda-Jowasi	Bunyamwera		
4	Baluku-Neckford	Kagugu		
5	Sibitemwa asa			
6	KASUNDI ISAYA	KABWE	078553126I	[illegible]
7	Muhindo . W.	B/mwera		
8	Jeni M	B/mwera		
9	Samuson . R	"		
10	Zefaniya R.	"		

COMMUNITY MEETING
SINDILA MHP
SINDILA SUB COUNTY- February 28, 2012

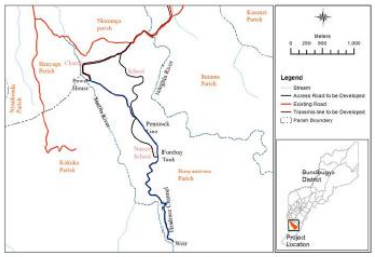
SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	NYAMUNYA SICOVIA	Kabwe	—	N. S.
2	BASISA FIIMONI	Kyaimbumba	0787946405	B. F
3	Helena Mutoro	Mutiti II	0774269019	HB
4	Mbambu Yoaesi	KABWE	— — —	M. Y
5	Musoki Murostya	B/KABWE	— — — —	M. M.
6	Masika Sofia	Bunyamwera	— — — —	M. S
7	Muhindo Julyeti	" " "	. . .	M. J.
8	Baganyire Suzana.	KABWE.	0785117549	B. S.
9	Kasundi Yozotina	Bunyamwera.	.. ..	K. Y
10	Musoki HERYET.	" "	—	M. H.

COMMUNITY MEETING

SINDILA MHP

SINDILA SUB COUNTY- February 28, 2012

SN	NAME	VILLAGE	TEL NUMBER	SIGNATURE
1	Nawambale Annon	Kaghughu		
2	Asimu Faisi	"		
3	Roda Musoke.ro	"		
4	Hbusa Mutonywa	Kabwe		
5	Nthirakali Nathan	Musalam I	0783033367	
6				
7				
8				
9				
10				



PROJECT LOCATION AND LAYOUT

MODEL OF THE PROPOSED POWER HOUSE

PROPOSED TIME FRAME

1. Approval from NEMA is expected - March 2012
2. Expected Date of Commencement of Construction - April 2012
3. Expected Date of Power Generation - April 2014

(An information pamphlet prepared by Butama Hydro Electricity Company Ltd. for the Public Consultation meeting held at Local Council Office, Bundibugyo on February 27, 2012)

SINDILA SMALL HYDROPOWER PROJECT

BASIC INFORMATION

Name of the Project: Sindila Small Hydropower Project

Investor: Butama Hydro Power Company Ltd,
Plot 41, Nakasero Road,
P.O. Box 9566,
Kampala.

Regulatory Agency
National Environmental Management Authority

Contact Persons: Krishantha Wimalasiri
Project Manager,
+94-773815511
+256-789430291
Krishantha.power@hemas.com

Project Location: Sindila sub county, Bundibugyo District

Total Area: About 8.5 Acres

Project Components

i. Weir (2m*22m)
ii. Intake (5m*12m)
iii. Headrace Chanel (1800m*2m)
iv. De-silting tank
v. Forebay Tank/Surge Tank
vi. Powerhouse (5.6 MW)
vii. Tailrace (12m*5m)

BENEFITS FROM THE PROPOSED PROJECT

1. Addition of 26 GWh to the Ugandan National Grid
2. Transmission line extension from Nyhuka to power house location, this will assist BECS to distribute electricity to villages around Butama and Sindila.
3. Making an investment worth US$ 14 million in Bundibugyo District
4. Employment opportunities to locals for 24 months during construction period
5. Salaries and wages amounting to about 850 million UGX during construction period
6. Permanent employment for 10-15 people during operation period
7. Salaries and wages amounting to about 65 million UGX annually during operation period
8. Job opportunities for women at the ratio of 10 men to 2 women
9. Indirect income of 3100 million UGX to the Bundibugyo region from jobs, purchasing of material etc.
10. Infusion of over 100 million UGX to the affected people as compensation payment
11. Improvement of about 2km of existing roads
12. Construction of about 1 km of new roads with a small bridge across River Sindila.
13. Increased demand for local products.
14. Increased standard of living of the people due to increased income.
15. Implementation of various community development activities in the area.
16. Training opportunities for University students and Senior school students

ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION

IMPACTS	MITIGATION
Reduction of water in Ndugutu river between weir and power house	Maintain base flow and establishing pools on stream
Acquisition of land for the development and roads.	Compensation for all lands acquired
Soil erosion and increased turbidity of the Ndugutu river	Implementing acceptable and effective soil erosion prevention and soil retention techniques

HOW CAN YOU GET INVOLVED?

We invite you to take an active interest in this project as it benefits you and your region. Please contact us for further information or queries. Our aim is to provide as much benefit to the community from this Project. We expect your fullest cooperation during the approval process as well as the construction and implementation stages.

Details of the consultative meetings with Governmental Officials

Specific Consultative Meetings with Bundibugyo District Officials

Place and date held Consultants Present	27th/Feb/ 2012, Bundibugyo District head quarters Tumusiime Alfred - Team Leader (Consultant, OPEP Consult Ltd) Sabiiti Charles (Consultant, OPEP Consult Ltd) Nanfuka Esther (Consultant, OPEP Consult Ltd)
Environment Officer – Bundibugyo (Mr.Maate Jockus)	
About Sindila and Ndugutu hydro power projects	**(Consultant) Qusetion:** Have you ever heard about the Sindila and Ndugutu small hydro power projects? **Response:** We are informed about the projects and we have been in touch with the developers and the consultants doing preliminary studies. **(Consultant) Question:** How do you welcome such projects in you district? **Response:** We do welcome such projects since we as a district have a power problem and yet we have a variety of resources like such rivers which we are unable to exploit.
Concerns	**(Consultant) Question:** What are some of your concerns as the district environment officer? **Response:** One major concern on my side is that, our area is mountainous and our soils are prone to landslides (Collapsing soils) and yet the local people are using poor agricultural practices. Therefore I would request the developer to sensitize the local people on better agriculture practices to ensure the sustainability of the projects. Also the developer should do enough water tests to get the baseline information and ensure that the quality is maintained throughout the implementation phase.Socially, the company should make sure that the local people benefit from the projects. For example in conjunction with REA, the company should provide power to the people of Sindila and Ndugutu sub-counties. About flora and fauna, am not sure whether there are some critical plants and animals in the project areas. About 1km away from the weir, there is a national park with plenty of wild life. However I expect that you studies will bring out such information.
District Community Development Officer (Katusiime Agness)	
About Sindila and Ndugutu hydro power projects	**Consultant Question:** Do you know about the Sindila and Ndugutu small hydro power projects? **Response:** Yes I have ever heard about the projects though I failed to attend the meeting which you held in the district hall
General Concerns and comments	**(Consultant) Question:** What are some of your concerns as the CDO?

	Response: As a community development officer, this is the first hydro power project in our district, so I expect community people to be concerned about water quality. I also hope that the local communities will be able to access power. Another concern is about the compensation of people who will lose their land to the project.
General	Generally I expect our area to develop as a result of these projects

Water and Sanitation – CDO Wash (Mr.Olegha Siza Tevin)

About Sindila and Ndugutu hydro power projects	**Consultant Question:** Do you know about the Sindila and Ndugutu small hydro power projects? **Response:** Yes and I even attended the meeting that we have just had in the district hall.
Concerns	**(Consultant) Question:** What are some of your concerns **Response:** Because of the nature of our water sources, there is a lot of tapping by different gravity flow schemes so the developer should take that into consideration in that their designs should cater for the existing flow scheme and also consider doing more extensions to the nearby communities. To avoid wrangles, any property/ land acquired should be properly documented and where possible agreements made and the local authorities should sign. The projects will result into the influx of outside people into the project area therefore the residents should be sensitized on how to protect their land We also expect these projects to support agro forestry activities by bringing in new species. The projects should also facilitate HIV/AIDS and Gender mainstreaming activities.
General comment	Generally, we highly welcome the projects hoping that we shall not just see wires flying over.

Consultative meeting with the Environmental Advisor, Ministry of Energy and Mineral Development

Date:24th April 2012	**Name:** Othieno John **Designation:** Environment Officerr **Place:** Board room, NEMA offices-Kampala **Present:** Tumusiime Alfred, EIA Consultant

Issues and responses (Quoted verbatim)

About the proposed Ndugutu and Sindila Mini Hydropower Stations	**Question:** Have you heard about the proposed Ndugutu and Sindila Mini Hydropower Stations in Bundibugyo district? **Answer:** I have heard of other mini hydro power stations especially those in Kasese like Rwimi but as for Ndugutu & Sindila, I have not heard of them yet.

Concerns	**Question:** These not being the first mini hydropower stations in Uganda so far, what are some of the issues that have been recurring and need to be addressed by the developer this time? **Answer:** Some of these problems are generic. I know there will be issues of biodiversity loss and how these will be mitigated if any. How do you intend to resettle the affected persons? The diversions may result into changes in the water table and as well water quality. The transmission for evacuating the power to the grid or consumers will go through community or private land and all these can result into conflict with surrounding community of they are not well sensitized. I think you need to carry out wide public consultations especially with the local community and ensure that all their concerns are addressed at planning stage. Issues of compensation should be well handled. Sometimes the district rates used to compensate people are normally 2-3 years old and hence the valuation report may not reflect the actual property rates. You need to bring in the community on board and try to sensitize them through their leaders such that their expectations are not too high. Issues of flooding if any can be handled at design level. **Question:** Is the development of mini hydropower stations such as the Ndugutu and Sindila in line with the strategy and priority of the Ministry? **Answer:** Government has put first priority to the generation of power. That's why they call upon such private investors to develop these mini hydropower stations. You need to appreciate that for any development to take place, you need power. Among the government priorities for next year is development of Karuma Hydropower station. You see these mini hydropower station help especially in rural electrification project. **Question:** If you borrow experience from the ongoing mini hydropower stations so far in the country, what are some of the key residual impacts that have come up to your office and should be focused on in the development of Ndugutu and Sindila mini hydropower projects? **Answer:** So far no issues now. You should also note that the number of mini hydropower stations that are operational are few. Majority of the pending mini hydropower stations are at EIA, Feasibility or Design stages. We have not seen any complaints with community in respect of mini hydropower stations and we hope that it will not occur with Ndugutu and Sindila projects.

Consultative meeting with the Environmental Officer, Uganda Electricity Transmission Company Ltd

Date: 24th April 2012	**Name** : Othieno John **Designation** : Environment Officer **Place** : UETCL Head Offices, Kampala **Present** : Tumusiime Alfred, EIA Consultant
Issues and responses (Quoted verbatim)	
About the proposed Ndugutu and Sindila Mini Hydropower Stations	**Question:** Have you heard about the proposed Ndugutu and Sindila Mini Hydropower Stations in Bundibugyo district? **Answer:** This is my first time to hear of them. Consultant: The consultant introduced the project area map and introductory letters to the officer. Response: Since these two rivers are close to each other, why don't they just divert the water from the two rivers into one power station? I think it would be cheaper.
Concerns	**Question:** These not being the first mini hydropower stations in Uganda so far, what are some of the issues that have been recurring and need to be addressed by the developer this time?
Hydrology	**Answer:** I have been seeing hydrological data for some rivers and it can be as old as 50 years. You see the Directorate of Water Resources Development installed gauges on some rivers and have been taking river discharges for a long time. Some of these developers use such data to design the hydropower. These days the patterns have changed and if they use such data to make designs, they will get it wrong. They need to factor in climate change issues because the rainfall patterns have changed. The source of water (catchments) are no longer productive as it used to be. These days mini hydropower stations can be shut down for 2-4 months due to low water levels which was not anticipated and have to re-open in the rainy season. They need to factor that in the design. It will not make sense to design for 10 megawatts are shut down the plant for 4 months.
Water quality concerns	There will be water quality issues before, during and after construction. The project should not result into significant changes in water quality.
Biodiversity and ecotourism	The Albertine rift region is also known for high species richness and rarity. You need to thorough documentation on the biodiversity of the area in terms of flora and fauna, whether threatened, endangered rear and others. Biodiversity issues are very important especially in the Albertine Rift Region. Do the rivers have fish? This also needs to be assessed and ensure that the diversions don't affect fish stocks.

	Are there no eco-tourism sites that may be affected by the proposed power plants?
Compensation	I know that there will be several compensation issues due to land take. This needs to be addressed well by consulting the affected stakeholders. Does the developer have some community development projects and livelihood restoration program? Through the company's Corporate and Social Responsibility, the company may have to look into community concerns such as lighting villages in collaboration with REA, supporting education programs in the project area, building resettlement houses among others. There has to be a grievance redress mechanism to settle dispute as a result of land take and displacement of community infrastructure. Opinion leaders, NGOs should be incorporated in the grievance redress mechanism to help in dealing with difficult people among the community.
Physio-cultural features	You may need to find out if there are any historical or archeological sites. There has to be a procedure for handling chance finds, if any.
Excavated earth works	The developer needs to plan how dispose the excavated earth works. The other concerns will be the source of aggregates and how sites will be restored after construction phase.
Environmental flow	The developer also need to determine appropriately the right amount of water as environmental flow.
Role of UETCL in Mini Hydropower project development	**Question:** Does UETCL have any role to play in the development of these mini hydropower projects especially in terms of monitoring design and construction activities? **Answer:** We normally don't have any role to play during construction of such mini hydropower stations unless NEMA or DWRM involves us. For example, we have been involved in monitoring the Bujagali project. UETCL is normally concerned with the Power Purchase Agreement (PPA) which has to do with the modalities of purchasing the power from the company generating it rather than monitoring environmental challenges. All power generated beyond 1 megawatt has to be sold to UETCL in bulk and this is in line with the Electricity Act. We leave environmental issues to NEMA, DWRM and ERA which issues the license.
Power evacuation	**Question:** In this case, does UETCL own the power evacuation lines? **Answer:** The transmission lines are owned by the company generating the power. They own the entire facility until they feed into our nearest substation.

Consultative meeting with officials from Uganda Museum

Date: 25th April 2012	**Name** : Nelson Abit, **Designation** : Conservator- Ethnography **Place** : Uganda Museum Head Offices, Kampala **Present** : 1. Sarah Musalizi, Conservator, Cultural Heritage 2. Tumusiime Alfred, EIA Consultant
Issues and responses (Quoted verbatim)	
About the proposed Ndugutu and Sindila Mini Hydropower Stations	**Question:** Looking at Bundibugyo as a district, are there som historical, monuments and or archeological sites of hig conservation value? **Answer:** Yes, we have the Karugutu fossils site although it may n be close to the proposed Ndugutu & Sindila mini hydropow stations. The albertine rift is more of fossil sites even the companies are using the specimen which were discovered to stuc this area for oil exploration. What we have discovered is that when it comes to archeology ar paleontology, most EIA experts don't have much knowledge abo this field and sometimes this requires that a physio cultural expe goes on site to do test pit excavations to prove their existence or nc Underground archeology is not easy to detect and needs specialize studies in addition to the usual EIA team members who normal look for cultural sites that are above the ground like graves, shrine and others.

Consultative meeting with officials from Uganda Electricity Regulatory Authority

Place and date held	13th/April/ 2012, Electricity Regulatory Authority Office, Kampala
Present	Tumusiime Alfred (Consultant, ESIA Team OPEP Consult Ltd) Sabiiti Charles (Field Assistant, ESIA Team OPEP Consult Ltd) Peter Kityo (Environmental Officer ERA) Peter Kakeeto (Project Engineer ERA)
Purpose	To obtain technical and social economic input into the environmental impact assessment process for the proposed Ndugutu and Sindila mini hydropower projects in Bundibugyo district.
Issues and responses	
(Consultant) Question: Do you know about Butama Hydro-Electricity Company Ltd? **Response:** Yes we know about it because we issued a permit to allow the company carry out preliminary findings / feasibility studies. The license was issued on 31st April 2011of which one of the conditions was to produce a comprehensive EIA report. However, the license was issued to last for a period of one year and it expired on 31st March 2012, therefore we expect the company to produce a progress report to allow the renewal of the license.	

(Consultant) Question: Have you visited the site?

Response: Yes, we visited the site though not comprehensively. Major issues discovered were, the site being densely populated and also being in a hilly place hence a need for comprehensive preliminary studies like EIA, RAP and other technical studies.

(Consultant) Question: These are two mini-hydro power stations in one sub-county and close to each other. According to you, does this present major environmental impact?

Response: Yes it has because of the following;

- First of all you have said that the canal will be open and this will greatly affect the wildlife especially if it cuts across animal routes. Therefore the company should consider fencing the canal as I have seen in other companies like KCCL.

- Also there will be diversion of water from the rivers, therefore issues related to environmental flow should be clearly addressed and permits obtained from the related lead agencies which allow water abstraction.

- Generally bigger issues are mainly social in nature.

(Consultant) Question: From your experience, what are the common residual impacts of such projects?

Response: Residual issues normally result from the construction phase and these include;

- Property acquisition especially land if not handled appropriately.

During the acquisition of property, all the procedures taken should be appropriately documented in presence of local leaders for future reference.

- Also corporate social responsibility should be well addressed other than leaving high the expectations of local communities.
- Accessibility. Communication network between the site and the main road should be properly worked on because during construction the traffic will be increased.
- Issues concerning biodiversity should be well addressed.
- If the company is to establish any quarry in the areas, it also has some residual impacts like effects of intensive vibrations
- Also the company needs to do another EIA for the transmission line which will connect power to the main grid.
- Also payments for compensation should be done as soon as possible since the country normally faces issues of inflation.

Residual issues during the operational phase include;
Noise, health and safety, erosion and impacts of the canal depending on the design.

(Consultant) Question: You as ERA, do you promote power production?

Response: Yes, because that's our mandate. We make sure that we give out permits such that power demand is silicified.

Consultative meeting with the official from the Gender Department, Ministry of Gender, Labour and Social Development

Place and date held	16th/April/ 2012, Ministry of Gender, Labour and Social development
Present	Sabiiti Charles (Field Assistant, ESIA Team OPEP Consult Ltd) Maggie M Kyomukama Ass. Commissioner for Gender and Women Affairs. (0772516778)
Purpose	To obtain technical and social economic input into the environmental impact assessment process for the proposed Ndugutu and Sindila mini hydropower projects in Bundibugyo district.

Issues and responses

(Consultant) Question: Do you know about Butama Hydro-Electricity Company Ltd?

Response: No it's my first time to hear about it.

(Then the consultant explained the nature of the project to the respondent)

(Consultant) Question: What are the gender related issues do you think such developments needs to address?

Response: There a number of Gender related issues that such companies need to address and these include;

- We expect women and men to get equal opportunities
- On the site, the facilities (Housing and hygienic / sanitary) for men and women should be separate.
- There should not be exploitation of children (Child labour)
- In conjunction with the local leaders, the company should put in place regulations and code of conduct to guide the people who will be employed during construction and after construction to avoid bad habits like prostitution which are dangerous to the community.
- In terms of compensation, some families are female headed therefore there is a need to carry out enough consultations before compensation is done to identify issues related to property ownership as well as land tenure systems in the area.
- We also expect the company to work hand in hand with the CDOs of Bundibugyo such that the community people can easily adopt the project.
- The company should consider supporting schools and hospitals in the area as part of it Corporate and social responsibility.
- Am ware that illiteracy level is very high in such communities, therefore the local leaders should try to sensitize the people on all the project activities that are to take place especially during the compensation process.

Lastly, the company and the local leaders should carry out continuous monitoring such that all the things mentioned in this EIA report are critically followed.

Consultative meeting with the officials from Rural Electrification Agency (REA)

Place and date held	30th/April/ 2012, REA Head Offices, Kampala
Present	Tumusiime Alfred (EIA Consultant) Herbert Oule, Environment Officer, REA
Purpose	To obtain technical and social economic input into the environmental impact assessment process for the proposed Ndugutu and Sindila mini hydropower projects in Bundibugyo district.

Issues and responses

(Consultant) Question: Do you know about Butama Hydro-Electricity Company Ltd?

Response: I can't say no on behalf of REA because am still new in the institution but I suppose the institution knows about it because REA is normally involved such projects because they constitute part of Rural Electrification Program which is the core activity of REA.

(Consultant) Question: Is it mandatory that ERA should to be involved in the planning and construction of such mini hydropower stations?

Response: It depends on how the project is proposed. Sometimes the developer may be licensed to produce and operate so we may not need to get involved. However, if the developer is only licensed to generate, then other players have to come in. For example REA normally comes in during construction of the transmission lines to nearby trading centres. However, since these projects contribute to rural electrification program, we still have to be in the know. REA is responsible for rural electrification so we have to coordinate and give input where necessary.

(Consultant) Question: The communities around the proposed Ndugutu and Sindila mini hydropower stations were tasking the developer to give them power and yet am told the community have to contribute 30% and the 70% is met by REA. Supposing the community are not in position to raise the 30%, can REA come in to foot all the 100% costs for delivering power to the communities surrounding these power plants?

Response: If the people work close with us, we can be able to put it in our plan. The Developer can work closely with us and we factor that in our planning.

(Consultant) Question: who will manage the operations of power distribution and charges?

Response: Since there is no UMEME in Bundibugyo, this cabbe treated like other projects we have done. We simply license another operator or UMEME if its interested or UEDCL. However for us to come, there should be potential consumers of services to boost such as schools, health centres, trading centers and others. If such infrastructure is in the project area, then it can be a starting point to justify rural electrification activities in such areas.

(Consultant) Question: Having learnt some lessons from other operating mini hydropower stations in the country so far, what are some of the key issues you think the Design, Feasibility andEIA team should consider at this stage of planning for the proposed Ndugutu and Sindila power stations?

Response: The most important thing is to have a reliable feasibility study undertaken in terms of hydrological characteristics, water flow and others. The most important question to raise should be; Can the water sustain the project? The study should be in-depth in terms of hydrology and catchment characteristics such that once we go into power generation, its sustainable economically instead of having to run one season and the other we shut down because there isn't enough water.

Final remarks:
Response: We need to be involved from the beginning. We need to know that there is this coming project such that we can plan together other than coming to us later when we are at different stage state of financial year.

Consultative meeting with the officials from Directorate of Water Management (DWRM)

Place and date held	30th/April/ 2012, REA Head Offices, Kampala
Present	Tumusiime Alfred (EIA Consultant) Paul Ayella, Senior Water Officer in charge of Hydraulic works and Reservoir Regulation
Purpose	To obtain technical and social economic input into the environmental impact assessment process for the proposed Ndugutu and Sindila mini hydropower projects in Bundibugyo district.

Issues and responses

(Consultant) Question: Do you know about Butama Hydro-Electricity Company Ltd?

Response: I have not heard about them especially on feasibility. You may have to advise them to interphase with us especially to avoid coming when they have finished.

(Consultant) Question: Having learnt some lessons from other operating mini hydropower stations in the country so far, what are some of the key issues you think the Design, Feasibility and EIA team should consider at this stage of planning for the proposed Ndugutu and Sindila power stations?

Response: The design discharge has always been taken when its not sustainable. Most of the existing mini hydropower stations have been over designed. This is one of the biggest concern. For example Mpanga Mini hydro which was designed for 18MW was generating 3.5MW when it was visited by the Asst. Commissioner Water Use planning and recently when I visited it, it was generating 1.5MW. Tronder Power operating Bugoye Mini Hydropower station in Kasese is suffering the same situation. It has become a chronic disease. We now need to start scrutinizing these feasibility studies.

There is need to discuss the hydrology of these rivers well. Hydropower needs to be designed with a high reliability of the hydrology. They need to send us an advance copy of the feasibility study report because oif they present it at the time of seeking for construction permit, they may face stiff resistance at that stage. Therefore its better we discuss the feasibility study with them at an early stage and agree on certain issues to avoid delays later.

Other concerns;

- The earth works should not end up in the river.
- We cant issue construction permit unless the EIA has been approved by NEMA.
- I also hope that site being close to Democratic Republic of Congo does not raise trans boundary issues like the Nyaga Mini Hydro has caused.

List of Governmental officers consulted

No	Name	Designation	Institution
1	Caroline Aguti	Environment Officer	Ministry of Energy and Mineral Development
2	Peter Kityo	Environment Officer	Electricity Regulatory Authority
	Peter Kakeeto	Projects Engineer	Electricity Regulatory Authority
3	John Othieno	Environment Officer	Uganda Electricity Transmission Company
4	Nelson Abit	Conservator- Ethnography	Uganda Museum
5	Sarah Musalizi	Conservator- Cultural Heritage	Uganda Museum
6	Maggie M Kyomukama)	Ass. Commissioner Gender and Women Affairs	Ministry of Gender, Labour and Social Development
7	Mr.MaateJockus	District Environment Officer	Bundibugyo District
8	Mr.OleghaSizaTevin)	CDO, Water and Sanitation (Wash)	Bundibugyo District
9	KatusiimeAgness	District Community Development Officer	Bundibugyo District
10	Herbert Oule	Environment Officer	Rural Electrification Agency
11	Twinimujuni Jackson	Ass. Commissioner, Water Use Planning	Directorate of Water Resources Management
12	Ayella Paul	Senior Water Officer in charge of Hydraulic works and Reservoir Regulation	Directorate of Water Resources Management
13	Tibemanya Jolly	Chairman LC V Bundibugyo District	Bundibugyo District Office
14	MbalibulhaBaluku Godfrey	Vice Chairman LC V Bundibugyo District	Bundibugyo District Office
15	Omulangiro David Awrago	CAO,	Bundibugyo District Office
16	Nsubuga Hood	Deputy CAO,	Bundibugyo District Office
17	Charles Mwesige	District Planner,	Bundibugyo District Office
18	Mbusa Daniel	LC III C/Person Sindila S/C	
19	Kalinda Iriya	LC I C/Person Bunyamwera	
20	Thembo John	LC I C/Person Ntuma	
21	Bwambale William	LC I C/Person Kaghughu	
22	Baluku John	LC I C/Person Musili	
23	Kihetha Benifasi	LC I C/Person Kabwe	
24	Josefu Mapali	LC I C/Person	
25	Bwambale Shem	Councillor, LC II Ntuma	
26	Musumba Arkwrichi	LC II C/Person Bunyamwera	

Consultation with Uganda Wildlife Authority (UWA), on May 31st 2014 at the UWA Offices-(Ranger's Office).

Consultants Present;
Dr Sally A. Lahm-(Ecology Consultant, Atacama Consulting Ltd)
Rhoda Nankabirwa- (Senior Consultant, Atacama Consulting Ltd)
Sarah Kasande- (Consultant, Atacama Consulting Ltd)
Eva Namutebi- (Consultant, Atacama Consulting Ltd)

Park ranger UWA– Bundibugyo (Mr. Maate M. Joseph)

What are the common animals in the Project Impact Area?	The animals in the project Area include the following; • black and white colobus monkeys, • blue monkeys • Rwenzori colobus • Common baboon in communities
Are there any community programmes in the area that should be taken note of?	World Wildlife Fund (WWF) in collaboration with RMNP is sensitizing communities on the importance of the tree planting. RMNP is also involved in an agricultural terracing project.
The Rwenzori Mountain National Park has no buffer zone, how are the intrusions by community members handled?	The boundary of Rwenzori Mountain National Park is made up of eucalyptus trees and the communities are aware of this boundary and on the other note in order to access the park community members are awarded user permits to obtain medicinal plants and bamboo, mushrooms, plant fibres, fuel wood, medicinal plants and other plant materials within an 'Integrated Use Zone' of 3km inside the national park boundary. These can be renewed if they are respected
Will this project have any impacts on the park?	Since the project foot print is outside the park, the project might have no impact on the Rwenzori Mountains National Park, therefore there will be no problem with the proposed project. The park management will also make a survey of the project and assess the impact of the project on the RMNP.

Attendance register

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	BUTAMA HYDRO-ELETRICITY COMPANY LIMITED
PROJECT	NDUGUTU & SINDILA MINI HYDRO POWER
DATE	31/05/19
VENUE	UWA OFFICES - (RANGER'S OFFICE HARUGALI)
TIME STARTED	0830 am
TIME ENDED	0900 am

Name	occupation	Contact Details			Signature
		Address	Telephone	Email	
Eva Namulebi	Environmental Consultant		0759466935	joan.phila@gmail.com	namulebi.
Maafe M. Joseph	Park Ranger	R.M.P.E Bugiri	~~0771641720~~		
Sarah Kasande	Environmet Consultant	Kampala	0771685589	sarah.kasande@atacama.co.ug	
Sally LAHM	Environmental Consultant	United States		Sallyalahm@gmail.com	Sally Lahm
Rhoda Nankabirwa	"	Kampala	0703892239	rhodanankabirwa@atacama.co.ug	Rhoda

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR Infrastructure and Butama Hydro.
PROJECT	SINDILA AND NDUGUTU SHPP
DATE	08/12/2014
VENUE	KAGUGU P/S
TIME STARTED	03:00 PM
TIME ENDED	04:23 PM

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
45	MUSOKI	PEARENT	B/MWE	—	—	M.
46	THEMBO MUS	〃	〃			[illegible]
47	masereka	Jeremah	kagugu	—	—	[illegible]
48	KULE SEDRACK musokoto Kabugho	JOY				S.M.
49	ETENGUTA ERINOT	PEARENT	Kagugu	—	—	K.:
50	Biira Joice	FAMER	〃	—	—	B.J
51	Biira Ronda	FAMER	〃	—	—	B.R.
52	KAbugho JENETI	FAMer	〃	—	—	K.J
53	Biira Joice	Famer	Kagugu	—	—	B.J
54	Biira Fausi	FAMER	Kagugu	—	—	B.F
55	MBAmbu Suzana	Famer	B/Mwe	—	—	M.S
56	Biira Ziporah	FAMer	B/Mwe	—	—	B.Z
57	Muhindo [illegible]	FAMer	B/ Mwere	—	—	[illegible]
58	KyAKINWE Forde	FAMer	B/ Mwere	—	—	K.
59	KAbugho Anet	FAMer	KABWE	—	—	K.A
60	Muhindo Roret	F	KABWE	—	—	M.R
61	Isabayanda Joas		B/mwera	0783519201	—	[illegible]

Details of consultation with potentially affected women, widows and female headed households; a special section of PAPs, on 08th December 2014 at Kaghughu Primary School

Minutes

Comments	Response
During the proposed project first surveys most of our crops were destroyed and it's now four years, we never received any kind of compensation. We have many children to take care of and most of our husbands left us and married other women.	All the affected crops and properties recorded in the valuation report will be compensated for by the project developer before the implementation.
Most of us have 6-8 children to take care of and some are studying but we do not have enough money to support them. If it is possible for the project developer to give us an upper hand so we can take our children to school it will better.	Noted.
Some of our husbands left us with no where to stay and now we have no houses where we can be with our children, if it's possible for the project developer to help some of us especially the widows and construct for us some small houses were we can be with our children, we shall be happy.	Noted.
During the first land survey and valuation some crops like cassava and groundnuts which were destroyed, will the project contractor compensate those people who were affected.	All the affected crops and properties recorded in the valuation report will be compensated for by the project developer before the implementation.

Meeting photos

Attendance register

Consultation with Sindila and Ndugutu women, widows and women headed families heads.

STAKEHOLDER CONSULTATION REGISTER

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	Sindila and Ndugutu
DATE	08/12/2014
VENUE	Kagugu Primary School
TIME STARTED	16:31
TIME ENDED	17:15

	Name	occupation	Contact Details			Signature
			Address	Telephone	Email	
1	Mbambu Jerusha	Farmer	Bunyamera	~~075~~ —	Window.	M.J.
2	Kabugho Jessica	Farmer	Bunyamera	0773477936	Window	K.J
3	Ekanisi Kalinda	Farmer	Bunyamera	—	With husband	E.K
4	Biira Lakot	Farmer	Bunyamera	—	Window	B.V.
5	Mbambu Susan.	Farmer	Bunyamera	—	With husband	M.S.
6	Nasiko Lakori	Farmer	~~Kabowe~~ Bunyamera	—	With husband	M.L.
7	Biira Susan	Farmer	Kabowe	—	With husband	B.S.
8	Biira Zipora	farmer	Bunyamera	—	With husband	B.Z
9	Fausi Biira	farmer	Kaghughu	—	Window	F.B
10	Biira Joice	farmer	Kaghughu	—	have husband	B.J
11	Kabugho janet	farmer	Kaghughu	—	has husband	K.J
12	Kabugho Rutena	farmer	Kabowa	—	Window	K.R.
13	Biira Joice	Nyasili	farmer	—	has husband	B.J.
14	RODA MUSEKOLO	Kaghughu	farmer	—	has ahusband	R.M.
15	Elizabeth Kabugho	Kabowa	farmer	—	Window	E.K.
16	Kabugho Joyce	Kabowe	farmer	—	Single	K.J.
17	Kabugho Jenafer	~~Bunyamera~~ farmer	Bunyamera	—	Single	K.J.
18	Biira Scovia	farmer	Kabowe	—	With a husband	B.S.

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	Sindila and Adugutu
DATE	08/12/2014
VENUE	Kaguga Primary School
TIME STARTED	16:31
TIME ENDED	17:15

	Name	occupation	Contact Details			Signature
			Address	Telephone	Email	
19	Kabagho Annet	farmer	Kabawe	—	with ahusband	K-A.
20	Kabagho Alleni	farmer	Kaghugh	—	with ahusband	K-A.
21	Katusiimwe Zunet	farmer	Bunyamera	—	with ahesband	K-Z.
22	Kabagho Kayagani	farmer	Bunyamera	—	With ahusband	K-K.
23	Kabagho Silvia	farmer	Bunyamera	—	With ahusband	K-S
24	Mbaka Alleni	farmer	Kabawe	—	With ahusband	M-A.
25	Barnabas Busheshe	Consultant	Atacama	0774694495	Barnabasbusheshe@atacama.co.ug	
26	Tonney Ssemmanda	Consultant	Atacama	0783148109	tonneyssemmanda@atacama.co.ug	

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	Sindila and Nduguta
DATE	08/12/2014
VENUE	Kagugu Primary School
TIME STARTED	16:31
TIME ENDED	17:15

	Name	occupation	Contact Details			Signature
			Address	Telephone	Email	
27	MASIKA ROSE		KABUGE			~~Rmka~~ K.F
28	KYAKIMWA FOROLANCE		KABUGE			
29	Mukundo Rose		〃			M.R
30	Biira Scovia		KABUGE			B.S
31	KABUGHO ANNET		〃			K.A
32	KABUGHO SILVIA					

Details of consultation with owners of potentially affected structures (schools and churches), on 08th December 2014 at Kaghughu Primary School
Minutes

Comments	Response
Bunyamwera Nursery School was funded by the government, we took the responsibility of looking for the land and we constructed that structure. All the community members are using that structure and our children will continuously use that structure. We want cash compensation and build another school somewhere else	All the affected structures within the project area of influence will be restored or replaced to similar or at last condition depending on the owner's wishes.
Ntuma nNursery School has four classes, we are requesting some support so that we can upgrade the school and we also need cash compensation to construct ourselves a new school. The school does not have more land but we can identify the land within our community so we construct a new and good school because the government also gave us the money for construction and we also identified the land which can also be done this time around.	Noted.
For Kabwe Nursery School, the community members received money from the government, identified the land and constructed the school. We want cash compensation so we can construct the school somewhere else. There is also a pit latrine at that school which was also constructed by the government hope that will be compensated for as well.	All structures will be compensated for including the pit latrine.
During the first survey we were constructing the Kawu cChurch of Uganda and we were told to stop construction because the proposed access road will pass at the church. The project developer promised to construct for us a new and good church but we are still waiting.	Before the construction phase of the project, the developer will construct another church to replace the existing one.

Meeting photos

Attendance register

Consultation with leaders of Institutions.

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMA Infrastructure and Butamira Hydro.
PROJECT	Sindila and Ayago SHPP
DATE	08/12/2014
VENUE	Kagugu Primary School.
TIME STARTED	17:20
TIME ENDED	17:50

	Name	occupation	Contact Details			Signature
			Address	Telephone	Email	
1	KULE SHEM	C/Person ECE	BUNYAMWERA	0777305138	B/mwera Nursary	
2	Themso John	Secretary ECI	NTUMA	—	NTUMA C.O.U.	T.J
3	Bangenyire Zepho	C/person ECD	Kabwe	—	Kabwe nursery S.	
4	KIHEMBA BENEFASI	C/Person Peterest.	Kabwe	—	Kabwe Peterest Church	K.B
5	Muhindo Samuson.	C/person. NTUMA NS	NTUMA	0782952631	NTUMA NURSERY School	Samuson
6	Sunday Muchimwe	C/Person Sunday Schoo	Bunyamwera	—	Bunyamwera C.O.U	S.M
	KASUNDI WALIGO	C/man LAND	KABWE	—	Bunyamwera C.O.U	
7	Kule JUSTUS	C/Person Nursary	KABWE	0783419715	Kabwe Nursary SE	KJ
8	KASUNDI ISAIAH	SEC BUNYAMWERA COU	BUNYAMWERA	0773686634	BUNYAMWERA COU	
9	Yokonia BUKUCHOKA	C/Person Kagwagwa	Kagwagwa	—	Kagwagwa C.O.U	Y.B.
10	Isyabayamba Joas	Youth leader C.O.U	Bunyamwera	—	Bunyamwera C.O.U	

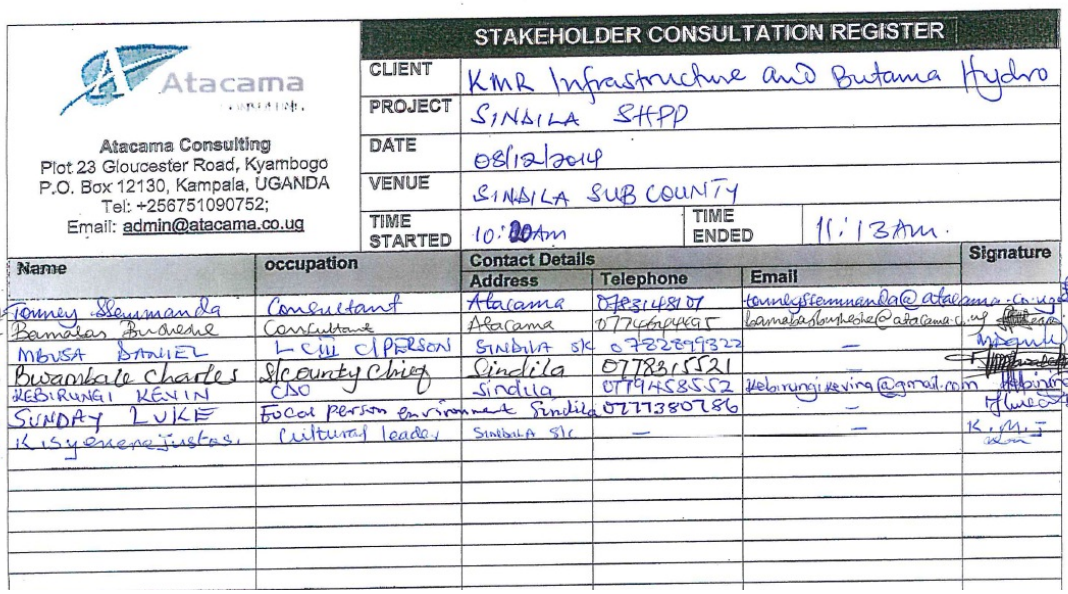
Details of consultation with Sindila Sub-county Technical Planning Committee, on 08th December 2014 at Sindila Sub-county Headquarters
Minutes

Comments	Response
There is a group of people who came on site at a previous time for a drilling exercise around the powerhouse.	Noted. Those were undertaking some of the assessments.
Initially the proposed Sindila and Ndugutu MHPs were managed by the Sri Lankans but now we had that Americans took over from the Sri Lankans, could you please clarify on who is handling these proposed projects?	The Sri Lankans are still the financiers of the proposed Sindila and Ndugutu MHPs but they are working together with other companies which are going to support these projects. In particular, KMR Infrastructure, a Sri- Lankan firm will support Butama Hydro, a local firm based in Uganda in developing the proposed hydropower project.
During the construction phase of the proposed project we expect some of our people to be employed by the project.	During the construction phase of Sindila and Ndugutu MHP projects the first priority will be given to the local people especially the semi and none skilled jobs.
We also expect improvement of our schools, health centers and roads especially the bridges on Ndugutu and Sindila rivers.	Some of the roads within the project area of influence will be improved during the project construction and as part of the corporate social responsibility. Other infrastructure like schools and health centers might also be worked on.
Last time there was a big challenge with the land and valuation survey, the distance left between project structures and people's houses was very small hence people were too close to some of the proposed project structures. There is need to revise the land survey and update the valuation report because people will be affected during the construction phase of the project.	During the first land and valuation survey 6 and 4 meters from the project structures to people's houses had been left especially the access road but due to the change in the project design those meters were increased from 6 and 4 meters to 10 meters. The valuation report is being updated and will be incorporated in the updated RAP report.
Initially we were told that it is the government that will distribute the electricity so we are requesting that the power line pass through Sindila Sub-county so that people can have access to electricity because the proposed power line is out of the Sub-county.	The electricity will first be connected to the national grid before the government starts distributing it within the Sub-county.
Initially the drainage systems were not considered so we are requesting that the drainage systems be considered because some people will be affected.	Noted.
After the project construction phase, the amount of water in the rivers will reduce and also water might be contaminated during the construction phase so we need to have a solution for this problem because it will affect some people who use water from the rivers.	The Environmental and Social Impact Statement (ESIS) contains all the management plans pertinent to the project impacts including the impacts on water.
There is a cultural site above the proposed Sindila MHP weir which is of high importance to the community; there is fear that it might be disrupted/destroyed during	Noted.

the project construction phase, so we are requesting the project contractor to put that into consideration during the project construction phase.	
Some of the affected people are trying to register their land but they have not got the certificate(s) - everything is still at the district.	All the affected persons will be compensated for the loss whether they have land certificate or not so long as they have the proof of the land ownership. Note that four types of land ownership categories are recognised in Uganda and one of them, cutomary ownership does not necessitate a certificate of ownership although having it is preferred.
We are requesting that the graves that will be affected by the project be fully compensated so that people can relocate them to other places.	All properties that will be affected by the project will be compensated for including the graves.
In case of any land grievances in the village it is handled by village LC1 first, if the LC1 cannot solve the case he/she can send the case to LC2 (Parish). In case the LC2 also fails then the case is referred to the Sub-county. If the Sub-county land committee also fails to handle the grievance, it can be forwarded to the district land board for more investigations, once the district land board also fails to handle or settle the grievance then it is forwarded to the courts of law.	Noted.

Meeting photos

Attendance register



Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	SINDILA SHPP
DATE	08/12/2014
VENUE	SINDILA SUB COUNTY
TIME STARTED	10:20Am
TIME ENDED	11:13Am.

	Name	occupation	Contact Details			Signature
			Address	Telephone	Email	
1	Tonney Ssemmanda	Consultant	Atacama	0783145807	tonneyssemmanda@atacama.co.ug	
2	Bamolas Bwambale	Consultant	Atacama	0774694495	bamolasbwambale@atacama.co.ug	
3	MBUSA DANIEL	L C III C/PERSON	SINDILA S/C	0782849322	—	
4	Bwambale charles	S/C county Chief	Sindila	0778315521	—	
5	KEBIRUNGI KEVIN	CSO	Sindila	0779458552	kebirungikevin@gmail.com	
6	SUNDAY LUKE	Focal Person environment	Sindila	0773380786	—	
7	Kisyeneenejustas.	Cultural leader	SINDILA S/C	—	—	

Details of consultation with the Rwenzururu Cultural Leader, on 08th December 2014 at Sindila Sub-county Headquarters
Minutes

Comments	Response
The Rwenzururu Kingdom has Chiefdoms and in case of anything related to their culture, it's good to inform the Cultural Leader before any activity takes place. The Cultural Leaders are from the Bunyagule family.	Noted.
The cultural site is 2km away from the proposed Sindila MHP weir but this should not be disrupted/ destroyed during the construction phase of the project. The project contractor has to make sure that people still have access to that site during the construction and operation phase of the proposed project.	Noted.
There are some graves of the Rwenzururu ancestors and small gods at the cultural site and people make rituals and sacrifices every year. The major interest of people is to leave the site where it is hence people have continued access to that site.	Noted.

Meeting photos

Attendance register

Atacama Consulting Plot 23 Gloucester Road, Kyambogo P.O. Box 12130, Kampala, UGANDA Tel: +256751090752; Email: admin@atacama.co.ug	**STAKEHOLDER CONSULTATION REGISTER**
CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	SINDILA SHPP
DATE	08/12/2014
VENUE	SINDILA SUB COUNTY
TIME STARTED	10:[illegible]Am
TIME ENDED	11:13Am.

	Name	occupation	Contact Details: Address	Contact Details: Telephone	Contact Details: Email	Signature
1	Tonney Ssemmanda	Consultant	Atacama	0783148107	tonneyssemmanda@atacama.co.ug	
2	Bamalas Buheshe	Consultant	Atacama	0774694495	bamalasbuheshe@atacama.co.ug	
3	MBUSA DANIEL	LCIII C/PERSON	SINDILA S/C	0782899322	—	
4	Bwambale charles	S/county chief	Sindila	0778315521	—	
5	KEBIRUNGI KEVIN	CDO	Sindila	0779458552	kebirungikevin@gmail.com	
6	SUNDAY LUKE	Focal person environment	Sindila	0771380786	—	
7	Kisyenene Justus.	Cultural leader	SINDILA S/C	—	—	K.M.J

Details of consultation with Bunyagule Catholic church leaders, on 09th December 2014 at Sindila Sub-county Headquarters

Minutes

Comments	Response
There is a group of people who are moving around with some local people but they do not tell us what they are going to do on the church land.	The church land will be affected by the proposed access road heading to the proposed Sindila power house and other project structures.
That proposed access road to the proposed Sindila power is too close to the church and its exposing risks to the people.	There is a change in the design of the project and the project will have to consider other alternatives to avoid the church if this is not possible the church will be relocated to another place.
Relocating the church is not a problem and leaving it there is not also a problem but what we want is to have a place where our people can go for prayers.	Noted.
Initially we were confused about the project because we were not aware of what was going to be done on our land that's why the church leaders refused to sign the memorandum of understanding with the project developer.	The church land will be affected by proposed access road heading to the proposed Sindila power house and other project structures.
Giving cash compensation is risky so we are requesting the project developer to construct for us a new church in case it is going to be affected by the proposed project activities.	Noted.
Initially we were not involved in the project by the first people who came on ground but from today on wards we want to be engaged and work together in all the project activities.	The project developer will keep all the stakeholders informed of the planned project activities all stages.
The church has a large amount of land, so in case the church is going to be affected by the proposed project, the developer can build another church on that land, though it is rocky. If the project developer can blast the rocks, then it can be possible.	Noted.
Initially we were intimidated by a certain group of people that the church will be destroyed without any kind of compensation because this is a government project and church leaders cannot stop it.	The project developer will keep on working close with all stakeholders including the Bunyangule Catholic church leaders and all structures to be affected by the project will be compensated for before the proposed project activities commence.
We are requesting the project developer if it is possible to construct for us a bridge on Sindila river because during the rainy season it becomes hard for people to cross the river and we also need to have an alternative road.	Noted.

Meeting photos

Attendance register

Meeting with leaders of Bunyangule Catholic Church along the proposed access road for Sindila SHPP.

STAKEHOLDER CONSULTATION REGISTER

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	SINDILA SHPP
DATE	09/12/2014
VENUE	SINDILA SUBCOUNTY
TIME STARTED	09:41 Am.
TIME ENDED	10:32 Am.

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
1	Tonney Ssemmanda	Consultant	Atacama	0783148107	tonneyssemmanda@atacama.co.ug	[signature]
2	Barnabas Bushere	Consultant	Atacama	0774644495	barnabasbushere@atacama.co.ug	[signature]
3	BAKASIIMA TADEO	Chairperson Bujulube	Sindila S/C	0775642861		[signature]
4	Tadeo Bwambale	Catechist	Sindila s/c	0775460616		[signature]
5	BYAMAKA NYANSO	secretary	"	0774686710		[signature]
6	KIBAMBA JACKSON	Sec. social Action	Bunyangule	0772642444		[signature]

Details of consultation with potentially affected elders and orphans (some of the identified vulnerable groups within PAPs), on 08th December 2014 at Kaghughu Primary School

Minutes

Comments	Response
Most of the elders want cash compensation and then buy land somewhere else or build for themselves in case someone's house is affected by the proposed project.	Noted.
There are some groups of the elderly within the community (like Bunyangule young and elderly FAL class group etc.) but some elders are not registered with those groups.	All affected people will be treated equally whether they have a group or not. However, it is better to have you organised in groups.
All elders do not have bank accounts hence they will need to open up bank accounts before compensation.	The project contractor will work together with all affected persons including those with no bank accounts and also help them in the process of opening bank accounts before compensation.
Some of the elders have orphans they are taking care of and they need extra support in terms of school fees because some are still studying.	The project developer will compensate all PAPS but as part of corporate social responsibility, school fees that might also be worked upon during the implementation of the proposed project.
There is one person with a physical disability, his land will also be affected by the proposed project access road and he wants cash compensation to buy another piece of land to replace that which will be affected by the proposed project.	Noted.

