Annex

ANNEX I.

Terms of Reference

ANNEX I. Terms of Reference

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இலங்கை மகாவலி அதிகாரசபை
Mahaweli Authority of Sri Lanka
500, ටී. බී. ජයා මාවත, කොළඹ 10.
500, டி. பீ. ஜயா மாவத்தை, கொழும்பு 10.
500, T. B. Jayah Mawatha, Colombo 10.

My No : RBM/EIA/07-23
30.06.2008

Mr. R.H.R. Lokubalasuriya
Deputy General Manager
Ceylon Electricity Board
Transmission Design & Environment
No. 50, Sir Chiththampolam A Gardiner Mawatha
Colombo - 02.

Victoria Hydro Power Expansion Project

This has reference to the Scoping Meeting and field visit held on 11.12.2007 & 29.04.2008 at the Mahaweli Authority of Sri Lanka and to the subsequent site inspection held on 22nd May 2008 on the above project.

This project falls within the projects and undertakings for which approval shall be necessary under the provisions of Part 1V C of the National Environment Act No. 47 of 1980 as stipulated in Gazette (Extra-Ordinary) No. 772/22 dated 24th June 1993. As such an Environmental Impact Assessment (EIA) Report will be required to be prepared by the developer for the said project prior to considering granting of approval, the Terms of Reference (TOR) of which are attached hereto.

The EIA must address all matters referred to in the TOR.

Please submit the draft final EIA for the purpose of checking for adequacy. Once checked for adequacy, required number of copies of the EIA have to be submitted for the purpose of evaluation. The EIA should be submitted in Sinhala and Tamil Languages as well, since the EIA is a public document according to the Evidence Ordinance.

Eng. K.W. Ivan De Silva
Director General
Mahaweli Authority of Sri Lanka.

Cc:
Director /EIA/Env. Management & Assessment Division/CEA -for information and necessary action pl.

Director (Env.)/RBP&MD/MASL

අධ්‍යක්ෂ කාර්යාලය / பொது இயக்குநர் / Director Office 2687238
මහජ සම්බන්ධතා / பொது அலுவலகம் / General Office
දුරකථනය / தொலைபேசி / Telephone 2687491-5
කේබල් / Cable MAHAGANGA
ෆැක්ස් / பெக்ஸ் / Fax 2687240

TERMS OF REFERENCE FOR THE ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT FOR THE PROPOSED VICTORIA HYDRO POWER STATION CAPACITY EXPANSION PROJECT ON MAHAWELI GANGA IN KANDY DISTRICT

This ToR is valid only for one and half years from the date of issue. The EIA Report should be submitted within the validity period.

Project Title	:	Victoria Hydro Power Station Capacity Expansion Project
Project Proponent	:	Ceylon Electricity Board
Project Approving Agency:		Mahaweli Authority of Sri Lanka
Outline of EIA Report	:	**Executive Summary**

Chapters

1. Introduction.
2. Description of the proposed project & reasonable alternatives.
3. Description of the existing environment.
4. Descriptions of the anticipated environmental impacts.
5. Proposed mitigatory measures.
6. Monitoring programme
7. Conclusion & recommendation.

Annexes

i. Terms of Reference.
ii. Sources of data information.
iii. References.
iv. List of preparers including their work allocation.
v. Comments made by the public, NGOs and other agencies during the formal and informal scoping meetings held by the EIA team.
vi. Complete set of relevant maps, tables, charts, layout plans and other details.

Executive Summary

The summary should be a brief, non-technical summary of the justification of the proposed project, description of the salient features of the project and alternatives considered, the existing environment of the project site and its environs, key environmental impacts, the measures proposed to mitigate the environmental impacts, monitoring programme and conclusions. A one page summary table indicating the

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significant impacts and proposed mitigatory measures should be presented. This should also include the final conclusions and recommendations.

1. INTRODUCTION

This chapter should include the following:

- Background of the project
- Objective of the proposed project and justification of the project
- Summarize the need or problem being addressed by the project and how the proposed project is expected to resolve the problem or the issue.
- Objective of the EIA Report
  Specify the objectives of the assessment and the relationship of the results to project design and implementation
- Extent and scope of the study
- Methodologies adopted in report preparation
- The approval needed for the proposed development from state agencies

Such clearances should include

1. Approval from Ceylon Electricity Board for connection to National Grid (Transmission line)
2. Approval from Divisional Secretaries
3. Clearance from Dept. of Wild Life Conservation
4. Approval from Pradeshiya Sabhas for construction activities
5. Approval from Mahaweli Authority of Sri Lanka. Some of the issues (related to MASL) regarding the proposed project including the pump storage option that should be considered in the EIA study is given in ***Annex I***
6. Approval from Road Development Authority
7. Approval from Dept. of Archeology
8. Any other relevant organization

- Any conditions laid down by state agencies in granting preliminary clearance for the project
- Conformity with other development plans in the area.

2. DESCRIPTION OF THE PROPOSED PROJECT AND REASONABLE ALTERNATIVES

2.1 Evaluation of Alternatives

Describe reasonable alternative considered and the basic environmental engineering and economic parameters used in their investigation and evaluation.

Compare alternatives in terms of potential environmental impacts, mitigatory measures, capital and operating cost, reliability etc.

The following alternatives could be considered

- No action alternative
- Alternative sites
- Alternative design, technology and construction techniques
- Alternative operational and maintenance procedures

Comparison of the alternatives considered and recommendations should be given.

2.2 Description of the Project

2.2.1 Name of the Project Developer (Company firm individual)
Postal Address :
Phone / Fax No :
Contact person Name / Designation phone, fax

Project location :

Give details on extent of the project area and installed capacity, (KW/MW) average annual energy output (Mwh/Gwh)

Indicate the Divisional Secretariat Division/s and the Pradeshiya Sabha area/s within which the project site falls.

State the present ownership of the project site including the transmission line trace. If state owned, please submit a letter of consent from the relevant state agency.

A location map of reasonable scale (1:10,000 scale is preferred) indicating the project site, accessibility to the site, surrounding developments, transmission line trace, land use and infrastructure.

2.2.2 Drawing showing project layout plan covering the entire project area including all major components of the project related structures etc. and reservation area (water intake/s, penstock tunnel, power house, head race tunnel , tail race, switch yard, related temporary & other permanent structures and ponding area etc.) Also should indicate the boundaries of the VRR Sanctuary.

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State the present land ownership of the project site including the transmission line trace.

If state owned, please submit a letter of consent from the relevant state agencies if any private land involved, give the relevant details such as acquisition etc.

2.2.3 Give a brief description on major components of the projects of the following project options

(i) Basic options
(ii) Down stream options
(iii) Pump storage options

Permanent Structures

Details of the water intakes, penstocks, powerhouse, head trace tunnel, tail race tunnel, switch yard, surge chamber, regulation pond, fore bay tank, power grid and transmission line routes, resettlement sites etc.

Temporary Structures

a. Coffer dams, Contractors and Engineer's site offices, Contractor's store building and store yards, Dumping sites, Temporary quarry sites, Labour camps and access to these structures.

Machinery

Generators and transformers with their capacities, type of turbine etc.

2.2.4 Methodology of construction

- Site preparation activities (land clearing, cutting, dredging, excavation, filling, rock blasting etc.)
- Facility construction (temporary & permanent)
- Details of access roads to be built (including a map)
- Construction activities related to resettlement
- Other construction activities such as slope protection, refuse disposal
- Material to be used - sources and amounts
- Method / installation
- Techniques and equipment to be used
- Excavation methodology for new tunnel, blasting method and parameters / if any blasting activities involved in tunnel of excavation.

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2.2.5 Methodology of operation

- Water utilization schedule
- Repairs & maintenance activities

2.2.6 Infrastructure facilities required / provided by the project

2.2.7 Details of any phased implementation plan and time schedule.

2.2.8 Work force

Requirement and availability (both during construction and operation) occupational health and safety facilities required / provided.

2.2.9 Investment and funding sources, state the total cost of the project, the time schedule of the construction period and details of phased development if any.

2.2.10 In case of civil structures, dimensions, drawings etc.

2.2.11 Arrangement for discharge of forecasted probable maximum flood.

2.2.12 Details required to check the adequacy of the associated structures considering probable failure conditions.

2.2.13 Proposals for Emergency Action Plan along with arrangements for early warning systems & details required to ensure the dam safety aspects.

2.2.14 Limitation to Randenigala Minimum Operation Level and possible changes to the presently approved reservoir operation characteristic curves if pump storage option is considered.

3. DESCRIPTION OF THE EXISTING ENVIRONMENT

Study Area

The study area for the assessment shall include the following:

i. Project site [Areas directly affected by the project itself and areas indirectly affected (maintenance area etc.)]
ii. Locations affected by construction activities (quarries, refuse disposal areas, tunnel muck disposal area, traffic diversions, work camps, temporary access roads etc.)
iii. Area beyond the project site where there is potential for environmental impacts.
iv. Area along the transmission line route including a width of 25 m. on either side of the transmission line path.

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Assemble, evaluate and present baseline data on the following environmental characteristics of the study area.

This chapter should provide information on physical, biological, socio-economic, archaeological and cultural aspects of the environment likely to be affected by any activity of the project during and after the project. Information should be presented in a comprehensive format using tables, maps and diagrams where appropriate. The methods used to collect data should be clearly stated under each category. All technical terms should be clearly defined. The existing environment should be described under following.

3.1.1.1 Physical environment

3.1.2 Topography

Provide concise information on the topography of the study area (attach a contour map with location of project components) drainage channels, land slide prone erodable areas, exposed rocks etc.

3.1.3 Geology & Soil

- Underline geology
- Regional and local geological structure, presence of active linear faults
- Rock mass strength
- Soil types, distribution and thickness
- Leakage conditions
- Soil characteristics in relation to salinity, acidity, iron toxicity, ground water recharge and land use capabilities
- Landslide potentials of the area
- Mineral resources
- 1:10,000 scale site specific geological map
- 1:10,000 scale site specific landslide hazard zonation map

3.1.4 A Meteorology

- Rainfall pattern
- Wind

3.1.5 Hydrology

- General description of the catchment areas of water bodies
- Flow regimes during dry season
- Surface drainage pattern
- Occurrence of flooding and return period

- Existing water use pattern of the area
- Surface water quality of the river regime

- Ground water levels, including ground water level along the tunnel route
- Ground water quality
- Drainage pattern of the study area
- Mean annual flow of the river
- Mean monthly discharges for a period of 100 years
- Indicate the approximate level of the highest flood experienced at the site
- Drainage Management Plan
- Flood frequency analysis giving the flood peaks corresponding to the following return period of 2, 5, 10, 50, 100 (Describe the method and data used for the analysis)
- The discharge corresponding to the bank full discharge at the Dam site (Explain the method and data used for the calculation)
- Find the return period corresponding to the bank full discharge
- The minimum dry season flow, base flow.
- Flow details including the mean natural flow average flow and the annual variation of the flow
- Is the project area prone / subject to natural disasters such as landslides earth slips ? If so give a brief description of hazard potential and the description of disaster management plan.