Meeting photos

Attendance register

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR Infrastructure and Butama Hydro.		
PROJECT	Sindila and Ndugutu SHPP.		
DATE	09/12/2014.		
VENUE	Kagugu primary School.		
TIME STARTED	12:00.	TIME ENDED	12:40.

Name	occupation	Contact Details			Signature
		Address	Telephone	Email	
MULIMULA JACKLINE		Old			
KABUGHO ELIZABETH		old with orpans			
KABUGHO EVANISI RUTEWA		old with orpans			
BWAMBALE GEORGE		old with orpans			
BAKAMA JOAL		orpan			
yohana mubindo		old			
BALUKU MULYANDASU		orpan			
YOKANIA BWAMBACHI		~~orpan~~old			
YOKANIA BUKIDIKA		old			
YOHANA MUSANANA		old			
BALUKU MUSA		old			
IHUNGU HARIET		orphan			
BURA EVARETI		orphan			
MUSA BULUMBA		orpan			
KULE RICHARD		old			
BWAMBALE WILLIAM		old			
KIHANGA JOHN		old.			
EVANISI KASAIJA					

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR Infrastructure and Butama Hydro
PROJECT	Sindila and Nduguta SHPP.
DATE	09/12/2014
VENUE	Kagugu primary School.
TIME STARTED	12:50
TIME ENDED	12:40.

Name	occupation	Contact Details			Signature
		Address	Telephone	Email	
GRACE BURA		Old			
SITONIYA KYAKIMWA		Old			
BURA REGINA		Orpan			
ERISA PAGHANI		Old with orpan			
KYAKIMWA JOROLINA		Old			
MUSUMBA SADRUCK		Old			
KASUNDI ISAYA		Old with orpan			K. I
Paghani YEREMA		Old Man only			
Tereura MBamba		Old			

Details of the public hearing for Sindila MHP

Call for the meeting

Box 1

The notice for the public hearing below was published in New Vision, Uganda's National news paper, and Daily Monitor, one of the widely circulated private news papers in Uganda on Tuesday 9th December 2014. This was in fulfillment of the national requirements for Electricity (Application for permit, License and Tariff Review) Regulations, 2007; Section 8 (1) of these regulations states that "The Authority shall, within forty days after receipt of a complete application for a licence, cause a notice of the application to be published in the Gazette and in at least one national newspaper of wide circulation in Uganda. Section 8(2) that follows states the contents of such a publication.

English is the official language for Uganda and all the widely circulated news papers including the National news paper are in English, thus, the notice was in English; however, to ensure that the local stakeholders including PAPs who might not have access to the newspapers or only understand the local language are fully informed of the public hearing, the call for the public hearing was also announced three times on each of the two local radio stations based in Bundibugyo District (Development FM and UBC- Bundibugyo) in a local language, Rukonjo.

Public notice

ELECTRICITY REGULATORY AUTHORITY

Plot 15 Shimoni Road, Nakasero, P.O. Box 10332, Kampala
Tel: +256 414 341 852, +256 757 341 646 Fax: +256 414 341 624
Email: info@era.or.ug, Web: www.era.or.ug

NOTICE OF PUBLIC HEARING

(Under Regulation 18 (2) of the Electricity (Application for Permit, License and Tariff Review) Regulations, 2007)

The general public is hereby requested to **TAKE NOTICE** that the Electricity Regulatory Authority shall on the **16th day of December 2014** hold a Public Hearing regarding the Application for a License for the Generation and Sale of **5.46 MW** of electricity from a hydropower plant proposed to be established across **Rivers Ndugutu** and **Sindila** in **Bundibugyo District.**

The Hearing shall be held at **Kagugu Primary School, Bunyamwera Village, Bundibugyo District** starting at **10:00a.m.**

Government agencies, Electricity sector stakeholders and persons affected by the application are hereby invited to attend the Public Hearing.

Directly affected parties and all stakeholders wishing to make presentations may register with the Secretary to the Authority not later than the 15th day of December 2014. The Secretary may be reached through the following address:

The Secretary
Electricity Regulatory Authority
ERA House, Plot 15
Shimoni Road, Nakasero
P.O. Box 10332, Kampala
Tel: +256 414 341 852, +256 757 341 646
Fax: +256 414 341 624
Email: info@era.or.ug

Minutes of the public hearing

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road,
Kyambogo.
P.O. Box 12130, Kampala,

CLIENT	KMR Infrastructure
PROJECT	Proposed Sindila MHP
DATE	16th December 2014

UGANDA. Tel: +256751090752; Email: admin@atacama.co.ug	**VENUE**	Bulimba Primary School		
	TIME STARTED	10:00 am	**TIME ENDED**	13:37 pm

Agenda

1. Opening prayer
2. Opening remarks by the LC I Chairperson
3. Opening remarks by the Presiding Officer
4. Presentation from Electricity Regulatory Authority (ERA)
5. Presentation from the Developer and the consultant
6. Remarks from the LC III Chairperson
7. Remarks from the Resident District Commissioner (RDC) of Bundibugyo District
8. Remarks from the Gombolola Internal Security Officer (GISO)
9. Discussion (Questions and Answers)
10. Closing remarks by the Presiding Officer
11. Departure

Minute 1: Opening prayer

The Presiding Officer requested a volunteer to lead in the opening prayer. After the opening prayer, Mr. Robert Baluku, one of the community members who understands both English (official language for Uganda) and Rukonjo (local language spoken in the project area of influence) was selected as the translator of the day.

Minute 2: Opening remarks by the LC I Chairperson

Mr. John Baluku, the LC I Chairperson of Musili Village welcomed everyone to the meeting and noted that security was guaranteed. In his opening remarks, he acknowledged that it was not his first time to hear about the proposed Sindila MHP.

Minute 3: Opening remarks by the Presiding Officer

The Presiding Officer greeted the attendees and made an apology for the Chief Executive Officer (CEO) of ERA who was unable to attend and whom she was representing. She then introduced the Developer to the attendees. In her remarks, she noted that the Developer, Butama Hydro Electricity Company Limited, attracted a financier, KMR Infrastructure, who was going to contribute towards development of the proposed Sindila MHP.

She also noted that the main purpose of the public hearing was to ensure that all the Project Affected Persons (PAPs) had been consulted and their views put into consideration, potentially affected people are assured of compensation and measures have been put in place to ensure that all the potential negative impacts will be minimised before a power generation license is granted to the developer.

Minute 4: Presentation from ERA

After the Presiding Officer's opening remarks, she requested one of her team members to give a brief introduction of ERA and its role in the power sector of Uganda.

In this presentation, the disbandment of Uganda Electricity Board was elaborated and noted that this was done to ease management and improve efficiency in the power sector. The rights of power consumers were also highlighted.

Minute 5: Presentation from the Developer and the consultant

A representative of the Developer, Vy Manthripragada, gave a brief description of the proposed Sindila MHP. In her presentation, she noted that the project footprint has been increased to ensure that all potentially affected property is compensated for and that the valuation report was being updated to put this into consideration.

She noted that all measures have been put in place to ensure that physical resettlement of the PAPs is avoided.

Her presentation was supported by the Environmental and Social Consultant who noted that a detailed Environmental and Social Impact Statement (ESIS) has been prepared to ensure that all the potential environmental and social impacts are minimised. She also noted that an originally prepared Resettlement Action Plan (RAP) is being updated and will be ready before the end of January 2015.

She further noted that there will be an on-site complaint's register at the time of implementing the project where complaints will be registered and investigated. She noted

that a grievance management committee comprising of some of the PAPs, local leaders and developer's representatives will be formulated mainly to handle grievances if any.

In her conclusion, the Consultant noted that this is the PAPs' and other stakeholders' opportunity to raise any outstanding issues related to the proposed project.

Minute 6: Remarks from the LC III Chairperson of Sindila Sub-county

The LC III Chairperson of Sindila Sub-county, Mr. Daniel Mbusa welcomed everyone to the public hearing. In his remarks, he noted that as a sub-county, they support the project and that they are willing to work with the Developer as much as possible to ensure its success.

He also noted that Sindila Sub-county has a number of challenges which include lack of safe water, inadequate health facilities, poor quality schools in terms of structures and other support infrastructure, and a poor road network. In particular, he noted that Bunyamwera Parish recently received an aid post which is currently operating under private arrangement and still needs support. He, therefore, requested the Developer to help them in overcoming these challenges as part of their corporate social responsibility.

He also emphasised the need for a fair compensation of all the PAPs. In addition, he noted that when recruiting unskilled and semi-skilled labour at the time of implementing the proposed project, the first priority should be given to the local people and in particular PAPs.

He also requested the Developer to formulate a committee which will be on ground at the time of developing the proposed Sindila MHP mainly for monitoring and handling grievances.

In his concluding remarks, he assured the local people that Rural Electrification Agency (REA) will coordinate the distribution of power to the local community members once generated.

Minute 6: Remarks from the RDC of Bundibugyo District

The RDC of Bundibugyo District, Mr. Elias Nuwagaba, welcomed everyone to the meeting and assured them of safety. In his remarks, he noted that the government and district leadership in particular fully support the proposed Sindila MHP. He also noted that the people of Bundibugyo District will have priority for power connection once generated before being transmitted to other areas.

He also noted that he needs copies of the ESIS and RAP in his office to ensure that what is stated in the respective documents is done. He expressed his dissatisfaction with developers who do not fully compensate all the PAPs citing those of the recently completed road as an example. He stated that there is a national law governing compensation and that this should be observed at all times.

He also noted that the people of Bundibugyo District are very lucky and should start strategising for positive utilisation of the power once generated, he urged them to cooperate.

He restrained any locals from participating in stealing of the construction materials.

He also noted that he had observed that the area is currently becoming bare and recommended tree planting as one of the mitigation measures.

He noted that there is need to have corporate social responsibility hinting on the challenges earlier highlighted by the LC III Chairperson of Sindila Sub-county.

Minute 6: Remarks from the GISO of Sindila Sub-county

The GISO, Mr. Robert Tumusiime, welcomed everyone to the public hearing. In his remarks, he restrained the local people from participating in stealing of machines and other construction materials once the project kicks off, he noted that culprits if any will be dealt with in accordance with the law.

Minute 7: Discussion (Questions and Answers)

After all the above presentations and remarks, the Presiding Officer opened the discussion session and requested the attendees to ask questions.

No.	Question	Response

1	How will the people up the hill get power? The possibility of establishing a substation has not been mentioned.	As of now, the focus is on generation of power, distribution and connection of power to local people's homes will be looked at a later stage. In particular, connection of local people will be coordinated by REA.
2	Is there an option of land for land compensation?	Yes, this is the preferred option especially for vulnerable households and PAPs who will lose much of their land.
3	There has been a change of the Developer from former Sri-Lankan to KMR Infrastructure. Will the new Developer propose new changes especially along the access roads and penstock?	Some modifications have already been made and the strip map updated, the valuation report will be updated in January to cater for the new changes in land take and loss of property.
4	The survey has been done twice. During the first survey and in particular for the access road, the surveyors were marking 4m in some sections and 8m in other sections, will this be considered.	The survey has been repeated and the strip map showing all the potential land take updated, this is presented in the RAP.
5	The former surveyors destroyed some crops while doing their work, will compensation for those be made?	If there is enough evidence to confirm that property was lost as a result of the surveys for example authentic documentation confirming this, those will be compensated. However, note that while carrying some studies, minor damages may be accidentally caused which may not attract compensation.
6	When is compensation going to be made? Some members came expecting compensation.	This will be done early next year, possibly in the months of February and March.
7	Shall the people of Ndugutu Sub-county benefit from this power?	Yes, note that some benefits are crosscutting. However, note that the Ndugutu MHP is also still under consideration and will be discussed on some other day.
8	Shall the local people benefit from electricity?	Yes. As earlier noted by the RDC, the local people should start strategising on how to positively utilizse the power, they will be connected to power through REA.
9	How shall water be protected?	All potential impacts on water have been analysed and appropriate mitigation measures recommended.
10	The access road is near some people's homes, will they remain safe?	All potential impacts related to health and safety have been discussed in Section 6 of this ESIS and appropriate mitigation measures have been recommended to minimise them.
11	Will the land of the Catholic church be taken?	Encroachment on the church's land will be avoided as much as possible, however, if the access road encroaches on part of this land, appropriate compensation will be made.

Minute 8: Closing remarks

After the discussion, the Presiding Officer made closing remarks. In her remarks, she noted the following:

1. The RAP will be updated in January 2015 to reflect the new changes;
2. The office of RDC will receive copies of the ESIS and RAP reports;
3. All the people will be compensated before the construction phase;
4. Land for a house compensation will be discussed on a case by case scenario;
5. The Developer should also consider connecting the local people to power as part of the corporate social responsibility;
6. There will be a grievance committee where issues that will arise during construction will be discussed;

7. There will be a compensation review committee which will foresee the compensation process and the vulnerable people will be protected. For married people, both couples will be required to sign the compensation forms;
8. This public hearing was for the proposed Sindila MHP, another one for the proposed Ndugutu MHP will be arranged at a later stage.

By the end of the meeting, everyone was in favour of the proposed Sindila MHP.

The public hearing was closed at 13:37 pm with a prayer lead by the head teacher of Bulimba Primary School.

Meeting photos

Attendance register

(P)

Atacama CONSULTING

Atacama Consulting
Plot 23 Gloucester Road, Kyambogo
P.O. Box 12130, Kampala, UGANDA
Tel: +256751090752;
Email: admin@atacama.co.ug

STAKEHOLDER CONSULTATION REGISTER

CLIENT	KMR INFRASTRUCTURE AND BUTAMA HYDRO		
PROJECT	SINDILA MHP		
DATE	16/12/2014		
VENUE	BULIMBA PRIMARY SCHOOL		
TIME STARTED	10:00 am	**TIME ENDED**	01:37 Pm.

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
1.	Barnabas Bushone	Consultant	Atacama	0774644495	barnabasbushone@atacama.co.ug	[signature]
2.	KITEGURA SHEM	PESANT	Kaghughu	0789131759	—	K.S.
3.	Sibitsomusa Asa	peasant	Kabwe	0789131776	—	[signature]
4.	BWAMBALE MBAKANIA	—	KABUTABURE	0787174797	—	[signature]
5.	Yayeri Kakoko	"	Butama T.C	0784563982	—	Y.K.
6.	NDOMBYA R.	"	Kaghughu	07883 2141	—	N.R.
7.	Muhindo ERICA	"	Butama	0779814940	—	M.E.
8.	Thembo John	"	Ntuma	—	—	T.J.
9.	Baluku Musa	"	Buyammbala	—	—	B.M.
10	Baluku Davide	"	Butama	0771877651	—	B.f.
11	Biira faisi	"	Kaghughu	—	—	B.f.
12	Biira Grace.	"	Ntuma	—	—	B.G.
13	Biira Roda	"	Kaghughu	—	—	B.G.
14	Maate Byagtesa	"	Ntuma	—	—	M.B.
15	Yokasi Mukitanya	"	Kyabumba	—	—	Y.M.
16	Bwambale Shem	"	Kagugu	0771078566	—	[signature]
17	John Baluku	"	Musili	0771826759	—	John
18	BIKWASO Ganafiya	"	Kabwe	0789125932		[signature]

(2)

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	PROJECT	SINDILA MHP	
	DATE	16/12/2014	
	VENUE	BULIMBA PRIMARY SCHOOL	
	TIME STARTED	10:00 am	**TIME ENDED** 01:37 Pm

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
19	Biira Yodesi	PESANT	Bunyamwera	—	—	B.Y.
20	Musumba Kandi	"	Ntuma	—	—	M.K.
21	Kule Busumba	"	Musili	—	—	K.B.
22	Mbusa Kiliho	"	Bunyamwera	—	—	M.K.
23	Maate Yozefu	"	Bunyamwera	—	—	M.Y.
24	Musumba Sedurack	"	Ntuma	—	—	[illegible]
25	Guma Dan	FOR DPC	NYAHUKA	0777299912	—	[illegible]
26	Kule Musokolo	PESANT	Kaghusha	—	—	K.M.
27	Biira Zipora	"	Bunyamwera	—	—	B.Z.
28	Baluwoneni Rughuna	"	Ntuma	—	—	B.R.
29	Mugisha Saimon	"	Kyembamba	—	—	M.S.
30	Baluku Matine	"	"	—	—	B.M.
31	Sereka Jerima	"	Kaghugha	—	—	S.J.
32	Mumbere Yonasani	"	Ntuma	—	—	M.Y.
33	Kabugho Jesita	"	Bunyamwera	—	—	K.J.
34	Maate Wilson	"	Kaghugha	—	—	M.W.
35	Thembo Rutewa	Pesant	Kaghugha	078912595N	—	T.R
36	KALINDA PHILMON	Civil Servant	Bulwera	0772455849	—	[illegible]

(8)

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	DATE	16/12/2014		
	VENUE	BULIMBA PRIMARY SCHOOL		
	TIME STARTED	10:00 am	TIME ENDED	01:37 Pm

No.	Name	occupation	Contact Details Address	Telephone	Email	Signature
37	KULE SHEM	PEASANT	Bunyamwera	0777305738	—	[signature]
38	Kule Isaleri	"	Bunyamwera	—	—	K.I.
39	Monday Aabson	peasnt	Bunyamwera	—	—	[signature]
40	BIIRA NAUME	peasnt	Bunyamwera			NAUME
41	MUHINDO WILSON	HEADTEACHER	Kaguga P.S	0789685892		[signature]
42	Kambale mabili P.	peasant	Bunyangule	0783415247		[signature]
43	Muhindo Misaki	D/LB - C/Person		0772969187	misakimuhindo@ymail.com	[signature]
44	MUSUMBA ARKWRIGHT	C/person LCII	Bunyamwera	0783351788	— —	[signature]
45	Yohana musinani	peasant	Kaghughu V.	—	—	[signature]
46	Mbumbo Jackeline		Bunyamwera	—	—	[signature]
47	Ag Bayisara Agasteri	peasent	Bunyamwera	—	—	—
48	Musumba Koronari	M. K	Bunyamwera	0772022783	—	[signature]
49	MUHINDO YOFESI	PEASANT	"	0789116057	—	[signature]
49	Bwambale George	Peasant	"	0789106931	—	[signature]
50	Sunday Mukine	peasant	Bunyamwera	0781979563	—	[signature]
51	Ngabuba Ihange B.	farmer	Butama	0782950596	[illegible]@gmail	[signature]
52	Baguma Julius	farmer	KABWE	0773960141	—	[signature]
53	SEMAKULA Kunyepa	V/Person LCI	Nkumbito	0788445684	"	[signature]

(68)

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	PROJECT	SINDILA MHP		
	DATE	16/12/2014		
	VENUE	BULIMBA PRIMARY SCHOOL		
	TIME STARTED	10:00 am	**TIME ENDED**	01:37 pm

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
54	Kyamanywa I	Famer	musalau	0785485453		K.I
55	Sisa Kajma	peasent	Bunyamwera	–	–	S.K
56	Saada mbusa	peasent	NTuma	–	–	A.M
57	Byamukam charles	P So	Bigule	078764357	–	[illegible]
58	Bwambale K. Patrick	Teacher	Bundimbuge	–	–	[illegible]
59	Budima Edison	Famer	musalau	–	–	B.E
60	Balinsangayo James	Teacher	musalau	– –	–	B.J
61	Mbusa Wilson	Peasant	Kabwe	- - -	–	[illegible]
62	Mukirania John	Cat: Bunyamwera Cou	Bunyamwera	0785120226	–	MJS
63	Thembo murutse	~~Bugaitera~~	Bunyamwera		–	T.M
64	Bagheni murutse	peasent	Bunyamwera		–	Bm
65	Muhindo Lahane	"	"		–	m L
66	Kyekamwe Jorori	~~Ntuma~~ "	NTuma	–	–	
67	Thango Rose	"	Bunyamwera	–	–	
68	murutse Erisa	peasent	"	–	–	M.E
69	Thango Harite	"	Bunyangola	0772460025	–	
70	Kule Jowase	"	Kaghugha	0779039245	–	
71	KASUNN ISAIAH	"	KABWE	0773686634	–	[signature]

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TIME ENDED	01:37 pm

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
72	Kabugho Erezabei	Peasent	Kabwe	–	–	K·E
73	KULE AINEA	Retired [illegible]	Ntagata	–	– –	
74	NJIANGAMU ELISS	C/man	Musalaw	0773734155	–	[signature]
75	Kalugho Enmore	Peasent	Kughegu	–	–	K·E
76	Biira Jeice	Peasant	Kagingh	–	–	B·J
77	Isaya Bksudda	Peasant	Kabwe	–	–	I·B
78	Bwambale Hakimu	Nurse	bundiKahonda	0789131713		Bwambale
79	Mbumbo Josse	Peasent	Musiti	–	–	–
80	Mbambo Sozani	11	Bunyamwera	–	–	–
81	Biira Direda	Peasent	Bunyamwera	–		–
82	Themothy Masineka	Peasent	11	–	–	–
83	Bwambale Wiley	Teacher	Bunyamwera	0775417847		[signature]
84	Kabugho Jenet	Peasent	Kaghughu	–	–	–
85	Thembo Rujumba	Peasent	Musiti	–	–	–
86	Yokonia Bukendiko	Peasent	Kaghughu	–	–	–

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VENUE	BULIMBA PRIMARY SCHOOL
TIME STARTED	10:00 am
TIME ENDED	01:37 PM

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
89	Sandala ALEX	Farm	Kabukere	0775038570		S.A
90	BENEFASI KINDIA	Farm	''			B.K
91	MASIKA ROSET	''	Kabwe	0784958182		[illegible]
92	KABUGHO JESKA	''	''			K.J
93	MUHINDO WILSON	Farm	''	0789927258		M.W
94	TEMBO EDISON		''			[illegible]
95	MAATE AWENDA YONSERI	FARM	Bumamwera	0777767875		[illegible]
96	Kikomberwa Simon	farm	NDUGUTO	0785388194		K.S
97	Kikombewa. peter	from	NDUGUTO	0771915720		K.P
98	BWAMBALE WILLIAM	Farm	Kagugu	—		[illegible]
99	BWENGE FANAHASI	Famer	Bumamwera	0786901361		[illegible]
100	Simoni Mbusi		musili			S.M
101	Maate Joas		Bumamwera	0783519201		M.J
102	NGELESE DANIEL	STUDENT	KABWE	0789542359		[illegible]
103	KULE LEVI	PEASANT	LUMBU	—		K.L
104	MUMBERE MICHEAL	STUDENT	Bumamwera	0789207492		[illegible]
105	BALUKU CHRISTON	STUDENT TEACHER	KABWE	0785101999		[illegible]
106	KULE RICHARD	FARM	BUDYAMAYA	077631511		[illegible]

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Tel: +256751090752;
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PROJECT	SINDILA MHP
DATE	16/12/2014
VENUE	BULIMBA PRIMARY SCHOOL
TIME STARTED	10:00 am
TIME ENDED	01:37 Pm

	Name	occupation	Contact Details: Address	Telephone	Email	Signature
107	TUMUSIIME ROBERT	CISO,	SINDILA	0775262792	—	[signature]
108	KISEMBO SALLY	DDISO	BUNDIBUGYO	0772460328	—	[signature]
109	MUHINDO MISAKI	C/person DLB	BUNDIBUGYO	0772969187	misakimuhindo@yahoo.com	[signature]
110	NUWAGABA ELIAS	DRDC	BUNDIBUGYO	0789390203	eliasnuwagaba@gmail.com	[signature]
111	MBUSA DANIEL	LCIII C/P	SINDILA S/C	0782899322	- 0782899322	[signature]
112	NZIRAPANDE JOPHET	C/P L.C3	NANGWE S/C	0772911684	—	[signature]
113	MUSUMBA ARKURIGHT	C/P LC2	Bunyamusa	0783351788		[signature]

ANNEXURE 6: PROJECT DESIGNS/DRAWINGS

Note to GETFIT: Updated design and drawings have been included separately in the technical update provided in September 2014. The drawings presented here were part of the original ESIA (2012).

Annexure 6.1: Project Layout Plan

Annexure 6.2: Weir Details

Annexure 6.3: Desilting tank details

Annexure 6.4: Headrace Canal (1)

Annexure 6.5: Headrace canal (2)

Annexure 6.6: Forebay Tank Details

Annexure 6.7: Penstock Support (1)

Annexure 6.8: Penstock Support (2)

Annexure 6.9: Powerhouse Details

Annexure 6.10: Tailrace Channel

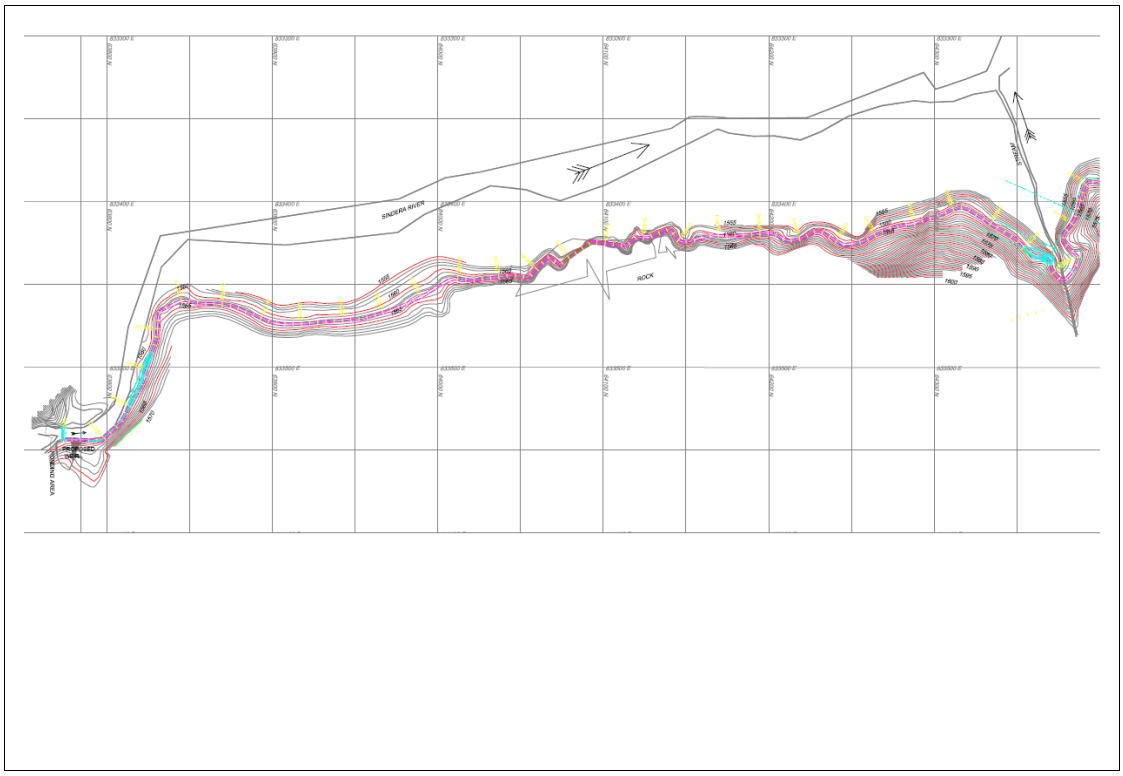
Annexure 6.11: Transmission line route

Annexure 6.12: Conceptual design of causeway

Annexure 6.13: Building plan – Staff Accommodation

Annexure 6.14: Building plan – Site Office

Annexure 6.15: Building plan – Labour Accommodation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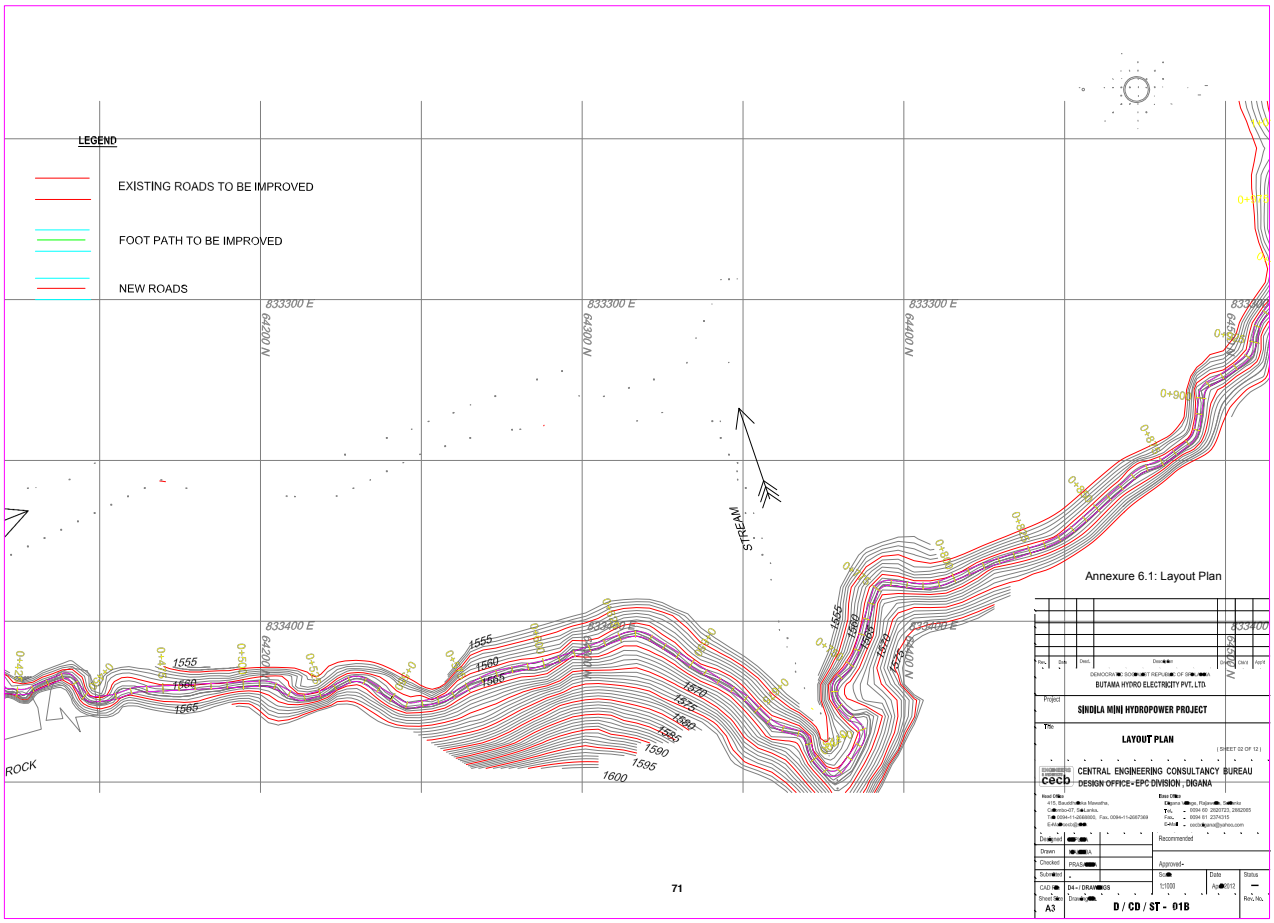
DREDGING AREA


LEGEND
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FOOT PATH TO BE IMPROVED
NEW ROADS
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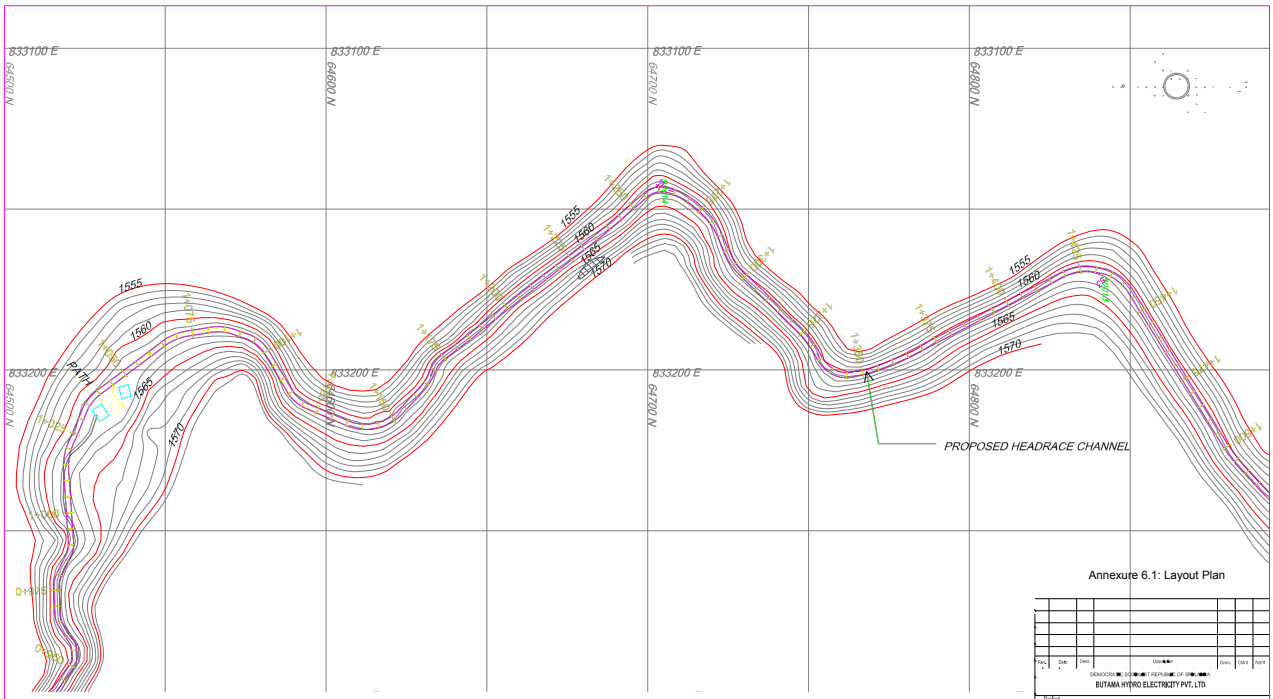
84300 N
84400 N
STREAM
ROCK
1555
1560
1565
1570
1575
1580
1585
1590
1595
1600
Annexure 6.1: Layout Plan
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BUTAMA HYDRO ELECTRICITY PVT. LTD.
Project
S[NDILA M[N] HYDROPOWER PROJECT
Title
LAYOUT PLAN
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION ; DIGANA
Drawn
Checked
Approved
Scale
1:1000
Date
Status
A3
D / CD / ST - 01B



Annexure 6.1: Layout Plan

LEGEND

EXISTING ROADS TO BE IMPROVED

FOOT PATH TO BE IMPROVED

NEW ROADS

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

Title: LAYOUT PLAN

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Designed: [redacted]
Drawn: [redacted]
Checked: PRASAD[redacted]
Submitted:
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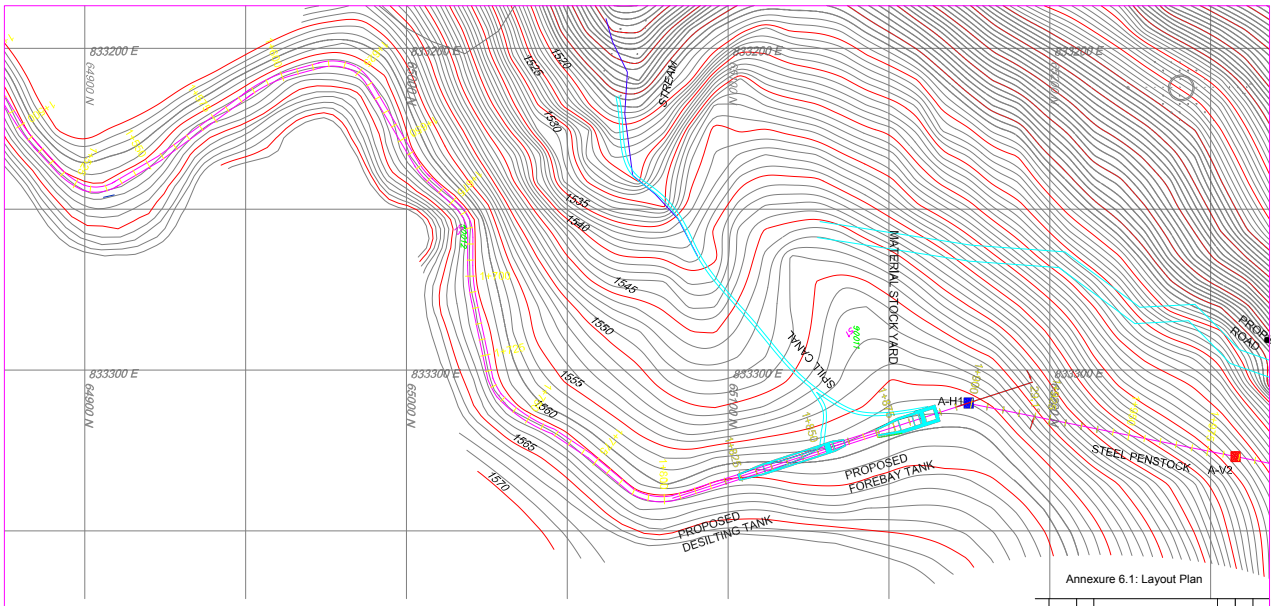
Sheet Size: A3
Drawing No.: D / CD / ST - 01C
Recommended
Approved:
Scale: 1:1000
Date: Aug 2012
Status:
Rev. No.:



Annexure 6.1: Layout Plan

LEGEND

EXISTING ROADS TO BE IMPROVED

FOOT PATH TO BE IMPROVED

NEW ROADS

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

LAYOUT PLAN

SHEET 04 OF 12

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Drawn

Checked

Submitted

Recommended

Approved

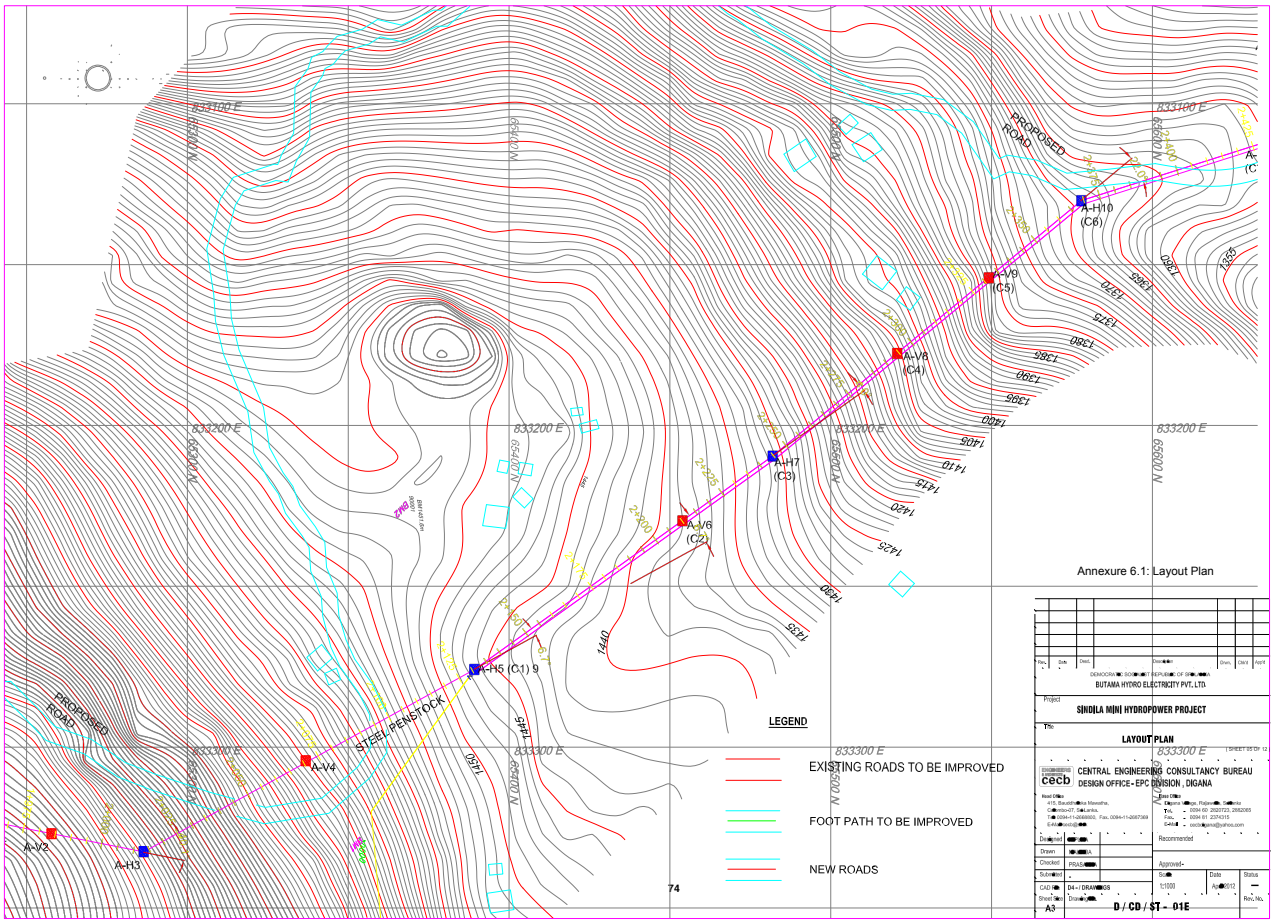
Scale: 1:1000

Date: August 2012

Status:

Sheet Size: A3

D / CD / ST - 01D



Annexure 6.1: Layout Plan

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

LAYOUT PLAN

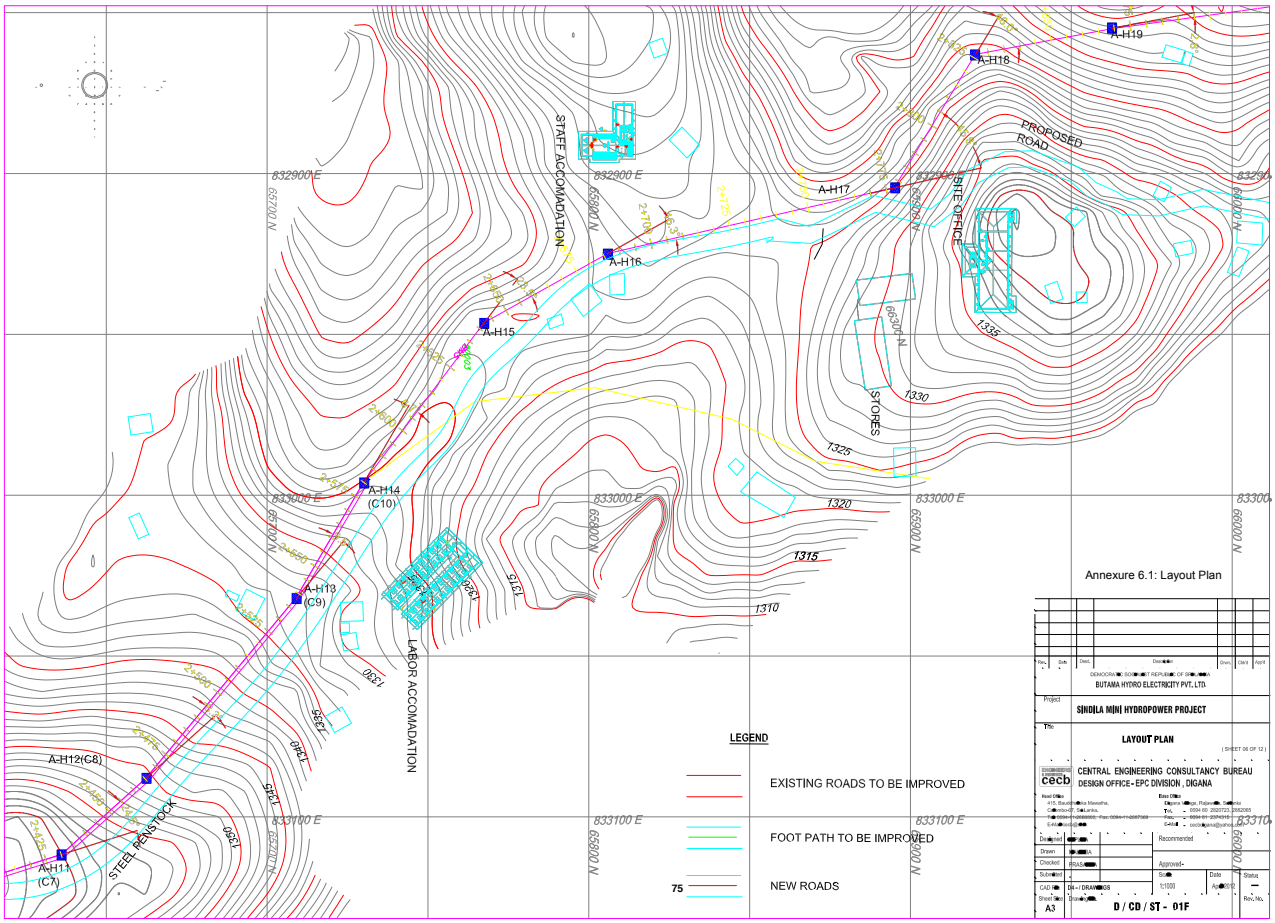
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Designed | Drawn | Checked | Submitted | Approved