3.1.6 Land Use

- Existing land use pattern in the area with details of extent and types
- Land use potential of the site
- Zoning if any

3.1.7 Air Quality & Noise :

- Baseline information on air quality & noise level of the study area

3.2 Biological Environment :

- Proximity to wildlife reserves, sanctuaries, elephant corridors, wetlands and forest reserves.
- An assessment of the present ecological status including the biodiversity of the area. The survey team should identify and map the existing habitats of fauna and flora and their distribution in the study area. Information on endangered, rare, migratory and commercially important flora and fauna and ecosystems including in down stream of the river. This study could be conducted to address the following:

- Fauna and flora in the river:

  Study the aquatic fauna and flora from 50 meters upstream of dam to 100 meters downstream from the tailrace outlet.

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- Fauna and flora in the inundation area :
  (a) fauna and flora in the area up to the high flood level
  (b) fauna and flora in the 60meter reservation area from high flood level

- Fauna and flora along the river reservation:

  Fauna and flora at a distance of 60 meters from the bank along transects at reasonable intervals. Location of line transect will be determined according to habitat variation and 100meter gradient contours.

- Fauna and flora in the spray zones:

  Study the fauna and flora in different habitats within the spray zone.

- Fauna and flora of the tunnel location and Transmission Line Path

  Fauna and flora of 25 meters on either side of the tunnel line (at reasonable intervals) and transmission line path. Positions of the line transects will be determined according to habitat variation and 100 meter gradient contours.

- Fauna and flora at the powerhouse, switch yard and other construction sites should be studied:

3.2.1 Number of trees (species names, height & girth size) that will be felled due to the construction activities should be given.

3.3 Social Environment

- Population characteristics, settlements in the study area.
- State the demographic and socio economic status of the community
- River users (drinking, agricultural requirements, transportation, commercial purposes and other uses
- Income generation sources and patterns
- Existing environmental considerations, problems or issues prevailing in the area
- Cultural, historical, protected reserves and archaeological aspects considerations
- Existing infrastructure facilities, transportation, communications, power supply, sanitation, healthcare, hospital, water supply etc.
- Present water supply and water uses (including current hydro power, irrigation drinking water, recreation water usage)
- List any social cultural sensitive areas such as residencies, schools, places of worship, protected archeological sites etc. in the study area within 1 k.m. indicating the approximate distances from the boundaries of the project site.

3.4 Details of existing and planned projects in the area

4. ANTICIPATED ENVIRONMENTAL IMPACTS OF THE PROJECT

This chapter should show the overall effects on the individual environmental components. Impacts should include the direct and indirect, long and short-term positive and negative effects. Significant impacts should be assessed using appropriate techniques. In all cases where an assessment is made it should be quite clear what criteria have been employed to assess impacts. Where possible effects should be quantified, uncertainties highlighted and the basis of predictions should be stated and justified through models, literature etc. Nature of impacts should be considered in terms of magnitude, severity, duration, frequency, risk and indirect effects. Cumulative impacts on the environment which results from the incremental impact of the action when added to the past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions should also be stated. It is preferred that if impact could be indicated as impacts on construction stage and impacts on operation stage.

Impacts shall include the following:

4.1 Soil Erosion and Siltation

- Surface runoff soil erosion, siltation, hazards, sedimentation of river basin during construction of project components including the transmission line
- River bank erosion during construction and operation of the project
- Impacts during construction of access road rehabilitation of access roads
- Slope failure and land slides due to heavy earth work
- Potential seismic impacts

4.2 Water Resource & Water quality impacts

- Surface water quality and ground water quality
- Change in surface water flow
- Change of ground water table
- Disruption of surface water flow
- Disruption of ground water flow
- Occurrence of water logging and flooding

- Impacts on water quality during construction of project component
- Waste generation and pollution from temporary workers camps
- Impacts on water quality of the proposed existing and planned project activities
- Water pollution due to contaminated leakages from machinery
- Ground water table along the tunnel route at present expected draw down during construction and after construction

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4.3 Ecological impacts

- Impacts on terrestrial fauna and flora
- Impacts on aquatic fauna and flora with special reference to migration of fish species and environment flow requirement of the down stream of the Dam
- Impacts on wildlife and forest reserves (if any)
- Impacts on elephant migratory routes
- Impacts due to changing habitats of the area
- Impacts due to changing of feeding areas/breeding areas / migratory routes of the animals
- Loss / disturbance of forest
  Number and name of each tree species having diameter more that 30 centimeters at the breast height which have been identified to be removed should be given
- Impacts on wildlife reserves / interference with wildlife migration
- Flooding of habitats
- Changes in water quality and quantity associated with changes in habitat environment
- Fragmentation of habitats
- Impacts on wetlands due to changes in water balance
- Introduction of invasive species due to hydrological alternatives
- Impact on rare / endemic species
- Impact on biological diversity
- Possible impact on the fauna and flora of the river terrain 6 km from the Dam to the Power Station if the existing provision for the Mini Hydro facility is utilized as a part of the Capacity Expansion Project

4.4 Impacts on Agricultural Fields

- Paddy cultivation
- Chena lands
- Home gardens and other
- Other cash crops

4.5 Air Pollution

- Exhaust gas from machinery, vehicular traffic
- Dust from construction

4.6 Noise / Vibration

- Noise / vibration of machinery, equipment and due to construction, blasting operations & transport

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4.7 Sociological / cultural impacts

- Change / disruption of life style
- Conflict between resident people
- Relocation of income generating activities
- Change in economic infrastructure
- Change in land use pattern
- Change in commercial activities
- Impacts on property values
- Effects on education
- Effects on health
- Impacts on quality of life
- Employment generation during construction and operation
- Impacts on sites and monuments of historical cultural and religious significance
- Impacts on existing transportation system of the area
- Impacts on existing water usage / extraction / irrigation schemes, downstream area
- Impacts on existing water extraction for drinking purpose (water)
- Impacts on flood protection
- Impacts due to ,material & machinery transportation
- Will the project result in uncontrolled migration of people into the area. If yes the regulatory measures proposed and the basis.
- Will the project activities create relocation of families ? If so,

1. State number of potential families affected
2. The resettlement plan
3. Compensation package and their acceptability by the affected and the local authorities
4. Location of the resettlement

4.8.1 State what construction hazards have taken into account in project construction planning, especially those relating to silt runoff, health and safety of workers.

4.8.2 Impact of the blasting works of the proposed tunnel on the existing structures, the dam, abutments, intake, tunnel surge chamber and the power station, methodology to minimize such impact, selection of and types and places to install instruments to measure the amplitude or the intensity of the blasting waves

4.8.3 Impact of water issues for D/S irrigation during construction and commissioning of the project.

4.9 Will the project activities including the tunneling change the flow path, deprive or alter the water flow, flow pattern of the existing waterways ground water table ? If so give the details of any effect to water users, details of health hazards (such as insect epidemics) and effect on the vegetative cover

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4.10.1 Will the project activities effect to the normal water management operations of Victoria reservoir, Randenigala reservoir & Rantambe reservoir.

4.10.2 Effect or impact of future operation rules of Victoria and Randenigala Reservoirs on reliability of water supplies to irrigation areas benefited by Randenigala Reservoir.

4.10.3 Impacts due to daily fluctuation / variation of the water level in Victoria, Randenigala, Rantambe reservoirs.

4.10.4 Impact of daily water level changes on behavior of Victoria Dam.

4.11 Impacts of the dumping of the tunnel muck (including the location of the dumping site of the tunnel muck)

4.12 Impacts on bedrock stability

- Penstock installation
- Power house construction
- Tunnel construction
- Transmission path

4.13 Impacts of the existing and planned project activities in relation to the components of the project proposal

4.14 Impact of blasting operations that would be required in construction of tunnel on the existing houses, retaining walls constructed along existing roads and soil stability of potential land slide areas.

4.15 It should be noted that the present rights of the MASL to operate the Spillway Gates and the Low Level Outlet Gates shall not be amended

5. PROPOSED MITIGATORY MEASURES

This chapter should set out the proposed measures to minimize the impacts identified in Chapter 4 to acceptable levels including conformity to gazetted Sri Lanka Standards. Alternative methods of mitigation should be discussed and the effectiveness of the proposed measures that are to be provided should be stated. Mitigation methods should be defined in specific practical terms. A rationale should also be presented for selection of chosen mitigatory measures. It is preferred if mitigatory measures could be indicated as

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mitigatory measures in construction stage and mitigatory measures in operation stage.

Special emphasis should be given on the following.

- Environment Management Programme including compensatory aforestation programme (no. of trees, species name, location of planting cost etc.) and wild animals
- Soil conservation management plan including soil erosion control / land stabilization measures
- Resettlement plan (in conformity within national involuntary resettlement policy)
- Noise and vibration control measures
- Debris waste, tunnel muck disposal facilities method and location
- Restructuring of the surrounding environment including landscaping of the construction areas
- Public health measures to control vector and water born diseases
- Disaster management plan
- Reestablishment, restoration of infrastructure
- Facilitate of the environmental flow requirement down stream of the Dam (this would include the water requirement release for the E-flow and the mechanism design of the dam to release the water requirement.
- Measures to salvage / relocate archeological / cultural movements
- Measures to salvage rehabilitate wild life reserves
- Landslide stabilization measures for present landslides as well as for the expected failures during and after the construction works.
- Measures to improve habitats
- Restoration of land in construction area
- Measures to ensure the existing riparian rights of the area
- Measures to control vector and water borne diseases
- Measures for Dam failure
- Measures to minimize the impacts on blasting on the dam structure dam foundation, the existing tunnel, the power station and the associated buildings.

  It should also be noted that blasting shall be controlled to a high degree by introducing appropriate technology, appropriate instruments such as accelerometers have to be installed to monitor impacts of blasts on all relevant constructions such as the dam structure, dam foundation and existing tunnel lining etc. (The dam is designed to withstand a maximum vibration or earth quake force of 0.1 g. Ref Article 1.12, Specification, Volume III, Hydraulic equipment contract No. 4)
- Measures to minimize the impacts of the transmission line
- Drainage management plan
- Precaution to keep the ground water level as at present avoiding any effects to the surface cultivation

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- Excavation Methodology for new tunnel and proposed precaution to avoid any collapse or failures on existing tunnel.

6. COST BENEFIT ANALYSIS

Include if one has been prepared by the Project Proponent.

The cost of the proposed remedial and mitigation measures, if any to protect the environment must be included in the project cost.

7. ENVIRONMENTAL MONITORING PROGRAMME

A suitable monitoring programme should be submitted to monitor the changes of environment and implementation of mitigatory measures. This plan should include the following.

- Parameters to be monitored
- Frequency of monitoring
- Location timing of sampling
- Institutional framework for mitigation of impacts
- Responsible agency / agencies of monitoring
- Availability of funds, expertise, facilities

8. CONCLUSION AND RECOMMENTAITON

The environmental acceptability of the proposed project and key findings and recommendations of the assessment should be given. The consultants should make a firm recommendation on one of the options based on the findings of the assessment.

Any programme to improve general environmental conditions can also be stated here.

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Annex I

1. The MASL must have a reasonably reliable water policy to avoid any shortage of D/S irrigation releases for Systems B and C if the pump - turbine alternative is implemented. This alternative must be accompanied with a **regulatory reservoir** incorporating the pump intake that also serves as the tailrace for the turbine, to avoid possible restrictions of using the active storage of the Randenigala reservoir. The regulatory reservoir should have a capacity of approximately 1-2 MCM being the daily peak volume pumped back. The minimum operating level of the regulatory reservoir must match the pump intake level.

   Further, diversion of 150-200 MCM off the Mahaweli Basin with the implementation of the Uma Oya Project and the expansion of the Maduru Oya RB are also to be considered.

   However, presently about 1200 - 1500 MCM is being released through Victoria and 2000 - 2500 MCM is passed via Rangenigala- Rantambe Complex annually. The water rights should be retained with the MASL giving priority to irrigation issues.

2. Lowering the proposed turbine axis by 5 - 10 meters with respect to the existing turbine is to be considered. Such a lowering of the proposed turbine axis would not interfere with the backwater of the Randenigala reservoir as it usually operates far below the FSL for most months of the year.

3. If pump - turbines are installed Randenigala Minimum Operating Level will have to be raised and the MASL will have to face difficulties in using the full active storage of Randenigala.

4. A full inspection of the Tunnel the Dam and the Power Station by an independent consultant such as the original designers, M/s. Gibb is recommended to ascertain any structural problems before construction and after commissioning.

   Water tightness of both the existing and the proposed tunnel, after its construction is to be tested and ensured before elapsing of its contract maintenance period.

ANNEX II.

Sources of Data Information

ANNEX II. Sources of Data Information

Ceylon Electricity Board
Department of Wildlife Conservation
Divisional Secretary, Hanguranketa
Field Surveys conducted by the EIA Consultants
Grama Niladri of Hipenkandura
Hakurutale, Ambewela and Welikada
Irrigation Department
Mahaweli Authority of Sri Lanka
Meteorology Department
Questionnaire administered by the EIA Consultants
Road Development Authority
Victoria Power Station

ANNEX III.

References

ANNEX III. References

Department of Wildlife Conservation, (1999) Management Plan, Victoria-Randenigala-Rantambe (VRR) Sanctuary, Vol. 2, Proposed Management Plan, FAO.

Environment & Generation Planning Branch, Transmission Division Ceylon Electricity Board, (June 2003), Long Term Generation Expansion Plan 2003-2017

Fauna and Flora Protection Act

Feasibility Study for Expansion of Victoria Hydropower station in Sri Lanka- Interim Report, (2008 September) Japan International cooperation Agency, Ceylon Electricity Board

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Government of the Democratic Socialist republic of Sri Lanka, Ministry of Agricultural Development & Agrarian Services, Mahaweli Authority of Sri Lanka, 2007 June, *Mahaweli Development Programme*

Land Management, Tenure and Institutions Involved in Land Issues in the Upper Mahaweli Catchment

M.U.A Tennakoon,S.B Ekanayake and Senarath Bulankulame, *Setteler Stress : A case Study Of Wekande In System 'C' of the Mahaweli Development Area*

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Mapa, R. B., Dassanayake, A.R. and Nayakekorale (2005) Soils of the Intermediate Zone of Sri Lanka, Special Publication No. 4, Peradeniya:Soil Science Society of Sri Lanka

Population Data of Impact Area of the Victoria 1st stage

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Resources Inventories for Protected Areas Victoria, , Randenigala, Rantambe Sanctuary, Vol. 1:183-278, Colombo:JEEP Publication.

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Sumanaratne, H D and S Somasiri, "Runoff Generation and Soil Erosion under Three Different Land Use in the Dry Zone of Sri Lanka," *Tropical Agriculturist 146,* 1990, pp 1-9.

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Wickramagamage, P. (1990) Soil erosion in the Upper Mahaweli Catchment: A literature review, A Report submitted to GTZ, Kandy

ANNEX IV.

List of Consultants with Their Work Allocation

ANNEX IV. List of Consultants with Their Work Allocation

Institution: The Center for Environmental Studies University of Peradeniya, Sri Lanka

EIAR Responsibility	Consultant
TL/EIA Specialist	Prof Shantha K. Hennayake, Director, Center for Environmental Studies, University of Peradeniya
Ecologist	Mr. Kithsiri Ranawana, Dept. Zoolgy, University of Peradeniya
Tunneling Engineer	Dr. G.S. Gurusinghe, Dept. of Civil Engineering, University of Peradeniya
Environmental Engineer	Dr. Uditha Rathnayake, Deputy Director, Center for Environmental Studies, University of Peradeniya
Environmental Engineer	Dr. Gemunu Herath, Dept. of Civil Engineering, University of Peradeniya
Social Scientist	Mr. MAS Jayakumara, Department of Geography, University of Peradeniya
GIS/Landuse Specialist	Prof. Wickremagamage, Department of Geography, University of Peradeniya
Electrical Engineer	Dr. Sunil Abeyrathne, Department of Electrical and Electronics Engineering, University of Peradeniya
Environmental Economist	Mr. Sunil Thrikawala, Post-Graduate Institute of Agriculture, University of Peradeniya
Development Specialist	Dr. Nalani Hennayake, Department of Geography, University of Peradeniya

Research Assistants	
GIS mapping	Inesha Vithange
GIS mapping	Sanjeewani Chandratilake
Project Assistant	Rajeetha Liyange
Field Assistant SIA	Devika Premadasa
Field Assistant SIA	Ariyasinghe Jayawardena
Field Assistant SIA	Pabha Herath
Field Assistant SIA	Anuradha Pilapitiya
Field Assistant SIA	Kanchana Gunawardena
Field Assistant SIA	*Wathsala Wellage*
Data Analyst	Sidath Perera
Field Assistant/ Ecology	Aloka Pushpakumara, Sanjeewa

ANNEX V.

Comments Made by the Public, NGOs and Other Agencies during the Formal and Informal Scoping Meetings Held by the EIA Team

ANNEX V.

Comments Made by the Public, NGOs and Other Agencies during the Formal and Informal Scoping Meetings Held by the EIA Team

SCOPING MEETINGS

1. Date and Places

Dates -	1. 2008.09.08	**Places** -	1. Hingurukaduwa Temple
	2. 2008.09.08		2. Kottegoda Temple, Adikarigama
	3. 2008.09.10		3. Sanasa Development Bank, Udawattha
	4. 2008.09.11		4. Hilpenkandura Communityhall

2. Agenda of the Meetings

1st Meeting

9.30am	Start the Meeting and welcome Speech
9.45am	Explain the Objective of the Meeting
10.00am	Examine the Community ideas and Tea Break
11.15am	Take the Social and Economic Information in the Area from the GN Officers
11.45am	Vote of Thanks

2nd Meeting

1.00pm	Start the Meeting and welcome Speech
1.15pm	Explain the Objective of the Meeting
1.30pm	Examine the Community ideas and Tea Break
2.45pm	Take the Social and Economic Information in the Area from the GN Officers
3.15pm	Vote of Thanks

3rd Meeting

9.30am	Start the Meeting and welcome Speech
9.45am	Explain the Objective of the Meeting
10.00am	Examine the Community ideas and Tea Break
11.15am	Take the Social and Economic Information in the Area from the GN Officers
11.45am	Vote of Thanks

4th Meeting

9.30am	Start the Meeting and welcome Speech
9.45am	Explain the Objective of the Meeting
10.00am	Examine the Community ideas and Tea Break
11.15am	Take the Social and Economic Information in the Area from the GN Officers
11.45am	Vote of Thanks

3. Summary of the Issues/ Questions Received -

- Water Problems-
  - Decrease the Water Level in the Wells
  - Changing the Rainfall Systems
  - Difficult to access the Drinking Water Sources
  - Drying water Sources
  - Siltation
  - Impact to the Ground Water Sources
- Agricultural Problems
  - Loss of the Cultivated Lands
  - Difficult to take Water Sources for Cultivation lands
  - Difficult to cultivate the Vegetables
  - Impacts from the Wild Animals
- Other Social Problems
  - Impacts to the Houses (Vibrations)
  - Problems of the Compensation
  - Loss of the Employment Opportunities
  - Resettlements
  - Increasing the Land Slide Problems
  - Increasing the Human- Elephant Conflict

4. List of Key Institutions Visited and People Interviewed

- Dam Office, Adikarigama - Mr .N.W Jayawardana
- Hanguranketha AGA Office - Mrs. M.P.W Shiromanee (Additional Divisional Secretary)
- Department of Wild Life Conservation, Minipe - Mr. Chamath, Mr.B.Piyal
- Mahaweli Authority of Sri Lanka, Digana - Mrs. Indu Kumarihami (RPM, Victoria Project)

5. People Attendant

Meeting No.	-	01
Date	-	2008.09.08
Place	-	Hingurukaduwa Temple

2008.09.08 - හිඟුරුකඩුව පන්සල, පළමුවන රැස්වීම

(පෙ.ව 9.30) හිඟුරුකඩුව විහාරය.

නම	ලිපිනය	
ආර්. ආර්. රත්නායක	[illegible]	[illegible]
ආර්. පී. කරුණාසේන	"	"
ඩබ්. උක්කුබණ්ඩා	"	"
පොඩිමැණිකේ හේරත්	[illegible]	[illegible]
W.M. කුඩා බණ්ඩා	"	"
කුසුමා රත්නායක	"	"
M.M. ලීලාවතී	"	"
M.M. [illegible]	"	"
R.M. [illegible]	"	"
[illegible]	"	"
[illegible]	"	"
H [illegible]	"	"
S.M. [illegible]	"	"
~~M.M. [illegible]~~ [illegible]	"	"
[illegible]	"	"
[illegible]	"	"
[illegible]	"	"
[illegible]	"	"
WM [illegible]	"	"
AM [illegible]	"	"
[illegible]	"	-
[illegible]	-	-
[illegible]	-	-
[illegible]	"	
R.M. [illegible]	"	"

Meeting No.	-	01
Date	-	2008.09.08
Place	-	Hingurukaduwa Temple
Covered GN Divisions	-	Hingurukaduwa, Ambewela