Scale: 1:1000 | Date: August 2012 | Status

CAD file: D4 - DRAWINGS | Sheet Size: A3

D / CD / ST - 01E



Annexure 6.1: Layout Plan

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

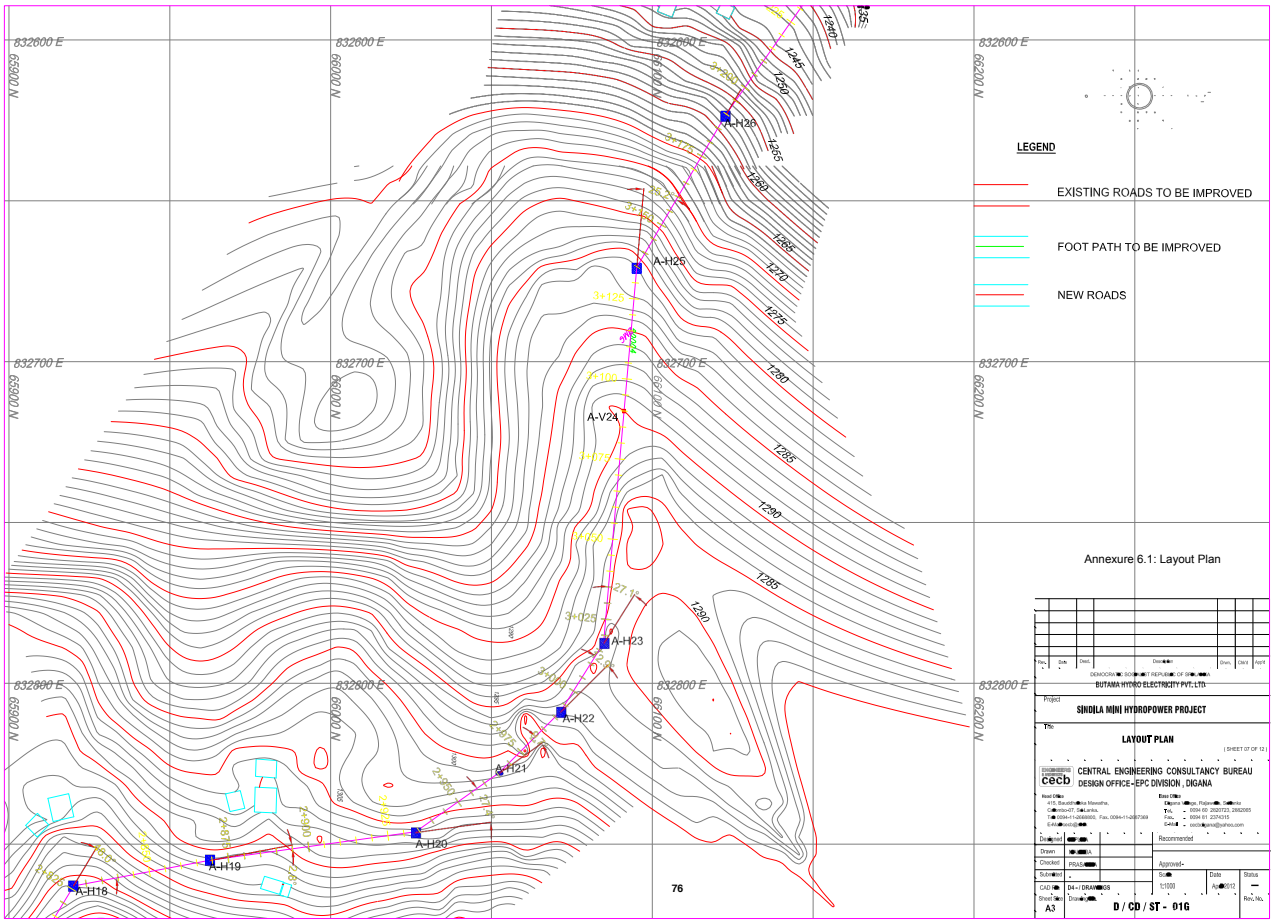
Title: LAYOUT PLAN

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Scale: 1:1000

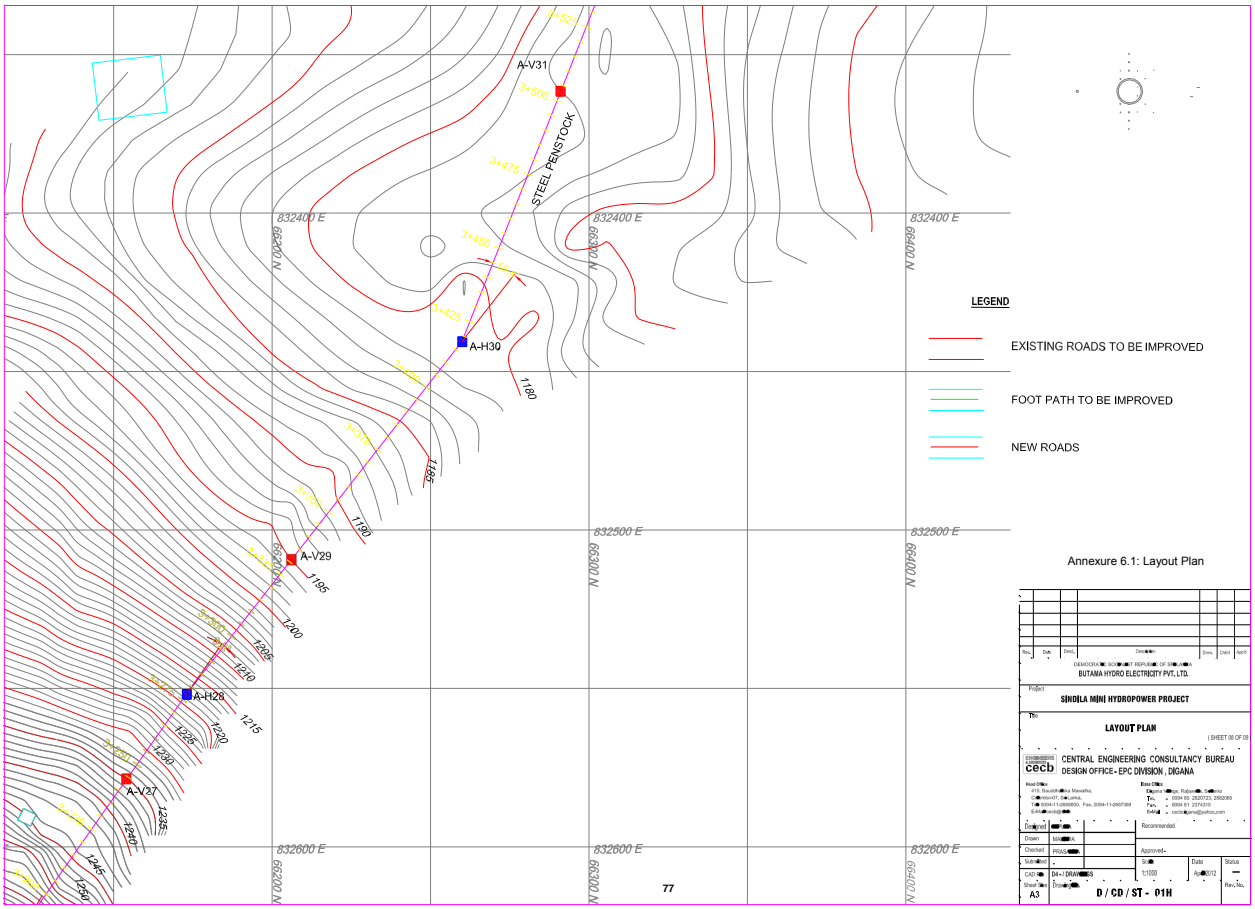
A3

D / CD / ST - 01F



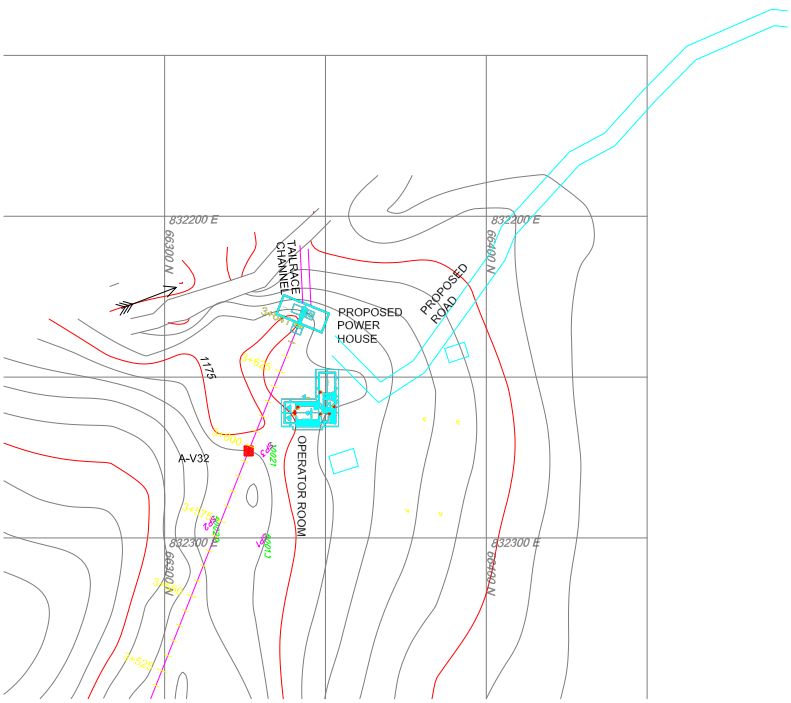
Annexure 6.1: Layout Plan

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BUTAWA HYDRO ELECTRICITY PVT. LTD
Project
SINDILA MINI HYDROPOWER PROJECT
Title
LAYOUT PLAN
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA
Scale 1:1000
Size A3
D / CD / ST - 01G



Annexure 6.1: Layout Plan

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BUTAMA HYDRO ELECTRICITY PVT. LTD.
Project
SINDILA MINI HYDROPOWER PROJECT
No
LAYOUT PLAN
SHEET 08 OF 09
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION, DIGANA
Drawn
Checked
Approved
Recommended
Scale 1:1000
Date April 2012
Status
Sheet Size A3
D4 - DRAWINGS
D / CD / ST - 01H
Rev. No.



LEGEND

EXISTING ROADS TO BE IMPROVED

FOOT PATH TO BE IMPROVED

NEW ROADS

Annexure 6.1: Layout Plan

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

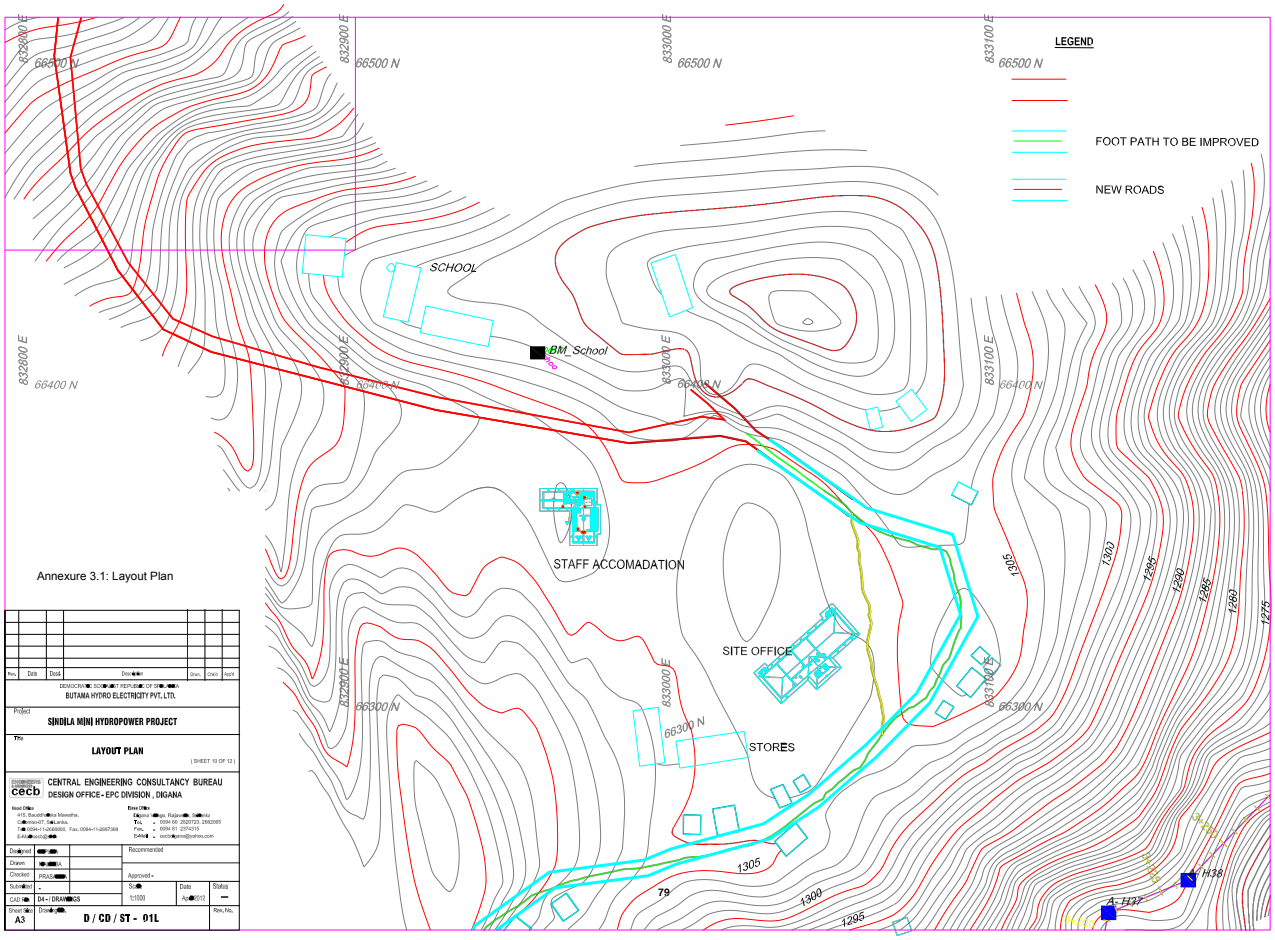
Title: LAYOUT PLAN

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Scale: 1:1000

Size: A3

D / CD / ST - 01J



Annexure 3.1: Layout Plan

Rev.	Date	Dsid.	Description	Drwn.	Chkd	Appd

DEVELOPMENT OF SINDILA MINI HYDROPOWER PROJ. ON BUTAMA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

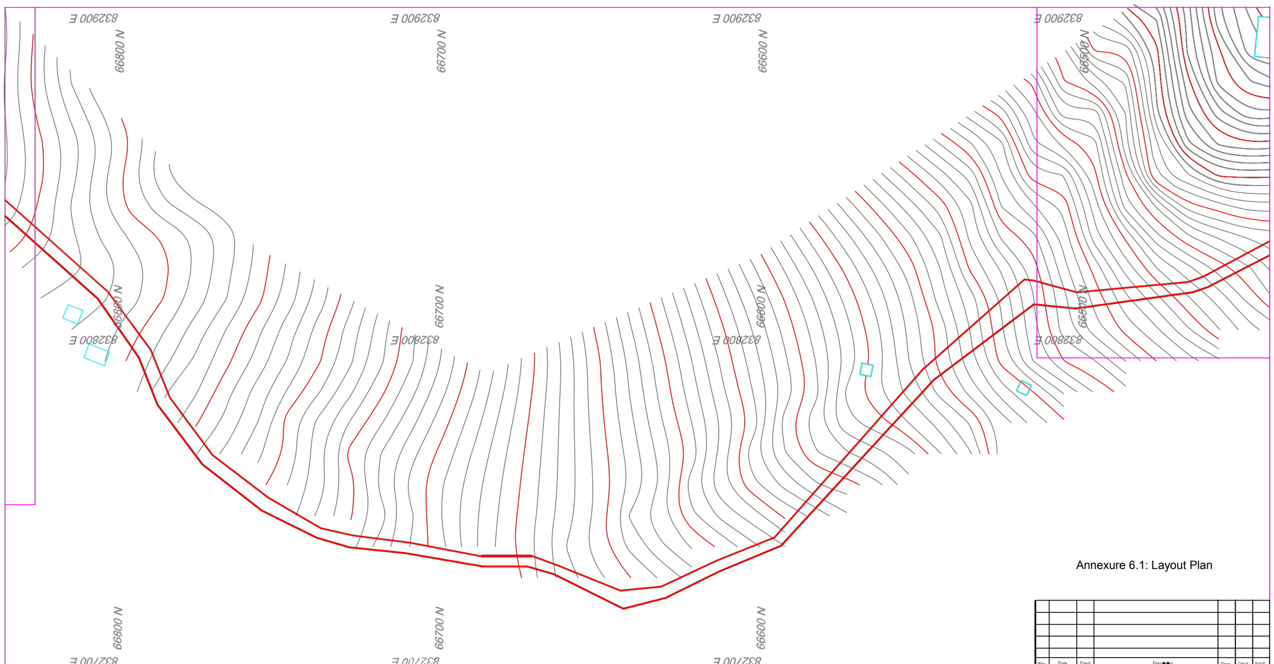
Project: SINDILA MINI HYDROPOWER PROJECT

Title: LAYOUT PLAN

(SHEET 10 OF 12)

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Designed		Recommended	
Drawn			
Checked	PRASAD	Approved -	
Submitted	-	Scale 1:1000	Date April 2013
CAD file	04 - / DRAWINGS		Status —
Sheet Size A3	Drawing No. D / CD / ST - 01L		Rev. No.



Annexure 6.1: Layout Plan

LEGEND

EXISTING ROADS TO BE IMPROVED

FOOT PATH TO BE IMPROVED

NEW ROADS

Rev.	Date	Desd.	Description	Drwn.	Chk'd	App'd

DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

BUTAMA HYDRO ELECTRICITY PVT. LTD.

Project

SINDILA MINI HYDROPOWER PROJECT

Title

LAYOUT PLAN

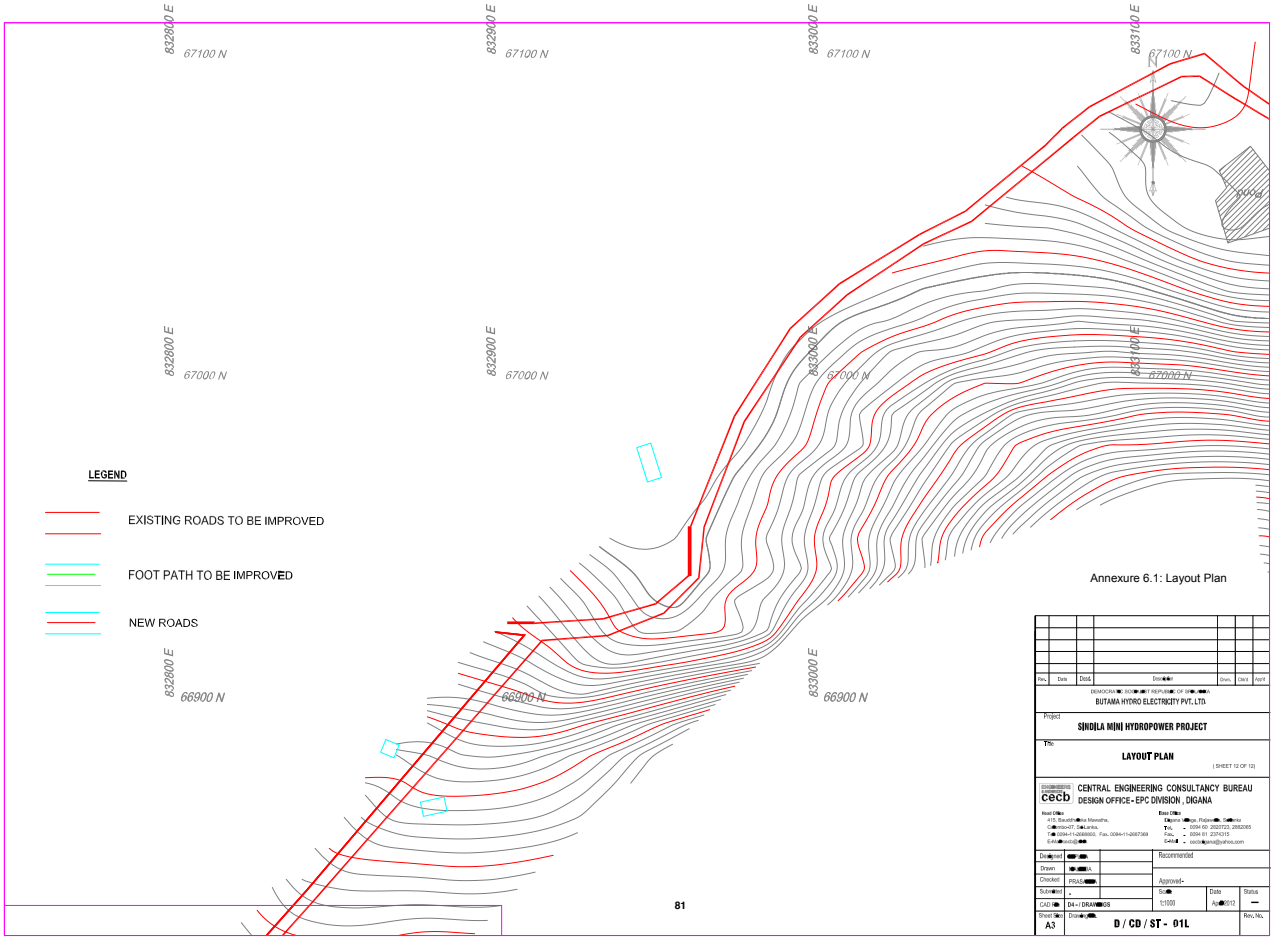
(SHEET 11 OF 12)

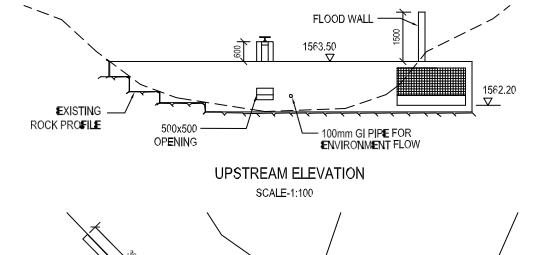
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Head Office
415, Bauddhaloka Mawatha,
Colombo-07, Sri Lanka.
Tel. 0094-11-2668800, Fax. 0094-11-2687369
E-Mail cecb@[redacted]

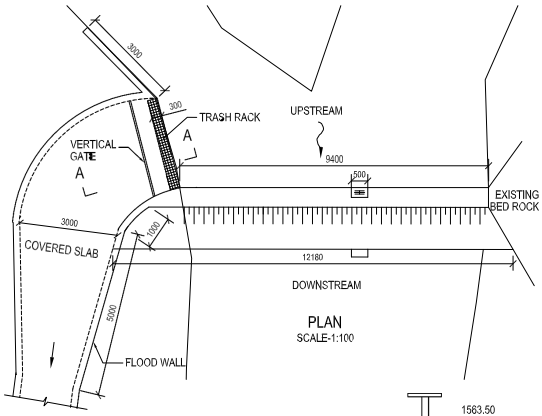
Base Office
Digana Village, Rajawella, Sri Lanka
Tel. - 0094 60 2820723, 2882065
Fax. - 0094 81 2374315
E-Mail - cecbdigana@yahoo.com

Designed	[redacted]		Recommended		
Drawn	[redacted]				
Checked	PRASA[redacted]		Approved -		
Submitted	-		Scale 1:1000	Date April 2012	Status —
CAD File	D4 - / DRAWINGS				
Sheet Size A3	Drawing No. **D / CD / ST - 01L**				Rev. No.

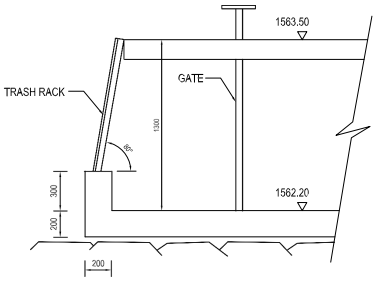

832800 E
832900 E
833000 E
833100 E
67100 N
67000 N
66900 N
LEGEND
EXISTING ROADS TO BE IMPROVED
FOOT PATH TO BE IMPROVED
NEW ROADS
Annexure 6.1: Layout Plan
DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA
BUTAMA HYDRO ELECTRICITY PVT. LTD.
Project
SINDILA MINI HYDROPOWER PROJECT
Title
LAYOUT PLAN
(SHEET 12 OF 12)
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA
Recommended
Approved -
1:1000
D / CD / ST - 01L
A3



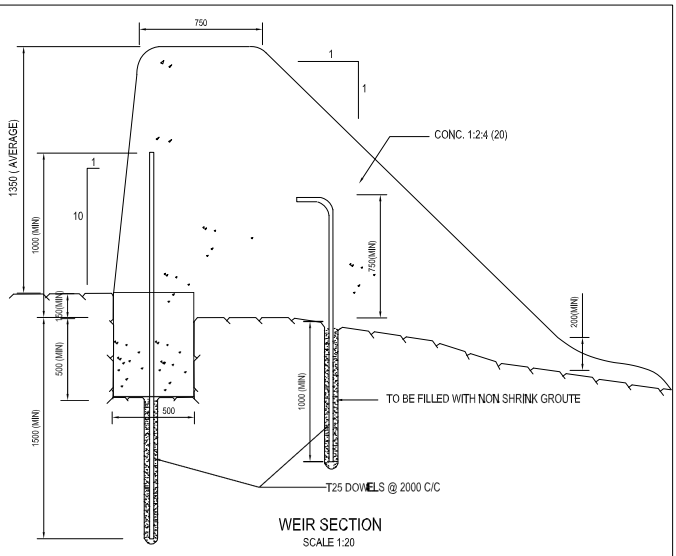
UPSTREAM ELEVATION
SCALE-1:100



PLAN
SCALE-1:100

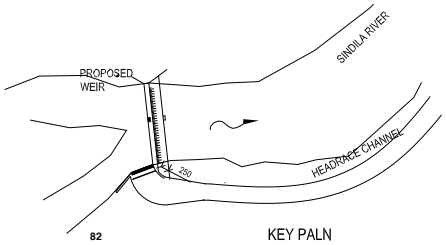


SECTION A-A
SCALE-1:25



WEIR SECTION
SCALE 1:20

Annexure 6.2: Weir Details



KEY PALN

Rev.	Date	Dsn&	Description	Dsn&	Chkd	Appd

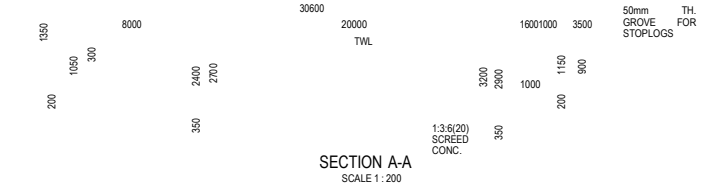
Client
BUTAWA HYDRO ELECTRICITY CO. LTD.

Project
SINDILA MINI HYDROPOWER PROJECT

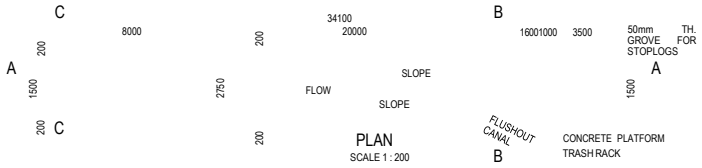
Title
DETAIL OF WEIR

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

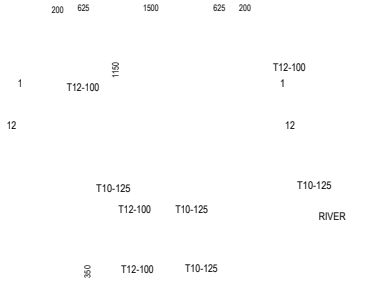
Designed	[illegible]	Recommended	
Drawn	[illegible]		
Checked	GRAS	Approved	
Submitted		Scale	Date / Status
CAD file	D4 - / DRAWINGS	YAS SHOWN	[illegible] RCH 2012
Sheet Size	Drawing No.		Rev. No.
A3	D/ CD / ST - 03		



SECTION A-A
SCALE 1 : 200



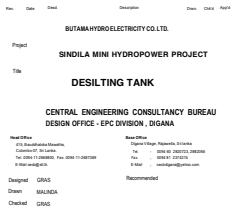
PLAN
SCALE 1 : 200

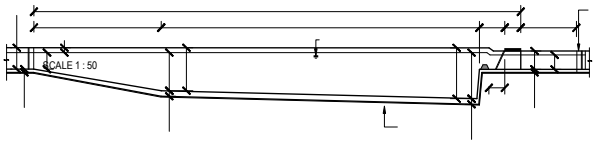


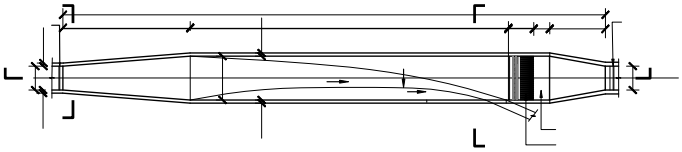
SECTION B-B

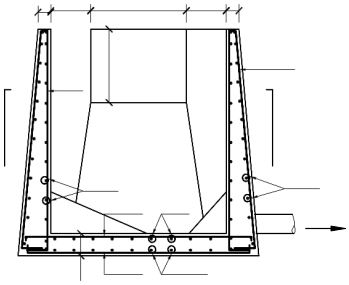
SECTION C - C
SCALE 1 : 50

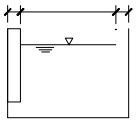
Annexure 6.3: Desilting tank details





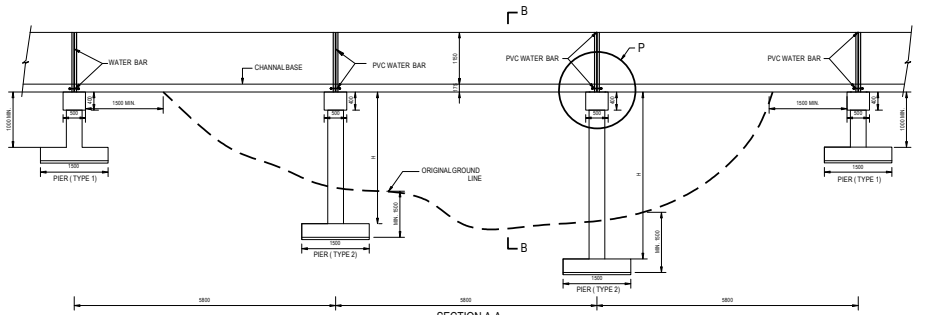




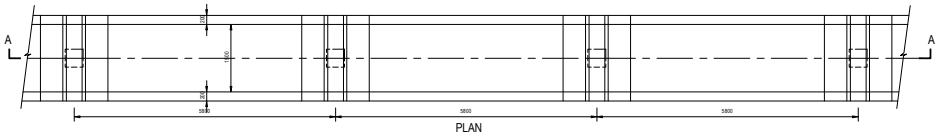


Submitted -		Approved - Scale	Date / Status
CAD File D4 - / DRAWINGS		1:20	MARCH 2012
Sheet Size A3	Drawing No. D-CD-ST-06		Rev. No.

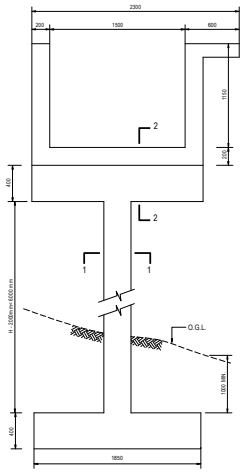
cecb



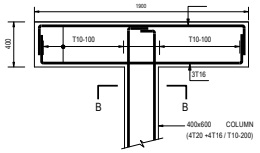
SECTION A-A
SCALE 1:50



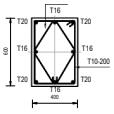
PLAN
SCALE 1:50



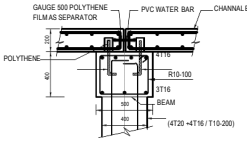
SECTION B-B
SCALE 1:20



COLUMN & BEAM JOINT DETAIL
SCALE 1:25



SCALE 1:20



SECTION 2 - 2
SCALE 1:20

1. ALL DIMENSIONS ARE IN MILLIMETERS.

No	Date	Mark	Description	Prep.	Chk'd	Appr.

BUTAWA HYDRO ELECTRICITY CO. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

Title: HEADRACE CHANNEL DETAIL
TYPE I

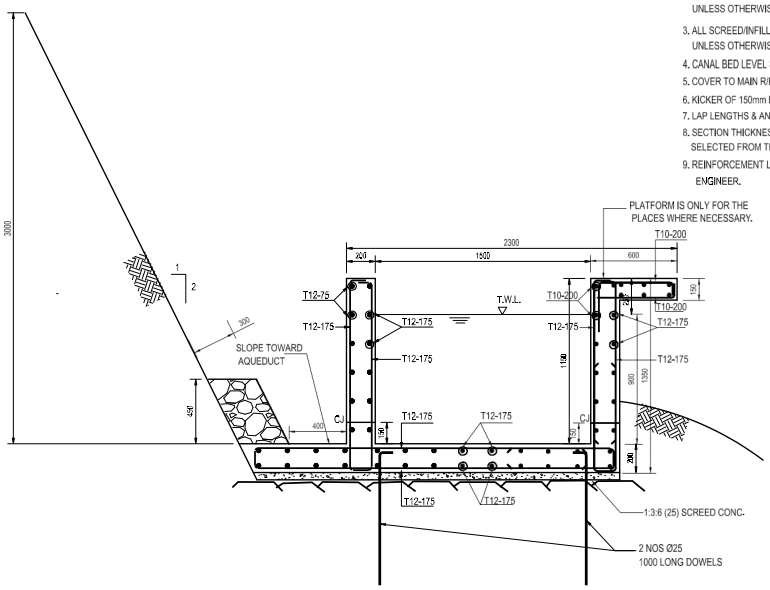
CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION, DIGANA

Designed	ILRAS	Recommended	
Drawn	MALINDA		
Checked		Approved -	
Submitted		Scale: AS SHOWN	Date: Mar. 2012
CAD File	D5 - / DRAWINGS		Status: ---
Sheet Size: A2	Drawing No.: D-CD-ST-05		Rev. No.: ---

Annexure 6.4: Headrace Canal (1)

NOTES.

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL R/F CONCRETE TO BE OF TYPE C35(20) UNLESS OTHERWISE SPECIFIED.
3. ALL SCREED/INFILL CONCRETE TO BE OF TYPE 1:3:6(25mm) UNLESS OTHERWISE SPECIFIED.
4. CANAL BED LEVEL SHALL BE MAINTAINED ACCURATELY AS SPECIFIED.
5. COVER TO MAIN R/F (VERTICAL) - 50mm.
6. KICKER OF 150mm HIGH SHALL BE PROVIDED MONOLITHICALLY WITH THE BASE SLAB.
7. LAP LENGTHS & ANCHORAGE LENGTHS, AS PER BS 8110.
8. SECTION THICKNESS AND REINFORCEMENT DETAILS SHALL BE SELECTED FROM THE CHART GIVEN.
9. REINFORCEMENT LAPPING PLACES AND LAP LENGTHS SHALL BE APPROVED BY THE ENGINEER.



CHANNAL SECTION (ON SOUND ROCK)

SCALE 1:20

LEGEND

CJ - CONSTRUCTION JOINT

Annexure 6.5: Headrace Canal (2)

BUTAMA HYDRO ELECTRICITY CO. LTD.

HYDROPOWER PROJECT

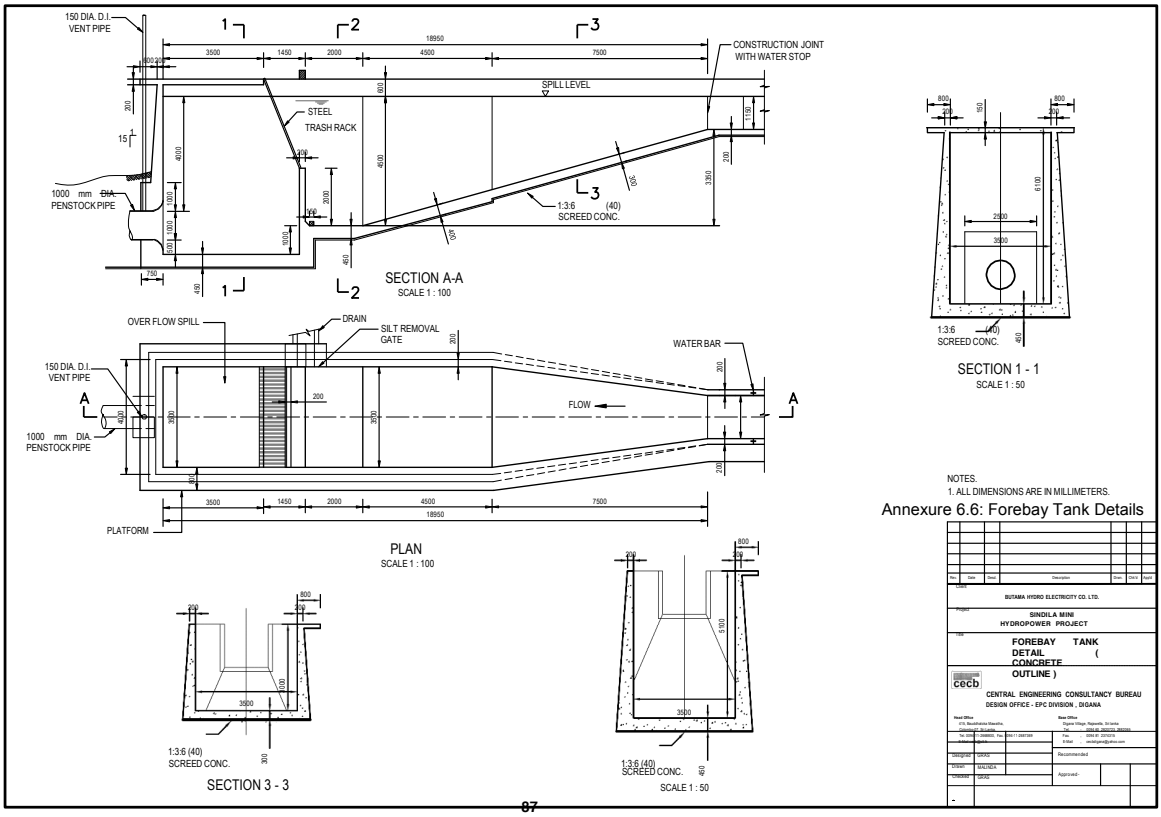
HEADRACE CHANNAL

SECTION & REINFORCEMENT DETAIL

CENTRAL ENGINEERING CONSULTANCY BUREAU

DESIGN OFFICE - EPC DIVISION, KANDY

Designed	GRAS	Recommended	
Drawn			
Checked	GRAS	Approved	
Submitted		Scale	Date / Status
CAD File	D4 – DRAWINGS	1:20	MARCH 2014
Sheet size	Drawing No.	D- CD -ST-04	Rev. No.
A3			



NOTES.
1. ALL DIMENSIONS ARE IN MILLIMETERS.

Annexure 6.6: Forebay Tank Details

BUTAMA HYDRO ELECTRICITY CO. LTD.

SINDILA MINI HYDROPOWER PROJECT

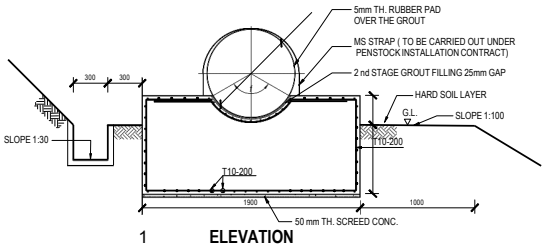
FOREBAY TANK DETAIL (CONCRETE OUTLINE)

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

SECTION 2 - 2
SCALE 1 : 50

Submitted _ Scale 1:20 Date MARCH 2012 Status

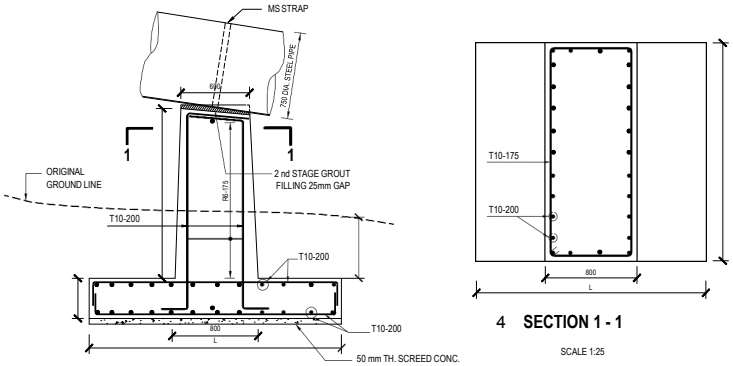
CAD File D4 - DRAWINGS
Sheet Size A3 Drawing No. D - CD - ST - 07 Rev. No.



1 **ELEVATION**

SCALE 1:25

2 **TYPICAL SUPPORT - TYPE 1 , WHEN < 500mm**



3 **ELEVATION**

SCALE 1:25

4 **SECTION 1 - 1**

SCALE 1:25

NOTES.

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL R/F CONCRETE TO BE OF TYPE GR. 25(20mm) UNLESS OTHERWISE SPECIFIED.
3. ALL SCREED/INFILL CONCRETE TO BE OF TYPE 15(20mm) UNLESS OTHERWISE SPECIFIED.
4. THE DETAILS OF FOUNDATION ONLY ARE TO BE USED FOR SOIL REFER ... FOR FOUNDATION TYPES OVER ROCK BASE.
5. MAXIMUM CENTER TO CENTER DISTANCE OF PIPE, PIPE THICK SUPPORT.

NOTE.

L=700 H<700
L=1900 700 < H < 1200

5 **TYPICAL SUPPORT - TYPE II**

PIPE OD

H

600

1900

H

500 (MIN.)

600

Rev.	Date	Desd.	Description	Drwn.	Chk'd	App'd

Client

BUTAMA HYDRO ELECTRICITY CO. LTD.

Project

SINDILA MINI
HYDROPOWER PROJECT

Title

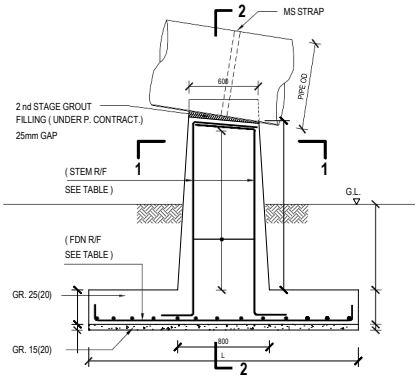
PENSTOCK SUPPORT DETAILS
(TYPE I & II)

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Head Office
415, Bauddhaloka Mawatha,
Colombo-07, Sri Lanka.
Tel. 0094-11-2668800, Fax. 0094-11-2687369
E-Mail cecb@slt.lk

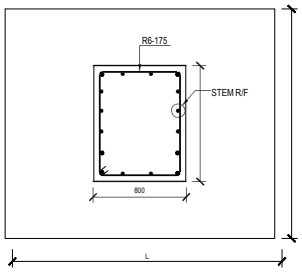
Base Office
Digana Village, Rajawella, Sri lanka
Tel. - 0094 60 2820723, 2882065
Fax. , 0094 81 2374315
E-Mail , cecbdigana@yahoo.com

Designed	GRAS		Recommended
Drawn	MALINDA		
Checked	GRAS		Approved -
Submitted	-		Scale: 1:20 / Date: MARCH 2012 / Status: CON
CAD File	D4 - / DRAWINGS		
Sheet Size: A3	Drawing No.: D-CD-ST-09		Rev. No.



6 **SECTION F-F**

SCALE 1:25



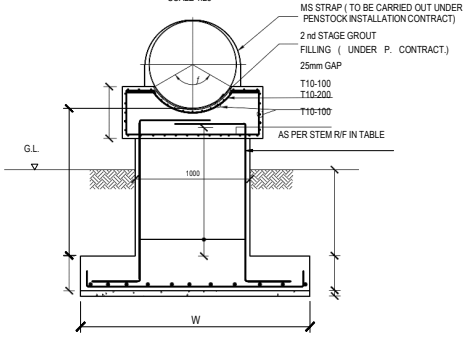
7 **SECTION 1 - 1**

SCALE 1:25

NOTES.

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. ALL R/F CONCRETE TO BE OF TYPE GR. 25(20mm) UNLESS OTHERWISE SPECIFIED.
3. ALL SCREED/INFILL CONCRETE TO BE OF TYPE 15(20mm) UNLESS OTHERWISE SPECIFIED.
4. THE DETAILS OF FOUNDATION ONLY ARE TO BE USED FOR SOIL REFER ... FOR FOUNDATION TYPES OVER ROCK BASE.

SCALE 1:25



8 **SECTION 2 - 2**

SCALE 1:25

Annexure 3.8: Penstock Support (2)

H(m)	L(m)	W(m)	FDN R/F	STEM R/F
2.0	2.0	2.0	T10-200(B/W)	T12-150
2.5	2.25	2.0	T10-150(B/W)	T12-125
3.0	2.25	2.25	T10-125(B/W)	T12-100

cecb

TYPICAL SUPPORT TYPE III

No	Date	Rev	Description	Drn	Chkd	Appd

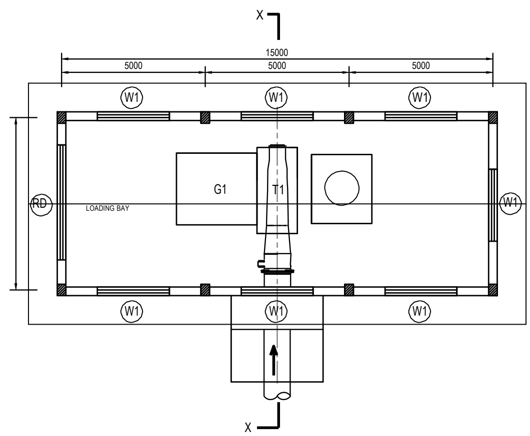
Client: BUTAMA HYDRO ELECTRICITY CO. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

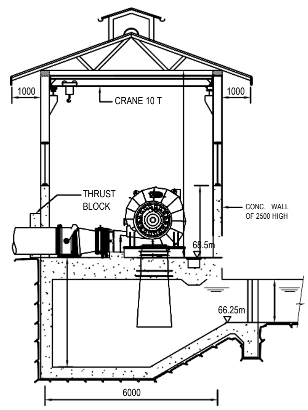
Title: PENSTOCK SUPPORT DETAILS (TYPE III)

CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Designed	SRAS		Recommended
Drawn	SRAS/DA		
Checked	SRAS		Approved -
Submitted			Scale: 1:20
CAD File	D4 :: DRAWINGS		Date: MARCH 2013
Sheet Size	A3	Drawing No:	D-CD-ST-10
Status	CON	Rev. No:	



FLOOR PLAN
SCALE 1:100



SECTION X-X
SCALE 1:100

NOTES.
1. ALL DIMENSIONS ARE IN MILLIMETERS.

SCHEDULE OF DOORS AND WINDOWS

TYPE	SIZE	DESCRIPTION	NOS.	SILL HEIGHT
RD	4000x4000	ROLLER SHUTTER DOOR	01	-
W1	1500x1500	ALUMINIUM FRAMED GLAZED WINDOW	07	2500

ACTUAL DIMENSIONS OF POWER HOUSE WILL BE DECIDED BY THE MACHINE SUPPLIER.

Rev.	Date	Desd.	Description	Drwn.	Chk'd	App'd

Client
BUTAMA HYDRO ELECTRICITY CO. LTD.

Project
SINDILA MINI HYDROPOWER PROJECT

Title
POWER HOUSE GENERAL ARRANGEMENT PLAN

cecb CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Head Office
415, Bauddhaloka Mawatha,
Colombo-07, Sri Lanka.
Tel. 0094-11-2668800, Fax. 0094-11-2687369
E-Mail cecb@slt.lk

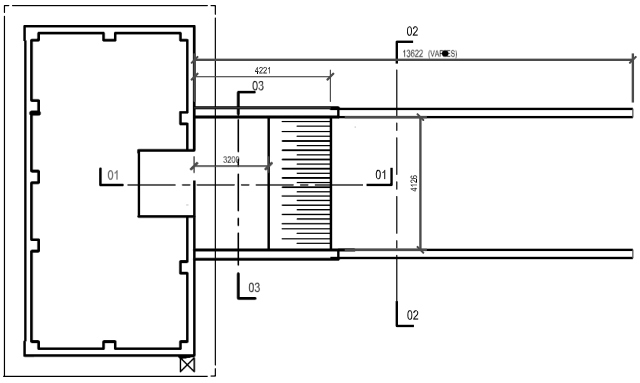
Base Office
Digana Village, Rajawella, Sri lanka
Tel. - 0094 60 2820723, 2882065
Fax. - 0094 81 2374315
E-Mail - cecbdigana@yahoo.com

Designed	GRAS	Recommended
Drawn	MALINDA	
Checked	GRAS	Approved -
Submitted	-	Sheet Drawing No. Size
CAD File	D4 - / DRAWINGS	A3

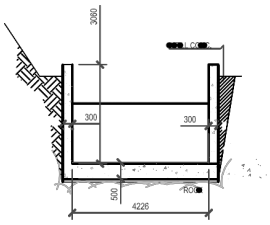
Annexure 6.9: Powerhouse Details

1:100 Date MARCH 2012 Status

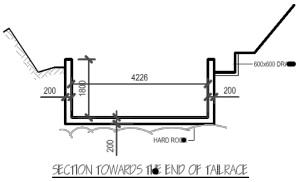
D-CD-ST-11 Rev. No.



LAYOUT

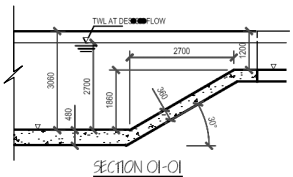


SECTION 02-02

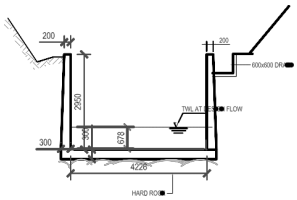


SECTION TOWARDS THE END OF TAILRACE

Annexure 5.10: Tailrace Channel



SECTION 01-01



SECTION 03-03

Rev.	Date	Desc.		Desc.	Appd.

Client: BUTAMA HYDRO ELECTRIC CO. LTD.