හිඟුරුකඩුව විහාර

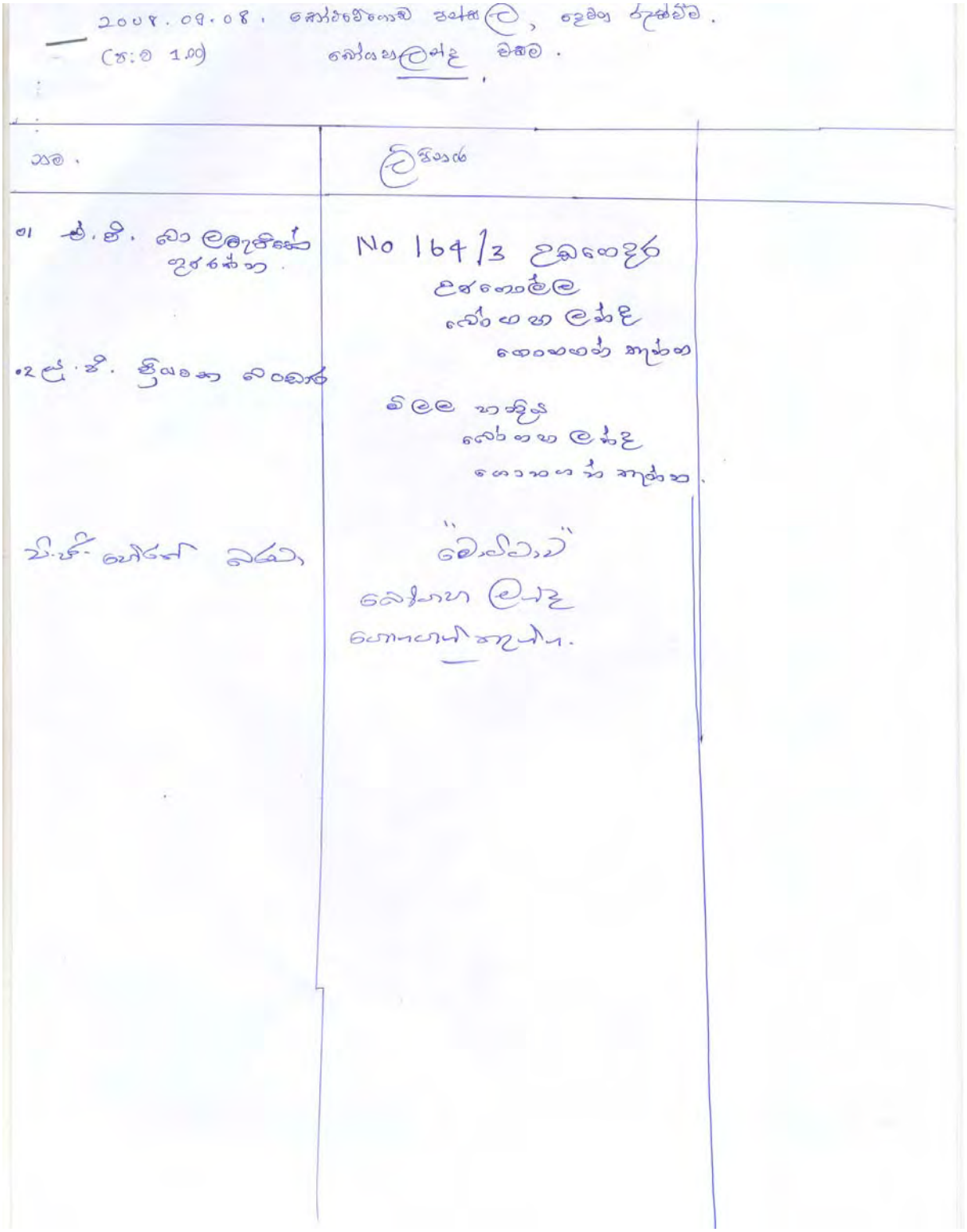
නම	ලිපිනය
W.T. අජිත් [illegible]	[illegible] - අඹකොටේ
R.B. [illegible]	,, ,,
W.M. මැදුම බණ්ඩා	,, ,,
G.G.N. ජයතිලක	,, ,,
M.G. කුමාරසිංහ	,, ,,

Meeting No.	-	01
Date	-	2008.09.08
Place	-	Hingurukaduwa Temple
Covered GN Divisions	-	Hingurukaduwa, Ambewela

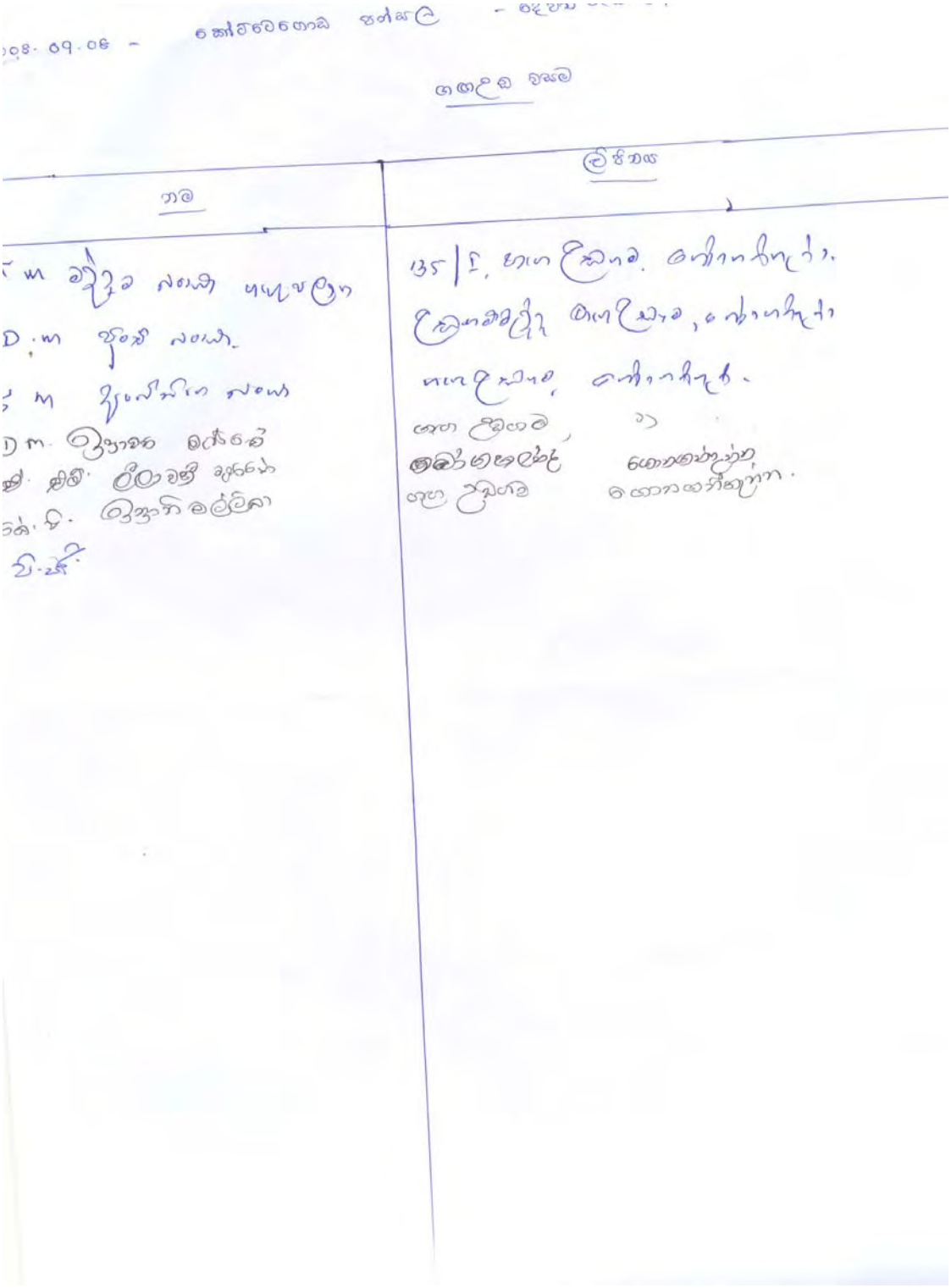
අඹේවෙල වසම.

නම	ලිපිනය
B.G. [illegible]	අඹේවෙල - අබ්කාරිගම.
D.M.P.G. ටිකිරි බණ්ඩා	" "
R.M.G.G. ඩිංගිරි බණ්ඩා	" "
H.M.K.G. අප්පුහාමි.	" "
G.A.B.R. [illegible]	" "
H.K. දයාසිරි	" "
H.M. ජයවීර	" "
T.M. [illegible]	" "
S.G.W. [illegible]	" "
T.M. කිරි මැණිකා	" "
R.M. [illegible]	" "
W.G. [illegible]	" "
D.M. සුමනාවතී	" "
H.M. [illegible]	" "
[illegible]	" "
[illegible]	
[illegible]	

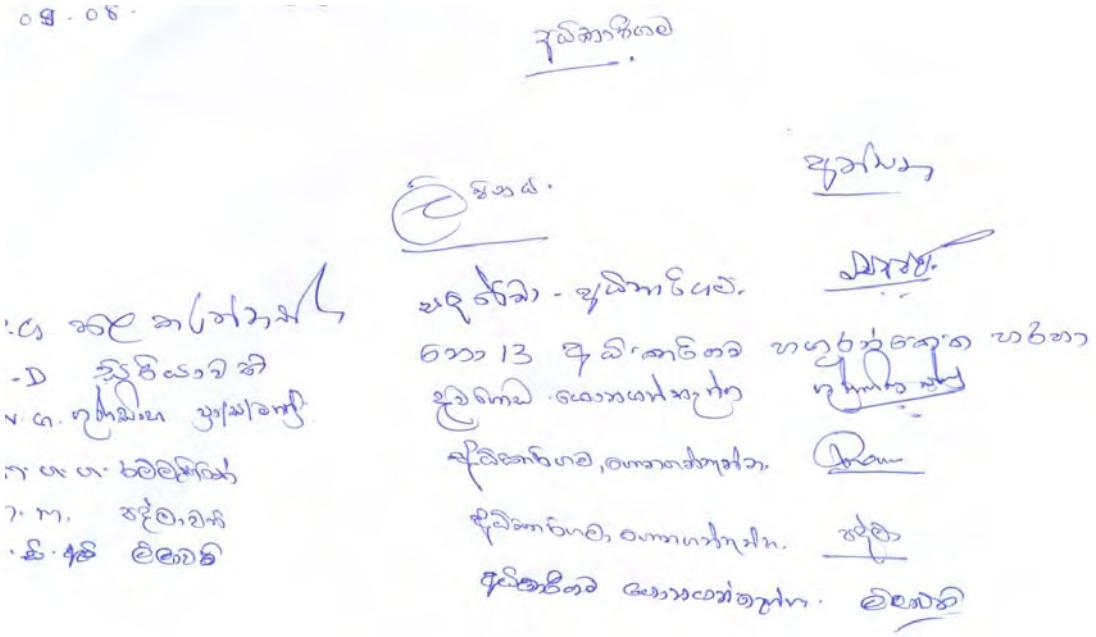
Meeting No.	-	02
Date	-	2008.09.08
Place	-	Kottegoda Temple
Covered GN Divisions	-	Bogahalanda, Gangaudagama, Adikarigama, Welikada, Idamalanda