Project: BUTAMA HYDROPOWER PROJECT

Title: TAIL RACE DETAILS

cecb — CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION, BUTAMA

Designed	GRAS		Recommended	
Drawn	MA[illegible]			
Checked	GRAS		Approved:-	
Submitted			Scale	Date / Status
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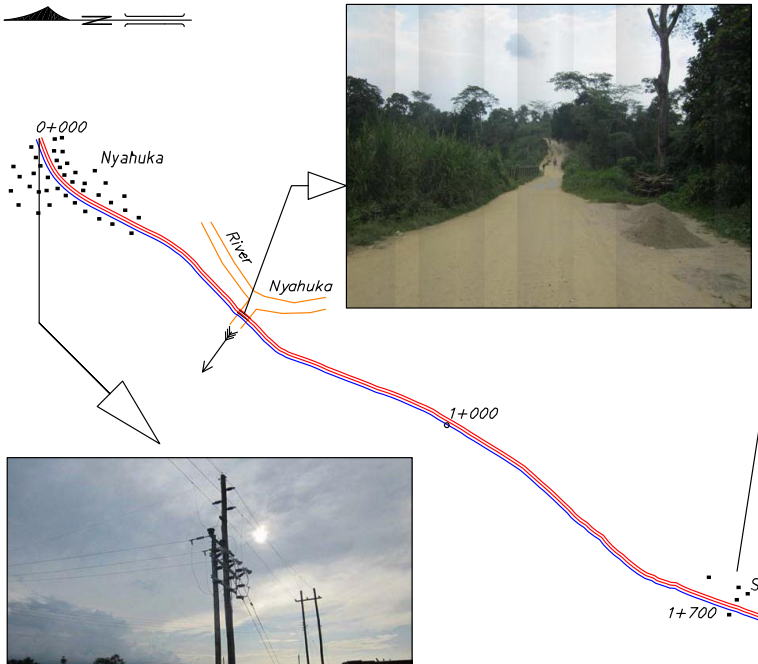
Sheet size	Drawing No.			Rev. No.
A3	D / CD / ST -16			

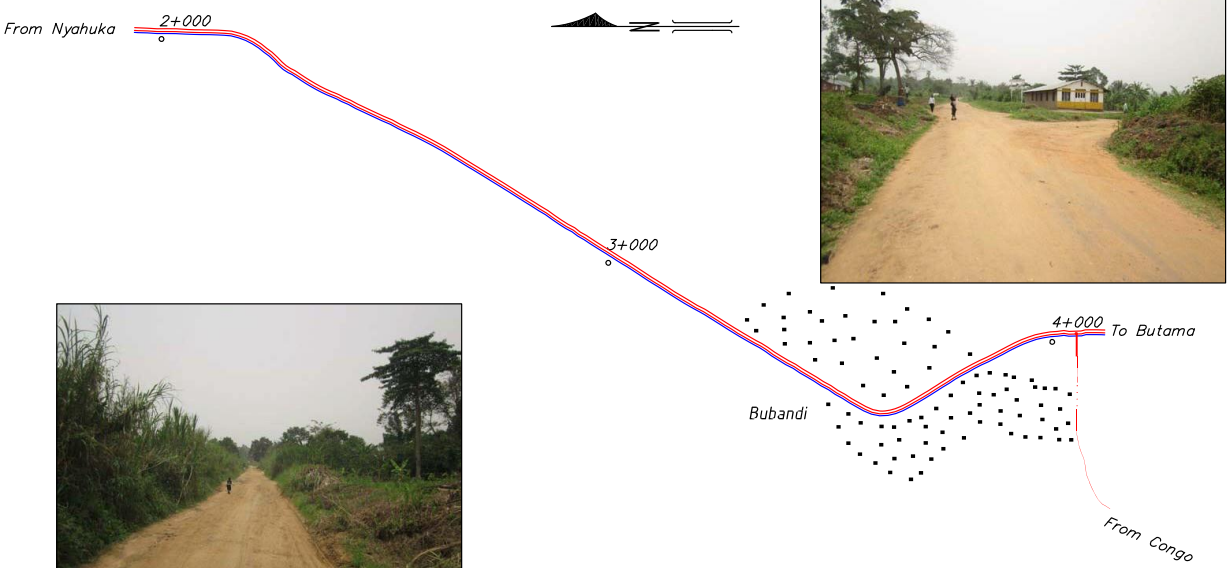


Reference

: Crowded Area
: Existing Road
: Proposed 33KV Line
: Streem
: House
: Foot Path

Annexure 6.11: Transmission line route

Client	BUTAMA HYDRO ELECTRICITY CO. LTD.				
Project	SINDILA MINI HYDRO POWER PROJECT				
Title	Proposed 33kV Transmission Line				
Designed	CKW		Recommended		
Drawn	NSD				
Checked	CKW		Approved -		
Submitted	-		Scale	Date	Status
CAD File	D4 - / DRAWINGS		1:10,000	APRIL 2012	CON
Sheet Size	Drawing No.				Rev. No.
A4	Tx-Sindila-1				



Annexure 6.11: Transmission line route

Reference

: Crowded Area
: Existing Road
: Proposed 33KV Line
: Streem
: House
: Foot Path

98

Client	BUTAMA HYDRO ELECTRICITY CO. LTD.				
Project	SINDILA MINI HYDRO POWER PROJECT				
Title	Proposed 33kV Transmission Line				
Designed	CKW		Recommended		
Drawn	NSD				
Checked	CKW		Approved -		
Submitted	-		Scale	Date	Status
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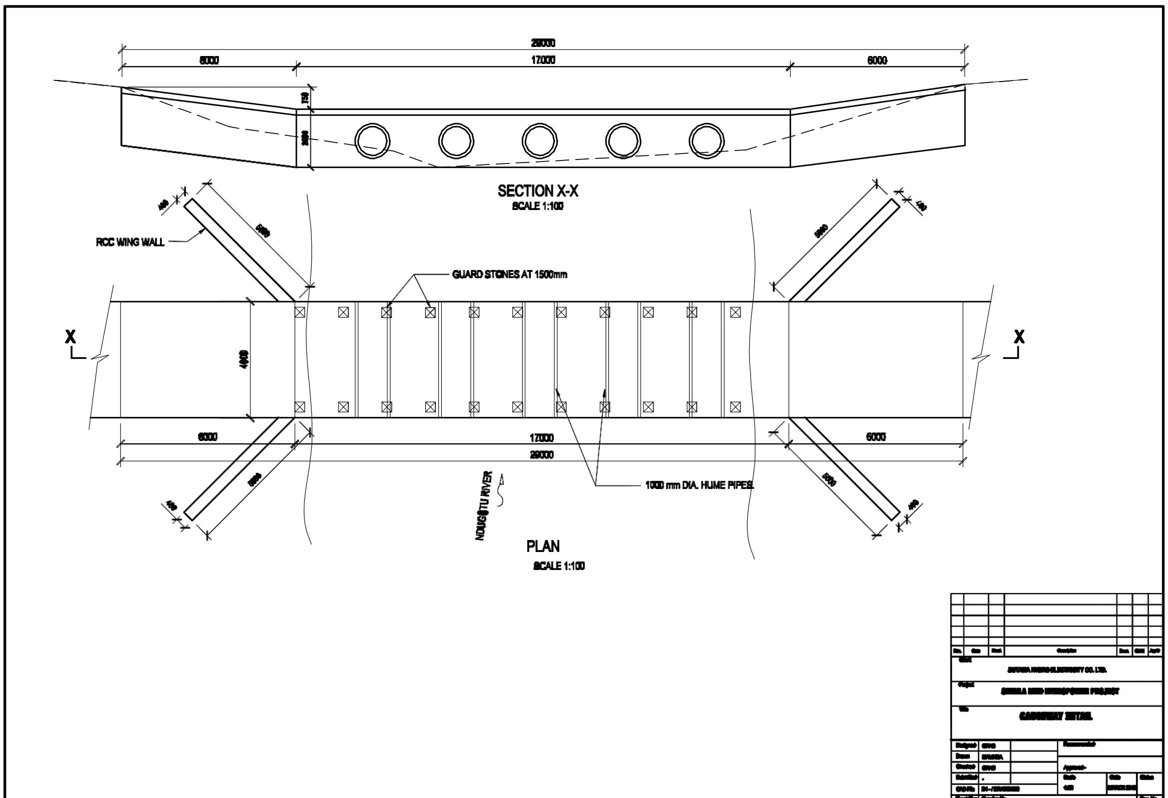
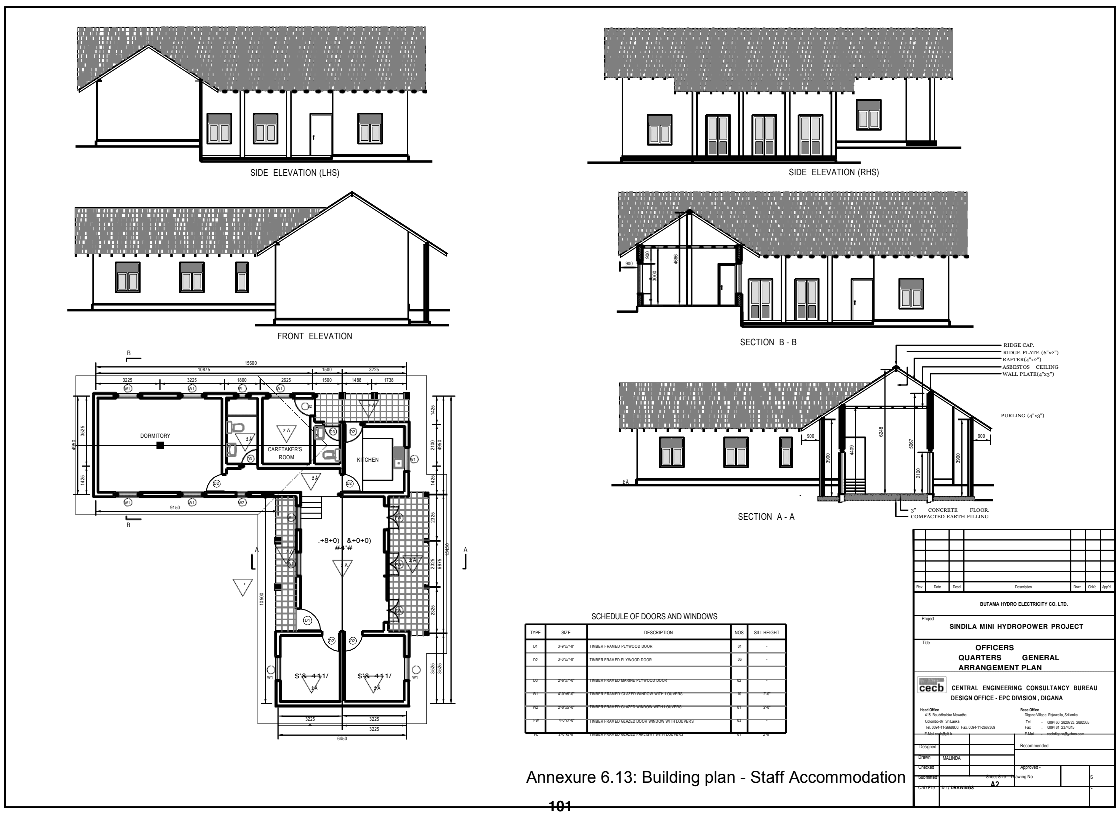
Sheet Size	Drawing No.				Rev. No.
A4	Tx-Sindila-2				


29000
6000
17000
6000
SECTION X-X
SCALE 1:100
RCC WING WALL
GUARD STONES AT 1500mm
X
X
6000
17000
6000
29000
1000 mm DIA. HUME PIPES.
PLAN
SCALE 1:100

Annexure 5.12: Conceptual design of causeway



SCHEDULE OF DOORS AND WINDOWS

TYPE	SIZE	DESCRIPTION	NOS.	SILL HEIGHT
D1	3'-9"x7'-0"	TIMBER FRAMED PLYWOOD DOOR	01	-
D2	3'-0"x7'-0"	TIMBER FRAMED PLYWOOD DOOR	06	-
D3	2'-6"x7'-0"	TIMBER FRAMED MARINE PLYWOOD DOOR	02	-
W1	4'-0"x5'-0"	TIMBER FRAMED GLAZED WINDOW WITH LOUVERS	10	2'-0"
W2	2'-0"x5'-0"	TIMBER FRAMED GLAZED WINDOW WITH LOUVERS	01	2'-0"
FW	4'-0"x7'-0"	TIMBER FRAMED GLAZED DOOR WINDOW WITH LOUVERS	03	-
FL	2'-0"x5'-0"	TIMBER FRAMED GLAZED FANLIGHT WITH LOUVERS	01	2'-0"

Annexure 6.13: Building plan - Staff Accommodation

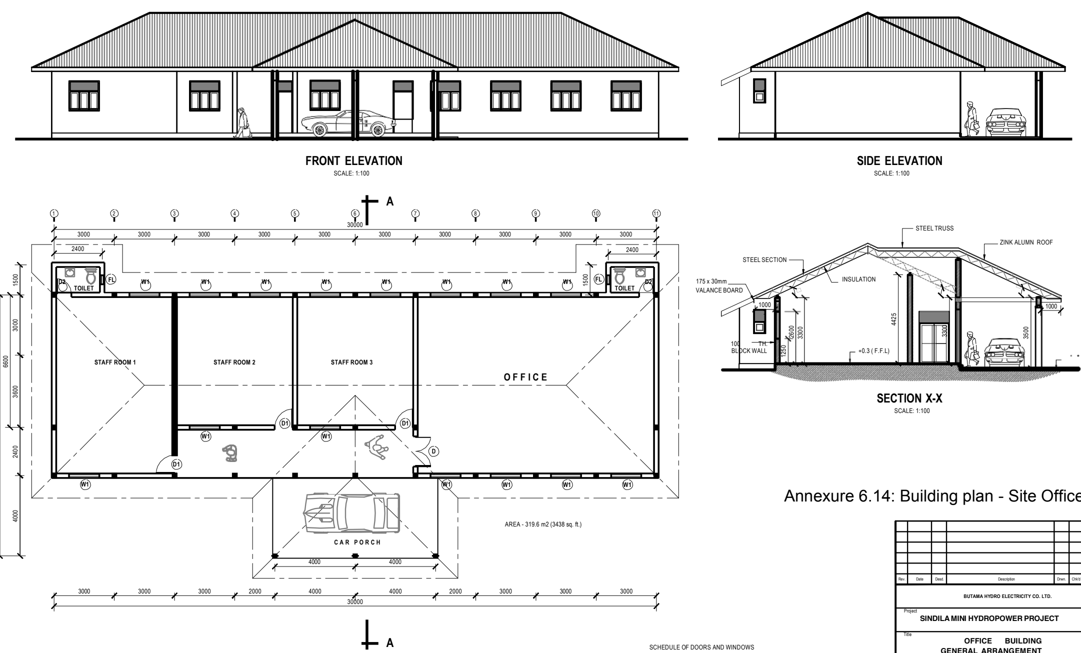
1 : 100

D - ST - CD - 14

Date MARCH 2012

Status

Rev. No.



Annexure 6.14: Building plan - Site Office

NOTES:

1. ALL DIMENSIONS ARE GIVEN IN MILLIMETRES AND LEVELS ARE GIVEN IN METRES UNLESS OTHERWISE STATED.
2. DRAWINGS ARE NOT TO BE SCALED FOR CONSTRUCTION PURPOSES.
3. ANY DISCREPANCY BETWEEN ARCHITECTURAL DRAWINGS, STRUCTURAL AND ELECTRICAL DRAWINGS OR ANY OTHER ITEM SHOULD BE BROUGHT TO NOTICE OF CONSULTANT FOR CLARIFICATION AND FINALISATION.

SCHEDULE OF DOORS AND WINDOWS

TYPE	SIZE	DESCRIPTION	NOS.	SILL HEIGHT
W1	1800x1500	ALU. GLAZED WINDOW WITH LOUVRES	15	1100
D	1500x2600	ALU. GLAZED DOOR WITH LOUVRES ABOVE	01	-
D1	1000x2600	ALU. FRAMED PLYWOOD DOOR WITH LOUVERS ABOVE	03	-
D2	750x2100	ALU. FRAMED PLYWOOD DOOR	02	-
FL	600x1200	ALU. FRAMED GLAZED FANLIGHT WITH ALU. LOUVERS	02	15-00

Rev.	Date	Desd.	Description	Drwn.	Chk'd	App'd

BUTAMA HYDRO ELECTRICITY CO. LTD.

Project: SINDILA MINI HYDROPOWER PROJECT

Title: OFFICE BUILDING GENERAL ARRANGEMENT PLAN

cecb CENTRAL ENGINEERING CONSULTANCY BUREAU
DESIGN OFFICE - EPC DIVISION , DIGANA

Head Office
415, Bauddhaloka Mawatha,
Colombo-07, Sri Lanka.
Tel. 0094-11-2668800, Fax. 0094-11-2687369
E-Mail cecb@slt.lk

Base Office
Digana Village, Rajawella, Sri lanka
Tel. - 0094 60 2820723, 2882065
Fax. - 0094 81 2374315
E-Mail - cecbdigana@yahoo.com

Designed
Drawn MALINDA
Checked
Submitted -
CAD File D - / DRAWINGS
Sheet Size A2
Recommended
Approved -
Drawing No.

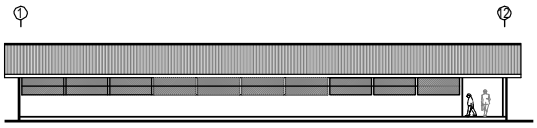
e 1 : 100

D - ST - CD - 13

Date MARCH/2012

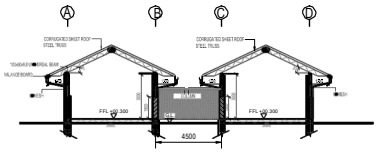
Status

Rev. No.



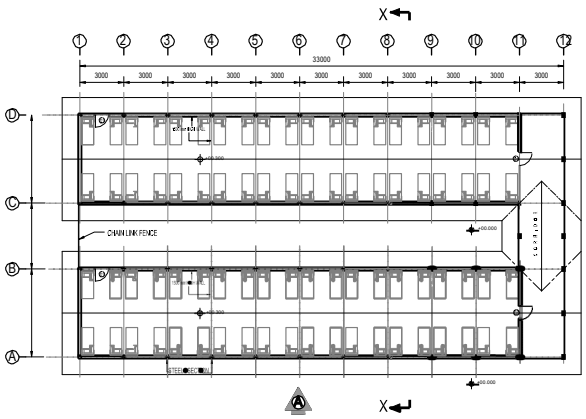
ELEVATION "A"

SCALE : 1:200



SECTION X - X

SCALE : 1:200



PLAN

SCALE : 1:200

NO. OF BEDS- 80

SCHEDULE OF DOORS AND WINDOWS (FOR ONE BUILDING)

TYPE	SIZE	DESCRIPTION	NOS.	SILL HEIGHT
D1	1000 X 2750	ALUMINIUM FRAMED PLYWOOD DOOR WITH LOUVERS ON TOP	02	-

Annexure 6.15: Building plan - Labour Accommodation

BUTAMA HYDRO ELECTRICITY CO. LTD.

SINDILA MINI HYDROPOWER PROJECT

LABOR ACCOMMODATION GENERAL ARRANGEMENT PLAN

Designed: GRAG

Drawn: MALINDA

Checked: GRAG

Recommended

Approved: -

CAD File D4 - / DRAWINGS
Sheet Size A3
Drawing No. D-CD-ST-12
1:20
MARCH 2012
CON
Rev. No

ANNEXURE 7: SUMMARY OF POWER EVACUATION STUDY

Note for GETFIT: For ease of review, a full, comprehensive power evacuation study updated as of September 2014 has been attached separately (Summary below)

CIVELIT ENGINEERING

SINDILA & NDUGUTU SMALL HYDRO POWER PLANTS

Power Evacuation Study

SEPTEMBER 2014

Executive Summary

Butama Hydro Electricity Company (pvt) Limited intends to construct two power plants, 5.25 MW Sindila and 5.0MW Ndugutu Small Hydropower plants which are to be located on River Sindera and River Ndugutu in Bundibugyo (Western Uganda) respectively. Sindila tentative commercial operation date is first quarter of 2016 whereas Ndugutu commercial operation date is last quarter of 2016.

All the power that is to be generated from both plants is to be evacuated to the main power grid via infrastructure that is to be proposed in this grid interconnection study report.

This report presents the results of a feasibility study that was carried out to determine the most optimum alternative for the evacuation of power from both SHPPs.

Two alternatives for the evacuation of power from the SHPPs were considered. One was to directly connect the individual plants to the existing and proposed grid at Bundibugyo and Bubandi Trading Centers respectively or to interconnect the two SHPPs then connect to the grid at Busunga with once evacuation line with an adequate conductor size and voltage. Both options were subjected to a thorough assessment and based on the results, it was proposed both plants be connected with a AAAC 100sqmm line and then a new approximately 5.7km 33kV 100AAAC line be constructed from Sindila switchyard to a new switching station at Busunga Trading center near the Uganda-Democratic Republic of Congo Border. Loadflow studies revealed that in order to keep the system losses on the interconnection lines within limits, the existing 33kV lines from Busunga to Fort Portal need to be converted to double circuit 33kV lines. The study also analysed the possibility of Island operation for both power plants and made recommendations on how this can be achieved and the necessary system reconfiguration.
Power line surveys were conducted for all the proposed alternatives and from these, estimated project costs were derived. These costs were then subjected to a Financial and Economic Analysis.

A comprehensive Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) shall be carried out before the evacuation power lines, line upgrades and substation upgrades are carried. Approvals from the respective authorities like NEMA and UWA shall be sought.

ANNEXURE 8: LAND SURVEY DETAILS

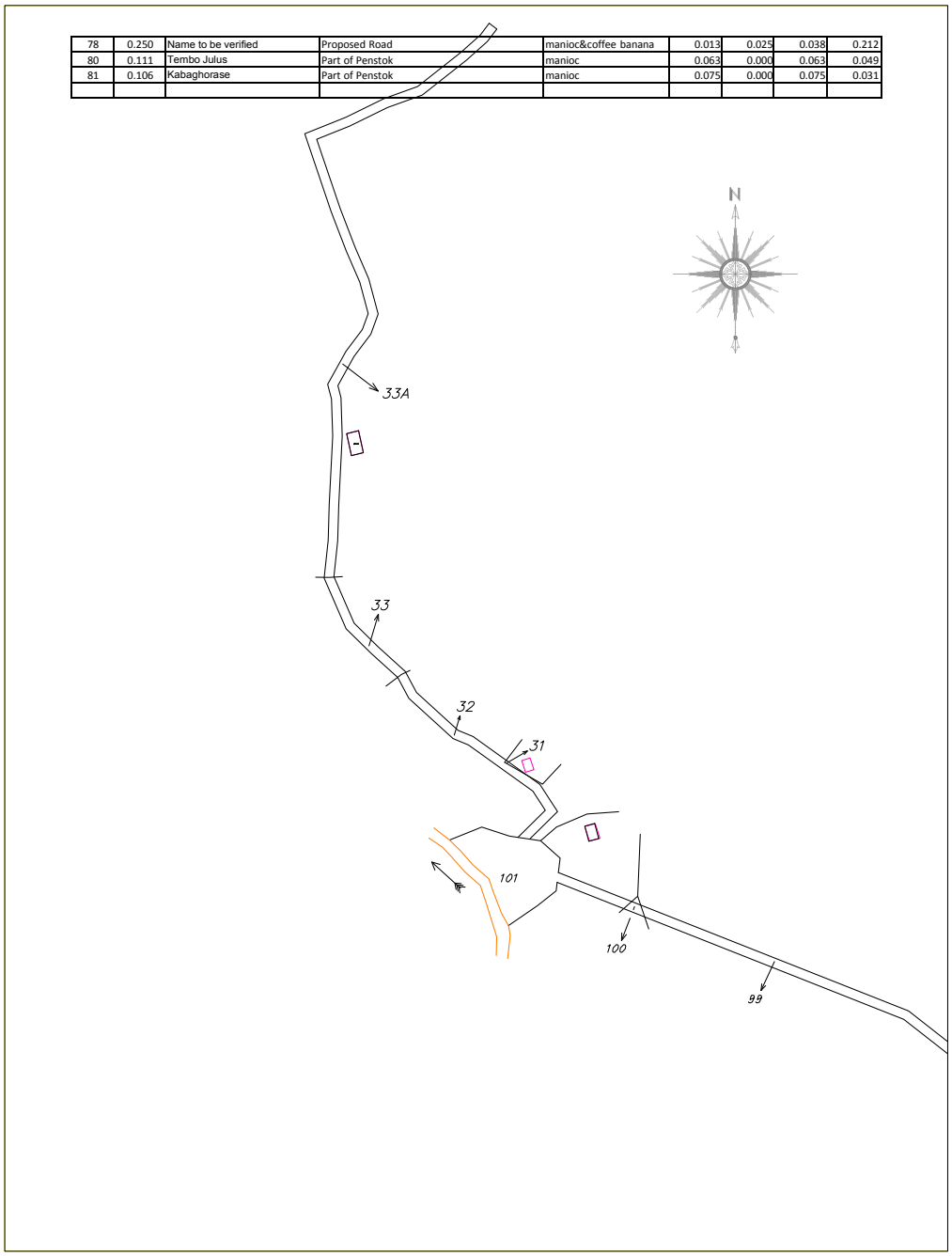
Note to GETFiT: Both the land survey details for the original ESIA and the updated land survey of September 2014 have been included here

ORIGINAL ESIA

Land Acquisition Requirement - Sindila MHP								
Plot No	Extent (Acres)	Name of Owner	Purpose	Crops	Extent (Acres)		Total Crops(A)	Free Land(A)
					1st Crop	2nd Crop		
1	0.116	Sedructc Musumboa	Part of Forebay	banana&coffee	0.006	0.019	0.025	0.091
2	0.075	Mumbeve Mutenyanye	Part of Forebay & Cannel	banana &manioc	0.019	0.031	0.05	0.025
3	0.091	Nyamutede Sekara	Part of Cannel	banana & manioc	0.031	0.025	0.056	0.035
4	0.087	Mbagherinde	Part of Cannel	coffee tree	0.031	0.000	0.031	0.056
5	0.089	Kyemwe Yodesi	Part of Cannel	free area	0.000	0.000	0.000	0.089
6	0.077	Mbusa Squle	Part of Cannel	free area	0.000	0.000	0.000	0.077
7	0.105	Bwambale Joneson	Part of Cannel	coffee tree	0.094	0.000	0.094	0.011
8	0.061	Thembo Musumda	Part of Cannel	yam&coffee	0.019	0.031	0.050	0.011
9	0.066	Kwerabuka	Part of Cannel	banana&manioc	0.019	0.031	0.050	0.016
10	0.002	Yokonia Bukondaika	Part of Cannel	manioc	0.001	0.000	0.001	0.001
11	0.021	Karide	Part of Cannel	banana&manioc	0.013	0.006	0.019	0.002
12	0.190	Bambonere	Part of Cannel	coffee&manioc	0.019	0.031	0.050	0.140
13	0.072	Wisselymuhindo	Part of Cannel	banana&yam	0.038	0.006	0.044	0.028
14	0.087	Ruchema Jestis	Part of Cannel	banana&coffee	0.031	0.019	0.050	0.037
15	0.022	Kiya Rubon	Part of Cannel	manioc&banana	0.006	0.013	0.019	0.003
16	0.085	Sunday Yokasi	Part of Cannel	free area	0.000	0.000	0.000	0.085
17	0.059	Kule Sekamubwera	Part of Cannel	free area	0.000	0.000	0.000	0.059
18	0.117	Moatenbatsi	Part of Cannel	manioc &banana	0.031	0.050	0.081	0.035
19	0.084	Sunday Iseak	Part of Cannel	manioc&coffee	0.013	0.031	0.044	0.040
20	0.084	Estion Mzabake	Part of Cannel	coffee tree	0.031	0.000	0.031	0.053
21	0.055	Monday Kambindi	Part of Cannel	yam&coffee	0.013	0.019	0.031	0.024
22	0.069	Themusaho Rughom	Part of Cannel	coffee & manion	0.013	0.019	0.031	0.038
23	0.087	Forest	Part of Cannel	banana	0.044	0.000	0.044	0.043
24	0.007	Mumbere Wisely	Part of Forebay	banana	0.003	0.000	0.003	0.003
25	0.049	John Kirenea	Part of Forebay & Penstok	banana&yams	0.013	0.013	0.025	0.024
26	0.077	Seemwele Basarerya	Part of Forebay & Penstok	banana &coffee	0.031	0.019	0.050	0.027
27	0.000	Yohana Musenene	Part of Penstok	banana	0.000	0.006	0.010	-0.010
28	0.015	Moasereka Neson	Part of Penstok	manioc& coffee	0.006	0.009	0.015	0.000
29	0.064	Mhhindo Willson	Part of Penstok	banana	0.013	0.025	0.038	0.026
30	0.008	Thembo Mulstoya	Part of Penstok	mnngo&manioc banana	0.006	0.000	0.006	0.001
31	0.002	Kamala Kahayika	Power House Access Road	manioc	0.001	0.000	0.001	0.001
32	0.156	Katoriki Charch	Power House Access Road	manioc	0.050	0.000	0.050	0.106
33	0.080	Yafa Bqmbenga	Power House Access Road	manioc	0.025	0.000	0.025	0.055
33A	0.190	Name to be verified	Power House Access Road (Semi motarable)	road	0.000	0.000		0.190
34	0.046	Shemu Pagheni	Proposed Forebay Access Road	free area	0.000	0.000		0.046
35	0.001	Semu Kalinda	Proposed Forebay Access Road	free area	0.000	0.000		0.001
36	0.087	Philimon Kalinda	Proposed Forebay Access Road	free area	0.000	0.000		0.087
37	0.017	Kabjniiki Nasson	Proposed Forebay Access Road	free area	0.000	0.000		0.017
38	0.049	Eriyakkalinda	Proposed Forebay Access Road	free arer	0.000	0.000		0.049

Plot No	Extent (Acres)	Name of Owner	Purpose	Crops	Extent (Acres)		Total Crops(A)	Free Land(A)
					1st Crop	2nd Crop		
39	0.004	Sundayedson	Proposed Forebay Access Road	free area	0.000	0.000		0.004
40	0.011	Kwulebemu	Proposed Forebay Access Road	free area	0.000	0.000		0.011
41	0.016	Maate Mukine Joas	Proposed Forebay Access Road	free area	0.000	0.000		0.016
42	0.020	John Mukine	Proposed Forebay Access Road	free area	0.000	0.000		0.020
43	0.052	Mbanb Zakalina	Proposed Forebay Access Road	free area	0.000	0.000		0.052
44	0.022	Bwambalemukine Wisely	Proposed Forebay Access Road	free area	0.000	0.000		0.022
45	0.017	Bwambale Emosi Mukimne	Proposed Forebay Access Road	free area	0.000	0.000		0.017
46	0.017	Government Land	Proposed Forebay Access Road	free area	0.000	0.000		0.017
47	0.025	Sunday Isaac	Proposed Forebay Access Road	free area	0.000	0.000		0.025
48	0.003	Samwiri Murotsqa	Proposed Forebay Access Road	no any cultivate	0.000	0.000		0.003
49	0.013	Kuule Justus	Proposed Forebay Access Road	no any cultivate	0.000	0.000		0.013
50	0.050	Rhoda Mbush	Proposed Forebay Access Road	free area road	0.000	0.000		0.050
51	0.044	Temdo Kasundi	Proposed Forebay Access Road	free area	0.000	0.000		0.044
52	0.047	Sunday Issac	Proposed Forebay Access Road	free area	0.000	0.000		0.047
53	0.010	Mbusa Wilson Kusund	Proposed Forebay Access Road	free area	0.000	0.000		0.010
54	0.007	Lyahinda Kasundt	Proposed Forebay Access Road	free area	0.000	0.000		0.007
55	0.036	Kabuaho Evenisi Vatewa	Proposed Forebay Access Road	free area	0.000	0.000		0.036
56	0.018	Baluka Crispas Kanudu	Proposed Forebay Access Road	sypress	0.000	0.000		0.018
57	0.015	Edireda Kasundi	Proposed Forebay Access Road	manioc&coffee	0.006	0.003	0.009	0.006
58	0.024	Isayakasundt	Proposed Forebay Access Road	free area	0.000	0.000		0.024
59	0.009	Dalukaochriston Kahugu	Proposed Forebay Access Road	coco	0.001	0.000	0.001	0.007
60	0.008	Bwembale Ranklin Kahuja	Proposed Forebay Access Road	coco	0.003	0.000	0.003	0.005
61	0.021	Muhindo Kamaison	Proposed Forebay Access Road	coco&coffee	0.013	0.000	0.013	0.009
62	0.014	Samuel Kasundi	Proposed Forebay Access Road	coco&coffee	0.013	0.001	0.014	0.000
63	0.017	Biira Edironi Musule	Proposed Forebay Access Road	coco&coffee	0.006	0.006	0.013	0.004
64	0.017	Bohniface Sepher	Proposed Forebay Access Road	coco	0.013	0.000	0.013	0.005
65	0.030	Bananuire Sephe Rkasundi	Proposed Forebay Access Road	coco	0.019	0.000	0.019	0.011
66	0.029	Musule Nelson Mumbere	Proposed Forebay Access Road	coco	0.022	0.000	0.022	0.007
67	0.105	Masereka Abel Mutiball	Proposed Forebay Access Road & Penstok	coco&banana	0.013	0.050	0.063	0.042
68	0.020	Bwambale Ratewa	Proposed Forebay Access Road	coco&banana	0.006	0.003	0.009	0.011
69	0.053	Muhindo Moris Georse	Proposed Forebay Access Road & Penstok	manio&coco	0.003	0.003	0.006	0.047
70	0.038	Masereka Abel Mutiball	Proposed Forebay Access Road & Penstok	banana manioc	0.006	0.031	0.038	0.000
71	0.154	Bwambale Ratewa	Proposed Forebay Access Road & Penstok	coco&banana	0.031	0.025	0.056	0.097
73	0.053	Yosefu Tsonan	Proposed Forebay Access Road	banana&manioc	0.013	0.009	0.022	0.031
75	0.042	Mgaten Mukudule	Proposed Forebay Access Road	banana&manioc	0.031	0.011	0.042	0.000
76	0.074	Aihea Muiyangash	Proposed Forebay Access Road	coffee tree	0.031	0.000	0.031	0.042
77	0.022	Muhindo Wilson	Proposed Forebay Access Road	free area	0.000	0.000		0.022

78	0.250	Name to be verified	Proposed Road	manioc&coffee banana	0.013	0.025	0.038	0.212
80	0.111	Tembo Julus	Part of Penstok	manioc	0.063	0.000	0.063	0.049
81	0.106	Kabaghorase	Part of Penstok	manioc	0.075	0.000	0.075	0.031



DRAWING SHOWING THE PROJECT LAYOUT OF

SINDERA MNI HYDRO POWER PROJECT

IN UGANDA

CLIENT: Butama Hydro Electricity Company LTD.

PROJECT: Sindera Mini Hydro Power Project

SCALE: 1:2000

DATE OF SURVEY: May 2011 - November 2011

SURVEYED: N.S.Dananjaya

CONTOUR INTERVAL: 1.00 Meters

DRAFTED: N.S.Dananjaya

CHECKED:

APPROVED:

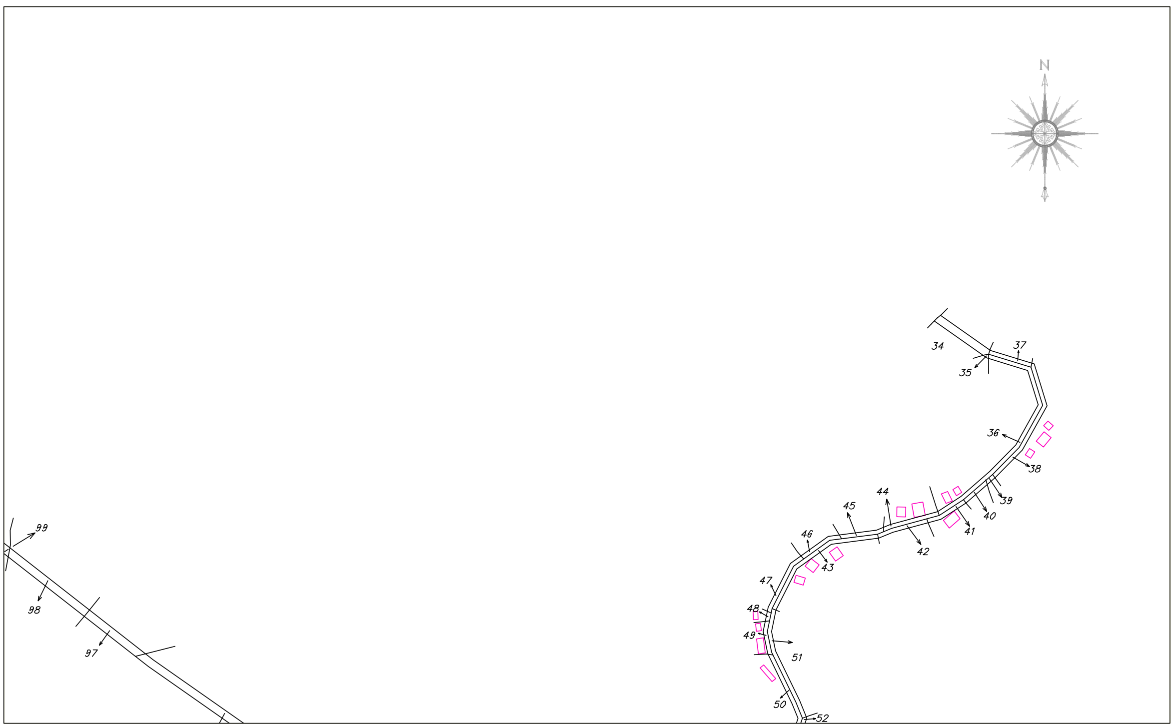
REVISION: 00

DATE OF DRAWING: 16.03.2012

SHEET: 1 of 6

SURVEYOR: Mr. N.S. Dananjaya
B.Sc Surveyor (University of Sabaragamuwa)
47/1, Wijaya Road, Kotahena, Maharagama
Phone:011-2803633, 0717274286; Fax:011-2802358
E-mail:dananjaya.12345@yahoo.com

SUPERVISOR: Mrs.K.W.D. Chandrani
Resident licensed Surveyor (Regn.No.109/99/181)
47/1, Wijaya Road, Kotahena, Maharagama
Phone:011-2803633, 0714791709; Fax:011-2802358
E-mail:chandrikakurukulasuriya@yahoo.com



DRAWING SHOWING THE PROJECT LAYOUT OF

SINDERA MNI HYDRO POWER PROJECT

IN UGANDA

111

CLIENT
Butama Hydro Electricity Company LTD.

PROJECT
Sindera Mini Hydro Power Project

SCALE	DATE OF SURVEY	
1:2000	May 2011 - Novermber 2011	
SURVEYED	CONTOUR INTERVAL	
N.S.Dananjaya	1.00 Meters	
DRAFTED	CHECKED	APPROVED
N.S.Dananjaya		
REVISION	DATE OF DRAWING	SHEET
00	16.03.2012	2 of 6

SURVEYOR
Mr. N.S. Dananjaya
B.Sc Surveyor (University of Sabaragamuwa)
47/1, Wijayaya Road, Navinna, Maharagama
Phone:011-2803633, 07173742486; Fax:011-2802358
E.mail:dananjaya.12345@yahoo.com

SUPERVISOR
Mrs.K.W.D. Chandrani
Registerd Licensed Surveyor (Reg No.19950181)
47/1, Wijayaya Road, Navinna, Maharagama
Phone:011-2803633, 0714791708; Fax:011-2802358
E.mail:chandranikaravita@yahoo.com

DRAWING SHOWING THE PROJECT LAYOUT OF

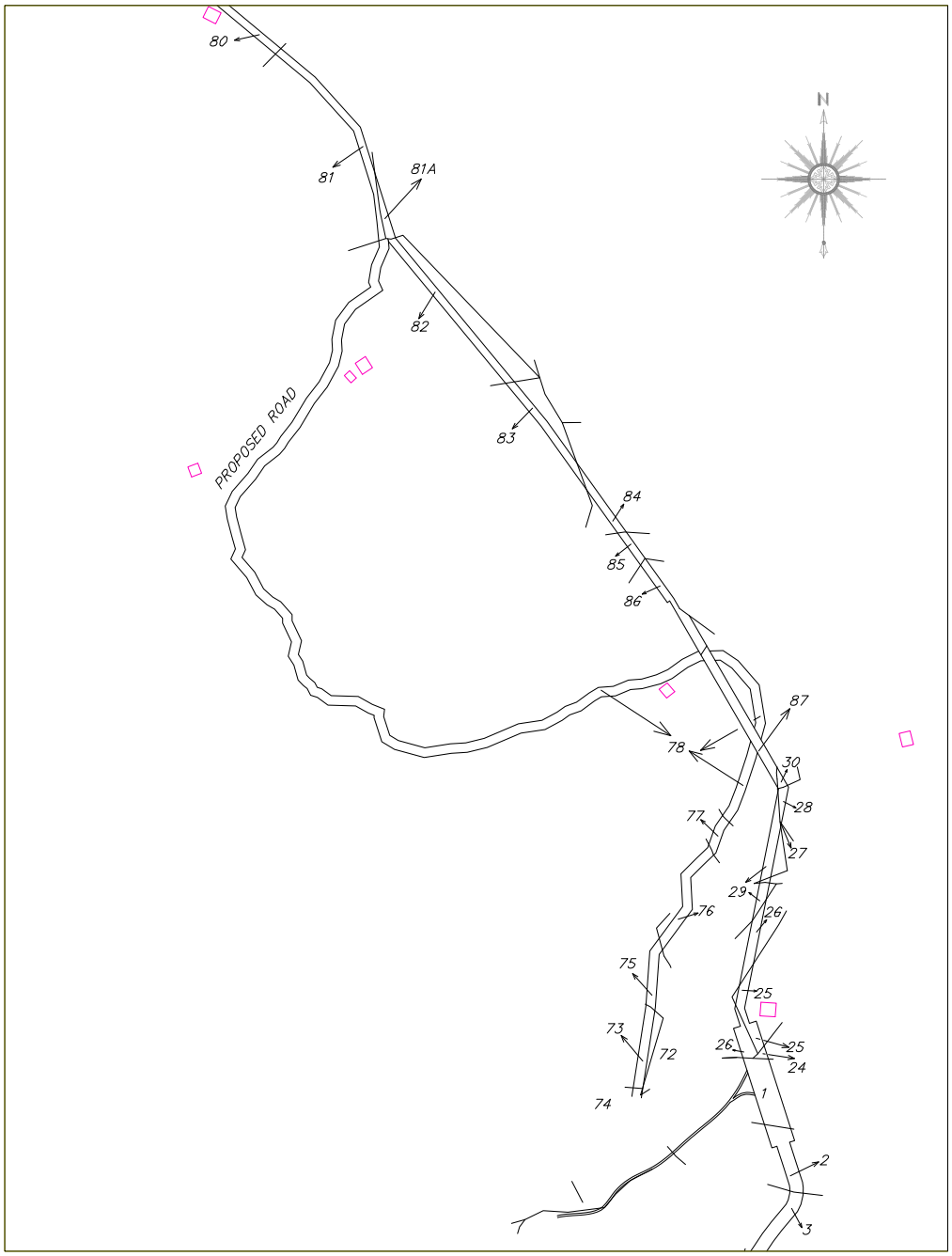
SINDERA MNI HYDRO POWER PROJECT

IN UGANDA

112

CLIENT Butama Hydro Electricity Company LTD.	PROJECT Sindera Mini Hydro Power Project
SURVEYOR Mr. N.S. Dananjaya B.Sc Surveyor (University of Sabaragamuwa) 47/1, Weliyaya Road, Navinna, Maharagama Phone:011-2803633, 07173742486; Fax:011-2802358 E.mail:dananjaya.12345@yahoo.com	SUPERVISOR Mrs.K.W.D. Chandrani Redisterd Licensed Surveyor (Reg.No.19950181) 47/1, Weliyaya Road, Navinna, Maharagama Phone:011-2803633, 0714791708; Fax:011-2802358 E.mail:chandranikaravita@yahoo.com

SCALE 1:2000	DATE OF SURVEY May 2011 - Novermber 2011	
SURVEYED N.S.Dananjaya	CONTOUR INTERVAL 1.00 Meters	
DRAFTED N.S.Dananjaya	CHECKED	APPROVED
REVISION 00	DATE OF DRAWING 16.03.2012	SHEET 3 of 6



DRAWING SHOWING THE PROJECT LAYOUT OF SINDERA MNI HYDRO POWER PROJECT IN UGANDA

CLIENT: Butama Hydro Electricity Company LTD.