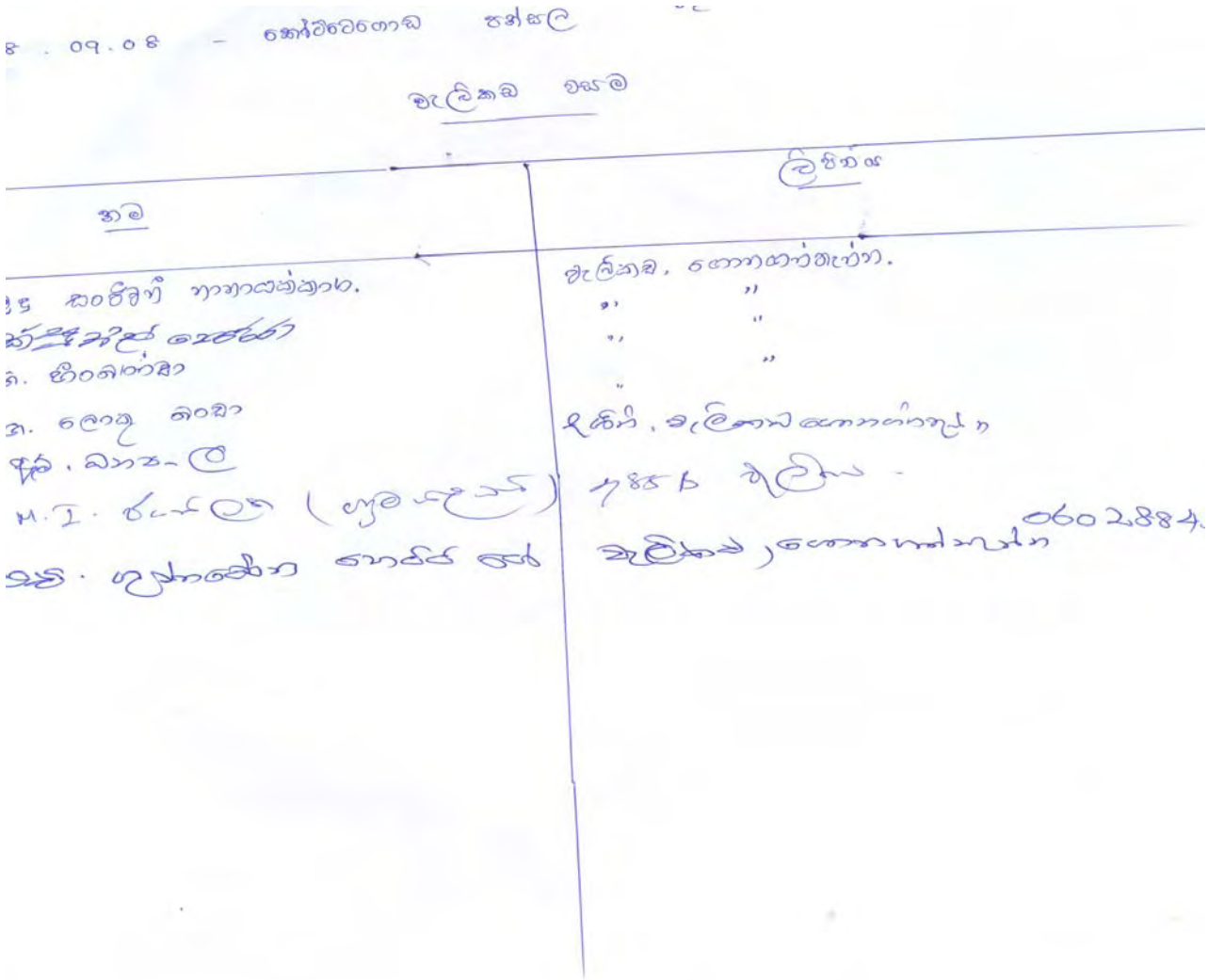
Meeting No.	-	02
Date	-	2008.09.08
Place	-	Kottegoda Temple
Covered GN Divisions	-	Bogahalanda, Gangaudagama, Adikarigama, Welikada, Idamalanda



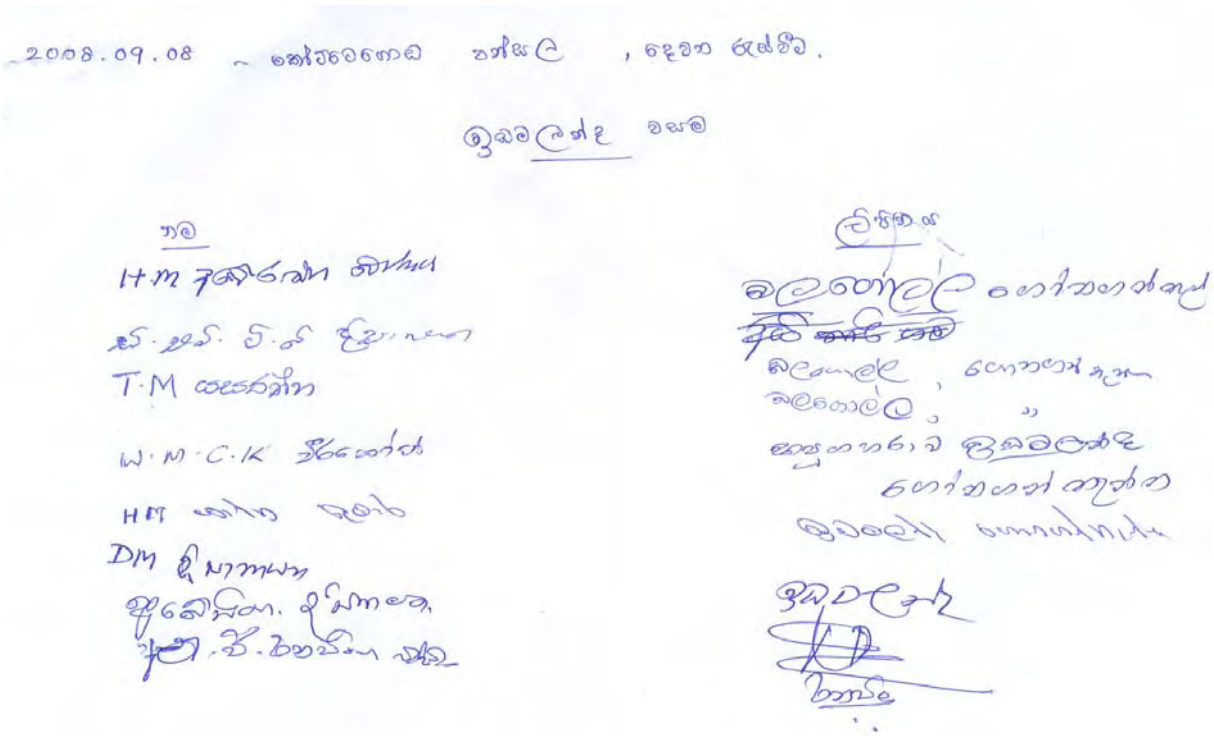
Meeting No.	-	02
Date	-	2008.09.08
Place	-	Kottegoda Temple
Covered GN Divisions	-	Bogahalanda, Gangaudagama, Adikarigama, Welikada, Idamalanda



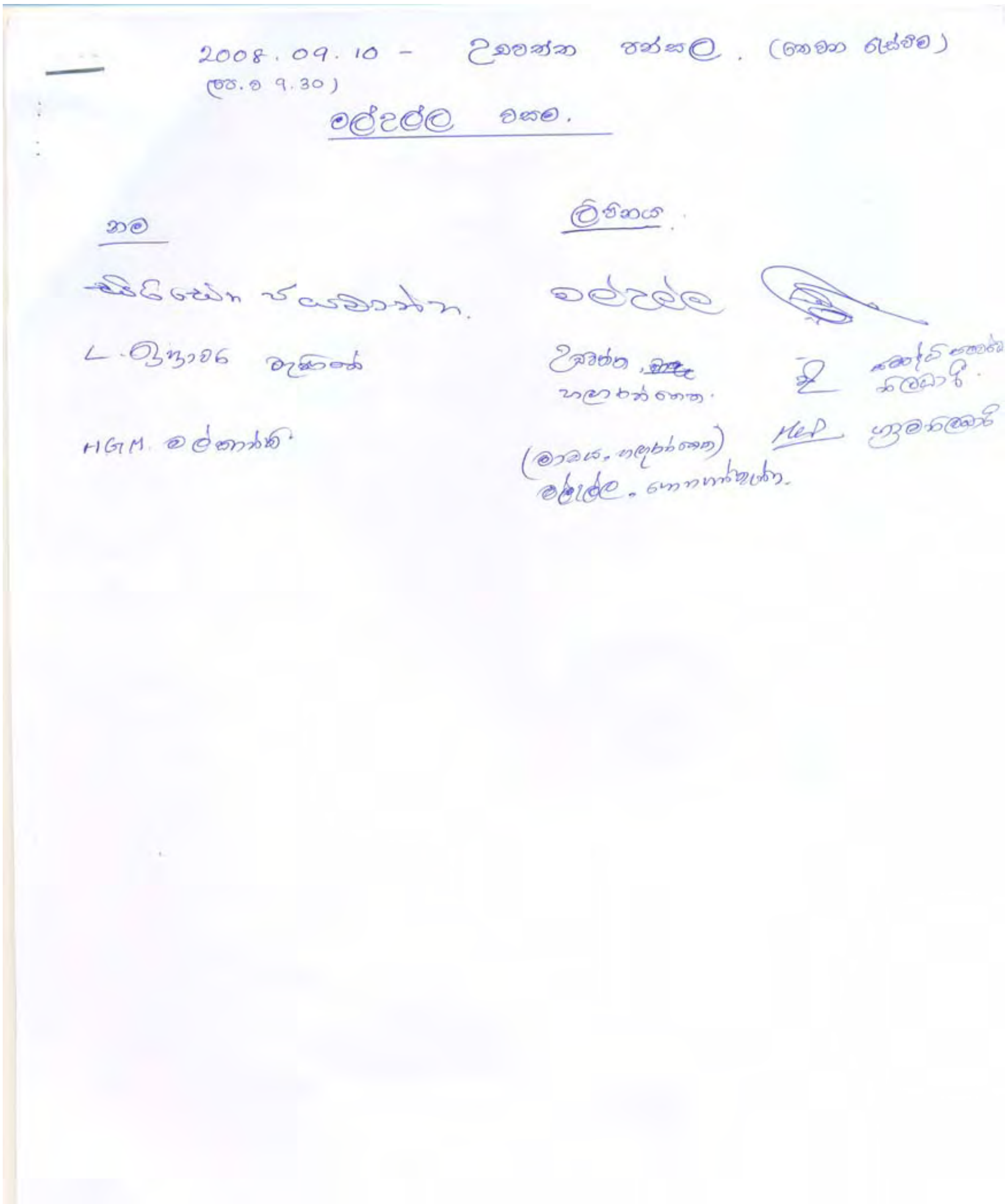
Meeting No.	-	02
Date	-	2008.09.08
Place	-	Kottegoda Temple
Covered GN Divisions	-	Bogahalanda, Gangaudagama, Adikarigama, Welikada, Idamalanda