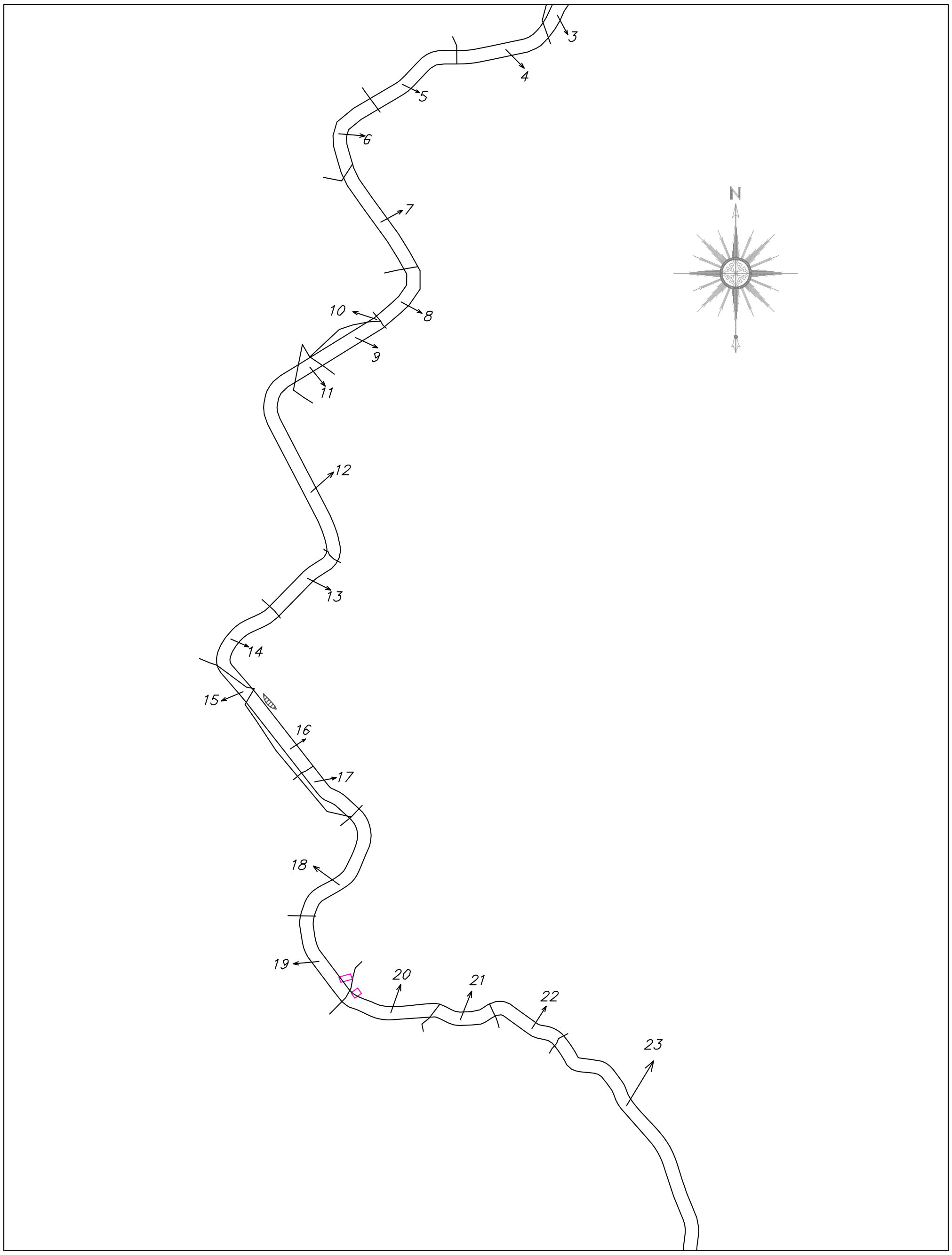
PROJECT: Sindera Mini Hydro Power Project

SCALE: 1:2000	DATE OF SURVEY: May 2011 - November 2011
SURVEYED: N.S.Dananjaya	CONTOUR INTERVAL: 1.00 Meters
DRAFTED: N.S.Dananjaya	CHECKED: APPROVED
REVISION: 00	DATE OF DRAWING: 16.03.2012

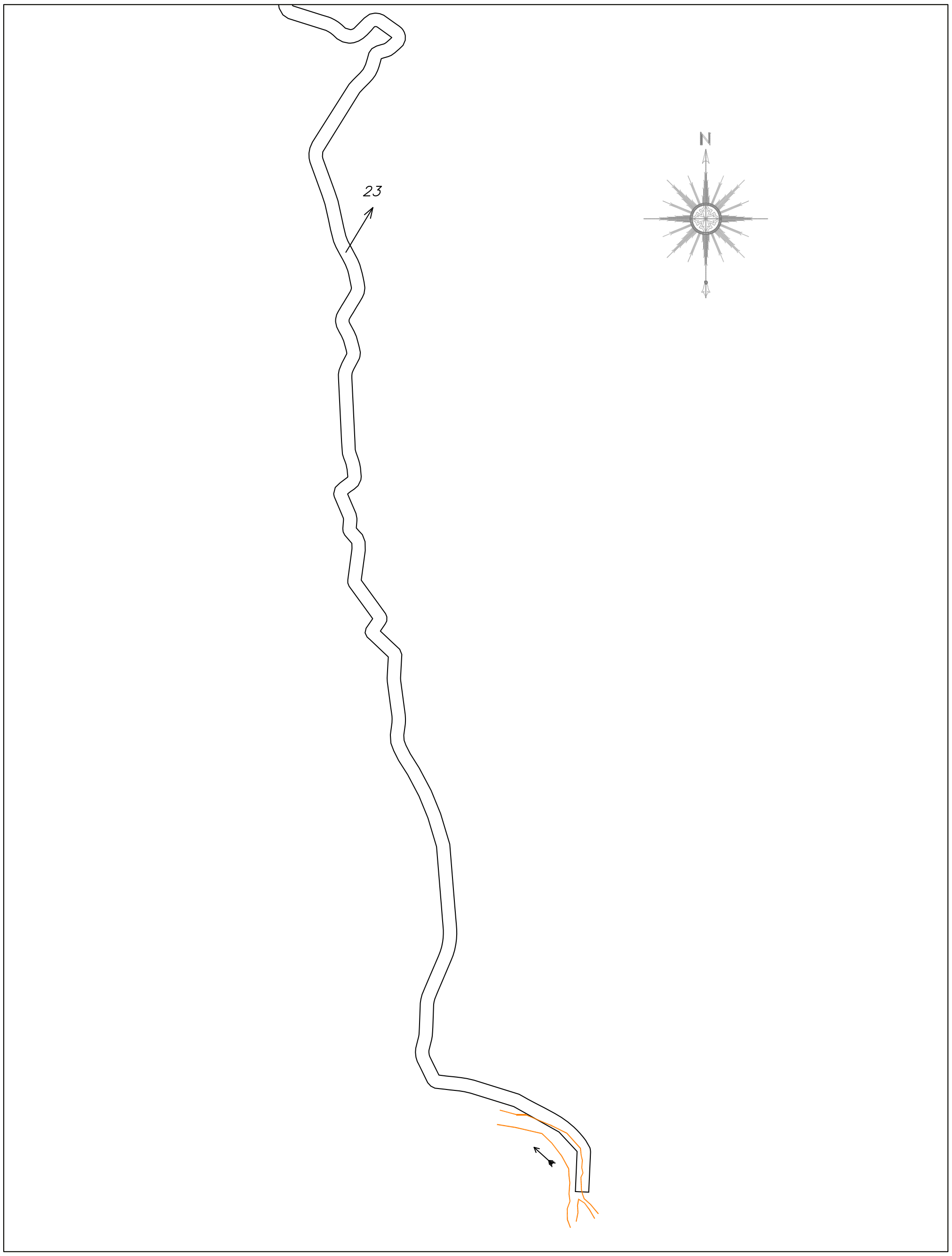
SURVEYOR: Mr. N.S. Dananjaya
B.Sc Surveyor (University of Sabaragamuwa)
47/1, Wellaya Road, Kurunegala, Maharagama
Phone:011-2803633, 0717374248 Fax:011-2802358
E-mail:dananjaya.123456@yahoo.com

SUPERVISOR: Mrs.K.W.D. Chandrani
Resident licensed Surveyor (Regn.No.109/99/181)
47/1, Wellaya Road, Kurunegala, Maharagama
Phone:011-2803633, 0714797709 Fax:011-2802358
E-mail:chandrikakurunegala@yahoo.com

SHEET: 4 of 6



DRAWING SHOWING THE PROJECT LAYOUT OF SINDERA MNI HYDRO POWER PROJECT IN UGANDA				
CLIENT: Butama Hydro Electricity Company LTD.		PROJECT: Sindera Mini Hydro Power Project		
		SCALE: 1:2000	DATE OF SURVEY: May 2011 - Novermber 2011	
SURVEYOR: Mr. N.S. Dananjaya B.Sc Surveyor (University of Sabaragamuwa) 47/1, Wijayaya Road, Navinna, Maharagama Phone:011-2803633, 07173742486; Fax:011-2802358 E.mail:dananjaya.12345@yahoo.com	SUPERVISOR: Mrs.K.W.D. Chandrani Redisterd Licensed Surveyor (Reg.No.19950181) 47/1, Wijayaya Road, Navinna, Maharagama Phone:011-2803633, 0714791708; Fax:011-2802358 E.mail:chandranikaravita@yahoo.com	SURVEYED: N.S.Dananjaya	CONTOUR INTERVAL: 1.00 Meters	
		DRAFTED: N.S.Dananjaya	CHECKED	APPROVED
		REVISION: 00	DATE OF DRAWING: 16.03.2012	SHEET: 5 of 6



DRAWING SHOWING THE PROJECT LAYOUT OF SINDERA MNI HYDRO POWER PROJECT IN UGANDA

CLIENT Butama Hydro Electricity Company LTD.		PROJECT Sindera Mini Hydro Power Project
SURVEYOR Mr. N.S. Dananjaya B.Sc Surveyor (University of Sabaragamuwa) 47/1, Wijayaya Road, Navinna, Maharagama Phone:011-2803633, 07173742486; Fax:011-2802358 E.mail:dananjaya.12345@yahoo.com	SUPERVISOR Mrs.K.W.D. Chandrani Registerd Licensed Surveyor (Reg.No.19950181) 47/1, Wijayaya Road, Navinna, Maharagama Phone:011-2803633, 0714791708; Fax:011-2802358 E.mail:chandranikaravita@yahoo.com	

SCALE 1:2000	DATE OF SURVEY May 2011 - Novermber 2011	
SURVEYED N.S.Dananjaya	CONTOUR INTERVAL 1.00 Meters	
DRAFTED N.S.Dananjaya	CHECKED	APPROVED
REVISION 00	DATE OF DRAWING 16.03.2012	SHEET 6 of 6

SEPTEMBER 2014

PROJECT:	SINDILA SHPP		VILLAGE: KYEBUMBA I		
PROJECT SUB COMPONENT: ACCESS TO POWER HOUSE			PARISH: NKURANGA	SUBCOUNTY: SINDILA	
LOT NO.	LAND OWNER	PROJECT LAND SIZE	TOTAL LAND SIZE	REMAINING LAND	REMARKS
		(Acres)	(Acres)	(Acres)	
1	Mubatsi Edward Maate	0.0371	3.6480	3.6109	
2	Mukirania Yokasi	0.1038	5.3410	5.2372	
3	Mubatsi Edward Maate	0.0018	0.0018	0.0000	
4	Bunyangule Catholic Church	0.3810	1.7700	1.3890	
5	Muhenda James	0.0217	0.1220	0.1003	
6	Mugisa Simon	0.0667	1.1370	1.0703	Also partly occupied by Power House Area
TOTAL		**0.6121**	**12.0198**	**11.4077**	

PROJECT:	SINDILA SHPP		VILLAGE: KYEBUMBA I		
PROJECT SUB COMPONENT: POWER HOUSE			PARISH: NKURANGA	SUBCOUNTY: SINDILA	
7	Bunyangule Catholic Church	0.1137	0.1137	0.0000	
8	Mbusa Daniel	0.2249	0.4830	0.2581	
TOTAL		**0.3386**	**0.5967**	**0.2581**	

PROJECT:	SINDILA SHPP		VILLAGE: MUSALAWO		
PROJECT SUB COMPONENT: PENSTOCK			PARISH: NKURANGA	SUBCOUNTY: SINDILA	
9	Mugisa Simon	0.0939	0.6760	0.5821	Kyebumba Village
10	Baluku Martin	0.0346	0.3670	0.3324	"
11	Bwambale Samuel	0.0395	1.5860	1.5465	"
12	Bananzi Friday	0.0371	1.2203	1.1832	"
13	Kyamanywa Jackson	0.0791	0.2300	0.1509	
14	Balisangayo James	0.0741	0.8530	0.7789	
15	Budima Edson	0.0865	0.1660	0.0795	
16	Musumba Yonasani	0.0136	0.2800	0.2664	
17	Mutanywana Justus	0.0865	0.1640	0.0775	
18	Bayisiriya Augustine	0.0717	0.5350	0.4633	
19	Mbusa Wilson	0.0445	1.0440	0.9995	
20	Masereka Isaiah Kasundi	0.0618	0.0950	0.0332	

21	Kabwe LC.1 Nursery School C/o Maate Zepher	0.1087	0.2630	0.1543	
22	Sunday Kighoma	0.0074	0.2020	0.1946	
23	Bwambale Rafiki	0.0717	0.1990	0.1273	
24	Masereka Isaiah Kasundi	0.0420	0.1490	0.1070	
25	Baguma Jailes	0.0420	0.2160	0.1740	
26	Kibethe Boniface	0.0494	0.0980	0.0486	
27	Samwiri Kasundi	0.0494	0.4720	0.4226	
28	Bwambale Zabuloni	0.0494	0.4695	0.4201	
TOTAL		**1.1429**	**9.2848**	**8.1419**	

PROJECT:	**SINDILA SHPP**		**VILLAGE: MUSALAWO/ BUNYAMWERA/ KABWE**		
PROJECT SUB COMPONENT: PENSTOCK ACCESS			**PARISH: NKURANGA/**	**SUBCOUNTY: SINDILA**	
			BUNYAMWEWRA		
29	Kasundi Samwiri	0.0939	0.5313	0.4374	Musalawo Village
30	Banganyire Zepha	0.1186	0.4626	0.3440	
31	Baguma Jailes	0.0890	1.2177	1.1287	Kabwe Village
32	Kyeya Justus	0.0321	2.7675	2.7354	"
33	Masereka Isaiah Kasundi	0.0692	1.4510	1.3818	"
34	Mbusa Wilson	0.0593	1.3838	1.3245	"
35	Kabugho Evanice	0.0084	1.3284	1.3200	"
36	Thembo Nehemiah	0.0086	0.0599	0.0513	Bunyamwera Village
37	Sunday Isaac	0.0618	0.1174	0.0556	Kabwe Village
38	Ganatiya Bikwaso	0.0057	0.1009	0.0952	"
39	Kibethe Boniface	0.0136	0.0728	0.0592	"
40	Maate Zepha Banganyire	0.0062	0.0939	0.0877	"
41	Bwambale William	0.0203	0.6927	0.6724	Bunyamwera Village
42	Mulyangasu Sedrack	0.0069	0.0563	0.0494	Kabwe Village
43	Biira Yodesi	0.0067	0.4547	0.4480	"
44	Kule Justus	0.0054	0.0989	0.0935	"
45	Matovu Medivan	0.0077	0.0554	0.0477	Bunyamwera Village
46	Murotsya Samwiri	0.0067	0.0469	0.0402	Kabwe Village
47	Kakooko Eliphaz	0.0040	0.0380	0.0340	"
48	Kule Mulyangasu	0.0086	0.1134	0.1048	"
49	Sunday Isaac	0.0035	0.0146	0.0111	"

50	Thembo Kasundi	0.0030	0.0146	0.0116	"
51	Jesca Kabugho Kadoma	0.0082	0.2110	0.2028	Bunyamwera Village
52	Bunyamwera Parish/ Local Council II	0.0188	0.2530	0.2342	"
53	Kule Justus	0.0069	0.1170	0.1101	"
54	Kule Richard	0.0185	0.4370	0.4185	"
55	Mbambu Jackline	0.0445	0.4760	0.4315	"
56	Kalinda Philemon	0.1137	1.3720	1.2583	"
57	Bunyamwera LCI Nursery School	0.0072	0.0639	0.0567	"
58	Sunday Mukine	0.0175	0.1600	0.1425	"
59	Kalinda Biira (*Wife of late Kalinda Eriya)*	0.0321	0.9430	0.9109	"
60	Kule Semu	0.0766	1.1550	1.0784	"
61	Kalinda Philemon	0.0166	0.1130	0.0964	"
62	Kalinda Semu	0.0220	0.7000	0.6780	"
63	Bwambale Zabuloni	0.0346	0.9765	0.9419	"
TOTAL		**1.0564**	**18.1501**	**17.0937**	

PROJECT:	**SINDILA SHPP**		**VILLAGE: KABWE/ BUNYAMWERA**		
PROJECT SUB COMPONENT: PENSTOCK ACCESS/ PENSTOCK			**PARISH: BUNYAMWERA**	**SUBCOUNTY: SINDILA**	
64	Bwambale George	0.1211	2.5441	2.4230	Kabwe Village
65	Bwambale Zabuloni	0.0074	0.0074	0.0000	"
66	Masereka Abel	0.0242	0.4112	0.3870	"
67	Kule Zepha	0.1137	1.1564	1.0427	"
68	Thembo Murotsya	0.0074	0.9785	0.9711	Bunyamwera Village
69	Thembo Murotsya	0.0133	0.0133	0.0000	"
70	Thembo Julius	0.0890	2.4779	2.3889	Kabwe Village
71	Baluku Yakobo c/o *Ithungu Annet*	0.0939	2.7181	2.6242	"
72	Bwambale Ezron	0.0395	6.2961	6.2566	"
TOTAL		**0.5095**	**16.6030**	**16.0935**	

PROJECT:	SINDILA SHPP		VILLAGE: KABWE		
PROJECT SUB COMPONENT: FOREBAY TANK ACCESS			PARISH: BUNYAMWERA	SUBCOUNTY: SINDILA	
73	Bwambale Ezron	0.0272	0.0272	0.0000	Kabwe Village
74	Masereka Semu Kisoro	0.0247	0.2471	0.2224	"
75	Peter Kasaija	0.0939	1.5790	1.4851	"
76	Baluku Robert	0.0494	0.3719	0.3225	"
77	Isaya Basuba	0.0445	0.3954	0.3509	"
78	Friday Andreya	0.0988	0.7314	0.6326	"
79	Baluku Stanley	0.1310	0.4411	0.3101	"
80	Kule Mulyangasu	0.0692	0.6721	0.6029	"
81	Baluku Clerkson Mulyangasu	0.0445	0.3321	0.2876	"
82	Thembo Mulyangasu c/o *Mbambu Dolice*	0.1013	0.5691	0.4678	"
83	Masereka Shem Kisoro	0.0519	0.9108	0.8589	"
84	Baguma William	0.1359	1.5470	1.4111	"
85	Mulyangasu Ainea	0.1087	1.4492	1.3405	"
86	Kule Mulyangasu	0.0049	0.1112	0.1063	"
87	Kadoma Jesca Kabugho	0.0568	0.5634	0.5066	"
88	Thembo Murotsya	0.1754	0.1112	-0.0642	"
89	Nguru Rutewa	0.0692	0.6301	0.5609	"
90	Muhairwe Joram	0.4547	2.5204	2.0657	"
91A	Kabugho Elizabeth	0.0494	0.2770	0.2276	"
91B	Muhindo Muthende Wilson	0.0618	0.4136	0.3518	"
92	Maate Mukunduli Johnson	0.0395	0.4982	0.4587	"
93	Tsongo Samwiri	0.1952	2.4710	2.2758	"
94	Muleju Jowasi	0.0988	1.5740	1.4752	"
95	Kaghughu Church Of Uganda	0.0136	0.1483	0.1347	"
96	Sedrack Musumba	0.0175	0.0395	0.0220	"
97	Ntuma Nursery school C/o Kule Robert/ Bulimbenda	0.0519	0.2842	0.2323	*/ Also occupied by spil way
98	Rughuma Justus	0.0232	0.1631	0.1399	"
99	Sedrack Musumba	0.1013	0.3558	0.2545	"
TOTAL		**2.3942**	**19.4344**	**17.0402**	

PROJECT:	SINDILA SHPP		VILLAGE: BUNYAMWERA/ KAGHUGHU/ NTUMA		
PROJECT SUB COMPONENT: PENSTOCK/ FOREBAY TANK			PARISH: BUNYAMWERA	SUBCOUNTY: SINDILA	
100	Masereka Shem Kisoro	0.0964	0.2471	0.1507	Bunyamwera Village
101	Murotsya Bagheni	0.0650	0.4569	0.3919	"
102	Murotsya Erisa	0.0568	1.1465	1.0897	"
103	Muhindo Samson	0.0840	1.7346	1.6506	"
104	Muhairwa Joram	0.0215	0.3855	0.3640	Kaghughu Village
105	Muhairwa Joram	0.0175	0.0175	0.0000	"
106	Musyenene Yohana	0.0544	0.5560	0.5016	"
107	Samwiri Tsongo	0.0247	0.5931	0.5684	Ntuma Village
108	Kiringa John	0.1211	2.1201	1.9990	"/Forebay Tank
TOTAL		**0.5414**	**7.2573**	**6.7159**	

PROJECT:	SINDILA SHPP		VILLAGE: NTUMA		
PROJECT SUB COMPONENT: FOREBAY TANK			PARISH: BUNYAMWERA	SUBCOUNTY: SINDILA	
109	Musumba Sedrack	0.1433	1.7421	1.5988	Ntuma Village

PROJECT:	SINDILA SHPP		VILLAGE: NTUMA		
PROJECT SUB COMPONENT: CANAL			PARISH: BUNYAMWERA	SUBCOUNTY: SINDILA	
110	Mumbere Charles	0.0445	0.4077	0.3632	Ntuma Village
111	Nyamutedya Justus	0.0079	0.0779	0.0700	"
112	Nyamutedya Zakeri	0.0988	0.5832	0.4844	"
113	Faisi Kyakimwa	0.0964	0.9980	0.9016	"
114	Bambonire Rughuma	0.0791	0.4003	0.3212	"
115	Bwambale Yonasani	0.0840	0.3099	0.2259	"
116	Mbusa Saul	0.1606	1.7124	1.5518	"
117A	Musumba Karidi	0.0865	0.5745	0.4880	"
117B	Bukundika Yokoniah	0.0350	1.8996	1.8646	"
118	Thembo Musumba	0.1161	1.7791	1.6630	"
119	Rughuma Josephat	0.1656	2.8169	2.6513	"
120	Bambonire Rughuma	0.1804	3.6620	3.4816	"
121	Kiiza Rauben	0.1853	2.2054	2.0201	"
122	Kule Erisania	0.1557	0.9251	0.7694	"

123	Sungwa Isaac	0.0544	0.7116	0.6572	"
124	Maate Byatsi	0.0890	0.7116	0.6226	"
125	Biira Naume	0.0593	0.9873	0.9280	"
126	Rughuma Josephat (Justus)	0.0815	0.4413	0.3598	"
127	Mbusa Saul	0.0840	0.3113	0.2273	"
128	Thembo John	0.1878	4.6949	4.5071	"
129	Bwambale Gideon	0.2496	6.5976	6.3480	"
130	Bwambale Watsurawa	3.0369	58.7110	55.6741	"
TOTAL		**5.3384**	**91.5186**	**86.1802**	

PROJECT:	**SINDILA SHPP**		**VILLAGE: KABWE/ BUNYAMWERA**		
PROJECT SUB COMPONENT: PENSTOCK ACCESS			**PARISH: BUNYAMWERA**	**SUBCOUNTY: SINDILA**	
131	Bwambale Zaburoni	0.0470	0.9765	0.9295	Kabwe Village
132	Masereka Abel	0.0490	0.0490	0.0000	"
133	Kule Zephanus	0.0300	1.1564	1.1264	"
134	Bwambale Eziron	0.0370	0.0370	0.0000	Bunyamwera Village
135	Bwambale Eziron	0.0070	0.0070	0.0000	"
136	Mbambu Sarah	0.0250	1.3467	1.3217	"
137	Thembo Julius	0.0470	0.9785	0.9315	"
138	Thembo Julius Kasundi	0.0890	2.4779	2.3889	"
139	Bwambale Eziron	0.1560	6.2961	6.1401	"
140	Baluku Yakobo	0.0220	2.7181	2.6961	"
TOTAL		**0.5090**	**16.0432**	**15.5342**	

PROJECT:	SINDILA SHPP		VILLAGE: NTUMA/ KABWE		
PROJECT SUB COMPONENT: SPIEL WAY			PARISH: BUNYAMWERA	SUBCOUNTY: SINDILA	
141	Bwambale Joseph	0.0111	0.2224	0.2113	Ntuma Village
142	Nyamutedya Ezekiel	0.0237	1.8977	1.8740	"
143	Rughuma Jasper	0.0152	0.1114	0.0962	"
144	Kaghughu Church Of Uganda	0.0107	0.2150	0.2042	"
145	Bambonire Rughuma	0.0463	5.5598	5.5134	"
146	Bulimbenda Rabson	0.0686	6.8570	6.7885	"
147	Mumbere Eliphaz	0.0575	4.9791	4.9216	"
148	Bwekwaso Ganatiya	0.1853	55.5975	55.4122	Kabwe Village
149	Sandala Alex	0.0474	1.5814	1.5340	"
150	Sandala Simon	0.0241	0.7710	0.7469	"
TOTAL		**0.4900**	**77.7923**	**77.3023**	

Strip Map

Please refer to attached AutoCAD file labeled “Cadastral Map, Sindila.dwg”.

ANNEXURE 9: DETAILED NOISE MEASUREMENTS RECORDED WITHIN THE PROPOSED SINDILA MHP PROJECT AREA

NOISE DATA COLLECTION FORM

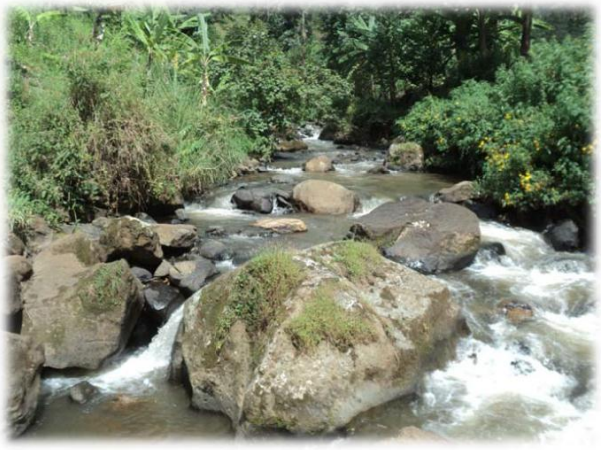
Location	Zone: 35N		Altitude/m	Date	Time (24)	Weather	Maximum Noise (dB[A])	Minimum Noise (dB[A])	Duration of measurement in minutes	Notes on sources of noise
	UTM (X)	UTM (Y)								
Access road; meets community foot path	0833096	0066321	1261	29/05/14	08:47	rainy	46.8	40.9	1	Noise was influenced by insects and children
Access road to the Bunyamwera Trading center	0832925	0066182	1262	29/05/14	08:57	rainy	66.2	64.4	1	Conversations from people and rain
Along the access road	0832909	0066028	1278	29/05/14	09:11	rainy	60.9	41.7	1	Conversations from people
Sensitive receptor (Household)	0832918	0065874	1275	29/05/14	09:21	rainy	45.2	29.4	1	Noise was influenced by noise from birds, and other insects.
Sensitive receptor (Household Along Sindila penstock)	0832928	0065801	1273	29/05/14	09:22	cloudy	39.8	37.0	1	Noise was influenced by birds, and other insects. insects
Sensitive receptor(penstock and house hold)	0833028	0065722	1275	29/05/14	09:24	cloudy	50.9	37.4	1	Conversations from people
Sensitive receptor (nursery school near the forebay)	0833279	0065105	1493	29/05/14	10:36	Cloudy	59.0	55.0	1	Conversations from people
Proposed Sindila fore bay site				29/05/14	11:01	Rainy	58.0	51.6	1	Noise levels were influenced by conversations from people, and birds and insects calls.
Sensitive receptor (Homestead)	0832992	0065906	1276	30/05/14	08:38	Cloudy	50.5	40.9	1	Noise was influenced by the river flow, noise from birds, and other insects. insects
Sensitive receptor (Homestead)	0832993	0065855	1266	30/05/14	08:43	Cloudy	37.2	30.5	1	Noise from birds and other insects.
Along Sindila headrace canal	35N 0833253	0064830	1548	30/05/14	10:17	Cloudy	43.7	35.3	1	Noise was influenced by the river flow, noise from birds, cicadas and other insects.
Sensitive receptor (Homestead)	0833216	0064702	1547	30/05/14	10:25	Cloudy	39.9	32.6	1	Noise was influenced by the river flow, noise from birds, cicadas and other insects.
Sensitive receptor (Homestead)	0833219	0064666	1535	30/05/14	10:34	Cloudy	63.3	43.2	1	Noise was influenced by the river flow, noise from birds, cicadas and other insects
Sindila headrace canal			1518	30/05/14	10:43	Cloudy	44.2	91.6	1	Noise from birds, cicadas and other

NOISE DATA COLLECTION FORM

Location	Zone: 35N		Altitude/m	Date	Time (24)	Weather	Maximum Noise (dB[A])	Minimum Noise (dB[A])	Duration of measurement in minutes	Notes on sources of noise
	UTM (X)	UTM (Y)								
										insects
Proposed Sindila weir			1400	30/05/14	13:32	Sunny	73.01	71.4	1	Noise was influenced by the river flow, noise from birds, cicadas and other insects
Sensitive receptor (Homestead)	0833301	0065204	1484	30/05/14	13:45	Cloudy	54.6	38.8	1	River Sindila and sound from insects calls and conversation from the nearby community
Sensitive receptor (Homestead)	0833042	0065711	1276	30/05/14	14:35	Sunny	42.7	30.4	1	Sound from insects calls and conversation from the nearby community
Sensitive receptor (Homestead)	0832791	0065918	1356	30/05/14	14:48	Sunny	42.6	45.2	1	Sound from birds and insects calls and conversation from the nearby community
Proposed Sindila Powerhouse			1120	30/05/14	14:55	Cloudy	46.0	43.0	1	Sound from birds and insects calls and conversation from the nearby community.
Sensitive receptor along the powerhouse access road (Homestead)	0832451	067000	1106m	30/05/14	15: 35	Cloudy	57.7	54.0	1	Calls from birds and insects and background conversations by the local community
Proposed camp site	0832231	066365	1121m	30/05/14	15:43	Cloudy	56.7	38.9	1	Background conversation from the neighbouring homesteads

ANNEXURE 10: HYDROLOGY STUDY REPORT

River Sindira Hydrology Assessment



14 September 2014

Eng. Dr. Henry K. Ntale
Vala Associates (Ltd).
P. O. Box 5933, Kampala, Uganda
Email: hntale@vala.biz
Phone: +256 751 746 384

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Executive Summary

A comprehensive hydrology assessment has been carried out on River Sindira, in order to assess the potential of the hydropower site that was identified on the river at coordinates 29°59'E and 34°44'N within Bwamba County of Bundibugyo District.

The drainage basin for Sindira hydropower project comprises of R. Sindira whose headwaters arise from the Mount Ruwenzori ranges. The total Sindira catchment that would contribute flow to the SHP project would be 38.62 km^2. The average rainfall for the catchment is 2054mm.

Due to the consistent cloud cover, sharp slopes, high altitude and considerable rainfall, the Sindira (SHP) catchment in general should have very low losses due to evapo-transpiration, and a high net yield. The losses due to evapo-transpiration and Ground Water Recharge are conservatively estimated at 40%, with a river runoff of 60% of the incident precipitation.

River Sindira is ungauged, like the rest of the rivers that flow off the western slopes of the Rwenzoris into the DRC and River Semuliki. There was no basis to establish a linear relationship between the R. Sindira and the gauged rivers that flow off the Eastern slopes of the Rwenzoris (such as Ruimi, Mobuku and Nyamwamba). Therefore, the approach that was adopted was to carry out hydrological modelling using available climate data and catchment characteristics. The SWAT model (http://swat.tamu.edu) was used for flow generation. Data for running the model were collected from various sources, including the Department of Meteorology for rainfall and other climate data as well as various internet sources for elevation (DEMs), land use, geology and soil data. Statistical analysis was then carried out on the modelled flow to estimate the different hydrological parameters.

The daily discharge data of the Mt Ruwenzori Rivers is highly skewed. Even though the average daily discharge of River Sindira (SHP) is 1.47 m^3/s, the median discharge (Q50) of the sites are 1.14m^3/s. This is an important note that should carefully be taken into consideration when designing the corresponding hydropower facilities for the sites. The Flow Duration Curve (FDC) for the river shows that a discharge of 2.93m^3/s is exceeded 10% of the time while 0.33 m^3/s is exceeded 80% of the time.

An environmental flow reserve of 0.15m^3/s has been proposed for the river section that will be looped by the canal/penstock system (using the Tennants method).

Given that there are times of the year when the flows at this site are quite low, it is important that a discharge gauge be placed at the site as soon as possible to monitor the flows. The data obtained shall be used to improve the hydrologic estimates at the site

1 Hydro-Climatology of the River Sindira Catchment

1.1 Background

Due to the amount of rainfall and the many rivers and streams that come down the slopes of the Ruwenzori mountain range, there is a high potential for hydropower generation in the region. River Ndugutu is one of the several perennial rivers that originate from the western slopes of the Ruwenzori flowing down through the western Ruwenzori National Park, several villages where it soon confluences with River Sindira whose combined waters eventually drain into River Lami/Semliki.

KMR Infrastructure has identified a hydro potential site on River Sindira approximately 12.6km downstream of the river source. In order to assess the site's power potential, there is need to analyse the river's catchment characteristics and the discharge patterns including its low and high flows. The results of this analysis will constitute an important input into the design process of the proposed Hydro-electricity facility at the site and provide an indication of its safe capacity and hydrological reliability. The river is ungauged.

1.1.1 Objectives

The objective was to carry out a hydrological assessment for River Sindira to inform decisions on the design flow quantity and reliability for purposes of designing the proposed hydro-electric power facilities.

1.1.2 Assignment scope

The scope of the hydrological assessment was as follows:-

(a) Evaluation of catchment details with particular reference to the areas of the catchment close to the proposed weirs intake and power house
(b) Estimation of annual average rainfall details and related analysis and observations
(c) Estimation of daily flow series (flow Vs percentage of occurrence) of the catchment for a typical year considering the given weir location.
(d) Provision the daily river flow data of Weir points that was used for daily flow series, over the years, (for the purpose of daily energy calculations)
(e) Assessment of flood and low flow frequency
(f) Any other assessments relevant to the design of the hydropower facilities (sediment estimation, environmental flow analysis etc.)

1.2 Sindira Catchment Characteristics

1.2.1 General Geology of the area

The Ruwenzori mountain range is an up-faulted (horst) block found in the middle of the rift valley. The range emerges almost directly from the plains with virtually no significant foothills apart from out-wash fans. The Ruwenzori range is composed of deformed rocks and highly metamorphosed pre-Cambrian rocks. The highest peak at Mt. Stanley (5110m a.s.l) is the highest land spot in Uganda. Small glaciers, ice fields and permanent snow are found on this range, apart from residuals on and remnants of upland surface, respectively.

Although the present form of the Rift Valley is due to movements during early Pleistocenic times, the original lines of crystal weakness along which these faults developed were initiated in pre-Cambrian times. In the immediate vicinity of the fault the rocks are highly sheared and altered by the enormous forces involved in the rift movement. The up-thrust mass of Ruwenzori is the most remarkable product of rift movement, where the block is estimated to have been elevated by as much as 3,000 meters above sea level. The structure of Mt. Ruwenzori is highly complex, consisting of a basement complex, magmatite series of granitic and amphibolitic gneisses and schists with massive quartzites, and synorogenic granites.

The geological formation of the area is mainly composed of basement complex from the precambrian era. Undifferentiated gneisses and granulite facies of metamorphic type predominate. There is a clear variation in soil properties from the upper part of the catchment to the lower reaches. Luvisols are dominant in the forested upper catchment elevations, Ferrasols dominate the middle reach while the podzols found in the lower reach contain dispersed organic matter and other minerals.

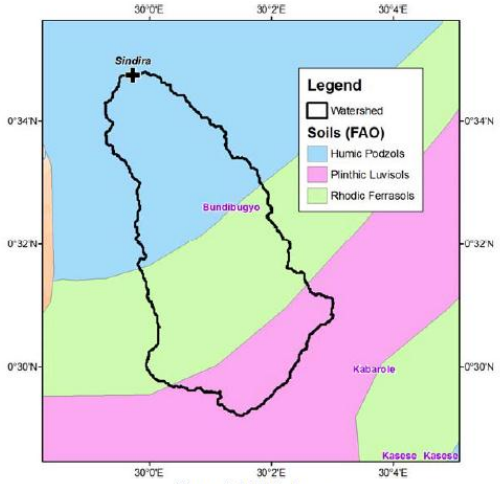

Figure 1-1: Soil classes

1.2.2 Drainage Characteristics

The drainage basin for Sindira hydropower project lies on the western slopes of Mountain Ruwenzori and is largely covered by the Ruwenzori National Park. The exact location of the proposed hydraulics take-off point for Sindira hydro-electric power are at coordinates of 29°59'E and 34°44'N within Bwamba County of Bundibugyo District (Figure 1-1). The River flows in a north easterly direction from the Ruwenzori Mountain Ranges towards the Congo Border. The catchment has a near oval shape with a maximum length (in the direction of flow) of 10 km and a maximum width of 3.6 km. The catchment area upstream of the proposed site is 38.6 km^2. The catchment elevation varies between 1,525 m asl at to about 3,821 m asl with an average of 2,769 m asl.

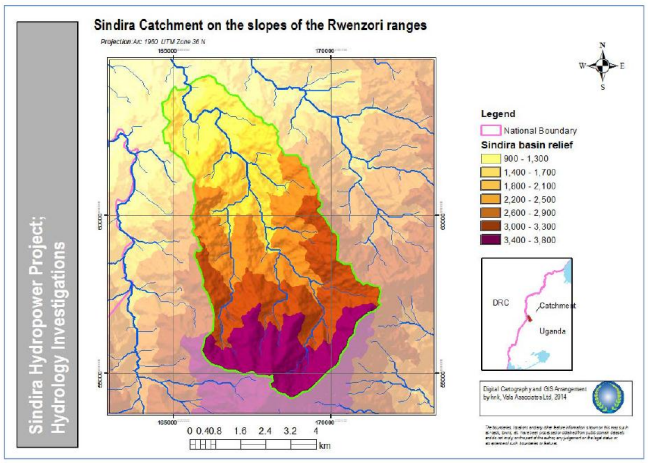

Figure 1-2: River Sindira and its catchment

1.3 Climate of the Sindira Basin

The Sindira catchment upstream of the take-off point is situated entirely in the western Ruwenzori alpine slopes. The general climate of the area is controlled by movement of air masses associated with the inter-tropical convergence zone (ITCZ) which results in a bimodal precipitation variation with wetter periods in from March-May and from August-November, separated by relatively drier periods. Unlike typical monsoon climates that are derived from a reversal of wind currents from the northeast in January to the southwest in July, a north-south reversal in East Africa causes the heavy rains to occur in April and October (Taylor et al. 2007).

1.3.1 Temperature

Temperature varies over a small range (Figure 1-3). Maximum temperature varies from 24.2°C in November to 29.2°C in March. Minimum temperature varies from 13.2°C in December to 15.1°C in March. Relative humidity varies from 59% in March to 86% in November. Average wind speed is 6.2 km/h.

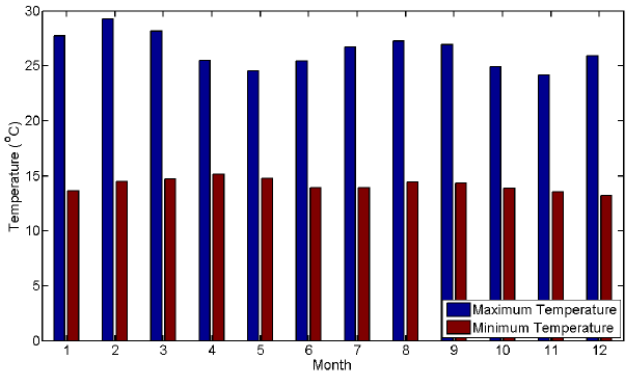

Figure 1-3: Temperature variation

1.3.2 Rainfall

Precipitation in the Ruwenzori Mountains occurs primarily during two pronounced seasons from March to May and August to November as demonstrated by the average monthly rainfall of Bundibujo rainfall station (Figure 1-4). The Mach-May rainy season receives 31% of annual rainfall while the August-November season receives 48% meaning that the two rainy seasons are responsible for 80% of the annual rainfall amount. There is also a strong orographic effect exerted by topography on rainfall. Mean annual rainfall at Bundibugyo is about 1350 mm but it can be as higher as 2300 mm higher in the mountains (Figure 1-4).

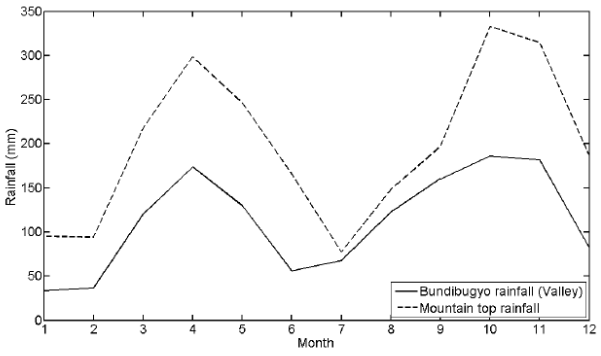

Figure 1-4: Sindira Rainfall variation.
Rainfall estimates in the higher elevations were downloaded from http://globalweather.tamu.edu

Rainfall gauging has only recently[1] (2012) started within the central high Ruwenzori massif. There are no a records from the National Meteorological services that track rainfall in the Ruwenzori mountains above 2500m asl. The only historical sustained measurements of precipitation within the core alpine areas of the Ruwenzori Mountains were collected by Osmaston (2006). Mean annual precipitation at four locations from 1951 to 1954 similarly showed pronounced variations with altitude. From the base of the mountains around 1250 m amsl, precipitation was observed to increase with rising elevation from 1150 mm per annum to a maximum annual precipitation of 2600 mm per annum recorded at 3290 m amsl in the Heath-moss forest zone. Above this, precipitation decreased to 2000 mm per annum at Lake Bujuku in the Afroalpine zone within the Central Ruwenzori Massif (Figure 1-5).

[1] Rainfall Gauges have been recently installed by the Uganda Wildlife Authority and Africa Nyamwamba Ltd, a private Developer of the Nyamwamba Hydropower Project at heights above 3000m

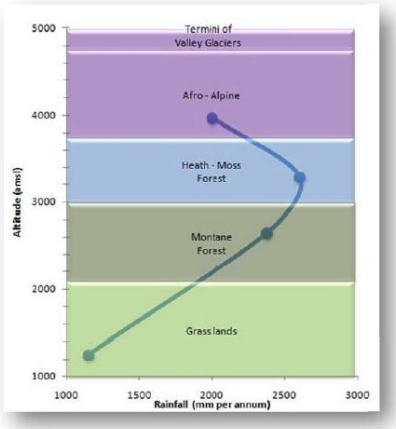

Figure 1-5 Plot of trends in observed precipitation with altitude in the Ruwenzori mountains.

The main vegetation zones (ecotones) are indicated in Figure 1.5 for reference. Data derive from Osmaton (1989) and Taylor et al. (2007). Fluctuations in sea surface temperatures of the Indian Ocean are thought to account largely for the observed interannual variability in East African precipitation. However the source of precipitation to the alpine areas of the Ruwenzori Mountains remains complicated by the fact that air currents of a different origin and direction than those at low elevations are frequently observed in the mid-troposphere (Whittow, 1960).

The spatial rainfall distribution in the Sindira catchment has been reconstructed using the available reports (Osmaton, 1989; Taylor et al. 2007 and rainfall data from the Bundibujo rainfall station) using GIS tools to arrive at Figure 1-6.

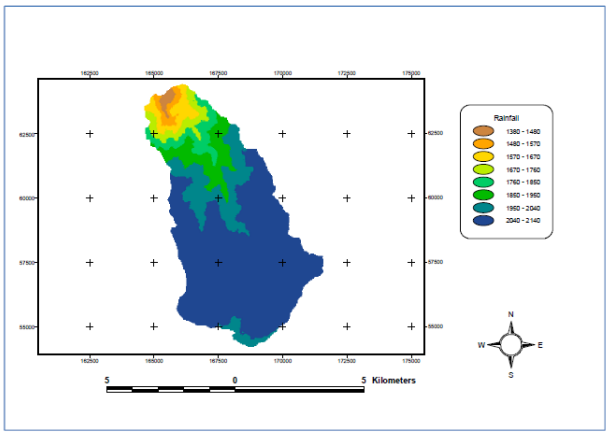

Figure 1-6 Average annual rainfall in the Sindira catchment

It will be observed from Figure 1-6 above that the Sindira catchment is a very wet one, with a weighted average of 2054 mm per annum.

1.3.3 The Glacial melt component of the Alpine River flows.

There are those who may have some fears that the melt-waters Ruwenzori alpine glaciers may strongly affect the hydrological regime and variability of the alpine rivers such as Sindira. This concern is unfounded. Taylor et al (2006, 2007) have investigated these Glaciers in detail and have established that meltwater flows from glaciers in the Ruwenzori Mountains do not contribute significantly (> 0.5%) to alpine riverflow. This conclusion, based on stream fluxes which Taylor et al (2007) measured during the dry season, is consistent with suggestions from Temple (1967) and Osmaston (2006).

Even then, recent field mapping and analysis of Landsat imagery confirm a rapid decline in the areal extent of glaciers on the Central Ruwenzori Massif that is consistent with an overall recessionary trend over the 20th century. Glacial cover on the three remaining glacierised summits (Mounts Stanley, Speke and Baker) has decreased from 2.01±0.56 km² in 1987 to 0.96±0.34 km² in 2003 and is expected to disappear within the next two decades. As of now, there is no active glacier within the R. Sindira catchment.

1.3.4 Land cover of the Sindira Catchment

Land cover is an important variable in the assessment of potential runoff from a watershed and for River Sindira this is composed of montane forests and Heath moss Forests. Higher up, towards the peaks, the woodlands gradually thin down to Afro – Alpine vegetation. (**Figure 1-7**). There are and subsistence farms near the off-take point. Further depletion of the montane

tropical forests will no doubt affect the hydrology of the Sindira several ways particularly in the sediment transport quantities of the river.

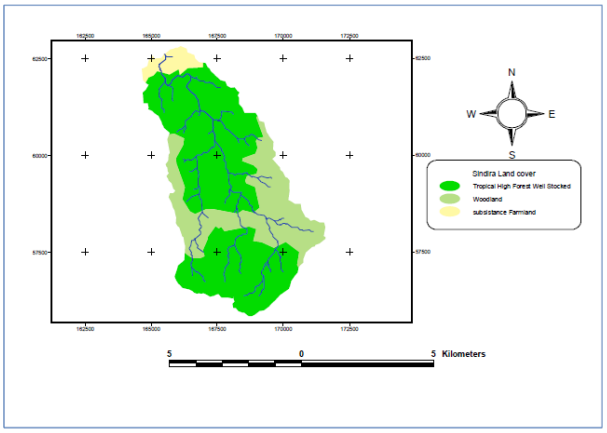

Figure 1-7 Vegetation cover of River Sindira SHP catchment

1.4 River Topography

The main stream has a length of about 12 km upstream of the proposed site while is joined by two large streams and several smaller ones. The source of the main river is at an elevation of about 3106 m asl while the elevation at the proposed site is 1525 m asl giving an elevation range of 1581 m and a gradient of 11.3%. The river has a number of rapids and falls along its length, some of which are potential HEP sites. However, there is a rapid drop in elevation downstream of the proposed site of 350m in a distance of 1.8 km.

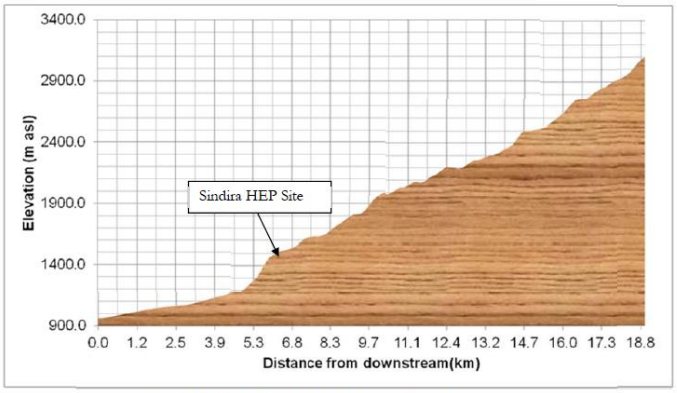

Figure 1-8: Hypsometric curve for the main river

2 The Sindira River flow characteristics

2.1 River Discharge data

2.1.1 Sindira (SHP) Catchment Net Yield and ET Losses.

Due to the consistent cloud cover, sharp slopes, high altitude and considerable rainfall, the Sindira (SHP) catchment in general should have very low losses due to evapo-transpiration, and a high net yield. The losses due to evapo-transpiration and Ground Water Recharge are conservatively estimated at 40%, with a river runoff of 60% of the incident precipitation. The catchment yield estimates are given in Table 2-1 below.

Table 2-1 Catchment yield estimates for the Sindira SHP basin

Property	Amount	Unit
Catchment Area	38.62	km^2
Average Catchment Rainfall	2054.24	mm
Catchment Gross Yield	79,334,749	m^3
Less ET and Ground Water Recharge Losses of 40%	32,976,829	m^3
Catchment Net Yield	46,357,920	m^3
Mean Annual Discharge (MAD)	1.47	m^3/s

2.1.2 Generation of the River Sindira Discharge data

River Sindira is ungauged implying that there are no readily available flow records for carrying out hydrological assessment. The approach that was adopted was to carry out hydrological modelling using available climate data and catchment characteristics. The SWAT model (http://swat.tamu.edu) was used for flow generation. Data for running the model were collected from various sources, including the Department of Meteorology for rainfall and other climate data as well as various internet sources for elevation (DEMs), land use, geology and soil data. Statistical analysis was then carried out on the modelled flow to estimate the different hydrological parameters.

In order to evaluate the hydrology of Sindira river, use was made of the semi-distributed Soil and Water Assessment Tool (SWAT) under the Automated Geospatial Water Assessment (AGWA) environment. The SWAT-AGWA model has been adopted for this study in part because of its ability to characterize complex watershed representations to explicitly account for spatial variability of soils, rainfall distribution, and vegetation heterogeneity; its ability to show the effects of different land management practices on surface runoff and sediment yield and also its ability to characterize surface runoff and sediment yield producing mechanisms.

SWAT was developed to predict the impact of land management practices on water, sediment, and agricultural chemical yields in large watersheds with varying soils, land use, and management conditions over long periods of time. The model simulates eight major components: hydrology, weather, erosion and sediment transport, soil temperature, crop growth, nutrients, pesticides, and agricultural management. Major hydrological processes that can be simulated by the model include evapotranspiration (ET), surface runoff, infiltration, percolation, shallow aquifer and deep aquifer flow, and channel routing.

SWAT uses the modified Universal Soil Loss Equation (USLE) by Wischmeier and Smith (1965) to estimate soil erosion and sediment caused by rainfall and runoff. Sediment yield prediction is improved because runoff is a function of antecedent moisture condition as well as rainfall energy. To parameterise the SWAT model, the Automated Geospatial Watershed Assessment (AGWA) tool was used. Spatial datasets of Elevation, Soils, and land cover were used to develop input files for SWAT. In particular, the AGWA tool was used to prepare datasets, run the SWAT model, and display results. The following steps were followed when using AGWA to run the SWAT model for the Sindira basin:

a) Watershed delineation using a 30 m DEM
b) Watershed parameterisation using topographic properties as well as land cover and soils information. The land cover and soils data were obtained from the FAO archives.
c) Writing the precipitation files. The precipitation data were obtained from the Meteorology Department databases, Ministry of Water and Environment. However, all stations in the Meteorology Department database are located at the foothills of Mountain Ruwenzori. Therefore, they are not representative of the true rainfall variations, especially high in the mountain. To account for the variation, additional precipitation data was obtained from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) dataset (http://globalweather.tamu.edu/). The dataset is global in nature and was prepared as a best estimate incorporating both ground-based and satellite data inputs.
d) Writing parameter files and running SWAT
e) Viewing results and calibration of the model.