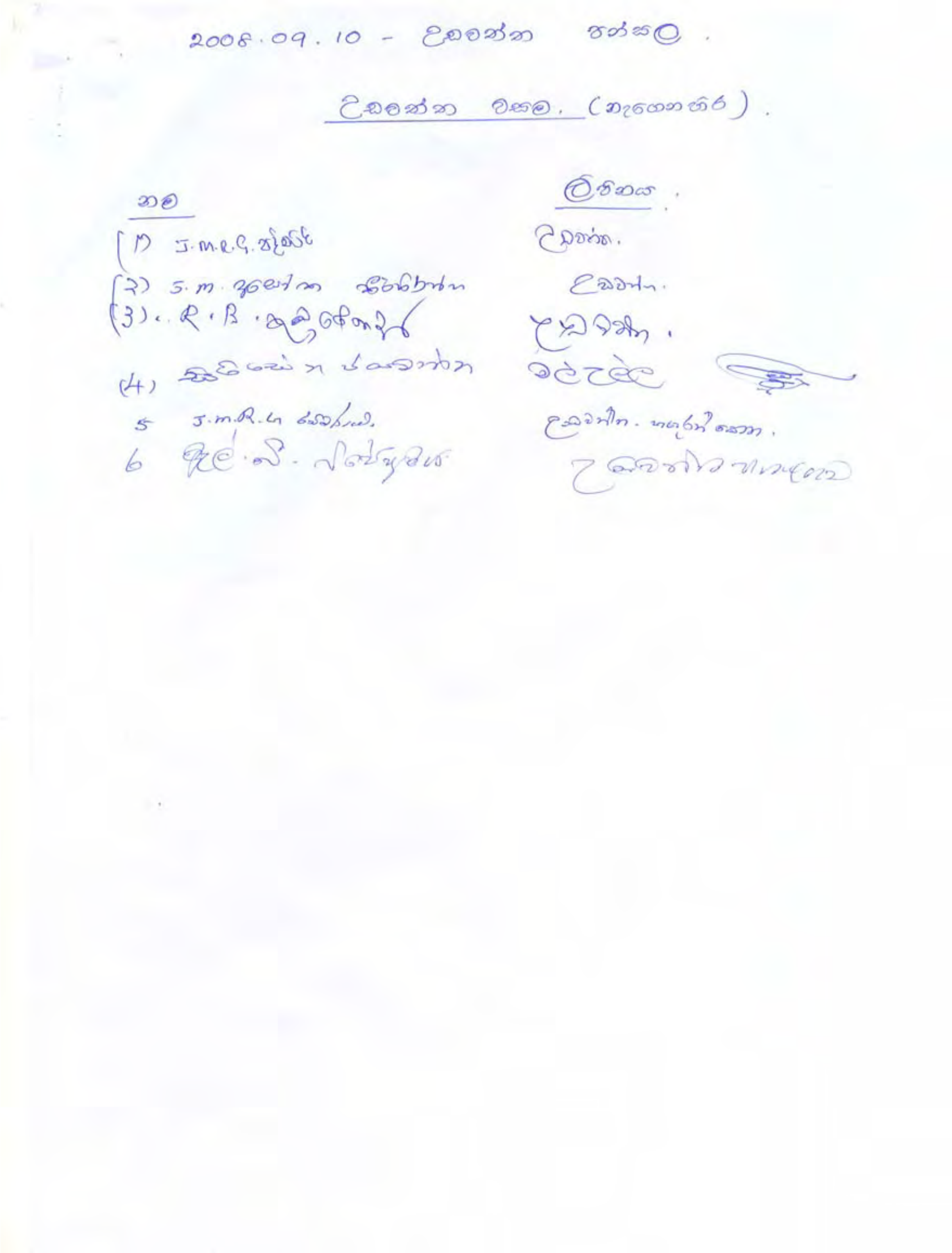
Meeting No.	-	02
Date	-	2008.09.08
Place	-	Kottegoda Temple
Covered GN Divisions	-	Bogahalanda, Gangaudagama, Adikarigama, Welikada, Idamalanda



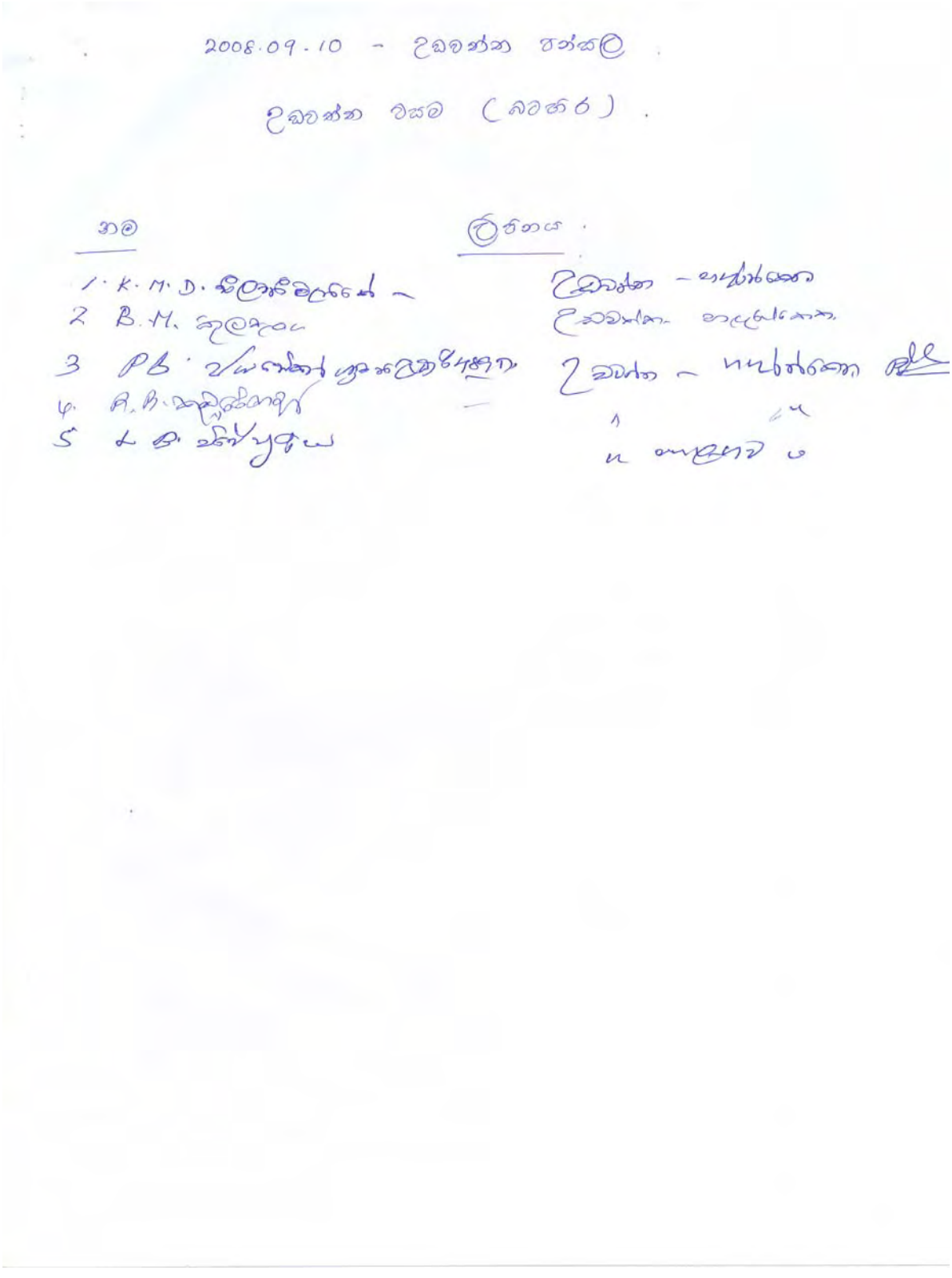
Meeting No.	-	03
Date	-	2008.09.10
Place	-	Udawaththa Temple
Covered GN Divisions	-	Malulla, Udawaththa East and West, Galauda North and South



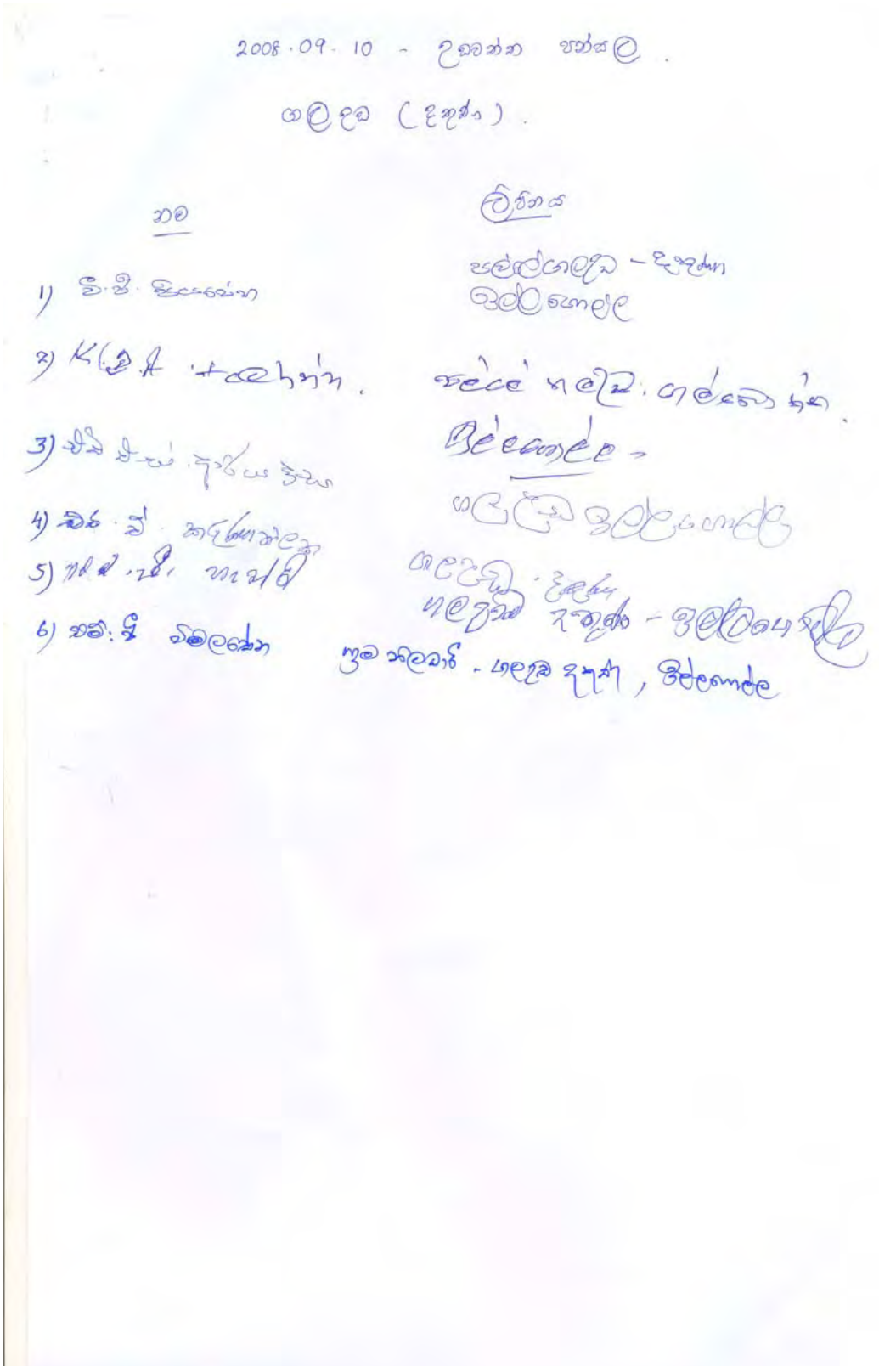
Meeting No.	-	03
Date	-	2008.09.10
Place	-	Udawaththa Temple
Covered GN Divisions	-	Malulla, Udawaththa East and West, Galauda North and South



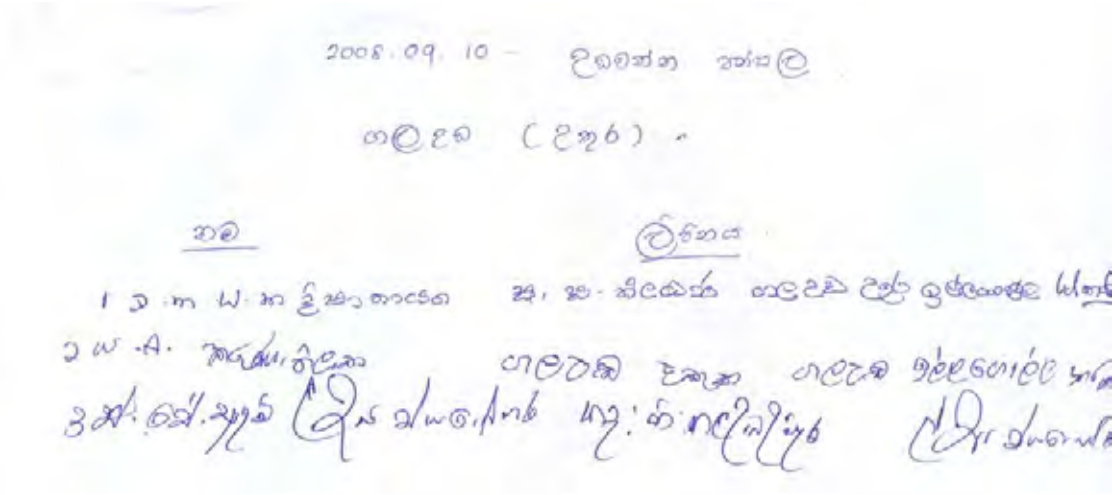
Meeting No.	-	03
Date	-	2008.09.10
Place	-	Udawaththa Temple
Covered GN Divisions	-	Malulla, Udawaththa East and West, Galauda North and South



Meeting No.	-	03
Date	-	2008.09.10
Place	-	Udawaththa Temple
Covered GN Divisions	-	Malulla, Udawaththa East and West, Galauda North and South



Meeting No.	-	03
Date	-	2008.09.10
Place	-	Udawaththa Temple
Covered GN Divisions	-	Malulla, Udawaththa East and West, Galauda North and South



Meeting No.	-	04
Date	-	2008.09.11
Place	-	Hilpenkandura Community Centre
Covered GN Divisions	-	Hipenkandura, Endiribedda

2008.09.11 - හිල්පැන්කඳුර ප්‍රජාශාලාව. ([illegible]

(පෙ.ව. 9.30)

හිල්පැන්කඳුර වසම

නම	ලිපිනය
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4 [illegible]	[illegible]
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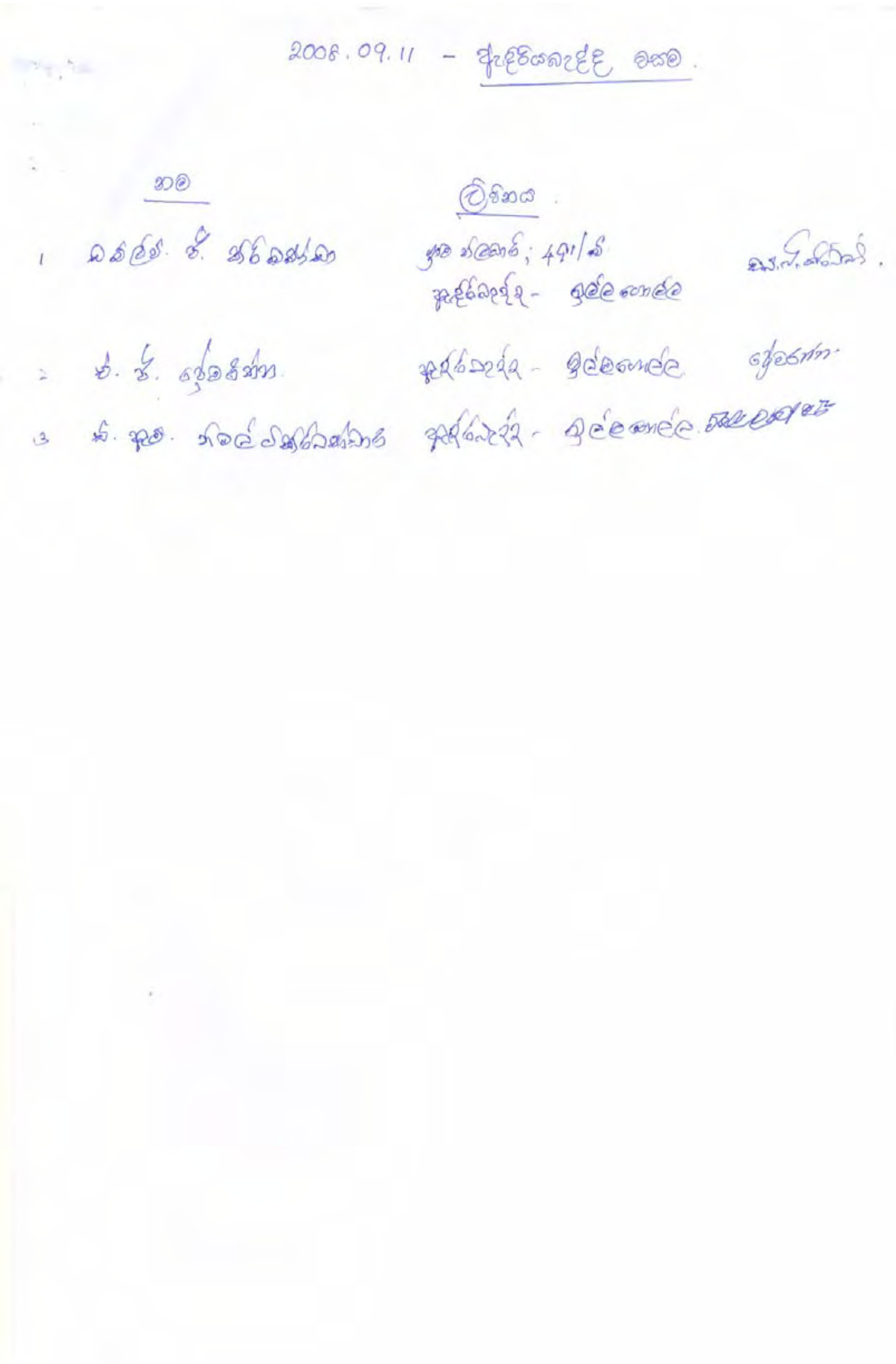
6 [illegible]	[illegible]
7 [illegible]	[illegible]
8 [illegible]	[illegible]
9 [illegible]	[illegible]
10 [illegible]	[illegible]
11 [illegible]	[illegible]
12 [illegible]	[illegible]
13 [illegible]	[illegible]
14 [illegible]	[illegible]
15 W/M [illegible]	[illegible]
16 P.H. [illegible]	[illegible]
17 M.U.M.E.G [illegible]	[illegible]
18 J.M.W.G [illegible]	[illegible]
19 D.M. [illegible]	[illegible]
20 [illegible] W.C [illegible]	[illegible]
[illegible]	[illegible]

Meeting No.	-	04
Date	-	2008.09.11
Place	-	Hilpenkandura Community Centre
Covered GN Divisions	-	Hipenkandura, Endiribedda



ANNEX VI.

Complete Set of Relevant Maps, Tables, Charts, Layout Plans and Other Details

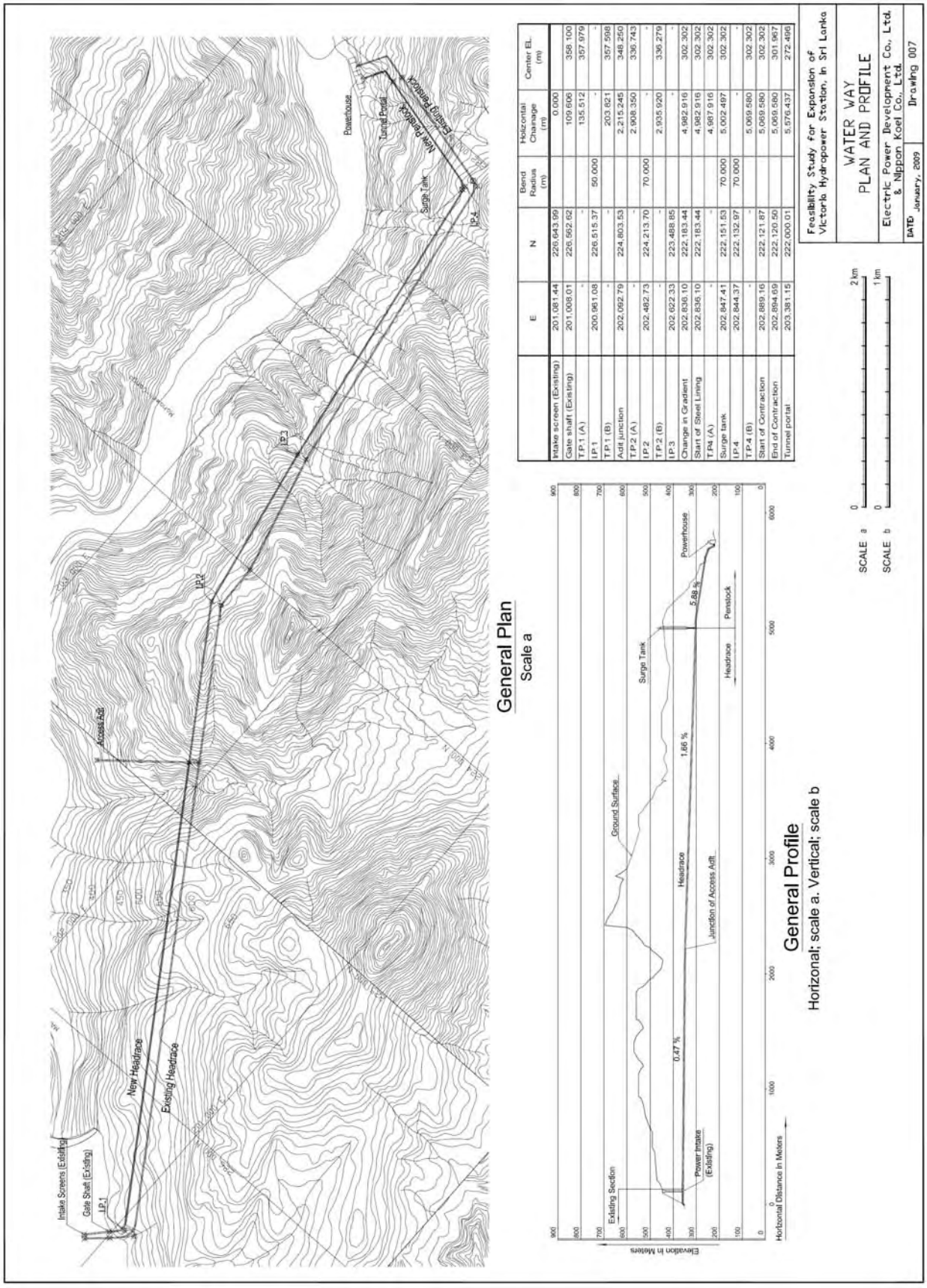
ANNEX VI.