2.1.2.1 Data preparation

To run the SWAT model, a number of datasets were necessary as detailed below

a) Rainfall and climate data:- measured data were obtained from the Directorate of Meteorology in the Ministry of Water and Environment. There are no long term rain gauges at the high mountain elevations where Sindira HEP site is located. To simulate the orographic effect, data were obtained from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) website (http://globalweather.tamu.edu). The data were then combined with rain gauge data from the valley to construct the rainfall database.
b) Climate data:- Climate data (temperature, humidity, sunshine hours etc.) for the study area are very scant and unreliable. Therefore data from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CFSR) website (http://globalweather.tamu.edu) were used.
c) Other datasets include the FAO soil dataset, the Uganda land-use dataset, the ASTER GDEM dataset (http://asterweb.jpl.nasa.gov/gdem.asp)

2.1.2.2 Model outputs

Based on the SWAT modelling results, the long term mean daily flow at the proposed site is 1.47 m^3/s with a standard deviation of 1.38 m^3/s (Figure 2-1). The modelled minimum flow was 0.02 m^3/s while the maximum flow was 27.1 m^3/s. The monthly flow varied between 0.1 Million cubic m (MCM) and 12.9 MCM with an average of 3.9 MCM (Figure 2-2). The annual flow varied between 33.9 MCM and 69.2 MCM with an average of 46.3 MCM.

In terms of total monthly cumulative flows, the mean monthly flow varies between 1.2 MCM in August and 6.7 MCM in November (Figure 2-3). Another peak flow of 6.2 MCM is experienced in May while February experience a second flow minima of 1.5 MCM.

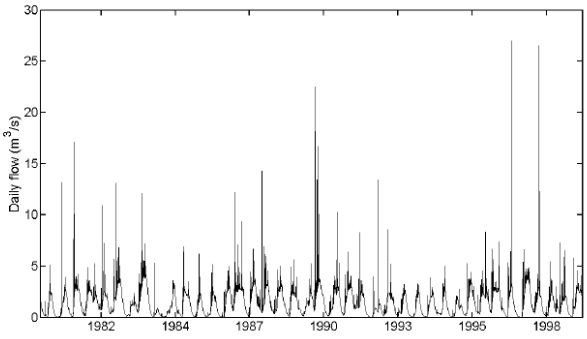

Figure 2-1: Modelled Daily flow for R. Sindira

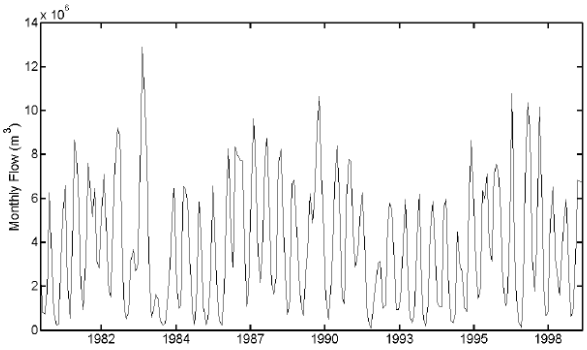

Figure 2-2: Monthly flow for Sindira

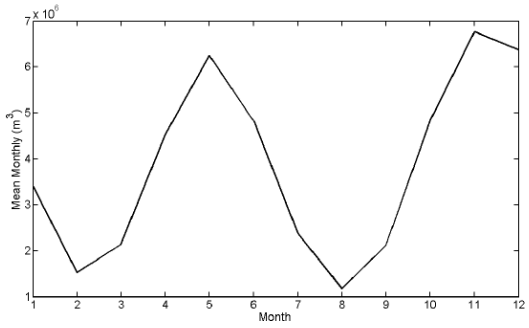

Figure 2-3: Mean monthly flow for R. Sindira

2.1.2.3 Flow duration curve

Analysis of the flow duration curve for the river shows that the median flow is 1.14 m^3/s while the mean flow has an exceedance probability of 43% (Figure 2-4). The flows corresponding to different exceedance probabilities are shown in Table 2-2.

Table 2-2: R. Sindira exceedance probabilities

Exceedance probability	Flow (m^3/s)
1%	4.77
5%	3.44
10%	2.93
20%	2.48
50%	1.14
80%	0.33
90%	0.16
95%	0.10
99%	0.04

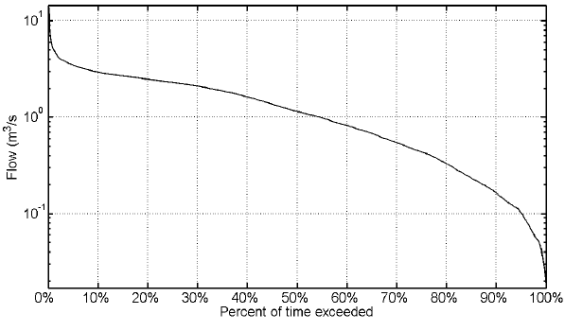

Figure 2-4: River Sindira flow duration curve

The derived mean monthly flows for the period 1980 – 2000 are presented in Annex 1 while the annual summary statistics for the catchment are presented in Table 2-3.

Table 2-3 Summary Statistics of the R. Sindira (SHP) derived Flows

Year	Minimum (m^3/s)	Maximum (m^3/s)	Mean (m^3/s)	Median (m^3/s)
1980	0.03	13.2	1.03	0.6
1981	0.09	17.1	1.70	1.7
1982	0.34	13.1	2.00	1.9
1983	0.12	12.1	1.81	1.3
1984	0.04	5.3	0.73	0.5
1985	0.06	6.9	1.24	1.0
1986	0.04	5.2	1.06	0.5
1987	0.10	12.2	2.19	2.4
1988	0.32	14.3	1.83	1.4
1989	0.11	5.6	1.26	1.1
1990	0.12	22.5	2.08	2.1
1991	0.20	8.3	1.79	1.7
1992	0.02	13.4	0.92	0.6
1993	0.11	3.3	0.99	0.6
1994	0.05	5.1	1.05	0.7
1995	0.07	5.3	1.14	0.8
1996	0.30	8.4	1.91	2.1
1997	0.02	27.0	1.50	0.8
1998	0.14	26.5	1.66	1.4
1999	0.09	7.3	1.46	1.2

The characteristics of the derived Sindira (SHP) time series are demonstrated in Figure 2-5 below.

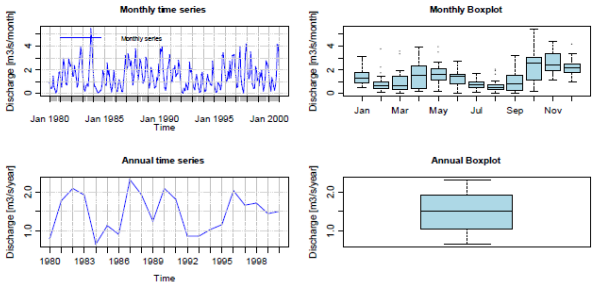

Figure 2-5 Hydroplots of the modelled Sindira SHP discharge

2.1.3 Comparison of derived River Sindira (SHP) water balance with nearby rivers

A rapid water balance was carried out for the River Sindira (SHP) using the derived discharge. A similar exercise was carried out for gauged Ugandans rivers (MWE, 2013) in their water resource assessment study from which Table 2-4 has been extracted.

Table 2-4 Comparison of water balance of R. Sindira (SHP) with nearby rivers

Station No.	Name	Area (km^2)	Rainfall	Runoff (m^3/s)	Runoff (mm)	Actual Evapotranspiration (mm)	Runoff Coefficient (Q/P) (%)
86201	Aswa	5,009	1,196	16.12	101	1,094	8.5
86213	Agago	4,450	1,160	5.06	36	1,125	3.1
86202	Aswa	2,770	1,392	27.41	312	1,080	22.4
87207	AyugiAtiak	1,076	1,299	10.9	319	980	24.6
87203	OraOkollo	1,726	1,266	14.09	257	1,008	20.3
87212	OraInde	1,002	1,044	7.42	234	810	22.4
87205	Kochi	898	1,365	6.24	219	1,146	16.1
85217	Waki-II	478	1,309	3.02	199	1,110	15.2
84227	Chambura	640	1,244	7.62	375	869	30.2
84267	Mitano	2,133	1,277	13.8	204	1,073	16
84264	Ntungwe	500	1,259	3.23	204	1,055	16.2
84228	Nyamugasani	492	1,069	7.7	493	576	46.1
84224	Rukoki	187	979	5.3	896	83	91.5
84219	Sebwe	86	980	2.32	851	128	86.9
	Sindira	**38.62**	**2054.24**	**1.47**	**1200**		**60.0**

It will be noted from the Table 2-4 above that Alpine catchments have a high runoff coefficients compared to the flatter basins. Sindira (SHP) catchment is higher in altitude than the rest of the sites and hence is expected to have less Evapotranspiration losses due to greater cloud and biomass (forest) cover. Using a composite map of mean annual potential open water evaporation for East Africa developed by Dagg et al. (1970), it can be established that the Potential Evapotranspiration (ET) of the Ruwenzori catchments is in the range 1400 – 1600mm. The higher cloudy slopes altitudes over 2,700 m probably have lower potential ET than 1400mm per annum. The actual evapotranspiration would be significantly less, in the range of 60 to 70% of the Potential ET. The rest of the water losses should be attributed to canopy interception and ground water recharge losses.

2.2 Extreme Value Analysis

The annual maximum and minimum flow series was formed by selecting the highest (and lowest) daily mean flow occurring in each year of the record respectively. The set of the derived average maxima (minima) are assumed to be a random statistical sample from the population of all possible maxima (minima) at the site. The Gringorten plotting formula (i-0.44)/(N+0.12), was used in the analysis. This formula is suitable when fitting any of the family of General Extreme Value distributions (GEV) to the data.

2.2.1 Low flow analysis

Low flow were analysed by carrying out frequency analysis on the 7-day low flow series of the river. The 7-day low flow series is the minimum cumulative flow over a 7-day period in a given year. The series followed the Lognormal distribution closely (Figure 2-6). Table 2-5 shows the low flows for the river that correspond to the various recurrence intervals.

Table 2-5: Low flows vs recurrence interval

Recurrence interval (years)	Low Flow (m^3/s)
2	0.098
5	0.048
10	0.033
25	0.022
50	0.017
100	0.013
1000	0.007

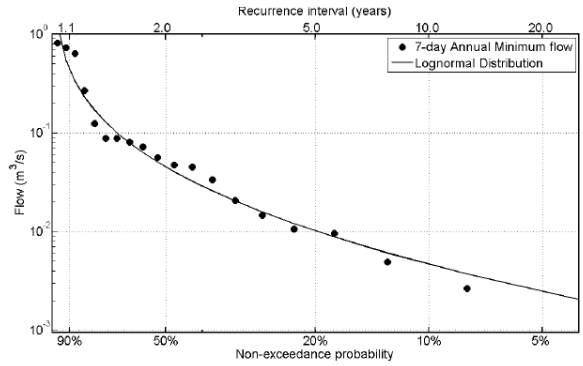

Figure 2-6: Low flow analysis for R. Sindira

2.2.2 Flood frequency analysis

Flood frequency analysis was carried out on the measured flow to determine the peak flows corresponding to various recurrence intervals using the following procedure

1. An annual maximum series was extracted from the simulated daily flows.
2. A probability distribution that best fits the annual maximum series was then selected for modelling the peak flows. A generalised extreme value (GEV) distribution performed best and was selected
3. The lognormal distribution was used to estimate the flow corresponding to different recurrence intervals (return periods). Given the nature of the proposed development, the selected recurrence intervals for estimation were 5, 10, 25, 50, 100, 500 and 1000 years which correspond to risks for at least one flood episode for a structure with a design life of 30 years of 99%, 95%, 70%, 45%, 26%, 6% and 3% respectively.
4. Estimation of the peak flood magnitudes (Table 2-6)

Table 2-6: Flood frequency analysis

Return period	Flow	Risk of at least one episode for a 30 year design life
10	21.5	96%
25	31.1	71%
50	40.5	45%
100	52.3	26%
200	67.1	14%
500	92.6	6%
1000	117.8	3%

2.3 A preliminary consideration of environmental impacts and mitigation measures of the R. Sindira (SHP)

The full extent of the impacts and mitigation measures to be undertaken before, during and after the implementation of the Sindira SHP project will be established after a comprehensive Environmental and Social Impact Assessment (ESIA) for the project. The following paragraphs are a preliminary assessment mainly informed by the understanding of the hydrology of the site, its physiographic properties and general observations noted during the site visit. First the Environmental flow reserve for the project is discussed and later the potential impacts and mitigation measures proposed

2.3.1 Environmental Flow Reserve for the Sindira SHP Project

The environmental flow is the amount of water that should be kept flowing down a river in order to maintain the river in a "desirable" environmental condition. Environmental flows are all about using the water resources sustainably to maintain the river in a predefined ecological state. The relation between the human need and the ecological need must be decided, and the recognition that there is a limit when a water resource suffers irreversible damage to its ecosystem functions. impacts and mitigation measures including recommendations for environmental flow requirements

2.3.1.1 Environmental flow methodology

There are mainly four categories of environmental flow determination methodologies, which are :

1. **Hydrological** (Desktop Estimates, Look Up Table)	This is a simple and rapid method that uses hydrological data to derive the environmental flow requirement. A "minimum flow" often represents the flow intended to maintain the recommended river condition. Hydrological methodologies are generally used for the planning level and have been applied widely, both in developed and developing countries. The Tennant Method is the most widely used hydrological method.
2. **Hydraulic Rating** (Rapid Determinations)	These type of methodologies measure changes in various single river hydraulic variables (e.g. depth and velocity) to develop a simple relationship between biota habitat availability and river flow. A common methodology is the Wetted Perimeter Method, developed in Australia.
3. **Habitat Simulation** (Habitat Rating, Expert Panels, Intermediate)	The Habitat Simulation methodology provides links between discharge and available habitat conditions. It uses key target biota to predict habitat discharge curves or habitat time and exceedence services. PHABSIM, developed in U.S.A. is the most commonly applied methodology.
4. **Holistic** (Holistic Approaches, Frameworks, Comprehensive)	In a holistic approach all important flow characteristics (high floods, base flows etc.) are identified. These methodologies incorporate hydrological, hydraulic and habitat simulation models. The Building Block Methodology (BBM) is a holistic methodology and was developed in South Africa.

This assessment has adopted the hydrological method, in particular the Tennant method, owing to its simplicity where by the environmental flow regimes are prescribed on the basis of the average daily discharge or the mean annual flow (MAF). In general cases, 10% of the MAF is recommended as a minimum instantaneous flow to enable most aquatic life to survive, while 30% MAF is recommended to sustain a good habitat.

2.3.1.2 Sindira SHP flow configuration and Environmental flows

The proposed configuration of the Sindira SHP is a straight forward run-of-the-river scheme with a diversion point; detour through a canal, then through a penstock to a power house after which all the water shall return to the original river course downstream.. An issue that concerns us is the amount of [environmental] flows that should be reserved to maintain the ecology of the section that will be looped by the canal-penstock system.

In regards to this aspect, the observation from the site visit was that:-

- there were no large-scale human water uses within this river reach;
- there were no sacred sites for prayers, swearing or taking oaths, circumcision, etc. within the river reach
- there was no small holder irrigation use of the water within the river reach

Since there are no significant water uses within the looped river reach we recommend that an environmental flow amounting to 10% of the Mean Annual Flow (MAF) be allowed to maintain the riverine system. The Mean Annual Flow for River Sindira SHP is 1.47 m^3/s. Therefore at least 0.15 m^3/s should be allowed to pass thru at all times to maintain the 1.7km riverine section.

Provision should be made at the diversion weir to allow for seasonal flushing to rejuvenate the looped river section.

2.3.2 Anticipated Impacts and Mitigation Measures for the Sindira SHP Project

One of the tasks of this assignment is preliminary identification of potential environmental impacts of the project and proposing mitigation measures. At this point, the consultant has identified some impacts as outlined in the sections below.

2.3.2.1 Positive Impacts

The following are some of the anticipated positive impacts of the Sindira (SHP) project. They are:

- The Project of necessity shall include specific integrated watershed management measures which will likely bring about improved environmental management in and around the wider watershed areas of the project;
- Some local can benefit from sale of local construction materials to the project such as sand and other fill materials;
- It is expected that, delivery of social services will likely improve once electricity is in place. Immunization, education and security will likely improve in the area;
- The electricity to be generated will likely induce other developments in the area in the long run;
- Access routes for transportation of equipment and, project machinery will be improved thereby benefitting the locals;
- The project will lead to production of electricity that will stimulate growth of agro-processing industries which will bring about a number of positive multiplier effects on the communities livelihoods;
- During construction phase, the communities will get benefits in terms of employment.

2.3.2.2 Negative Impacts

At this stage of the study, the preliminary potential impact examination has identified the following impacts:

- Land is a very critical factor in the Ruwenzori sub region. Social issues regarding land availability and subsequent compensation aspects will likely be crucial for the success of the project in view of scarce land in the areas of the project;
- Loss of vegetation through clearances of the sites and access roads;
- Noise and vibrations from equipment operations as well as air quality concerns;
- Due to the diversion of the river for a short distance, the ecosystem near the Project area should be taken in consideration during the ESIA;
- Pollution of water sources from loose soils, and agro-chemical residual impacts;
- HIV/AIDS from the workforce and the communities;

2.3.2.3 Proposed mitigation measures

The mitigation measures listed in Table 2-7 could go a long way in addressing the negative impacts earlier identified in the section above for the Sindira SHP Project.:

Table 2-7 Key impacts and mitigation measures for the planned Sindira SHP Project

N°.	Project Impact	Mitigation measures
01.	Land uptake through construction of access roads, camp sites, etc	Compensation for land uptake after Resettlement Action Plan (RAP) studies.
02.	Concerns relating to management of cut to spoil materials	Disposal sites for cut to spoil have to be approved by the Supervising consultant.
04.	Loss of vegetation through clearances of the sites and access roads.	Restrict clearances to work/designated portions or areas. Compensatory planting of trees by the projects.
05.	Conflicts in water use due to a multiplicity of users (power generation, water supply and irrigations needs including local domestic uses further downstream).	Put in place site-based sectoral committees to handle equitable and rational use of water in the project. Good enough The Hydropower water use is a **non – consumptive** water use. Even then There is need to plan the development of this SHP site while ensuring that the needs of other users are taken care of.
08.	Soil erosion concerns which will likely arise through loose soil materials causing sedimentation	Soil control measures have to be instituted during works implementation.
09.	Pollution of water sources from loose soils, and agro-chemical residual impacts.	Impacts of water quality from agro-chemicals have to be mitigated through monitoring water quality parameters during the project phases.
10.	Equipment related concerns in terms of oil spillages, used batteries and oil filters as well as used tyres.	Preparing decommissioning plan and site restoration and re-grassing.
11.	Human waste management especially in workers camp sites.	Measures for human waste management to be instituted on the sites.
12.	Noise and vibrations	Noise from equipment and the workforce
13.	HIV/AIDS from the workforce and the communities	Contractors to work with HIV/AIDS service providers to sensitize communities on HIV/AIDS. Furthermore, the project should work out HIV/AIDS mitigation measures with the district leadership and the health department so that there should be an HIV/AIDS programme dedicated to the project. This is important in that, the project will affect social dynamic of the areas, hence there will be induced developments and population influx which all will have impacts on the communities with reference to HIV/AIDS prevalence.
15.	Crime rate possible increase	Working together with the police and law enforcement agencies to control crime in the areas.
17.	Impacts on biodiversity areas of high conservation concerns (Important Bird Areas- national and central forest reserves)	In all, the detailed ESIA should investigate this issue and propose appropriate mitigation measures.

3 Summary and conclusion

A comprehensive hydrology assessment has been carried out on River Sindira, in order to assess the potential of the hydropower site that was identified on the river at coordinates 29°59'E and 34°44'N within Bwamba County of Bundibugyo District. The following are the principal findings:

- The total Sindira catchment that would contribute flow to the SHP project would be 38.62 km^2. The average rainfall for the catchment is 2054 mm.
- The losses due to evapo-transpiration and Ground Water Recharge are conservatively estimated at 40%, with a river runoff of 60% of the incident precipitation.
- River Sindira is ungauged, like the rest of the rivers that flow off the western slopes of the Ruwenzori into the DRC and River Semuliki. There was no basis to establish a linear relationship between the R. Sindira and the gauged rivers that flow off the Eastern slopes of the Rwenzoris (such as Ruimi, Mobuku and Nyamwamba). Therefore, the approach that was adopted was to carry out hydrological modelling using available climate data and catchment characteristics. The SWAT model (http://swat.tamu.edu) was used for flow generation.
- The daily discharge data of the Mt Ruwenzori Rivers is highly skewed. Even though the average daily discharge of River Sindira (SHP) is 1.47 m^3/s, the median discharge (Q50) of the sites are 1.14m^3/s. This is an important note that should carefully be taken into consideration when designing the corresponding hydropower facilities for the sites.
- The Flow Duration Curve (FDC) for the river shows that a discharge of 2.93m^3/s is exceeded 10% of the time while 0.33 m^3/s is exceeded 80% of the time.
- An environmental flow reserve of 0.15m^3/s has been proposed for the river section that will be looped by the canal/penstock system.

Given that there are times of the year when the flows at this site are quite low, it is important that a discharge gauge be placed at the site as soon as possible to monitor the flows. The data obtained shall be used to improve the hydrologic estimates at the site.

4 References

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Appendix 1: Derived R. Sindira (SHP) flows (Average Monthly flows).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1980	1.17	0.32	0.27	0.67	2.34	1.30	0.33	0.08	0.10	1.22	2.08
1981	0.87	0.22	1.04	3.34	2.94	2.23	0.75	0.35	1.40	2.84	2.44
1982	2.41	1.29	1.06	1.95	2.65	1.87	0.78	0.56	1.75	2.78	3.56
1983	1.54	0.41	0.19	0.34	1.17	1.42	1.00	1.12	2.80	4.82	4.12
1984	0.89	0.24	0.38	0.63	0.52	0.18	0.07	0.12	0.50	0.91	1.83
1985	0.78	0.41	0.43	2.52	2.41	2.23	1.22	0.29	0.10	0.69	2.25
1986	0.40	0.10	0.19	0.94	2.45	1.67	0.65	0.17	0.08	0.69	2.23
1987	1.72	1.19	3.12	3.09	2.89	2.97	1.56	0.40	0.71	2.25	3.71
1988	1.30	0.86	1.32	2.88	3.26	2.02	0.79	0.61	0.94	2.80	3.18
1989	0.94	0.29	0.50	2.57	2.56	1.91	0.90	0.41	0.25	0.99	1.41
1990	1.82	2.68	3.32	4.11	2.68	1.74	0.53	0.19	0.69	1.48	2.76
1991	2.14	0.62	0.45	2.31	2.91	2.97	1.65	1.08	1.39	2.02	2.41
1992	0.41	0.10	0.04	0.55	0.83	1.18	1.16	0.37	0.43	1.74	2.22
1993	1.18	0.39	0.35	0.56	1.56	2.29	0.92	0.24	0.13	0.26	1.63
1994	0.84	0.20	0.07	0.44	1.60	2.26	1.45	0.48	0.42	0.40	2.14
1995	0.69	0.17	0.13	0.29	1.67	1.19	1.00	0.38	0.32	2.08	3.33
1996	1.19	0.57	0.73	2.45	2.23	2.74	1.49	1.17	2.72	2.83	2.77
1997	0.84	0.46	0.48	1.99	4.02	1.57	0.55	0.15	0.05	0.87	3.03
1998	3.28	1.36	0.65	1.42	3.79	2.56	0.71	0.25	0.33	1.84	2.52
1999	0.96	0.65	1.28	1.96	2.21	0.91	0.23	0.37	1.26	2.55	2.61

ANNEXURE 11: WATER QUALITY ANALYTICAL LABORATORY RESULTS

NATIONAL WATER AND SEWERAGE CORPORATION

CENTRAL LABORATORY - BUGOLOBI.
P.O.BOX 7053 KAMPALA.
Tel: 0414257548, 0414341144. Fax: 256 41 4255441
E-Mail: waterquality@nwsc.co.ug

CERTIFICATE OF ANALYSIS

CLIENT: Butama Hydro Electricity Company Ltd (Sindila Mini)

InvoiceNo: INV/2011/586

Sample Source: Sindila river **Sampled by:** Client staff

Date Sample Received: 29-02-2012 **Date of Report:** 02-05-2012

Table of Analytical Results

Parameters	Units	Proposed Weir site	*National Standards for potable water.*	*National Standards for effluents discharge.*
WS Sample Nr	--	**K5323/12/C/B**		
pH	--	7.62	*6.5-8.5*	*6.0 – 8.0*
Electrical Conductivity	µS/cm	111	*2500*	*1500*
Colour: apparent	PtCo	10	*15*	*500*
Turbidity	NTU	1.603	*10.0*	*300*
Total Suspended Solids	mg/L	1	*0*	*100*
Total Dissolved Solids	mg/L	71	*700*	*1200*
Alkalinity: total as $CaCO_3$	mg/L	44	*500*	*800*
Hardness: total as $CaCO_3$	mg/L	52	*500*	*800*
Calcium: Ca^{2+}	mg/L	36.8	*75*	*100*
Magnesium: Mg^{2}	mg/L	4.8	*50*	*100*
Bi-Carbonate	mg/L	44	*500*	*800*
Fluoride: F^-	mg/L	0	*1.5*	*3.0*
Chloride: Cl^-	mg/L	1	*500*	*500*
Iron: total	mg/L	0.042	*1.0*	*10.0*
Sulphates: SO_4^{2-}	mg/L	7	*200*	*500*
Nitrate – N	mg/L	0.00	*5.0*	*5.0*
BOD_5	mg/L	11	*Not Specified*	*50*
COD	mg/L	37	*Not Specified*	*100*
Faecal Coliforms	CFU/100mL	60	*0*	*5,000*
Escherichia Coli (E-Coli)	CFU/100mL	0	*0*	*5,000*

Remarks: The sample showed satisfactory physio-chemical characteristics of the water but indicated moderate faecal contamination of the source, which renders the water unfit for domestic use unless disinfected or boiled.

NATIONAL WATER AND SEWERAGE CORPORATION
02 MAY 2012
THE CENTRAL LABORATORY

Lance E. Okwerede
PRINCIPAL ANALYST

Christopher Kanyesigye
QUALITY CONTROL MANAGER

NB: The NWSC certificate of analysis by no means constitutes a permit to any person or organisation to conduct business

NATIONAL WATER AND SEWERAGE CORPORATION

CENTRAL LABORATORY - BUGOLOBI.
P.O.BOX 7053 KAMPALA.
Tel: 0414257548, 0414341144. Fax: 256 41 4255441
E-Mail: waterquality@nwsc.co.ug

CERTIFICATE OF ANALYSIS

CLIENT: Butama Hydro Electricity Company Ltd (Sindila Mini)

InvoiceNo: INV/2011/586

Sample Source: Sindila river **Sampled by:** Client staff

Date Sample Received: 29-02-2012 **Date of Report:** 02-05-2012

Table of Analytical Results

Parameters	Units	At Nyamuchimba	*National Standards for potable water*	*National Standards for effluents discharge.*
WS Sample Nr	--	K5324/12/C/B		
pH	--	7.74	*6.5-8.5*	*6.0 – 8.0*
Electrical Conductivity	µS/cm	112	*2500*	*1500*
Colour: apparent	PtCo	8	*15*	*500*
Turbidity	NTU	1.41	*10.0*	*300*
Total Suspended Solids	mg/L	0	*0*	*100*
Total Dissolved Solids	mg/L	72	*700*	*1200*
Alkalinity: total as	mg/L	44	*500*	*800*
Hardness: total as	mg/L	48	*500*	*800*
Calcium: Ca^{2+}	mg/L	22.4	*75*	*100*
Magnesium: Mg^{2}	mg/L	2.9	*50*	*100*
Bi-Carbonate	mg/L	44	*500*	*800*
Fluoride: F	mg/L	0.03	*1.5*	*3.0*
Chloride: Cl	mg/L	1	*500*	*500*
Iron: total	mg/L	0.03	*1.0*	*10.0*
Sulphates: SO_4^{2-}	mg/L	4	*200*	*500*
Nitrate – N	mg/L	0.00	*5.0*	*5.0*
BOD_5	mg/L	7.1	*Not Specified*	*50*
COD	mg/L	18	*Not Specified*	*100*
Faecal Coliforms	CFU/100mL	0	*0*	*5,000*
Escherichia Coli (E-Coli)	CFU/100mL	0	*0*	*5,000*

Remarks: The sample showed good bacteriological and physio-chemical characteristics of the water source. The water may be used for domestic and commercial purposes.

Lance E. Okwerede
PRINCIPAL ANALYST

NATIONAL WATER AND SEWERAGE CORPORATION
02 MAY 2012
THE CENTRAL LABORATORY

Christopher Kanyesigye
QUALITY CONTROL MANAGER

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NATIONAL WATER AND SEWERAGE CORPORATION
CENTRAL LABORATORY - BUGOLOBI.
P.O.BOX 7053 KAMPALA.
Tel: 0414257548, 0414341144, Fax: 256 41 4255441
E-Mail: waterquality@nwsc.co.ug

CERTIFICATE OF ANALYSIS

CLIENT: Butama Hydro Electricity Company Ltd (Sindila Mini)

InvoiceNo: INV/2011/586

Sample Source: Sindila river **Sampled by:** Client staff

Date Sample Received: 29-02-2012 **Date of Report:** 02-05-2012

Table of Analytical Results

Parameters	Units	Proposed Power house	National Standards for potable water.	National Standards for effluents discharge.
WS Sample Nr	--	**K5325/12/C/B**		
pH	--	7.83	*6.5-8.5*	*6.0 – 8.0*
Electrical Conductivity	µS/cm	117	*2500*	*1500*
Colour: apparent	PtCo	21	*15*	*500*
Turbidity	NTU	1.49	*10.0*	*300*
Total Suspended Solids	mg/L	0	*0*	*100*
Total Dissolved Solids	mg/L	75	*700*	*1200*
Alkalinity: total as $CaCO_3$	mg/L	48	*500*	*800*
Hardness: total as $CaCO_3$	mg/L	52	*500*	*800*
Calcium: Ca^{2+}	mg/L	48	*75*	*100*
Magnesium: Mg^{2}	mg/L	4.8	*50*	*100*
Bi-Carbonate	mg/L	48	*500*	*800*
Fluoride: F^-	mg/L	0	*1.5*	*3.0*
Chloride: Cl^-	mg/L	4	*500*	*500*
Iron: total	mg/L	0.073	*1.0*	*10.0*
Sulphates: SO_4^{2-}	mg/L	4	*200*	*500*
Nitrate – N	mg/L	0.00	*5.0*	*5.0*
BOD_5	mg/L	9.6	*Not Specified*	*50*
COD	mg/L	24	*Not Specified*	*100*
Faecal Coliforms	CFU/100mL	10	*0*	*5,000*
Escherichia Coli (E-Coli)	CFU/100mL	5	*0*	*5,000*

Remarks: The sample showed satisfactory physio-chemical characteristics of the water but indicated poor bacteriological quality. The source is not fit for domestic use unless disinfected or boiled.

Lance E. Okwerede
PRINCIPAL ANALYST

NATIONAL WATER AND SEWERAGE CORPORATION
02 MAY 2012
THE CENTRAL LABORATORY

Christopher Kanyesigye
QUALITY CONTROL MANAGER

NB: The NWSC certificate of analysis by no means constitutes a permit to any person or undertaking to conduct business

NATIONAL WATER AND SEWERAGE CORPORATION

CENTRAL LABORATORY - BUGOLOBI.
P.O.BOX 7053 KAMPALA.
Tel: 257548, 341144. Fax: 256 41 255441
E-Mail: waterquality@nwsc.co.ug

CERTIFICATE OF ANALYSIS

CLIENT: ATACAMA CONSULTING

Serial No: INV/2014/298-3

Sample Source: River Ntuma

Sampled by: Client

Date Sample Received: 31-05-2014

Date of Report: 11-06-2014

Table of Analytical Results

Parameters	Units	Source: **River Ntuma**	National Standards for potable water (un-treated)
WS Sample Nr	--	**K1504/14/C/B**	
pH	--	7.22	**6.5-8.5**
Electrical Conductivity	µS/cm	151	**2500**
Colour: apparent	PtCo	64	**15**
Turbidity	NTU	8.0	**10.0**
Total Dissolved Solids	mg/L	83	**1500**
Total Suspended Solids	mg/L	12	**0**
Alkalinity: total as $CaCO_3$	mg/L	82	**500**
Hardness: total as $CaCO_3$	mg/L	54	**500**
Copper: Cu	mg/L	<0.001	**1.00**
Lead: Pb	mg/L	<0.001	**0.05**
Zinc: Zn	mg/L	<0.001	**5.00**
Cadmium: Cd	mg/L	<0.001	**0.001**
Chloride: Cl^-	mg/L	1.5	**500**
Iron: total	mg/L	0.307	**1.0**
Sulphate: SO_4^{2-}	mg/L	1	**200**
Nitrate – N	mg/L	0.03	**5.0**
Ammonia – N	mg/L	0.09	**1.0**
BOD_5 at 20°C	mg/L	0.8	**Not Specified**
COD	mg/L	4	**Not Specified**
Oil & Grease	mg/L	<1.0	**1.0**
Faecal Coliforms	CFU/100mL	168	**10**

Remarks:
The sample showed satisfactory physio-chemical characteristics, but with higher colour, suspended solids & moderate faecal coliform count which failed to meet the National Standards for potable water (untreated) quality.

Approved by:

NATIONAL WATER AND SEWERAGE CORPORATION
EXTERNAL SERVICES
P O. Box 7053, Kampala, Uganda
Tel: +256 414 315 111/107
Email: external.services@nwsc.co.ug

Christopher Kanyesigye
MANAGER, QUALITY CONTROL

NB: The NWSC certificate of analysis by no means constitutes a permit to any person or undertaking to conduct business

3

NATIONAL WATER AND SEWERAGE CORPORATION

CENTRAL LABORATORY - BUGOLOBI.
P.O.BOX 7053 KAMPALA.
Tel: 257548, 341144. Fax: 256 41 255441
E-Mail: waterquality@nwsc.co.ug

CERTIFICATE OF ANALYSIS

CLIENT: ATACAMA CONSULTING

Serial No: INV/2014/298-4

Sample Source: River Sindila 02 (Stream/Control)

Sampled by: Client

Date Sample Received: 31-05-2014

Date of Report: 11-06-2014

Table of Analytical Results

Parameters	Units	Source: River Sindila 02 Stream/Control – along Access Road	National Standards for potable water (un-treated)
WS Sample Nr	--	**K1505/14/C/B**	
pH	--	7.06	**6.5-8.5**
Electrical Conductivity	µS/cm	177	**2500**
Colour: apparent	PtCo	96	**15**
Turbidity	NTU	7.3	**10.0**
Total Dissolved Solids	mg/L	97	**1500**
Total Suspended Solids	mg/L	6	**0**
Alkalinity: total as $CaCO_3$	mg/L	86	**500**
Hardness: total as $CaCO_3$	mg/L	72	**500**
Copper: Cu	mg/L	<0.001	**1.00**
Lead: Pb	mg/L	<0.001	**0.05**
Zinc: Zn	mg/L	<0.001	**5.00**
Cadmium: Cd	mg/L	<0.001	**0.001**
Chloride: Cl^-	mg/L	2.0	**500**
Iron: total	mg/L	1.170	**1.0**
Sulphate: SO_4^{2-}	mg/L	1	**200**
Nitrate – N	mg/L	0.03	**5.0**
Ammonia – N	mg/L	0.10	**1.0**
BOD_5 at 20°C	mg/L	1.4	**Not Specified**
COD	mg/L	7	**Not Specified**
Oil & Grease	mg/L	<1.0	**1.0**
Faecal Coliforms	CFU/100mL	210	**10**

Remarks:
The sample showed satisfactory physio-chemical characteristics, but with higher colour, suspended solids & moderate faecal coliform count which failed to meet the National Standards for potable water (untreated) quality.

Approved by:

NATIONAL WATER AND SEWERAGE CORPORATION
EXTERNAL SERVICES
P. O. Box 7053, Kampala, Uganda
Tel: +256 414 315 111/107
Email: external.services@nwsc.co.ug

Christopher Kanyesigye
MANAGER, QUALITY CONTROL

ANNEXURE 12: GEOLOGICAL AND GEOLOTECHNICAL REPORT

GEOLOGICAL AND GEOTECHNICAL INVESTIGATION REPORT FOR THE PROPOSED BUTAMA MINI HYDROPOWER DEVELOPMENT PROJECTS IN BUNDIBUGYO DISTRICT, UGANDA

SECTION A

GEOLOGICAL MAPPING, INVESTIGATIONS AND EVALUATION OF SEISMICITY AND ENGINEERING GEOLOGICAL CONDITIONS AT THE PROPOSED PROJECT SITES

1. INTRODUCTION

The site investigation report for the geotechnical feasibility study was carried out by the CECB for the purpose of determining the terrain stability and to recommend the parameters for the design and construction of the Butama Mini Hydropower Projects which is being developed by the Butama Hydro Electricity Company Ltd. The proposed power projects are expected to generate 7.5 to 10 MW of electricity mainly to supply the national grid.

- Ndugutu Mini Hydropower Project - Gross Head 358m
- Sindila Mini Hydropower Project - Gross Head 393m

The purpose of this report is to provide an evaluation of potential geological and geotechnical impacts on the project, reasonable mitigation measures, and whether these mitigation measures can reduce the potential impacts to acceptable levels. The report is compiled in two separate sections namely;

1. Section A: Geological Mapping, Investigations and Evaluation of Seismicity and Evaluation of Engineering Geological Conditions at Site
2. Section B: Subsurface Exploration Drilling, Laboratory Testing, Evaluation of Slope Stability and Recommendation for Foundations Structures

Specifically, the Section A of this report addresses the some important aspect on geology setting and seismic impacts of the proposed project. The Section B of the

report is based on detail subsurface exploration work drilling and laboratory testing conducted by the Hemas Power Ltd during the detailed investigation phase. The report contains some relevant information supported with the available published and unpublished geological/geotechnical data.

2. THE CECB SERVICE AGREEMENT

The Centre for Research & Development of the Central Engineering Consultancy Bureau (CECB), Sri Lanka was requested by the Hemas Power Pvt Ltd., Sri Lanka to serve as Consultant for the detailed geological and geotechnical investigation phase including field coordination of detail engineering investigations, evaluation of geological and geotechnical suitability, identify potential threats due to the terrain and finally to make suitable recommendations for the design and construction of the project.

It is worth to note that one of the prime objectives of the recently established Center for Research & Development of the Central Engineering Consultancy Bureau is to initiate international services through exchange of knowledge between Sri Lankan expertise in public/private sector Institutions and conducting collaborative activities of mutual interest, providing open communication throughout that process.

3. PROJECT DATA

3.1 LOCATION & ACCESSIBILITY

The proposed site is located almost 24 km away from the Bundibugyo town. Detail layout map CB/CRD/UG/HP/01-01 and CB/CRD/UG/HP/01-02 is given in the Annexure 1 indicating final layout selected for the proposed development.

Ndugutu proposed mini-hydropower project is located in the valley of Ndugutu in the villages of Kaghughu and Bunyamwera in Sindila sub County, Bundibugyo district of Uganda. This site is located about 15km far from Bundibugyo town. Also this site is near Congo border.

Sindila proposed mini-hydropower project is located in the valley of Sindila river, and project area covers the vallages of Ntuma,Bunyamawera and Kabwe in Sindila sub County, Bundibugyo district of Uganda. This site is located about 15km far from Bundibugyo town. Also this site is near Congo border.

3.2 Proposed Ndugutu Mini Hydropower Project

Catchment area is 29 sq.kms

Proposed Weir	834863 E, 65538 N
Proposed Desilting Tank	834842 E, 65513 N
Proposed Forebay Structure	833684 E, 65289 N
Proposed Power House	833234 E, 66994 N

Gross Head (m) – 358

3.3 Proposed Sindira Mini Hydropower Project

Catchment area is 33 sq.kms

Proposed Weir	833539 E, 63773 N
Proposed Desilting Tank	833328 E, 65117 N
Proposed Forebay Structure	833313 E, 65164 N
Proposed Power House	832229 E, 66343 N

Gross head (m) - 393

3.3 Scope of Services

Major objectives of this report are set as follows.

- Geological inspection, evaluate the site conditions and study all alternative layouts at filed, confirm locations of major civil structures on site and evaluate the site according to the geological aspects for both hydropower projects(Ndugutu and Sindila).
- Identify project anticipated geological and geotechnical problems with respect to the foundation conditions, locality and the stability of the surrounding terrain etc.
- Establish requirements of geotechnical investigations for the detail design aspects.

Figure 3.1: Location of the proposed Weir site in Ndugutu River

Figure 3.2: Location of the proposed Weir site in Sindila River

4. METHOD OF APPROACH AND BRIEF NOTE ON REPORT

The construction of mini-hydropower projects at Ndugutu and Sindila rivers has been discussed in detail according to the geological and geotechnical aspects to ensure that the information about this project is scientifically valued and to provide provisions for detail design for development.

4.1 GEOMORPHOLOGICAL DESCRIPTION: Geomorphological description will contain descriptions of slopes, catchment hydrological patterns (physical features), elevation differences within each segment/ project element and also include the link in between each section of the project

4.2 GEOLOGICAL MAPPING: Geological traverses were made to map the lithology and to obtain bedrock conditions at site. Cut sections of the roads and canal opening provided invaluable evidence of the geological history of the project area. Outcrops and the cross-cutting valleys and ravines were effectively examined in order to reach reasonable accuracy of the mapping exercise.

4.3 DESCRIPTION OF THE SEISMICITY OF THE AREA: More appropriate data for the interpretation and explanation about the seismicity of the past and any recorded instability potentials due to such nature were considered.

4.4 EVALUATION OF GEOLOGICAL ASPECTS FOR THE DETAIL DESIGN: Evaluation of sub-surface conditions and identify the most significant engineering geological conditions and thereafter make recommendations for foundation design, slope stability, construction and monitoring of the project.

4.5 STANDARDS

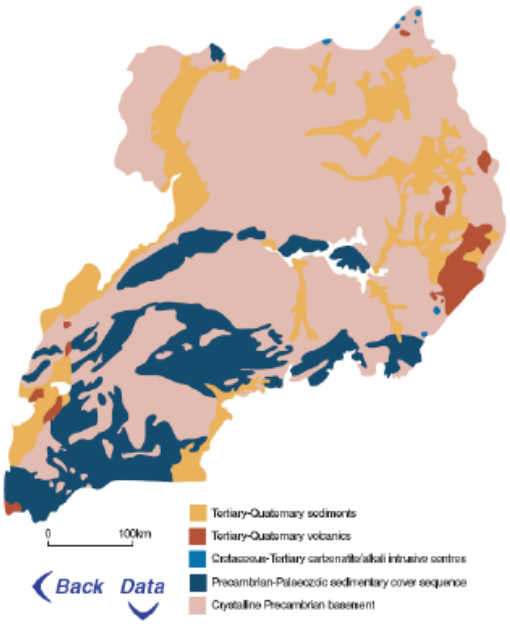
All the field and laboratory tests were confirmed to the standards given in ICTAD publication No ICTAD/ID/11 Alternative British standards (in particular BS1377 and BS5930) or equivalent ASTM standards and recommendations of ICOLD (International Commission on Large Dams) and ISRM (International Society for Rock Mechanics).

5. GEOLOGY AND GEOMORPHOLOGICAL INVESTIGATION AT NDUGUTU SITE

5.1 General Geology (Both Ndugut and Sindila Project sites)

It was identified four major rock formations from simplified geology map of Uganda, and summarized below;

Tertiary-Quaternary sediments
Tertiary-Quaternary volcanics
Cretaceous-Tertiary carbonatite/alkali intrusive centres
Precambrian-Palaeozoic sedimentary cover sequence
Crystalline Precambrian basement



Two third of Uganda is covered by highly metamorphosed, Precambrian rocks. East African rift system is very characteristics to Uganda and the project area is lying at Western Uganda rift valley system.

The major structural controls within Uganda include orogenic fold belts and shear zones in the Precambrian, and the processes of formation of the Rift Valley and

headrace channel along the left bank with the section of 1.5mx1.5m.

This project under consideration is located in Bundibujyo District in Uganda. The site is located on the Ndugutu river, and weir site is located Ndugutu river in the villages of Kaghughu and Bunyamwera in Sindila sub County, Bundibugyo district of Uganda.

The proposed channel trace and the penstock line are 1.6km and 2.3km long and lying along the left bank of the river maintaining 358m gross head. This trace is mainly passing along steep slopes and numbers of land slide scars could be identified. The power house is located at the river crossing causeway on the road to Ndugutu primary school.

The main objective of this assignment is to study prevailing engineering geological conditions of weir, powerhouse area and along the channel trace. Sub disciplines are

a. Detailed Engineering Geological Mapping at Weir, along Channel Trace and Power House Area
b. Propose most suitable foundation technique for main structures.
c. Study of actual locations of penstock anchors and relocate them to stable ground.
d. Execution of 31 numbers of test pits and asses the sub-surface geological condition
e. Identification of land slide areas and propose mitigatory measures

Table 5.1-Summery of Executed Test Pits
(D-Disturbed Sample, U/D-Undisturbed Sample)

Test Pit No.	Structured Locations & Chainage	Coordinates and Elevation			Depth (m)	Samples tested	
		X	Y	Z		Number	Depth (m)
NC1	Channel Trace 0+250	166810	65320	1470	01.90	SNC1	0.90-1.30
NC2	Channel Trace 0+390	166659	65325	1448	01.80	-	-
NC3	Channel Trace 0+710	166415	65311	1453	01.50	-	-
NC4	Channel Trace 0+860	166280	65356	1455	01.60	SNC4	0.90-1.30
NC5	Channel Trace 1+040	166218	65229	1471	01.60	-	-
NC6	Channel Trace 1+105	166170	65257	1479	02.00	-	-
NC7	Channel Trace 1+270	166075	65265	1455	01.50	SNC7	1.00-1.40
NC8	Channel Trace 1+370	833899	65253	1455	02.20	-	-
NC9	Channel Trace 1+410	833866	65252	1457	01.70	-	-
NC10	Channel Trace 1+520	833759	65269	1451	02.10	-	-
NC11	Channel Trace 1+540	833739	65265	1453	09.50	-	-
NF1	Fore Bay Tank	833705	65285	1453	02.00	SNF1	0.90-1.30
NF2	Fore Bay Tank	833697	65292	1456	02.50	-	-
NF3	Fore Bay Tank	833699	65290	1460	02.50	-	-
NP1	Penstock	833681	65288	1457	02.40	-	-
NP3	Penstock	833648	65365	1444	01.90	-	-
NP5	Penstock	833556	65358	1444	02.70	-	-
NP8	Penstock	833388	65368	1438	02.00	-	-
NP9	Penstock	833329	65360	1426	02.00	-	-
NP13	Penstock	832987	65861	1275	01.80	-	-
NP17	Penstock	833012	66018	1263	01.50	-	-
NP18	Penstock	833045	66028	1249	01.60	SNP18	0.90-1.30
NP23	Penstock	833052	66185	1225	01.80	-	-
NP2	Penstock	833107	66169	1217	01.50	SNS2	0.90-

5						5	1.30
NP28	Penstock	833199	66270	1211	01.70	-	-
NP31	Penstock	833221	66394	1197	01.70	-	-
NP37	Penstock	833295	66705	1174	02.00	-	-
NP41	Penstock	833269	66856	1138	02.30	SNP41	1.40-1.70 0.90-1.30
CP1	Common Penstock	833274	65390	1403	02.00	SCP1	1.10-1.60
CP2	Common Penstock	833246	65436	1394	02.00	-	-
CP4	Common Penstock	833184	65518	1363	02.30	-	-
CP7	Common Penstock	833106	65634	1309	01.80	-	-
CP9	Common Penstock	832995	65730	1270	01.70	-	-
PH1	Powerhouse	833233	66980	1107	02.50	SPH2 SPH1	0.40-0.70 1.40-1.70

Finally the field observations were summarized to evaluate sub- surface condition at main structured locations and propose basic recommendations for foundation of weir, channel and power house. Mitigation measures for land slide prone areas are proposed in this report.

This study was carried out from 7th.February.2012 to 21st.February.2012 at proposed Ndugutu Project site in order to achieve the above objectives.

5.3 Topography and Geomorphology

This area maintains ridge and valley morphology and the main river Ndugutu runs along 5-10m wide V- shaped valley on to SW direction. The slope on both left and right bank is very steep to moderately steep (80^0-45^0). The main ridge runs parallel to the river and numbers of small streams runs perpendicular to the main valley. The bottom part of the main river flows on rocky bed bounded by rock escarpment.

Numbers of perennial stream paths across the channel trace were identified during this study and most of them are dry in this season. The details of stream are summarized below.

Table-5.2 Details of Stream Paths along the Channel Trace

Chainage	Stream type	Flow (l/min)
0+290	Perennial stream	dripping
0+425	Perennial stream	dripping
0+590	Perennial stream	dry
0+650	Perennial stream	dry
1+105	spring	30 l/min
1+175	Perennial stream	dry
1+350	Perennial stream	dry
1+420	Perennial stream	dry
1+480	Perennial stream	dry
1+550	Perennial stream	dry

The project area is mainly covered by large trees and shrubs.

5.3.1 Weir Site

The weir site is located just downstream of small waterfall on the river across V-shaped valley refers as chainage 0+000.

Both left and right banks of the river rises gradually (>50^0) for about another 50m higher elevation from outwards from the river. River bed is mainly covered by 0.5m-2m diameter fresh rock boulders. Just upstream of the proposed weir is a small pool formed by river action of the small water fall. A rock escarpment of 3-4m high can be seen at the waterfall.

The left bank of the river covered by large trees while right banks covered by shrubs. (See Annexure 5; Photographs)

5.3.2 Channel Trace

The channel trace runs along left bank of the river from chainage 0+000 to chainage 1+600. Three major types of vegetation covers as home gardens, large tree areas with lesser under growth and shrubs can be observed along the channel trace. The varying slope angle, vegetation types and drainage patterns along channel trace are key factors affecting slope stability and summarized below.

Table-5.3 Topographical Summery along Channel Trace

Chainage from Weir	Vegetation	Drainage pattern	General Slope angle
0+000-0+050	shrubs	No stream paths	Below 5^0 about 15m from river bank
0+050-0+285	Large trees and thin undergrowth	Low lying areas are water logged	60^0-70^0
0+285-0+385	Banana & beans plantation	Small scale perennial streams	30^0-40^0
0+400-	Larger trees and shrubs	Small scale perennial	60^0-70^0

0+650		streams	
0+650-0+920	Mana Grass and Maniyok cultivation	Small scale perennial streams	60^0-70^0
0+920-1+180	Shrubs and Banana cultivation upper slopes	Small scale perennial streams	50^0-60^0
1+180-1+350	Coffee garden	Small scale perennial streams	30^0-40^0
1+350-1+600	Mana grass	Small scale perennial streams	30^0-40^0

Most of the stream paths across channel trace are perennial and irregular. The slopes show undulating topography.

5.3.3 Power house Area

The powerhouse meets at chainage 3+900 m and located on the left bank of the river at the stream crossing causeway on the main road leading to primary school. The slope at powerhouse is almost flat and standing on the river floodplain. Moderately (40^0) rising ridge can be seen at left hand corner of the powerhouse.

This slope is mainly covered by mana grasses and flat area covered by banana plantation. There is a possibility of submerge low lying areas of proposed power house site during river flood seasons.

5.4 Engineering Geology of Main Structured Sites

Engineering geological situation of main structured sites was studied by carrying out surface geological mapping in 1:1000 scale. The site condition is described below concentrating to each structured areas.

5.4.1 Weir

The river section along proposed weir axis is 15m long and both river banks rise about 50 m high for about 50m away from river banks. Rock escarpment about 3-4m high can be seen on the river section about 15m upstream of proposed weir and a small waterfall has formed.

Both left and bank slopes about 30m distance is mainly covered by slightly to moderately weathered rock of quartz feldspathic gneisses. The river bed is covered by alluvium deposits (AL1) consists 0.2-0.5m boulders mixed with gravelly sand. Refer Annexure 1-Surface Engineering Geology Map of Project Area. Thickness of this layer may be about 1-1.5m.

Talus material (TL1) about 2m wide can be identified on the left bank between rock escarpment and the alluvium deposit. This material consists 1-5m diameter rock blocks detached from rock escarpment.

Hard, slightly weathered, quartz feldspathic gneiss rock exposes shows moderately strong characteristics. General strike and dip direction of exposed bed rock is 30^0/120^0. Two major joint sets were identified. One is 40^0/090^0 in 2m spacing and the other one 90^0/330^0, in 1m spacing. These joints are tight and iron staining can be observed along

the joint planes 335^0 /60^{0}SW. Major three joint sets can be identified on rock exposes as their trend and plunge 335^0 /60^{0}SW , 160^0/60^{0}NE ,040^0/90^0 . These joints are 0.5-1m intervals. (Refer annexure 1- Detailed Engineering Geology Map of Project area) (See Annexure 1-photograph of the weir axis)

5.4.2 Channel Trace

Detailed engineering geological mapping was conducted along the channel trace and 1:1000 scale detailed engineering geological map was prepared. (Refer Annexure 1- Detailed Engineering Geological Map of Project Area).

The geological data obtained during mapping are summarized based on material types identified along the channel trace. (Refer table 4-Summarized Geological Data). Also eleven numbers of test pits were excavated along this channel section and geological sections were drawn representing each material category. (Refer Annexure 3; Geological Sections).

Table 5.5 Summerized Geological Situation along Channel Trace

Chainage	Surface Geology	Sub-surface Geological Summery				
		Geological section	Test pit number	Depth of layers (m)	Layer Description	Depth of Ground water table(m)
0+000-0+050	Talus Material (TL1)	A-A	Not done	<2.00m	Talus Material (TL1)	Not identified
0+050-0+285	`Talus Material (TL1,TL3), Residual clay (RS1)	B-B	NC1	0.00-0.20	Silty organic Clay (OC)	Not encountered
				0.20-1.90	10-15cm rock pieces mixed with gravelly clay	
0+285-0+385	Residual Soil (RS2)	-	NC2	0.00-0.20	Organic Clay(OC)	Not encountered
				0.20-1.90	5-10cm rock pieces mixed with gravelly clay,Hard,moist (RS)	
0+385-0+650	Talus Material(TL 2), Residual clay(RS1), Slightly weathered rock (SWR)	C-C	-			
0+650-0+920	Talus material TL5, Residual clay(RS2),	D-D	NC3,NC 4	(NC3) 0.00-0.30	Silty organic Clay (OC)	

					with gravelly clay,Hard,moist (RS)	
				NC9 0.00-0.20	Silty organic Clay (OC)	
				0.20-0.80	Completely weathered rock (CWR)	
				0.80-1.70	Highly weathered rock	
				NC10 0.00-0.20	Silty organic Clay (OC)	
				0.20-1.20	5-10cm rock pieces mixed with gravelly clay,Hard,moist (TL)	
				1.20-2.10	5-10cm rock pieces mixed with gravelly clay,Hard,moist (TL)	

Geology from chainage 0+000 to 0+050

The surface geological features were studied during detailed geological mapping. A-A was produced to evaluate subsurface condition. (Refer Annexure 3- Geological section A-A).

This area is mainly covered by 1-5m diameter hard rock boulders which are concentrated. This material has formed by rock blocks derived from rock escarpment on left side. (Refer geology map) This rock mass in this escarpment shows moderately weathered characteristics and slightly jointed. However depth of this material may be limited to 1-2m and bed rock may encounter within shallow (<3m) depth. The proposed desilting tank is lying within this zone and some boulder blasting may required to remove surface boulders.

Geology from chainage 0+050 to 0+285

The surface geological features were studied during detailed geological mapping and sub-surface geological situation was assessed by executing a test pit NC 1 to 1.9m depth. Geological section BB was produced across NC1 to evaluate subsurface condition. (Refer Annexure 3- Geological section BB)

Majour three types of materials as Talus (TL1,TL3 AND RS1) were identified during mapping and test pit data shows penetration of Talus material (10-15cm rock fragments mixed with gravelly clay) for deeper than 1.9m. The slope angle maintains 60^0-70^0 on this weak talus material and there is a higher risk for failing during excavation. Also some rock blocks on steep slope tend to move down.

Geology from chainage 0+285 to 0+385

The surface geological features were studied during detailed geological mapping and sub-surface geological situation was assessed by executing test pit NC2 for 1.90m depth.

The slope maintains 30^0-40^0 average slope angle mainly covered by gravelly clay material of residual origin.

The subsurface data reveal that a this residual mass underlained by o.3m thick top soil mass. The top soil mass is silty organic clay shows soft characteristics under moist condition. This residual material (RS2) is composed of gravelly clay material and shows stiff to hard characteristics under moist condition.

A perennial stream with 5l/min water flow crosses at chainage 0+295 and necessary to provide an underpass to handle runoff water.

Banana and Beans are cultivated in this land.

Geology from chainage 0+385 to 0+650

The surface geological features were studied during detailed geological mapping. Geological section C-C was produced to evaluate subsurface condition. (Refer Annexure 3- Geological section C-C)

This area is mainly covered by hard bed rock exposes of Quartz feldspathic gneisses and some time very thin layer (<0.3m) of residual clay layer is overlying this rock exposes. The rock mass is moderately jointed and the general strike and dip of foliation shows as $240^0/40^0$ SE. Three major jont sets were identified and their trend and the plunges are $040^0/90^0$, $010^0/90^0$, $320^0/45^0$SW and $100^0/80^0$NE. This creates 0.5-0.8m diameter rock blocks.

The average slope angle varies from 70^0-80^0 and the very steep upper slope rises more 50m. Also the lower slope maintains very steep slope angle and continued up to the river.

The slopes are covered by larger trees and shrubs. The proposed channel runs across the deep dry perennial stream between chainage 0+600 to 0+625 and stream bed is mainly covered by hard bed rock exposes.

Geology from chainage 0+650 to 0+920

The surface geological features were studied during detailed geological mapping. Two test pits NC3 and NC4 were excavated to 1.5m and 1.6m depths and Geological section D-D was produced to evaluate subsurface condition. (Refer Annexure 3- Geological section D-D)

This area is mainly covered by hard bed rock exposes of very fine grained rock and some time very thin layer (<0.3m) of residual clay layer is overlying this rock exposes. The rock mass is highly jointed and the general strike and dip of foliation shows as $240^0/40^0$ SE. Three major jont sets were identified and their trend and the plunges are $040^0/90^0$, $010^0/90^0$, $320^0/45^0$SW and $100^0/80^0$NE.Also numbers of tight joints can be observed and they tend to open up on applying hammer blows. This creates 0.1-0.2m diameter rock pieces. The test pit data shows that the talus material generated from this rock escarpments penetrated deeper than 1.5m.

The average slope angle varies from 70^0-80^0 and the very steep upper slope rises more 50m. Also the lower slope maintains very steep slope angle and continued up to the river. The slopes are covered by larger trees.

Geology from chainage 0+920 to 1+180

The surface geological features were studied during detailed geological mapping and sub-surface geological situation was assessed by excavating two test pits NC5 and NC6 for the depths of 1.6m and 2.0m.

Surface geological data shows that the channel section mainly covered by residual clays and slightly weathered rock escarpment. However the test pit data shows the completely weathered original ground meets at 1.5m depth after penetration through talus material composed of 5-10cm diameter rock fragments.

The average slope angle maintains within varies from 50^0-70^0 and a rock escarpment can be observed from chainage 1+000 to 1+130 which the toe area lying above 2m from channel level.

Dry perennial stream was identified at chainage 1+050 and residual materials covered this section.

This area mainly covered by shrubs and banana cultivation.

Geology from chainage 1+180 to 1+350

The surface geological features were studied during detailed geological mapping and one test pit NC7 was excavated to study the sub-surface condition.

It was identified gravelly clay material of residual origin along this channel section. The excavated test pit data shows that a talus (TL) material layer consists 5-10cm diameter rock fragments mixed with clay penetrates for about o.8m thickness and over laying the hard, completely weathered rock material. (Refer Annexure 1- Surface Geological Map of the Project Area)

This channel section runs across a coffee cultivation and maintains about 40^0 slope angle.

Geology from chainage 1+350 to 1+625

The surface geological features were studied during detailed geological mapping and sub-surface geological situation was assessed by executing three test pits NC8,NC9 and NC10. (Details of these test pits are summarized in the Table 4 above).

It was encountered talus material (TL3) and residual clay material (RS2) along this channel section.

At test pit NC8 the residual clay material composed of gravelly clay encountered at 0.3m depth and continued upto borehole termination depth of 2.2m. At test pit NC9 the completely weathered rock material encountered at 0.2m depth and shows hard characteristics under moist condition. However at NC10, talus material consists 5-10cm diameter rock fragments in clay matrix in talus origin and continued up to 2.10m borehole termination depth. The geological section F-F in annexure 3 shows generalized sub- surface situation.

5.4.3 Spillway Location

Proposed spillway structure is located at chainage 1+590 on a perennial stream path. This stream was dry during study period and evidence for considerable flow during rainy season. The stream bed and the immediate slope above the proposed location is covered by bed rock exposes of coarse grained quartz feldspathic gneiss. The upper slopes maintains about 50^0slope angle while lower slope is about 70^0 slope along the steam.

The exposes show general strike and the dip of rock formation $010^0/40^0$ NW. Three majour joint sets were identified as their trend and punge $190^0/85^0$, $010^0/40^0$, $010^0/55^0$ .The joints are with 2-5mm weathering and 0.5-1.0 diameter detached rock block are formed. The rock exposes are hard and strong.

The channel level and bottom of stream bed maintain about 3m elevation gap at the crossing point.

5.4.4 Forebay Location

Forebay location meets at chainage 1+625 and located on a mountain nose. Upper slope above the proposed forebay tank maintains about 40^0 slope angle while lower slope is a 70^0-80^0 rock escarpment extending deeper than 50m.

Three test pits NF1, NF2 and NF3 were excavated to study sub-surface condition for 2.0m,2.5m and 2.5m depths respectively. Similar types of materials were encountered at all three test pits and continued from top to bottom.

Table 5.6-Summerized Geological Situation at Fore bay Location

Location	Surface Material	Geological section	Depth of layers (m)	Layer Description	Depth of Ground water table(m)
NF1	Talus Material (TL3)	F-F	0.00-0.20	Silty organic Clay (OC)	Not identified
			0.20-2.00	5cm angular rock fragments in gravelly clay (TL)	
NF2	Talus Material (TL3)	F-F	0.00-0.20	Silty organic Clay (OC)	
			0.20-2.00	5-10cm angular rock fragments in gravelly clay (TL)	
			2.00-2.50	2-5cm angular rock fragments in gravelly clay (TL)	
NF3	Residual Soil (RS2)	-	0.00-0.30	Organic Clay(OC)	
			0.30-1.30	5-10cm rock pieces mixed with gravelly (TL)	
			2.00-2.50	30-40cm angular rock fragments in gravelly clay (TL)	

The summarized sub-surface geological data shows that, continuation of talus material mass deeper than 2.5m and actual depth of this formation cannot be verified.

5.4.5 Penstock Line

Surface engineering geological mapping was carried out along the 2.3km long penstock line. During mapping, the some of proposed penstock anchor locations were sifted to geological feasible grounds avoiding landslide scars. Also 19 numbers of test pits were excavate to study the sub-surface geological condition. The surface and sub-surface geological situation is summarized in the table given below.

Table 5.7-Summerized Geological Situation along the Penstock Line

Chainage	Anchor Numbers	Test pits excavated	Surface geological condition	Depth of Ground Water Table (m)
1+625-1+675	AV1,AV2	NP1	Talus material (TL3)	Not Encountered
1+675-1+730	AH3	NP3	Talus material (TL4)	
1+730-1+795	AH4	-	Talus material (TL2)	
2+160-3+355	AV12,AH13,AV14, AV15,AH16,AH17,AH18, AH19, AH20AH21,AH22,AH23, AH24, AV25,AV26AH27,AH28, AV29, AH30,AH31,AH32AH33, AH34, AH35,AH36,AH37,AH38 AH39,AV40	CP4,CP7,NP 13 NP17,NP18,N P23 NP28,	Residual Soil (RS2)	
3+355-3+400	AH41	NP31	Talus material (TL3)	
3+400-3+540	AH42,AH42,AH43,AH44	NP37	Residual Soil (RS2)	
3+540-3+570	AH45	-	Talus material (TL3)	
3+570-3+815	AH46,AV48,AH49,AH50, AV51	NP37	Residual Soil (RS2)	
3+815-3+850	AV52	-	Talus material (TL3)	
3+850-3+875	-	-	Debris (DB1)	
3+875-3+950	AV53	NP41	Talus material (TL3)	
3+950-4+032	AV54	-	Residual Soil (RS1)	

The summarized data shows varying geological condition along the penstock line and the geological logs of test pits excavated shows the depth of penetration of sub-soil layers.

5.4.6 Powerhouse and Tailrace Channel

Surface engineering geological mapping was carried out at powerhouse area and one test pit (NPH1) and trench excavation was done to evaluate sub-surface geological condition.

The power house and tailrace channel is located on the left bank river flood plane and the left side boundary is adjacent with the hillock. The lower area maintains as flat terrain while left side slope maintains about 50^0slope angle.

The lower area is mainly covered by silty gravelly sand mixed with 0.5-1.0m diameter rounded rock boulders in alluvium origin. The left bank slope is mainly covered by gravelly clay of residual origin.

The test pit excavated shows top most organic clay layer penetrates to 1.10m depth and yellowish brown gravelly clay layer is underlying the organic clay and continued up to 2.5m test pit termination depth. The colluviums material shows stiff characteristics under wet condition. The stabilized ground water table was identified at 1.5m depth. The excavated trench shows same profile about 2m distance from NPH-1 towards the ridge.

The geological situation is summarized in the table given below.

Table 5.8-Summerized Geological Situation at Powerhouse Location

BH Number	Depth of Penetration (m)	Subsurface profile		Depth of Ground Water Table (m)
		Depth(m)	Material	
NPH1	2.50m	0.00-1.10	Silty organic Clay (OC)	-1.50
		1.10-2.50	Yellowish brown gravelly clay, cohesive, moist to wet, Stiff	

Successive layers of organic clay, gravelly clay was encountered at powerhouse location. The geological sections P1P1 & P2P2 envisage the sub-surface condition. (Refer Annexure 3- Geological section P1P1& P2P2 and Annexure 5-Photographs of powerhouse area.)

5.5 Geological Evaluation and Recommendations

Geological evaluation and recommendations are summarized under main structured locations as below.

5.5.1 Weir Site

About ten meters distance from right BANK along the weir axis is covered by alluvium deposits of rounded gravelly sand with 0.5-1.0m diameter rock boulders (AL1). This layer penetrates about 1m depth evident from surrounding rock exposes. Another 2-3m distance towards left bank is covered by talus material (TL1). Also thickness of this layer up to bed rock may be 1.5m. The weir foundation can be placed on hard, moderately

weathered to fresh rock formation after 1-2m deep excavation on river bed. However the proposed weir structure only rises about 2m and not feasible for deep excavation.

Moderately weathered rock is exposed on both abutments and the weir structure can abutted to Moderately weathered rock after scale down detached rock blocks and weathered rock pieces. Large rock bolder can be seen disturbing weir intake and it should partly removed by controlled blasting.

However the wing walls should be constructed and extended towards upstream direction to avoid erosion on both abutments.

It was observed that a topographic depression on river bed just upstream of weir axis and maintains as a pool. Attention should be paid on this feature during designing of weir structure.

5.5.2 Channel Trace

It was assed the slope angle and surface and sub-surface engineering geological situation during mapping and test pitting. Also foundation type of each section was assessed by evaluating slope angle and type of material identified on the slope. The situation is summarized and suggestions are made for foundation of channel structure.

The studied geological data shows existence of very steep slopes covered by talus material. This material is very vulnerable for slope failures during excavation. Also this material starts to move down once it is disturbed.

The hard slightly weathered to fresh rock exposes can be seen at some places along the channel trace. These rock exposes are moderately to highly jointed and detached and higher possibility of rock falls during excavation.

Considering above factors it is proposed to place individual short pier foundations (Aqueduct Sections) along the critical sections. On the other section normal pad footings can be place after excavation up to hard layers. The summarized data is given in the table below.

Table 5.9-Type of Channel Sections Proposed

Chainage (m)	Type of channel Sections
0+000-0+200	Normal Channel
0+200-0+290	Aqueduct Sections
0+290-0+400	Normal Channel
0+400-0+805	Aqueduct Sections
0+805-0+880	Normal Channel
0+880-0+920	Aqueduct Sections
0+920-1+125	Normal Channel
1+125-1+200	Aqueduct Sections
1+200-1+550	Normal Channel
1+550-1+625	Aqueduct Sections

Special attention should be paid during excavations from chainage 0+ 650 to 0+920 where highly jointed rock exposed encountered along steep slopes. It is proposed to make column foundations attaching loose blocks using mass concrete blocks. If necessary blasting should be carried out through slightly weathered or fresh rock encountered during excavation and free splitting technique with suitable delays should be performed to avoid damage to the surrounding area. At some places loosed rock blocks can be seen on upper slopes and possibility of moving down after construction causing damages to channel structure. However these blocks should be removed because it may destabilize further upper slopes. It is proposed to place concrete toe support at the ground to avoid erosion.

Excavated surplus soil and rock materials should be spread around the short piers with some tamping.

Underpass should be designed along perennial streams across headrace channel to reduce pore pressure on channel walls.

5.5.3 Spillway Location

Spillway location is mainly covered by hard rock exposes and the stream gulley is 3-4m deep. It is proposed to place spillway structure on piers and foundation should be placed on hard rock exposes.

Also proposed to pave at the pier foundations and make some cascade allowing flow runoff water freely.

Bed rock exposes can be observed along the stream bed and maintains a steep slope. Also propose to remove the boulders near the spill way structure.

5.5.4 Forebay Location

Proposed forebay is located above very steep rock escarpment. This area is mainly covered by talus material. Thickness of this material layer is more than 2.5m and actual depth of this formation cannot be verified by test pitting. Also there is risk of placing foundation on talus material.

It is proposed to install a borehole up to the bed rock or the actual situation should be studied during construction period.

5.5.5 Power House Area

Power house location is covered by alluvium deposits and the test pit data shows penetration of this layer deeper than 2.5m. The stabilized ground water table is encountered at 1.5m depth.

Depth of alluvium deposit could not be verified during test pitting and proposed to study the sub-surface by executing a borehole or study during excavation.

However a raft foundation can be recommended at suitable depth defined by powerhouse bottom level.

This location is on the floodplain and possibility of reaching flood water during heavy rain. It is proposed to arrange a flood barrier around the power house. The rock boulders removing during excavation can be used to construct this flood barrier.

It is recommended to excavate upper slopes to 1:4 (V:H) slope angle through RS1 and completely to highly weathered material. If excavation continue >4m, recommended to provide 2m burm and contour drains divert runoff water.

5.5.6 Landslide Areas

Numbers of land slide scars were identified along the channel trace and along the penstock line. These landslides are very old and not active under existing geological conditions. Identified landslides scars are summarized below.

Table 5.10-Summerized Data on Landslide Scars within the Project Area

Chainage	Length along the structure (m)	Affected Structure	Material type on surface and depth to the rock	Remedial Measures
0+912-0+923	11m	Headrace Channel	Moderately Weathered rock	Bed rock is exposed and no need Special measures and joint condition should be studied during construction
1+465-1+475	10m	Headrace Channel	Residual Soil (RS2) & about 2m up to bed rock	Channel should be founded on hard bed rock
1+745-1+760	15m	Penstock Line	Talus material (TL2) and depth to bed rock cannot be verified	Anchor location was shifted to firm ground
1+776-1+796	20m	Penstock Line	Talus material (TL2) and depth to bed rock cannot be verified	Anchor location was shifted to firm ground and foundation should be place on original ground
3+215-3+232	17m	Penstock Line	Debris material (DB1) and depth to bed rock cannot be verified	Anchor location was shifted to firm ground and foundation should be anchored to bed rock
3+270-3+290	20m	Penstock Line	Debris material (DB1) and depth to bed rock cannot be verified	Anchor location was shifted to firm ground and foundation should be anchored to bed rock
3+460-3+490	30m	Penstock Line	Debris material (DB1) and depth to bed rock cannot be verified	One Anchor location is scar and cannot be shifted and foundation should be anchored to bed rock

Considering above geological conditions it is proposed to lay the channel section across this landslide area as an aqueduct and individual column foundations should be penetrated passing debris mass to a consistent layer(Completely to highly weathered rock N>50).

Also it is recommended to construct a boulder arrangement around the pier foundation to minimize the erosion.

The small gullies on slip area should be developed as cascade drains to enhance surface runoff and divert water to the river. It is proposed to make contour drain above the upper limit of landslide area and grass sods can be paved on exposed areas.

Special Note

This project area shows varying topography, geology and slope angles. It is proposed to hire special consultant to evaluate the foundation condition at each pier location to decide the most suitable foundation type during construction.

6.0 GEOLOGY AND GEOMORPHOLOGICAL INVESTIGATION AT SINDILA SITE

6.1 Sindila Mini Hydropower Project

As per agreement made with Hemas Power PLC (Butama Hydro Electricity Company (Pvt) Ltd), a detailed Geotechnical Investigation Program was carried out at proposed Sindila Project sites.

This is a high head type Mini hydro power Project to generate 4.5Mw. The proposed weir is 2m high and 20m long. It is proposed to construct a 1930m long headrace channel along the left bank with the section of 1.5mx1.5m.

This project under consideration is located in Bundibujyo District in Uganda. The site is located on the Sindila river, and project area covers the vallages of Ntuma,Bunyamawera and Kabwe in Sindila sub County, Bundibugyo district of Uganda.

The proposed channel trace and the penstock line are 1.9km and 1.74km long and lying along the left bank of the river maintaining 393m gross head. This trace is mainly passing along steep slopes and numbers of land slide scars could be identified. The power house is located at broad valley.

The main objective of this assignment is to study prevailing engineering geological conditions of weir, powerhouse area and along the channel trace.

a. Detailed Engineering Geological Mapping at Weir, along Channel Trace and Power House Area
b. Propose most suitable foundation technique for main structures.
c. Study of actual locations of penstock anchors and relocate them to stable ground.
d. Execution of 31 numbers of test pits and asses the sub-surface geological condition
e. Identification of land slide areas and propose mitigatory measures

Table 6.1-Summery of Executed Test Pits D-Disturbed Sample, U/D-Undisturbed Sample

Test Pit No.	Structured Locations & Chainage	Coordinates and Elevation			Depth (m)	Samples tested	
		X	Y	Z		Number	Depth (m)
SC1	Channel- Ch. 0+740	833391	64395	1519	02.00	SSC2 (D)	1.10-1.40
SC2	Channel- Ch. 1+080	833208	64593	1517	02.00	SSC4(D)	0.90-1.30
SC3	Channel- Ch. 1+125	833201	64630	1511	01.60	-	-
SC4	Channel- Ch. 1+225	833139	64707	1509	02.00	-	-
SC5	Channel- Ch. 1+300	833196	64755	1509	01.90	SSC7(D)	1.10-1.40
SC6	Channel- Ch. 1+385	833165	64836	1509	01.50	-	-
SC7	Channel- Ch. 1+590	833215	64944	1513	01.90	SSC9(U/D)	1.00-1.30
SC8	Channel- Ch. 1+670	833288	65028	1512	01.90	-	-
SC9	Channel- Ch. 1+740	833333	65063	1513	02.20	SSC11 (D)	1.00-1.40
SD1	Desilting Tank	833330	65092	1517	02.00	SSD1(D)	1.20-1.60
SF1	Fore Bay Tank	833333	65132	1511	01.70	SSF1(D) SSF1(U/D)	1.10-1.40 0.50-0.80
SP1	Penstock Anchor-01	832945	65773	1272	02.50		
SP3	Penstock Anchor-03	832852	65970	1261	01.90	-	-
SP5	Penstock Anchor-05	832807	66070	1242	02.70	SSP5(D)	0.80-1.20
SP9	Penstock Anchor-09	832624	66127	1208	02.00	SSP9(D) SSP9(U/D)	1.00-1.40 1.00-130
SP11	Penstock Anchor-11	832554	66172	1172	02.00	-	-
SP14	Penstock Anchor-14	832460	66230	1138	01.80	-	-
SP15	Penstock Anchor-15	832425	66250	1133	01.50	-	-
SP18	Penstock Anchor-18	832284	66316	1130	01.60	SNP18 (D)	0.90-1.30
SP19	Penstock Anchor-19	832945	65773	1272	01.80	-	-
SP21	Penstock Anchor-21	832852	65970	1261	01.50	SNS25 (D)	0.90-1.30
CP1	Common Penstock	833274	65390	1403	02.00	SCP1(D)	1.10-1.60
CP2	Common Penstock	833246	65436	1394	02.00	-	-
CP4	Common Penstock	833184	65518	1363	02.30	-	-
CP7	Common Penstock	833106	65634	1309	01.80	-	-

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SC5	Channel- Ch. 1+300	833196	64755	1509	01.90	SSC7(D)	1.10-1.40
SC6	Channel- Ch. 1+385	833165	64836	1509	01.50	-	-
SC7	Channel- Ch. 1+590	833215	64944	1513	01.90	SSC9(U/D)	1.00-1.30
SC8	Channel- Ch. 1+670	833288	65028	1512	01.90	-	-
SC9	Channel- Ch. 1+740	833333	65063	1513	02.20	SSC11 (D)	1.00-1.40
SD1	Desilting Tank	833330	65092	1517	02.00	SSD1(D)	1.20-1.60
SF1	Fore Bay Tank	833333	65132	1511	01.70	SSF1(D) SSF1(U/D)	1.10-1.40 0.50-0.80
SP1	Penstock Anchor-01	832945	65773	1272	02.50		
SP3	Penstock Anchor-03	832852	65970	1261	01.90	-	-
SP5	Penstock Anchor-05	832807	66070	1242	02.70	SSP5(D)	0.80-1.20
SP9	Penstock Anchor-09	832624	66127	1208	02.00	SSP9(D) SSP9(U/D)	1.00-1.40 1.00-130
SP11	Penstock Anchor-11	832554	66172	1172	02.00	-	-
SP14	Penstock Anchor-14	832460	66230	1138	01.80	-	-
SP15	Penstock Anchor-15	832425	66250	1133	01.50	-	-
SP18	Penstock Anchor-18	832284	66316	1130	01.60	SNP18 (D)	0.90-1.30
SP19	Penstock Anchor-19	832945	65773	1272	01.80	-	-
SP21	Penstock Anchor-21	832852	65970	1261	01.50	SNS25 (D)	0.90-1.30
CP1	Common Penstock	833274	65390	1403	02.00	SCP1(D)	1.10-1.60
CP2	Common Penstock	833246	65436	1394	02.00	-	-
CP4	Common Penstock	833184	65518	1363	02.30	-	-
CP7	Common Penstock	833106	65634	1309	01.80	-	-

CP9	Common Penstock	832995	65730	1270	01.70	-	-
SPH1	Power House TP-1	832253	66326	1127	01.70	SSP1(U/D)	1.70-2.00
SPH2	Power House TP-2	832251	66333	1127	02.60	SPH1(D)	1.20-1.60

Finally the field observations were summarized to evaluate sub- surface condition at main structured locations and propose basic recommendations for foundation of weir, channel and power house. Mitigation measures for land slide prone areas are proposed in this report.

This study was carried out from 7th.February.2012 to 21st.February.2012 at proposed Sindila Project site in order to achieve the above objectives.

6.2 Topography and Geomorphology

This area maintains ridge and valley morphology and the main river Sindila runs along 5-10m wide V- shaped, deep valley on to NW direction. The slope on both left and right bank is very steep to moderately steep (80^0-45^0). The headrace channel runs on the right bank of the river. The main ridge runs parallel to the river and numbers of small streams runs perpendicular to the main valley. The bottom part of the main river flows on rocky bed bounded by rock escarpment.

Numbers of perennial stream paths across the channel trace were identified during this study and most of them are dry in this season. The details of stream are summarized below.

Table-6.2 Details of Stream Paths along the Channel Trace

Chainage	Stream type	Flow (l/min)
0+450	Perennial stream	dry
0+705	Perennial stream	60 l/min
1+140	Perennial stream	dry
1+530	Perennial stream	dry
1+655	Perennial stream	dry
1+800	Perennial stream	dry

The initial section from chainage 0+000 to 0+950 is mainly covered by large trees with some under growth.

6.2.1 Weir Site

The weir site is located just downstream of stream confluence on the river across U-shaped valley refers as chainage 0+000.

The left bank of the river along the weir axis rises gradually (>50^0) for about another 20m higher elevation and the right bank rises slowly maintaining 5^0-10^0 mild slope angle for about 20m distance. River bed is mainly covered by 0.5m-

1m diameter fresh rock boulders. About 4-5m section on left bank maintains as floodplain. After impounding the small pond the tail end will run for another 30m from the weir due to rising river bed towards upstream. (See Annexure 5; Photographs)

The left and the right bank of the river covered by large trees and shrubs. (See Annexure 5; Photographs)

6.2.2 Channel Trace , Desilting Tank , Forebay

The channel trace runs along right bank of the river from chainage 0+000 to chainage 1+930. Three major types of vegetation covers as home gardens, large tree areas with lesser under growth and shrubs can be observed along the channel trace. The varying slope angle, vegetation types and drainage patterns along channel trace are key factors affecting slope stability and summarized below.

Table-6.3 Topographical Summery along Channel Trace

Chainage from Weir	Vegetation	Drainage pattern	General Slope angle
0+000-0+100	Large trees and thin undergrowth	No stream paths	60^0-70^0
0+100-0+300	Large trees, Mana grass and shrubs undergrowth	Small scale perennial streams	60^0-70^0
0+300-0+475	Shrubs on steep rock slopes	Small scale perennial streams	70^0-80^0
0+475-0+740	Larger trees and shrubs	Small scale perennial streams	60^0-70^0
0+740-0+950	Larger trees and shrubs	Small scale perennial streams	60^0-70^0
0+950-1+275	Shrubs and Banana cultivation	Small scale perennial streams	40^0-60^0
1+275-1+630	Home gardens and Mana grass	Small scale perennial streams	30^0-40^0
1+630-1+875	Vegetable cultivation and Banana	Small scale perennial streams	10^0-30^0

Most of the stream paths across channel trace are perennial and irregular. The slopes show undulating topography. Specially the rock escarpment from chainage 0+300 to 0+475 shows very steep slope sections.

Desilting tank and the forebay structure is located on a platue morphological area mainly covered by home gardens. About 100m distance toward down the slope maintains very mild 5^0-10^0 slope angle. The desilting tank is on a dry very shallow gulley path and the section along the gulley maintains very mild slope for 100m downstream.

6.2.3 Power house Area

The powerhouse meets at chainage 3+645 m and located on the right bank of the river about 15m offset distance from the river bank. This location is on the center of a very broad valley (500m wide) maintains as a flood plane. This valley is filled by alluvium deposits and ancient glacial deposits.

The Sindila river is about 5-7m wide and 4-5m deep at the proposed power house location.

This area is mainly covered by vegetable cultivations.

6.3 Engineering Geology of Main Structured Sites

Engineering geological situation of main structured sites was studied by carrying out surface geological mapping in 1:1000 scale. The site condition is described below concentrating to each structured areas.

6.3.1 Weir

The river section along proposed weir axis is about 20m long and right bank rises slowly for about 20m maintaining 5^0-10^0 slope angle while left bank rises gradually maintaining 50^0-60^0 . Rock escarpment about 5-10m high can be seen on the left of the river and only 1-2m high rock exposer can be seen on the right bank.

Both left and bank slopes about 30m distance is mainly covered by slightly to moderately weathered rock of quartz feldspathic gneisses. The river bed is covered by alluvium deposits (AL1) consists 0.5-1.0m diameter rock boulders mixed with gravelly sand. Refer Annexure 1-Surface Engineering Geology Map of Project Area. Thickness of this layer may be about 1-1.5m.

Moderately weathered hard rock escarpment can be observed along the right bank towards downstream.

Hard, slightly weathered, quartz feldspathic gneiss rock exposes shows moderately strong characteristics. General strike and dip direction of exposed bed rock is $225^0/40^0$. Two major three joint sets can be identified on rock exposes as their trend and plunge 295^0 /900^0SW , $160^0/60^0$NE ,. These joints are 0.5-1m intervals. (Refer annexure 1- Detailed Engineering Geology Map of Project area) (See Annexure 1-photograph of the weir axis).

6.3.2 Channel Trace

Detailed engineering geological mapping was conducted along the channel trace and 1:1000 scale detailed engineering geological map was prepared. (Refer Annexure 1-Detailed Engineering Geological Map of Project Area).

The geological data obtained during mapping are summarized based on material types identified along the channel trace. (Refer table 4-Summarized Geological Data). Also ten numbers of test pits were excavated along this

channel section and geological sections were drawn representing each material category. (Refer Annexure 3; Geological Sections).

Table 6.4-Summerized Geological Situation along Channel Trace

Chainage	Surface Geology	Sub-surface Geological Summery				
		Geological section	Test pit number	Depth of layers (m)	Layer Description	Depth of Ground water table(m)
0+000-0+100	Alluvium deposits(AL1), Slightly weathered to moderately weathered rock (SW to MWR)	C1-C1	Not done	<1.00m	Most of the areas bed rock is exposed	Not identified
0+100-0+300	` moderately weathered rock (MWR) Residual clay (RS1)	C2-C2	Not done	<1.00m	Thin layer of RS1 and bed rock is very near	Not encountered
0+300-0+475	Fresh Rock (FR)	-	Not done	Most of the areas bed rock is exposed		Not encountered
0+475-0+740	Residual clay(RS1),	C3-C3	SC1	0.00-0.20	Silty organic Clay (OC)	
				0.20-0.50	2-5cm angular rock fragments(Concentrated) TL5	
				0.50-2.00	Highly weathered Rock	
0+740-0+950	moderately weathered rock (MWR) Residual clay (RS1)		Not done	Most of the areas bed rock is exposed		
0+950-1+275	Talus Material (TL3) Residual clay(RS2) Talus Material (TL2) Residual	C4-C4 C5-C5	SC3 SC4	(SC3) 0.00-0.60	Silty organic Clay (OC)	Not encountered

	clay(RS1)					
				0.60-1.10	Silty clay mixed with 5-10cm rock fragments(TL)	
				1.10-1.60	Silty clay ,stiff, moist (CW)	
				(SC4) 0.00-0.20	Silty organic Clay (OC)	
				0.20-2.00	Silty clay mixed with 5-10cm rock fragments(TL)	
1+275-1+630	Residual clay(RS1) Talus Material (TL3)	C6-C6	SC5 SC6 SC7 SC8	(SC5) 0.00-0.20	Silty organic Clay (OC)	Not encountered
				0.20-1.20	Silty clay mixed with 5-10cm rock fragments(TL)	
				1.20-1.90	Silty clay ,stiff, moist (RS)	
				(SC6) 0.00-0.30	Silty organic Clay (OC)	
				0.30-1.30	gravelly clay mixed with 5cm rock fragments(TL)	
				1.30-1.50	gravelly clay mixed with 5cm rock fragments (HWR)	
				(SC7)	Silty	

				0.00-0.30	organic Clay (OC)	
				0.20-1.20	Silty clay mixed with 5-10cm rock fragments(TL)	
				1.20-1.90	Silty clay ,stiff, moist (RS)	
				(SC8) 0.00-0.20	Silty organic Clay (OC)	
				0.20-0.80	gravelly clay mixed with 5-10cm rock fragments(TL)	
				0.80-1.20	Silty clay ,stiff, moist (RS)	
				1.20-1.90	Silty clay ,stiff, moist (CWR)	
1+630-1+875	Residual clay(RS1) Talus Material (TL3)	C7-C7	SC9	(SC9) 0.00-0.20	Silty organic Clay (OC)	
				0.20-2.20	gravelly clay mixed with 5-20cm rock fragments(TL)	

Geology from chainage 0+000 to 0+100

The surface geological features were studied during detailed geological mapping. C1-C1 was produced to evaluate subsurface condition. (Refer Annexure 3- Geological section C1-C1).

This area is mainly covered by hard rock exposes and rock mass shows slightly to moderately werathered characteristics. (Refer geology map) This rock mass in this escarpment shows moderately weathered characteristics and slightly jointed. Topography shows undulating ground condition along this section. At some place rock boulders can be identified and some boulder blasting may required to remove surface boulders.

The average slope angle along this section is 60^0-70^0 rock escarpment shows more steeper angles.

Geology from chainage 0+100 to 0+300

The surface geological features were studied during detailed geological mapping and Geological section C2-C2 was produced to evaluate subsurface condition. (Refer Annexure 3- Geological section C2C2).

Majour two types of materials were encountered along this section. Initial 100m long section is covered by moderately weathered rock and next part is covered by 1-3m diameter anguler rock blocks mixed with sandy clay material in talus origin. The slope angle maintains 60^0-70^0 on this weak talus material and there is a higher risk for failing during excavation. Also some rock blocks on steep slope tend to move down.

Geology from chainage 0+300 to 0+475

The surface geological features were studied during detailed geological mapping and this section mainly covered by fresh rock exposes. The slope maintains 70^0-80^0 average slope angle and very difficult to do excavations. Also the rock exposure at chainage 0+305 is very massive and continued for another 10m distance while remaining section shows moderately jointed and possibility of rock falling during excavation.

Geology from chainage 0+475 to 0+740

The surface geological features were studied during detailed geological mapping and sub-surface geological condition was assessed by executing test pit SC1. Geological section C3-C3 was produced to evaluate subsurface condition. (Refer Annexure 3- Geological section C3-C3)
This area is mainly covered by Talus materials and residual clays. At some places hard rock exposes can be seen which are highly jointed. The test pit data shows that the overburden material thickness is 0.5m up to the hard rock.

Deep stream gulley (5-7m) runs across main channel at chainage 0+710 and both banks and stream bed are covered by hard moderately weathered Quartz feldspathic gneisses. It is necessary to lay the channel for about 5-7m across the stream. Stream has 60l/min water flow during the study period.

The average slope angle varies from 70^0-80^0 and the very steep upper slope rises more 50m. Also the lower slope maintains very steep slope angle and continued up to the river.
The slopes are covered by larger trees and shrubs.

Geology from chainage 0+740 to 0+950

The surface geological features were studied during detailed geological mapping. (Refer Annexure 1- Surface Geological Map)

This area is mainly covered by Residual clays and moderately weathered rock exposes. Talus material consists 5-10cm diameter concentrated rock fragments can be identified along this section and penetrates for about 0.5m depth up to the hard rock.

The rock mass is highly jointed and and they tend to open up on applying hammer blows. This creates 0.1-0.2m diameter rock pieces.

The average slope angle varies from 60^0-70^0 and the very steep upper slope rises more than 50m. Also the lower slope maintains very steep slope angle and continued up to the river.

The slopes are covered by Mana Grass and shrubs.

Geology from chainage 0+950 to 1+275

The surface geological features were studied during detailed geological mapping and sub-surface geological situation was assessed by excavating two test pits SC3 and SC4 for the depths of 1.6m and 2.0m.

Surface geological data shows that the channel section mainly covered by two types of materials as residual clays and Talus. It was observed that the thickness of the overburden up to the weathered rock layer is about 1.10m at residual areas (RS1 & RS2) while talus material consists of 5-10cm diameter rock fragments penetrates for 2.00m depth. Exact thickness of this material can not be verified.

The average slope angle maintains within varies from 30^0-40^0 and mainly covered by home gardens.

Geology from chainage 1+275 to 1+630

The surface geological features were studied during detailed geological mapping and four numbers of test pits as SC5,SC6,SC7 and SC8 were executed to study the sub-surface condition.
It was identified gravelly clay material of residual origin along this channel section. The summarized excavated test pit data shows that the original residual material or completely weathered rock material is encounters at 1.2m depth penetrating through ailca talus (TL) material layer consists 5-10cm diameter rock fragments mixed with clay. (Refer Annexure 1- Surface Geological Map of the Project Area).

This channel section runs across home gardens maintaining 30^0-40^0 slope angle.

Geology from chainage 1+630 to 1+875

The surface geological features were studied during detailed geological mapping and sub-surface geological situation was assessed by executing three test pits SC9. (Details of this test pit is summarized in the Table 6.3 above).

It was encountered residual clay material (RS1) along this channel section.

At test pit SC9 ,gravelly clay mixed with 5-20cm rock fragments in talus origin penetrates deeper than 2.2m test pit termination depth and actual depth of this material can not be verified.

The slopes along this section section maintains 5^0-10^0 average slope angle.

6.3.3 Spillway Location

Proposed spillway structure is located from chainage 1+825 to 1+860 on a perennial stream path. This stream was dry during study period and evidence for verylittle flow during rainy season. The stream bed and the immediate slope above the proposed location is covered by residual soil of gravelly clay. The upper slopes maintains about 5^0slope angle while lower slope continued same angle for 100m and gently sloping down along the steam.

One test pit, SD1 was excavated to study the sub-surface condition and the data is summarized below.

Table 6.5 Summerized Geological Situation at Spillway Location

Location	Surface Material	Geological section	Depth of layers (m)	Layer Description	Depth of Ground water table(m)
NF1	Residual Clay (RS1)	F1-F1	0.00-0.20	Silty organic Clay (OC)	Not identified
			0.20-0.40	5cm angular rock fragments in gravelly clay (TL)	
			0.40-1.30	Silty clay with some gravel (RS1)	
			1.30-1.80	Gravelly clay, Hard	
			1.80-2.00	Moderately weatherd rock	

The data shows it is about 1.80m depth to the hard rock.

6.3.4 Forebay Location

Forebay location meets at chainage 1+865 and extends for 1+890. It is located platue on a mountain where average slope angle maintains 2^0-5. The surface area is mainly covered by gravelly clay material of residual origin (RS1).

One test pit SF1 was excavated for 2.to study sub-surface condition for 2.20m.The sub-surface geological condition is summarized in the table given below.

Table 6.6 Summerized Geological Situation at Fore bay Location

Location	Surface Material	Geological section	Depth of layers (m)	Layer Description	Depth of Ground water table(m)
SF1	Residual Clay (RS1)	F2-F2	0.00-0.20	Silty organic Clay (OC)	Not identified
			0.20-0.70	gravelly clay (RS),hard,moist	
			0.70-1.70	Silty clay (RS), hard, moist	

The summarized sub-surface geological data shows that, continuation of residual clay material from 0.2m and continued upto test pit termination depth of 2.2m.

6.3.5 Penstock Line

Surface engineering geological mapping was carried out along the 1.74km long penstock line. During mapping, the some of proposed penstock anchor locations were sifted to geological feasible grounds avoiding landslide scars. Also 17 numbers of test pits were excavated to study the sub-surface geological condition. The surface and sub-surface geological situation is summarized in the table given below.

Table 6.7-Summerized Geological Situation along the Penstock Line

Chainage	Anchor Numbers	Test pits excavated	Surface geological condition	Depth of Ground Water Table (m)
1+890-1+985	AH1,AV2	SP1	Residual Soil (RS1))	Not Encountered
1+985-2+025	AH3	SP3	Talus material (TL2)	
2+025-2+125	AV4	-	Residual Soil (RS1)	
2+125-2+185	AH5(C1)	CP1	Talus material (TL4)	
2+185-2+575	AV6,AH7,AV8,AV10, AH11, AH13,AH14,	, CP1,CP2,CP4,CP7, CP9	Residual Soil (RS2)	
2+575-3+395	AH15,AH16,AH17, AH18, AH20,AH21,AH22, AH23,AV24,AH25, AH26,AV27,AH28, AV29,	SP9,SP11,SP14, SP15,SP18,SP19	Residual Soil (RS1)	

3+395-3+455	AH30,	SP21	Alluvium material (AL1)	
3+455-3+645	AV31,AV32	-	Alluvium material (AL1)	

The summarized data shows varying geological condition along the penstock line and the geological logs of test pits excavated shows the depth of penetration of sub-soil layers.

6.3.6 Powerhouse and Tailrace Channel

Surface engineering geological mapping was carried out at powerhouse area and two test pits SPH1 and SPH2 were excavated to evaluate sub-surface geological condition.

The power house and tailrace channel is located on the right bank river flood plane in the middle of the 500m wide broad valley mainly filled with alluvium and glacial deposits. The adjacent river section shows about 3-5m thick alluvium bed consists well rounded 0.1-0.3m diameter rock boulders.

Two test pits excavated shows penetration of alluvium deposits up to test pit termination depths of 2.5m. The stabilized ground water table was identified at 2.5m depth

The detailed layer description of test pits excavated is summarized below.

Table 6.8-Summerized Geological Situation at Powerhouse Location

BH Number	Depth of Penetration (m)	Subsurface profile		Depth of Ground Water Table (m)
		Depth(m)	Material	
SPH1	1.70m	0.00-0.60	Silty organic Clay (OC)	-2.50
		0.60-1.20	Grayish black silty clay, firm, moist (AL)	
		1.20-1.40	Gravelly coarse sand ,Dense(AL)	
		1.40-1.70	Yellowish grey silty fine sand,Medium dense, moist (AL)	
SPH2	2.60m	0.00-0.50	Silty organic Clay (OC)	
		0.50-1.10	Grayish black silty clay, firm, moist (AL)	
		1.10-1.40	Gravelly coarse sand ,Dense(AL)	
		1.40-2.40	Yellowish grey silty fine sand,Medium dense, moist (AL)	
		2.40-2.60	0.5m boulders mixed with sandy gravel,very dense, wet (AL)	

Successive layers of organic clay, silty clay, gravelly sand, silty fine sand and sandy gravel were encountered at powerhouse location. The geological sections P1P1 & P2P2 envisage the sub-surface condition. (Refer Annexure 3- Geological section P1P1& P2P2 and Annexure 5-Photographs of powerhouse area.)

6.4 Geological Evaluation and Recommendations

Geological evaluation and recommendations are summarized under main structured locations as below.

6.4.1 Weir Site

About fifteen meters distance from right BANK along the weir axis is covered by alluvium deposits of rounded gravelly sand with 0.5-1.0m diameter rock boulders (AL1). This layer penetrates about 1m depth evident from surrounding rock exposes. The weir foundation can be placed on hard, moderately weathered to fresh rock formation after 1-2m deep excavation on river bed. However the proposed weir structure only rises about 2m and not feasible for deep excavation.

Moderately weathered rock is exposed on both abutments and the weir structure can abutted to moderately weathered rock after scale down detached rock blocks and weathered rock pieces.

However the wing wall should be constructed and extended towards upstream direction to avoid erosion on right abutment.

6.4.2 Channel Trace

It was assed the slope angle and surface and sub-surface engineering geological situation during mapping and test pitting. Also foundation type of each section was assessed by evaluating slope angle and type of material identified on the slope. The situation is summarized and suggestions are made for foundation of channel structure.

The studied geological data shows existence of very steep slopes covered by talus material. This material is very vulnerable for slope failures during excavation. Also this material starts to move down once it is disturbed.

The hard slightly weathered to fresh rock exposes can be seen at some places along the channel trace. These rock exposes are moderately to highly jointed and detached and higher possibility of rock falls during excavation.

Considering above factors it is proposed to place individual short pier foundations (Aqueduct Sections) along the critical sections. On the other section normal pad footings can be place after excavation up to hard layers. The summarized data is given in the table below.

Table 6.9-Type of Channel Sections Proposed

Chainage (m)	Type of channel Sections
0+000-0+950	Aqueduct Sections
0+950-1+875	Normal Channel

Special attention should be paid during excavations from chainage 0+ 300 to 0+475 where slight weathered rock is exposed along steep slopes.

At chainage 0+305 the massive rock escarpment can be identified and the channel foundation can be placed on the rock slope forming a small ledge by pre-splitting and some anchor bolts may be required for attaching the foundation.

Also, It is proposed to make column foundations attaching loose blocks using mass concrete blocks. If necessary blasting should be carried out through slightly weathered or fresh rock encountered during excavation and free splitting technique with suitable delays should be performed to avoid damage to the surrounding area. At some places loosed rock blocks can be seen on upper slopes and possibility of moving down after construction causing damages to channel structure. However these blocks should be removed because it may destabilize further upper slopes. It is proposed to place concrete toe support at the ground to avoid erosion.

At chainage 0+710 , 5-7m deep and 8m wide stream gulley crosses the channel trace and hard rock exposes could be identified on both banks and bridge foundation is proposed on suitable piers.

Excavated surplus soil and rock materials should be spread around the short piers with some tamping.

Underpass should be designed along perennial streams across headrace channel to reduce pore pressure on channel walls.

6.4.3 Spillway Location

Spillway location is mainly covered by gravelly clay of residual origin and hard rock is encountered about 1.5m depth. It is proposed to place spillway structure on hard rock about 1.5m depth. The slope maintains along the stream path as very mild. (2^0-5^0). Also it is proposed to construct a cascade drain along the gulley path to avoid erosion during runoff.

6.4.4 Forebay Location

Proposed forebay is located on very mild sloppy area. This area is mainly covered by residual clay material consists gravelly clay. Thickness of this material layer is more than1.7m and actual depth of this formation can not be verified by test

pitting. This material shows hard characteristics and foundation can be placed on this material below 1.0m depth.

6.4.5 Power House Area

Power house location is covered by alluvium deposits and the test pit data shows penetration of this layer deeper than 2.6m. The stabilized ground water table is encountered at 2.5m depth

.

Depth of alluvium deposit could not be verified during test pitting and proposed to study the sub-surface by executing a borehole or study during excavation.

However a raft foundation can be recommended at 2.40m depth on boulder bed.

This location is about 10m distance far from river bank and possibility of erosion during flood. Hence it is proposed to shift this location towards landwards.

6.4.6 Landslide Areas

Numbers of land slide scars were identified along the channel trace and along the penstock line.These landslides are very old and not active under existing geological conditions. Identified landslides scars are summarized below.

Table 6.10 Summerized Data on Landslide Scars within the Project Area

Chainage	Length along the structure (m)	Affected Structure	Material type on surface and depth to the rock	Remedial Measures
0+265-0+295	30m	Headrace Channel	Debris,0.2-0.5m dia rock boulders mixed with organic clay	Pier foundation recommended an foundation should b placed on hard bed rock
0+515-0+530	15m	Headrace Channel	Talus material (TL2) and depth to bed rock cannot be verified	Pier foundation recommended Channe should be founded on har bed rock
0+625-0+645	20m	Headrace Channel	Talus material (TL2) and depth to bed rock cannot be verified	Pier foundation recommended Channe should be founded on har bed rock
1+240-1+255	15m	Headrace Channel	Talus material (TL2) and depth to bed rock cannot be verified	Pier location should b shifted to firm ground an foundation should b placed on hard rock o original ground

1+335-1+345	10m	Headrace Channel	Talus material (TL3) and depth to bed rock cannot be verified	Pier location should b shifted to firm ground an foundation should b placed on hard rock o original ground
1+555-1+575	20m	Headrace Channel	Debris material (DB1) and depth to bed rock cannot be verified	Pier location should b shifted to firm ground an foundation should b placed on hard rock o original ground
1+640-1+670	30m	Headrace Channel	Talus material (TL3) and depth to bed rock cannot be verified	Pier location should b shifted to firm ground an foundation should b placed on hard rock o original ground

Considering above geological conditions it is proposed to lay the channel section across this landslide area as an aqueduct and individual column foundations should be penetrated passing debris mass to a consistent layer(Completely to highly weathered rock N>50).

Also it is recommended to construct a boulder arrangement around the pier foundation to minimize the erosion.

The small gullies on slip area should be developed as cascade drains to enhance surface runoff and divert water to the river. It is proposed to make contour drain above the upper limit of landslide area and grass sods can be paved on exposed areas.

Special Note

This project area shows varying topography, geology and slope angles. It is proposed to hire special consultant to evaluate the foundation condition at each pier location to decide the most suitable foundation type during construction.

7.0 SEISMICITY

7.1 REGIONAL SEISMICITY IN UGANDA

The African rift comprises with eastern and western branches, Uganda is the country which is situated in between Eastern and western rift formations. The eastern rift is characterized by volcanic activities while the western branch is characterized by deep basins which contain lakes and sediments.

The western branch of the East African rift valley passes through the northern and western boundary of the Uganda and is the most seismically active region in the African continent where about 100 earthquakes has recorded annually. There are two major shear zones crosses the country. One is the Aswar Shear zone lies from Northern corner to Eastern sides of the Uganda. The other shear zone is "Katonga Shear (break) zone" which started from foot of the Rwenzori mountains and runs up to Lake Victoria. It is believed that this faulting crosses under the lake to join the Kavirondo rift in south western Kenya.

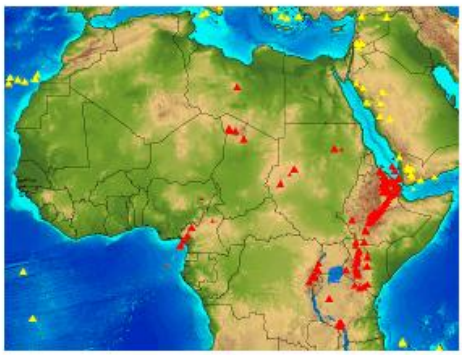


Figure 7.1 : Maps of Volcanoes in Africa :
Source: http://www.volcano.si.edu/world/region.cfm?num=02

Note: Large red triangles show volcanoes with known or inferred Holocene eruptions; small red triangles mark volcanoes with possible, but uncertain Holocene eruptions or Pleistocene volcanoes with major thermal activity. Yellow triangles distinguish volcanoes of other regions.

There are five earthquake monitoring stations were established by Geological Survey and Mines Department, Uganda at Entebbe (ENT), Hoima (HOI), Kilembe (KIL), Dundu (ENTD) and Mbarara (MBAR). Number of earthquakes has recorded in the past in the Ugandan region. From the recorded earthquakes the majority is located in the western rift region of the country. The most serious earthquakes

have recorded in 1966 and 1994 at western Uganda with 6.6 and 6.2 magnitudes in Richter scale respectively. The earthquake in 1966 has caused about 150 deaths and about million dollars worth of property damages [1]. The occurrence of these earthquakes indicates that the rifting is still active in the Rwenzori region. Details of the recorded notable earthquakes during past hundred years in Uganda are as follows.

TABLE -7.1 : REMARKABLE EARTHQUAKES IN UGANDA

Date	Epicentre	Magnitude (on Richter Scale)	Effects
09.07.1912	Kitgum on Aswa shear zone	6.7	Partial destruction of buildings in Northern & Northwestern Uganda
02.10.1929	Toro, Western Uganda	5.9	Change of water colour in the hot springs, Landslides occurred
18.03.1945	Sembabule	6.0	5 dead and Destruction of some buildings
20.03.1966	Toro, Western Uganda	6.6	150 dead and over 1300 injured and million dollars worth property loss
07.09.0991	Lake Victoria area, near Kampala	5.0	Destroyed semi permanent buildings around Kampala city
09.10.1991	Butaiba on Lake Albert	5.3	Destroyed semi permanent buildings
05.02.1994	Kisomoro, Western Uganda	6.2	8 dead and destruction of property worth 61 million dollars

7.2 Earthquakes located in Project Area

The project area is earthquake prone. For example, within a radius of 20 to 50 km large earthquakes occurred. The following major earthquakes occurred: (i) on 2nd October 1929, Location (0.4° N 30° E) Toro earthquake in the western rift measuring 5.9,(ii) 20th March 1966 Location (0.84° N 29.9° E) Toro earthquake measuring 6.7, and (iii) on 5th February 1994, Location (0.59° N 30.03° E) Kisomoro-Toro earthquake measuring 6.2, claiming lives of 8 people and causing destruction of property worth $ 61 million. However, moderate earthquakes continue to be felt often in the country.

7.3 Records of Seismic Hazard

The seismic hazard for the whole region has been simplified and presented in figs.3.2, 3.3 and 7.4. The information provided in the figures show that the project area is very seismically active and ranks number 1 in the whole country for the past, present and future seismic risk prone areas. It is therefore important to consider seriously the procedure for implementing projects in high seismic risk zones considering the project's importance.

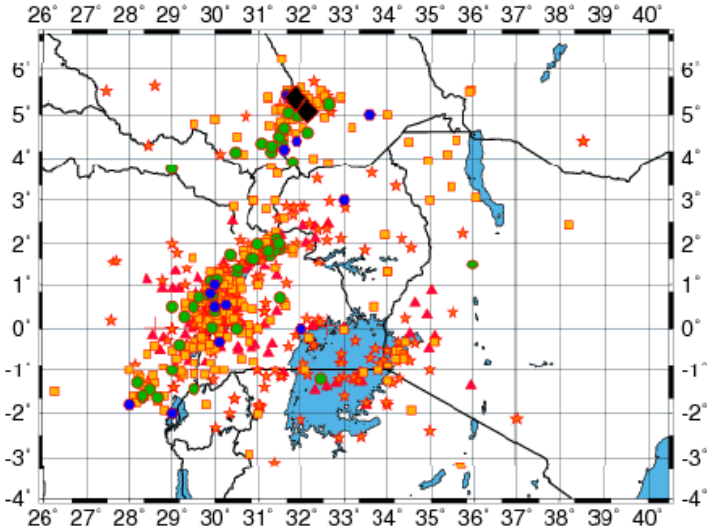


Figure 7.2 : Locations of all the earthquakes used in the computation of Seismic Energy Release

Earthquake activity in Uganda : Locations of earthquakes used in the computation of Seismic Energy Release Map: 1.0≤Ms≤1.9 red triangles; 3.0≤Ms≤3.9 red star; 4.0≤Ms≤4.9 Orange; 5.0≤Ms≤5.9 green circle; 6.0≤Ms≤6.9 blue hexagon; 7.0≤Ms≤7.9 black symbols;

Source: http://www.ugandaclusters.ug; Tumwikiriez, 2007.

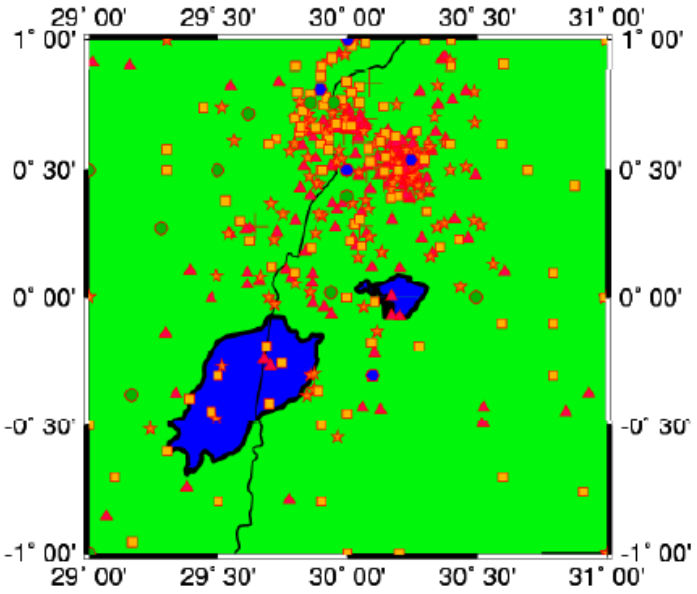


Figure 7.3 : Seismicity of the project zoomed from (7.2)

Earthquake magnitudes
1.0 ≤ Ms ≤ 1.9 red cross;
2.0 ≤ Ms ≤ 2.9 red triangle;
3.0 ≤ Ms ≤ 3.9 red star;
4.0 ≤ Ms ≤ 4.9 orange square;
5.0 ≤ Ms ≤ 5.9 green circle;
6.0 ≤ Ms ≤ 6.9 blue hexagon;
7.0 ≤ Ms ≤ 7.9 black diamond symbols (Tumwikirize 2007)

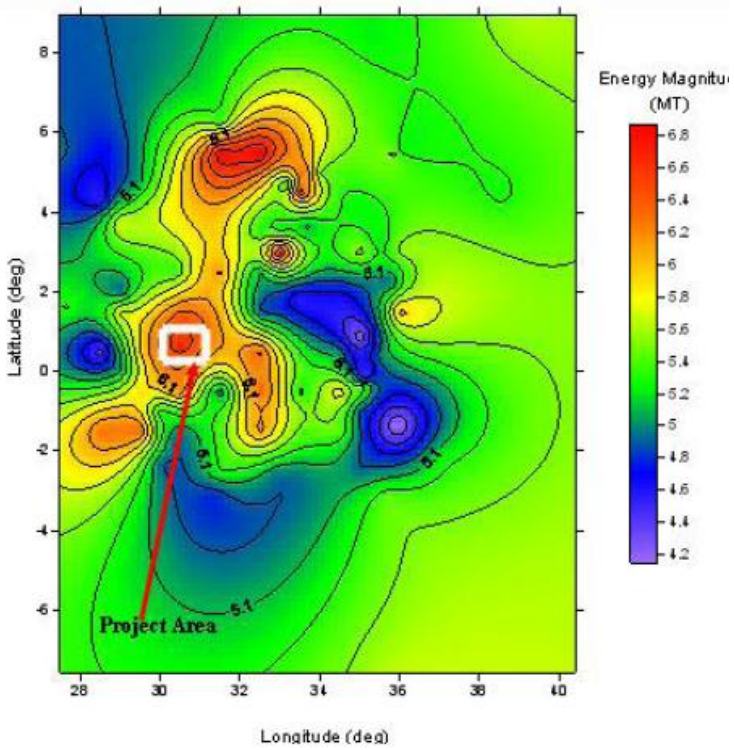


Figure 7.4 : Seismic energy Zone

Note:
The Project Area lies in highest Seismic Energy zone (red-orange) of potential earthquakes of magnitude greater than 6.8, and highest seismic hazard considering a radius of 20 to 50km from major seismic source zones. Seismic Energy Release Map obtained from the seismic data of Uganda Seismic Network catalogue using the Moving Block Method proposed by Bath (1980b, 1982a, b). The method is implemented by considering a moving block of 1° by 1°. Note the seismic energy highs (red-orange) and lows (blue colour). The areas of high seismic energy correlated with the Western arm of the EARS and Lake Victoria basin. There are prominent low seismic energy zones which may reflect the role of the Tanzanian craton and basement complex in eastern Uganda (See related map in figure immediately below) (Tumwikirize 2007).

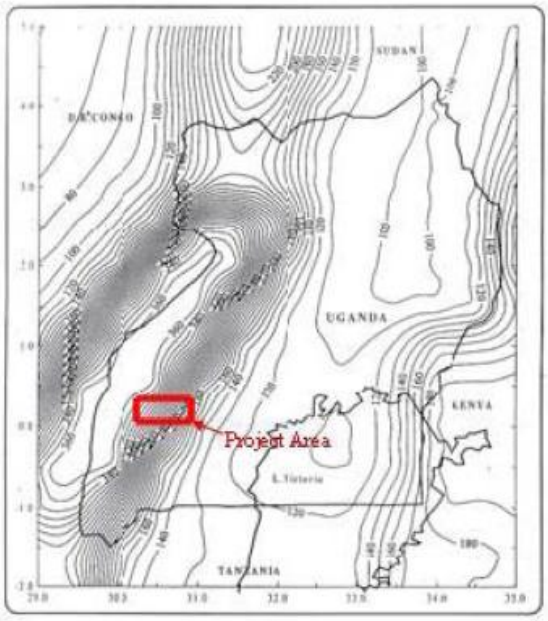
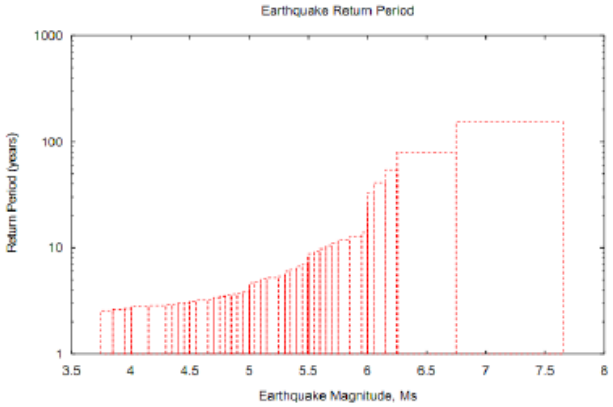


Figure 7.5 : Seismic hazard map by Twesigomwe, 1996

Peak ground acceleration varying from 120 cm/s2 for cratonic sites to 360 cm/s2 for the western rift for 100 years. The Project area lies in a zone of high seismic risk. Peak ground acceleration of at least 360 cm/s2 and more should be used for design of the structures for the project.

7.4 Earthquake Return Period

The results of return period for various magnitudes of earthquakes are shown in figure 7.4. Earthquake reoccurrences in this study can be analysed in four groups. There are those earthquakes which are more likely to return after a short period of less than 5 years (Ms ≤ 3.8). The second group of characteristic earthquakes to return fall in (Ms ≤ 5.7), and these are more likely to re-occur in 10 ± 5.0 years. A third category of earthquake events of magnitude (Ms ≥ 6.0) show return periods of 50 to 85 years. The fourth group of earthquake magnitude (Ms ≥ 6.8), are likely to re-occur in over 85 years.



(Tumwikirize, 2007)

Figure 7.6 : Return period of the Earthquakes
Source: http://www.ugandaclusters.ug

7.5 Seismic Disaster Proneness state for design of structures

This project area is lying near the western rift formation and experiencing numbers of earthquacks. It has experienced 6.8 scale earthquakes in Bundibugyo area causing damages to buildings. Numbers of parties have done seismic hazard zonation in Uganda and the published data by Elsevier Science Limited in 1997 is summarized below . The resulting hazard map suggests that the whole of Uganda except in or close to the rifts, can expect to experience a PGA of between 0.5 and 0.6 m s(-2), equivalent to an earthquake of intensity V-VI (slight damage) on average once every 50 years. In or close to the Western Rift, the expected PGA is between 1.O and 2.2 m s(-2), equivalent to an earthquake of intensity VII-VIII (moderate to heavy damage) on average once every 50 years. The frequency

of occurrence of a PGA = 2.0 m s(-2) (heavy damage earthquake) for various parts of Uganda was also calculated. The results indicate that northeast Uganda can expect a destructive earthquake on average once in more than 3000 years, while south of latitude 0.5 degrees N, except in and close to the Western Rift, can expect a destructive earthquake on average once every 1000-1500 years.

According to the early studies and recent earthquake records number of epicenters falls in and around Rwenzori region of the western rift. Though the return period of the earth quake which has the higher magnitude than 6.0 are about 100 years while the return period for the magnitude less than 6 are around 10 years. Therefore there is an evidence to occur number of minor earthquakes (magnitude less than 6.0) in future. So the proposed project area has a significant seismic hazard and that can affected the proposed structures of the small hydropower project.

7.6 Seismic Coefficient for the Analysis

According to the U.S. Army Corps of Engineers manual for seismic design of new dams requires use of a seismic coefficient of 0.1 in Seismic Zone 3 and 0.15 in Seismic Zone 4, in conjunction with a minimum factor of safety of 1.0. In California, many state and local agencies also require the use of a seismic coefficient of 0.15 but impose the slightly more conservative requirement that the minimum computed factor of safety be not less than 1.1. This approach was first explored by Seed (1979) who drew the general conclusion that for embankments composed of materials which show no significant loss of strength as a result of cyclic loading, "it is only necessary to perform a pseudo-static analysis for a seismic coefficient of 0.1 for magnitude 6.5 earthquakes or 0.15 for magnitude 8.25 earthquakes and obtain a factor of safety of the order of 1.15 to ensure that displacements will be acceptably small".

Seismic coefficient for the detail evaluation and analysis = 0.15

However, engineering judgment should be applied as to the applicability of such value for the above study in different localities. Therefore, some of the evaluations significantly control to the least factor of safety of 1.0 and most of limiting value under seismic loading limited to 1.1 or higher factor of safety might be varied with the uncertainties involved in a particular analysis.

8.0 Summary of Design Recommendation

Table 8.1 Ndugutu Mini Hydropower Project

No	Item	Ndugutu MHP	
		Geological Aspects	Design Aspects
1	Project Layout	Initially proposed structural locations were studied concentrating to; - Slope angle - Material Types - Land slides - Streams Final adjustment were done to locate penstock piers & weir site	Initially proposed layout was refined using additional information - Detail survey - Geological information - Accessibility - Social and environmental requirements
2	Weir & Intake Structure	• Weir; Orientation was adjusted to meet good abutment • Abutments; covered by slightly to moderately weathered rock of quartz feldspathic gneisses –Some blasting is required to remove part of boulder on left bank General strike and dip direction of exposed bed rock is $120^0/30^0$ • Riverbed; Covered by Alluvium deposits (0.2-0.5m boulders mixed with gravelly sand- Thickness of this layer is <2m) (Refer Detailed Geology map of Project area)	• Original location and orientation was confirmed by considering access availability, Topography and recommendations received by geological experts. • Weir orientation was adjusted (angular) to suit bank rock outcrops. • Covered channel section and flood wall was introduced up to desilting tank to avoid flood entering in to the channel. • Weir top level and intake was designed to carry with additional flow if required to the headrace channel. • Flush out gate was provided closed to the intake for better flushing around the intake and the weir. • Trash was kept parallel to the river flow direction to minimize accumulation of floating items • Two openings were provided for environmental flow and to use at water supply scheme downstream. • Weir section was checked for - Sliding - overturning - For accommodation of flood flow. Ref Dwg: (D/CD/ST-01A)

3	Headrace Channel Structure	Foundation of proposed channel was assessed by visual observations on; - Slope angle - Material Types - Land slides - Streams And Executing 11 numbers of test pits for about 2m depth Channel sections finalized are as follows; 0+000-0+200-N/C 0+200-0+290-A/D 0+290-0+400-N/C 0+400-0+805-A/D 0+805-0+880-N/C 0+880-0+930-A/D 0+930-1+125-N/C 1+125-1+200-A/D 1+200-1+550-N/C 1+550-1+605-A/D Individual short pier foundation and concrete block foundations on detached rock blocks were proposed to minimize the risk of failures on steep slopes Locations of stream crossing points were identified to design for under passes 0+290- Perennial stream 0+425-Perennial stream 0+590-Perennial stream 0+650-Perennial stream 1+105-Spring 1+175- Perennial stream 1+380- Perennial stream 1+420- Perennial stream 1+480- Perennial stream 1+550- Perennial stream	• Two alternatives were considered and best alternative was finalized based on topography, geology and also distance to the intake • Channel was designed on short concrete piers (6m intervals). By considering - steepness of slopes - to minimize, disturbance to natural drainage Finalized Channel parameters as follows - Length 1+625m - Internal dimensions 1400mm x1150mm. - Design flow = 1.6m^3/s - Design velocity = 1.5m/s - Bed slope = 0.0018 Ref Dwg: (D/CD/ST-04,05)

4	Desilting tank	Originally proposed location at channage 0+025 was finalized Covered by Talus material of 1-5m diameter rock boulders and blasting necessary	• Originally proposed location was used (at channage 0+025m) by considering availability of facility to flushing and channel spiller directly to the river. • Velocity along tank was kept around 0.3m/s to eliminate particles higher in dia. of 0 .3mm • Vertical steel gate was proposed to flush the accumulated sediments. Ref Dwg: (D/CD/ST-7)
5	Forebay Tank	Located on the area covered by Talus material of 0.2-0.5 m dia. rock boulders mixed with gravelly clay. Thickness of this layer is >2.5m and special design should be done	• Design to maintain the minimum of 2 minute storage and avoid any air entering to the penstock pipes. • Structure was finalized at channage of 1+625 to avoid landslides and to satisfy topographical conditions • Vertical gate was proposed and designed to flushing accumulated sediments
6	Penstock area	Numbers of landslide scars were identified along the penstock path and anchors were re-located Deviating from landslide areas.	• Steel penstock was proposed • The diameter was decided based on the economy, handling and transport • Preliminary sizes of the steel pipes are Diameter – 1000,1100 and 1200mm Thickness -10,12,14,16 mm Total length of penstock= 2441m • Both internal and external surfaces are to be paint with a suitable epoxy type paint • Pier supports (6m c/c) are provided at 6m intervals.

			• Suitable expansion arrangement for steel penstock is provided 1m D/S of each anchor • A vent pipe will be installed just below the bell mouth intake of the penstock.
7	Anchor Blocks and Supports		• Anchor blocks where provided at all locations with vertical and horizontal bends. • Grade C 20 concrete with 20% plumps were proposed for Anchor body and C 25 (20mm) structural concrete are proposed for base and anchor skin. • Soil bearing capacity was assume as 125Kn/m^2 • All anchor blocks are checked for - Overturning - Lifting - Sliding
8	Power House and Tailrace	Alluvium deposit of 0.2-.5m diameter of rock boulders in gravelly sand metrix was observed at powerhouse location. Test pit data shows depth of this layer is >2.5m Depth to the GWL-1.5m Raft foundation is proposed and left bank upper slope is covered by residual clays of gravelly clay and slope maintains about 45^0-50^0. It is proposed to make 2m burm above 4m excavation, and install contour drains to divert runoff water.	• Power house final design will be carried out after finalization of E&M equipment and receiving details from the manufacture.

Table 8.2 Sindila Mini Hydropower Project

No	Item	Sindila MHP	
		Geological Aspects	Design Aspects
1	Project Layout	Initially proposed structured locations were studied concentrating to; - Slope angle - Material Types - Land slides - Streams Final adjustment were done to locate penstock piers & weir site	Initially proposed layout was refined using additional information - Detail survey - Geological information - Accessibility - Social and environmental requirements
2	Weir & Intake Structure	• Weir; Orientation was adjusted to meet good abutment • Abutments; covered by slightly to moderately weathered rock of quartz feldspathic gneisses –Some blasting is required to remove part of boulder on left bank General strike and dip direction of exposed bed rock is $225^0/40^0$ • Riverbed; Covered by Alluvium deposits (0.2-0.2m boulders mixed with gravelly sand- Thickness of this layer is <2m) Boulder Blasting is required on river bed for foundation excavation ; (Refer Detailed Geology map of Project area)	• Original location and orientation was confirmed considering accessibility, Topography and recommendations of geological experts. • Covered channel section introduced up to 50m to avoid flood entering in to the channel. • Cutoff wall was introduced at the right bank of weir to avoid bank erosion • Weir top level and intake was designed to carry design flow with some additional flow if required to the headrace channel. • Flush out gate was provided close to the intake for better flushing around the intake and the weir. • Trash rack was kept parallel to the river flow direction to minimize accumulation of floating debris. • Opening was provided for environmental flow. • Weir section was checked against; - Sliding - Overturning - Accommodation of flood flow.

3	Headrace Channel Structure	• Foundation Type of proposed channel structure was assessed by visual observations on; - Slope angle - Material Types - Land slides - Streams And Executing 13 numbers of test pits for about 2m depth • Individual short pier foundation and concrete block foundations on detached rock blocks were proposed to minimize the risk of failures on steep slopes • Locations of stream crossing points were identified to design for under passes • From chainage 0+345-0+390 hard, massive rock escarpment was identified and foundation can be placed after forming rock ledge by blasting and with some anchor supports. • At chainage 0+720 about 20m wide 7-10m deep valley and proposed to place a bridge channel or pipe across the stream , founded on hard ,slightly weathered rock exposes at both abutments.	• Two alternatives were considered and best alternative was finalized based on topography, geology and also distance to the intake • Channel was designed on short concrete piers (at 6m intervals)considering; - steepness of slopes - to minimize, disturbance to natural drainage • Along the vertical rock face (from 0+345 – 0+395)ledge will be formed to accommodate the channel section • Bridge section was introduced at 0+700 to cross a deep narrow valley • Finalized Channel parameters as follows - Length 1875m - Internal dimensions 1500mm x1150mm. - Free board = 250mm - Design flow = 1.9m^3/s - Design velocity = 1.5m/s - Bed slope = 0.0018
4	Desilting tank	• Originally proposed location at forbay at chainage 1+825 was finalized • Bed rock is exposed or thin (<1m) residual clay overburden along the gulley path leads to the river	• Originally proposed location was used (at chainage 1+825m) considering availability of dry stream to facilitate flushing and channel spiller. • Velocity along tank was kept around 0.3m/s to eliminate particles higher in dia. of 0 .3mm • Vertical steel gate was proposed to flush the accumulated

			sediments.
5	Forebay Tank	• Located on the flat land covered by sandy clay material of residual origin, shows hard characteristics, Thickness of this layer is <2.5m	• Design to maintain the minimum of 2 minute storage and avoid any air entering to the penstock pipes. • Structure was finalized at channage of 1+875 to avoid landslides and to satisfy topographical conditions • Vertical gate was proposed and designed to flushing accumulated sediments
6	Penstock pipe	• Numbers of landslide scars were identified along the penstock path and anchors were re-located deviating from landslide areas.	• Steel penstock was proposed • The diameter was decided based on the economy , handling and transport • Preliminary sizes of the steel pipes are Diameter – 1000, 1100 and 1200mm Thickness -10,12,14,16 mm Total length of penstock= 1785m • Both internal and external surfaces are to be paint with a suitable epoxy type paint • Pier supports (6m c/c) are provided at 6m intervals. • Suitable expansion arrangement for steel penstock is provided 1m D/S of each anchor • A vent pipe will be installed just below the bell mouth intake of the penstock.
7	Anchor Blocks and Supports		• Anchor blocks where provided at all locations with vertical and horizontal bends. • Grade C 20 concrete with 20% plumps were proposed for Anchor body and C 25 (20mm) structural concrete are proposed for base and anchor skin. • Soil bearing capacity was assume as 125Kn/m^2

			• All anchor blocks are checked for • Overturning • Lifting • Sliding
8	Power House and Tailrace	Alluvium deposit of silty fine sand material was encountered and thickness of this material layer is >3m and rock level cannot be verified. GWL-2.5m Sand material shows medium dense characteristics. The proposed location of power house is too closer to the existing river and possibility of affecting during flood and proposes to move 5m toward landwards.	• Power house final design will be carried out after finalization of E&M equipment and receiving details from the manufacture.

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ANNEXURE 13: SOIL LABORATORY ANALYTICAL RESULTS

Telephone
+256 (0) 414 250 464 (Gen)
+256 (0) 414 250 474
Email: dgal@mia.go.ug
Web Site: www.mia.go.ug

In any Correspondence on
this subject please
quote No. .....GE072/14.....

THE REPUBLIC OF UGANDA

DIRECTORATE OF GOVERNMENT ANALYTICAL LABORATORY
MINISTRY OF INTERNAL AFFAIRS

Plot No. 2-4 Lourdel Road
Wandegeya,
P.O.Box 2174
Kampala - Uganda

June 10, 2014

REPORT OF ANALYSIS

Description of Sample
One composite soil sample labeled 'Support Structures SS 01' was received from ATACAMA CONSULTING on June 2, 2014 for environmental quality requirements

Methods of Analysis

Heavy metal contaminants were quantified from an ashed sample, at respective wavelengths, using Atomic Absorption Spectrometry technique, Shimadzu 6200. A five-point calibration curve was used to get the concentration of each metal ion. Extractable petro-hydrocarbons (EPHs) were determined by Solvent Extraction (Soxhlet) technique. Total Poly Aromatic Hydrocarbons (PAHs) were determined by GC/MS technique, Shimadzu QuadPro 2010. Nitrates, phosphates and sulphates were determined by UV-VIZ Spectrometry technique. Shimadzu, 1601 at respective absorption wavelengths. All determinations were done in duplicate.

Results of Analysis
The mean analysis values as compared to Environmental Protection Agency (EPA) of the US regulatory requirements are as below;

Parameter	Result	Limits/Authority
pH	6.8	6.0 – 8.0
Arsenic (mg/kg)	≤0.01*	5.0 Max
Barium (mg/kg)	2.2	100.0 Max
Cadmium (mg/kg)	0.04	1.0 Max
Calcium (mg/kg)	28.7	Not Indicated
Chromium Total (mg/kg)	1.2	5.0 Max
Chromium VI (mg/kg)	0.02	5.0 Max
Lead (mg/kg)	≤0.001*	5.0 Max
Manganese(mg/kg)	0.4	1.0 Max
Mercury (mg/kg)	≤0.01*	0.2 Max
Nickel (mg/kg)	1.4	20.0 Max
Silver (mg/kg)	0.3	5.0 Max
Zinc (mg/kg)	2.4	250.0 Max
Nitrates (mg/kg)	3.2	Not Indicated
Phosphorus (mg/kg)	9.6	Not Indicated
Sulfates (mg/kg)	24.4	Not Indicated
TOC	9.2	Not Indicated
EPHs (%)	0	Not Indicated
PAH (mg/kg)	≤0.01**	90.0 Max

Remarks
1. *Detection limit; Atomic Absorption Technique, Shimadzu, 6200
2. Analyzed parameters meet EPA requirements
3. Results relate to sample and are reported on as received basis

Justus Mike Ocom
Senior Government Analyst

"Go Scientific for a Safe And Just Society"

ANNEXURE 14: LIST OF PLANT SPECIES ENCOUNTERED IN THE PROJECT AREA

ABBRIVATIONS USED: HA – Habit, **T** - Tree, **S** - Shrub, **H** - Herbaceous, C - Climber or Creeper, **Ep** - Epiphyte, **WI** - Weir, **HC** - Headrace Channel, **FR** - Forests, **CL** - Cultivated Lands, **AB** - Abandoned Lands, **FO** - Forebay Tank, **PS** - Penstock Path, **HG** - Home Gardens, **PH** - Power House and Tailrace Canal

Family	Species	Local Name	HA	TS	RV	CA			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Acanthaceae	*Acanthus pubescens*	Pink-flowered acanthus	S	N	+	+							
Acanthaceae	*Brillantaisia cicatricosa*		S	N	+	+							
Amaranthaceae	*Achyranthes aspera*		H	I					+	+	+		
Amaranthaceae	*Cyathula uncinulata*		C	N						+	+		
Annonaceae	*Monodora myristica*	Calabash nutmeg	T	N	+	+							
Apocynaceae	*Rauvolfia caffra*	Quinine tree	T	N	+	+							
Apocynaceae	*Tabernaemontana stapfiana*	Wild magnolia	T	N	+	+							
Apocynaceae	*Thevetia thevetioides*	Yellow Oleander	T	I								+	
Araceae	*Anubias sp.*		H	N	+	+							
Araceae	*Culcasia falcifolia*		C	N	+	+							
Araceae	*Rhaphidophora africana*		C	N	+	+							
Araliaceae	*Polyscias fulva*	Parasol tree	T	N	+	+							
Arecaceae	*Elaeis guineensis*	Oil Palm	T	N						+		+	
Asteraceae	*Ageratum conyzoides*		H	I	+		+	+	+	+	+	+	
Asteraceae	*Bidens pilosa*		H	I			+	+	+	+	+	+	
Asteraceae	*Galinsoga parviflora*		H	I			+	+	+	+	+		
Asteraceae	*Gynura pseudochina*		H	I						+	+		
Asteraceae	*Microglossa pyrifolia*	Microglossa	S	N	+	+							
Asteraceae	*Solanecio mannii*	Solanecio	S	N	+	+							

Family	Species	Local Name	HA	TS	RV	CA			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Asteraceae	*Vernonia myriantha*		S	N	+	+							
Balsaminaceae	*Impatiens cecilii*		H	N	+	+							
Balsaminaceae	*Impatiens spp.*	Balsams	H	N	+	+							
Begoniaceae	*Begonia sp.*		H	N	+								
Bignoniaceae	*Markhamia lutea*		T	N	+	+						+	
Bignoniaceae	*Spathodea campanulata*	African tulip tree	T	N	+	+							
Boraginaceae	*Cordia africana*		T	N	+	+							
Boraginaceae	*Cynoglossum coeruleum*		H	N				+	+	+			
Clusiaceae	*Harungana madagascariensis*	Orange-milk tree	T	N	+	+							
Dennstaedtiaceae	*Pteridium aquilinum*		H	N			+	+		+	+		
Dracaenaceae	*Dracaena ellenbeckiana*		T	N	+								
Euphorbiaceae	*Manihot esculenta*	Cassava	S	I			+		+		+	+	+
Euphorbiaceae	*Neoboutonia macrocalyx*		T	N	+	+							
Fabaceae	*Albizia grandibracteata*	Large-leaved Albizia	T	N	+	+							
Fabaceae	*Erythrina abyssinica*		T	N	+	+							
Fabaceae	*Senna spectabilis*	Cassia	T	I	+					+	+	+	
Lamiaceae	*Leonotis mollissima*		H	N						+			
Lauraceae	*Persea americana*	Avacado	T	I								+	
Menispermaceae	*Stephania abyssinica*		C	N	+	+							
Moraceae	*Artocarpus heterophyllus*	Jack Fruit	T	I								+	
Moraceae	*Ficus natalensis*		T	N	+	+							
Moraceae	*Ficus spp.*	Fig trees	T	N	+	+						+	
Moringaceae	*Moringa oleifer*	Drumstick Tree	T	I								+	
Musaceae	*Ensete ventricosum*	Wild banana	H	N	+	+							
Musaceae	*Musa paradisiaca*		H	I			+		+		+	+	+

Family	Species	Local Name	HA	TS	RV	CA			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Musaceae	*Musa sapientum*		H	I			+				+	+	+
Myrsinaceae	*Maesa lanceolata*	Maesa	S	N	+	+		+		+	+		
Olacaceae	*Strombosia scheffleri*		T	N	+	+							
Oxalidaceae	*Oxalis corniculata*		H	I			+						
Oxalidaceae	*Oxalis obliquifolia*		H	N			+						
Piperaceae	*Piper umbellatum*		C	N	+	+							
Pittosporaceae	*Pittosporum viridiflorum*	Cheesewood	T	N	+	+							
Poaceae	*Cymbopogon nardus*		H	I				+					
Poaceae	*Pennisetum purpureum*		H	N	+			+		+	+		
Poaceae	*Zea mays*		H	I			+		+		+		+
Rhamnaceae	*Gouania longispicata*		C	N	+	+							
Rubiaceae	*Aidia micrantha*		S	N	+	+							
Rubiaceae	*Coffea arabica*	Coffee	T	N			+			+	+	+	
Rubiaceae	*Mussaenda arcuata*		S	N	+	+							
Rubiaceae	*Rothmannia urcelliformis*	Forest rothmannia	T	N	+	+							
Rutaceae	*Vepris nobilis*	White ironwood	T	N	+	+							
Sapindaceae	*Allophylus africanus*		S	N	+	+							
Sapindaceae	*Cardiospermum corindum*		C	N	+	+							
Sapindaceae	*Deinbollia xanthocarpa*		T	N	+	+							
Sapindaceae	*Glenniea africana*		T	N	+	+							
Solanaceae	*Solanum macranthum*		T	I								+	
Sterculiaceae	*Theobroma cacao*	Cacao	T	I							+	+	
Tiliaceae	*Triumfetta sp.*		H							+			
Ulmaceae	*Celtis durandii*	Stinkwood	T	N	+	+							
Ulmaceae	*Trema orientalis*		T	N	+	+							

Family	Species	Local Name	HA	TS	RV	CA			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Urticaceae	*Boehmeria macrophylla*		H	N	+	+							
Urticaceae	*Pouzolzia parasitica*		H	N	+	+							
Urticaceae	*Urera hypselodendron*		C	N	+								
Verbenaceae	*Lantana trifolia*		S	N						+			
Verbenaceae	*Stachytarpheta jamaicensis*		H	I						+	+		
Vitaceae	*Cayratia gracilis*		C	N	+	+							
Vitaceae	*Cyphostemma sp.*		C	N	+	+							
Zingiberaceae	*Costus afer*		H	N	+								

ANNEXURE 15: LIST OF BIRDS SPECIES ENCOUNTERED IN THE PROJECT AREA

ABBRIVATIONS USED: **CS** - Conservation Status, **TS** - Taxonomic status, **WI** - Weir, **HC** - Headrace Channel, **FR** - Forests, **CL** - Cultivated Lands, **AB** - Abandoned Lands, **FO** - Forebay Tank, **PS** - Penstock Path, **HG** - Home Gardens, **PH** - Power House and Tailrace Canal, **LC** - Least Concern

Family	Species	Local Name	CS	TS	WI	HC			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Accipitridae	*Accipiter badius*	Shikra	LC	N					+				
Accipitridae	*Milvus migrans*	Black kite	LC	N			+						
Alcedinidae	*Megaceryle maxima*	Giant Kingfisher	LC	N	+								
Alcedinidae	*Halcyon chelicuti*	Striped kingfisher	LC	N	+								
Alcedinidae	*Halcyon leucocephala*	Grey-headed Kingfisher	LC	N	+								
Apodidae	*Apus affinis*	Little Swift	LC	N				+			+		
Ardeidae	*Bubalcus ibis*	Cattle Egret	LC	N								+	+
Bucerotidae	*Tockus pallidirostris*	Crowned hornbill	LC	N		+							
Ciconiidae	*Anastomus lamelligerus*	African Open-billed Stork	LC	N									+
Cisticolidae	*Prinia subflava*	Tawny-flanked prinia	LC	N			+		+	+		+	
Coliidae	*Colius striatus*	Speckled mouse bird	LC	N				+		+	+	+	+
Columbidae	*Columba guinea*	Speckled pigeon	LC	N						+			
Columbidae	*Columba livia*	Feral pigeon	LC	N					+		+	+	+
Columbidae	*Streptopelia capicola*	Ring-necked dove	LC	N						+			
Columbidae	*Turtur tympanistria*	Tambourine dove	LC	N							+		
Corvidae	*Corvus albus*	Pied crow	LC	N					+	+	+	+	+

ANNEXURE 16: LIST OF BUTTERFLIES SPECIES ENCOUNTERED IN THE PROJECT AREA

ABBRIVATIONS USED: **CS** - Conservation Status, **TS** - Taxonomic status, **WI** - Weir, **HC** - Headrace Channel, **FR** - Forests, **CL** - Cultivated Lands, **AB** - Abandoned Lands, **FO** - Forebay Tank, **PS** - Penstock Path, **HG** - Home Gardens, **PH** - Power House and Tailrace Canal, **NE** – Not Evaluated

Family	Species	Local Name	CS	TS	WI	HC			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Nymphalidae	*Acraea eponina*	Orange Acraea	NE	N	+							+	+
Nymphalidae	*Acraea egina*	Elegant Acraea	NE	N	+	+							
Nymphalidae	*Acraea uvui*	Tiny Acraea	NE	N	=								
Nymphalidae	*Byblia illitia*	Spotted Joker	NE	N			+		+				
Nymphalidae	*Danus chrysippus*	African monarch	NE	N	+	+							
Nymphalidae	*Eurytela dryope*	Golden piper	NE	N			+			+			
Nymphalidae	*Harma theobene*		NE	N				+					
Nymphalidae	*Hypolimnas misippus*	Daidem	NE	N	+	+	+						
Nymphalidae	*Junonia chorimene*	Golden Pansy	NE	N				+			+	+	
Nymphalidae	*Junonia oenone*	Dark Blue Pansy	NE	N								+	+
Nymphalidae	*Junonia sophia*	Little Commodore	NE	N							+		=
Nymphalidae	*Junonia terea*	Soldier Commodore	NE	N				+					
Nymphalidae	*Neocoenyra gregori*	Small eyed brown	NE	N				+	+				
Nymphalidae	*Neptis morosa*	Morose Sailor	NE	N					+	+			
Nymphalidae	*Neptis saclava*	Small Spotted Sailor	NE	N								+	
Nymphalidae	*Precis ceryne*	Marsh Commodore	NE	N							+		

Family	Species	Local Name	CS	TS	WI	HC			FO	PS			PH
						FR	AG	AB		AB	AG	HG	
Nymphalidae	*Pseudargynnis hegemone*	False fritillary	NE	N								+	+
Nymphalidae	*Vanessula milca*	Lady's maid	NE	N						+			
Nymphalidae	*Ypthima albida*	Silver Ringlet	NE	N				+	+	+	+		
Papilionidae	*Papilio bromius*	Broad Green-banded swallowtail	NE	N	+								
Papilionidae	*Papilio dardanus*	Mocker swallowtail	NE	N		+							
Papilionidae	*Papilio demodocus*	Citrus butterfly	NE	N			+	+					
Papilionidae	*Papilio nireus*	Narrow green-banded swallowtail	NE	N	+								
Papilionidae	*Papilio phorcas*	Green-banded swallowtail	NE	N	+	+							
Pieridae	*Belenois thysa*	False Dotted Border	NE	N			+	+					
Pieridae	*Belenois theora*		NE	N				+	+		+		
Pieridae	*Catopsilia fiorella*	African emigrant	NE	N			+	+		+	+	+	
Pieridae	*Eurema brigitta*	Small grass yellow	NE	N	+		+	+		+	+		
Pieridae	*Leptosia alcesta*	African Wood White	NE	N	+	+							
Pieridae	*Pontia helice*	Meadow White	NE	N		+	+						