Complete Set of Relevant Maps, Tables, Charts, Layout Plans and Other Details

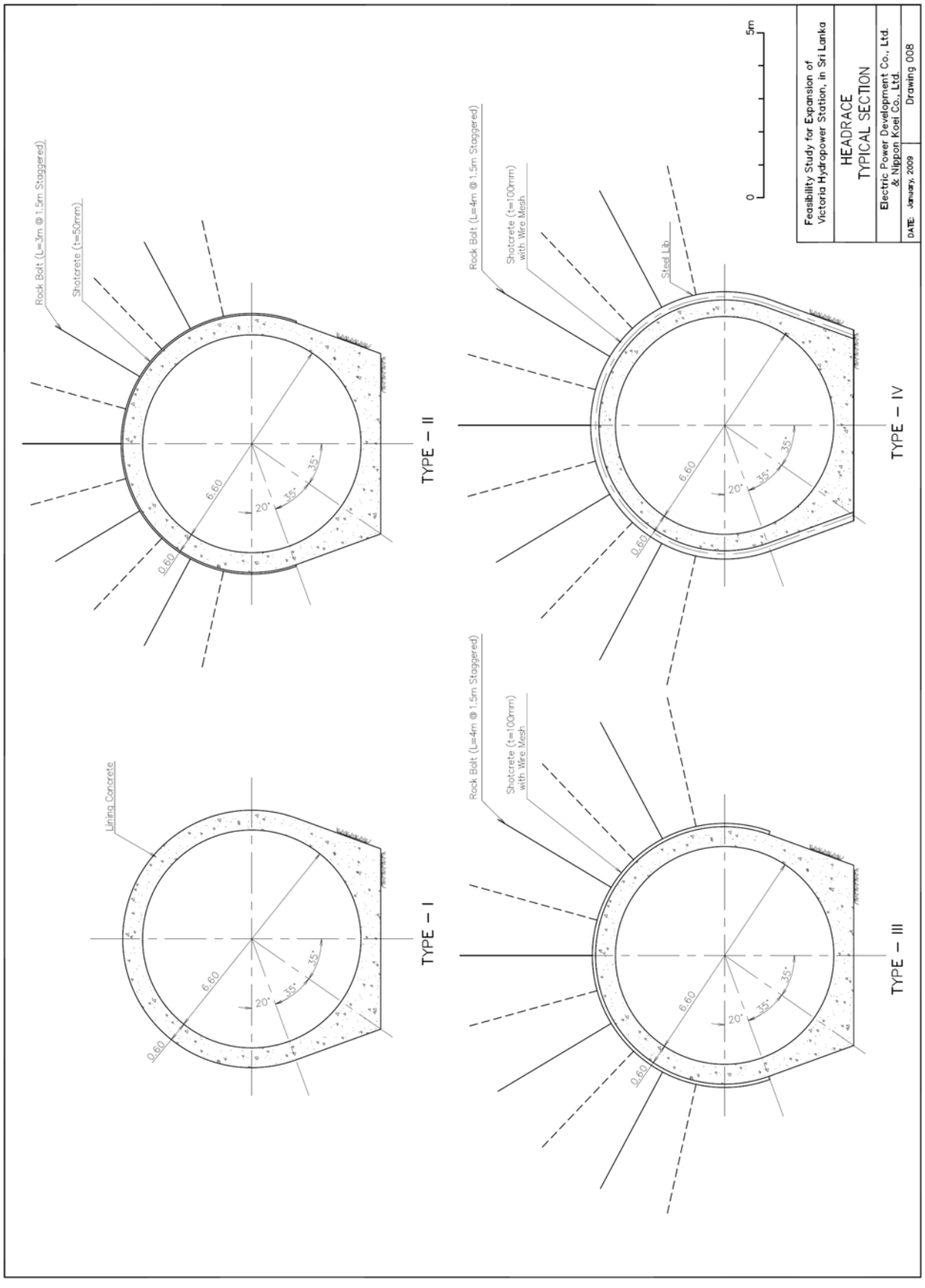
1. Scoping Matrix

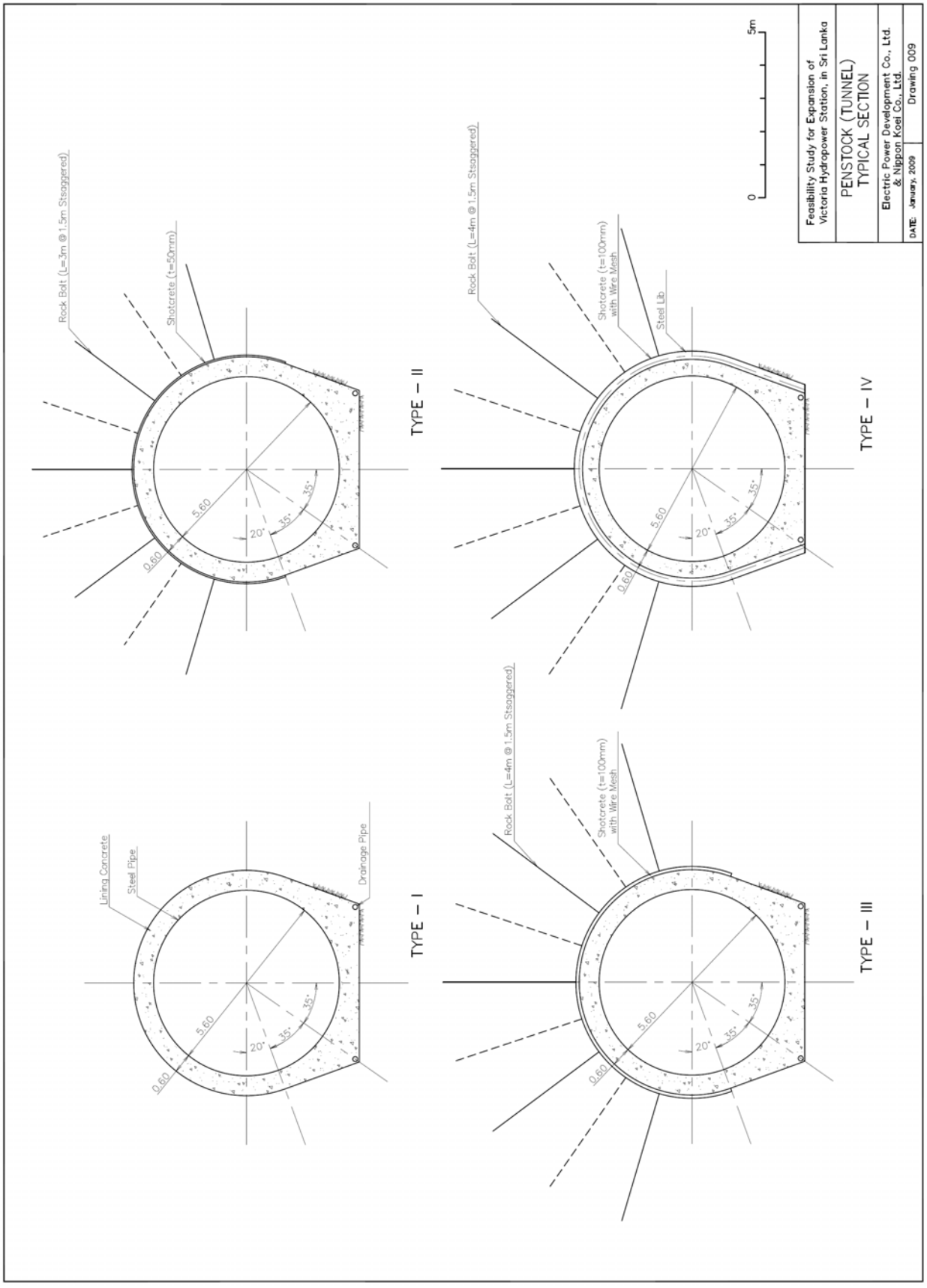
Environmental Parameter		Project Activities																														
		Planning Stage		Construction																						pearation		Restorat		Ranking		
		Surveying/feasibility study /EIA	Public Meetings	Tunnel												Camp sites and workshop							Building Access Roads		Power House related		Power House		Restoration of damaged sites	Conservation		
				Drilling	Blasting	Transport of explosives	Storage of explosives	Disposal of explosives	Waste transport	Waste dumping	Tunnel lining	Tunnel drainage	Ventilation	Water supply	Power supply	Land preparation	Construction of buildings	Construction of temp. facilities	Provision of Sanitary facilities	Material transport and storage	Equipment maintenance	Maintaining labour camps/workshops	Land preparation	Road surfacing and drainage	Land preparation	Construction	Operation of the plant	Maintaning the plant				**Potential Impact**
Physical	Soil			3	3			6		12						10							12		4				6	8	9	Soil erosion from waste dumps and road construction
	Slope stability			2	2											2							6		6				5	5		Landslides/slips
	Surface drainage			8	10					8		10				8	2	3					8	7	8							Temporary Alteration to Surface drainage patterns
	Ground water table			20	20																										2	Temporary lowering of ground water
	Surface water quality						4	16	6	16		16				12	4	4			14	10									5	Pollution of surface water from tunnel discharge
	Ground water quality							12		8		4							5		6										10	Ground Water Pollution
	Increased Noise and vibration			10	10											8	8				7		8									Incresed noise blasting sites/workshops/
	Air quality					2			6	8						8	8	6		6	4	6	8	10	8				8	8		Air pollution at plants/blasting sites
Existing Structures	Existing tunnel			16	20																										3	cracking
	Dam			1	1																											cracking
	Power house			1	1																											cracking
	Transport network			4	4											2	2	2		12											11	deterioration due to increase of heavy traffic
	Dwellings			4	4																											cacking
Biotic	Forest Cover									16						10							9								8	reduction of forest cover at dumping sites
	Species Diversity flora							12		16		8				10					8		9								7	reduction of forest cover at dumping sites
	Species Diversity fauna							12		16		8				10					8		9								7	migration of some species due to noise and activities
	Elephants									10						5											16					Drowning of elephants in the tailrace
Social	Employment opportunities					2	1	1	2	2																						
	Employment opportunities/local					1				6				8		10	10	12			6	12	12	9					12	12	9	Increase in regional employment opportunities
	Encroachment																															Increase in local economic opportunities
	Community cohesion																					10										Conflicts due to unequal benefits
	Atttitude towards the project	12	12																												10	Building a positive impression on the project
	Uncertainity on the future of AP	10	10																													Increase temporarily
	Migration																															temporary in-migration
	Local culture																					12									10	disturbances from the labourers
	Religious places																															increased contributons
	Health			16	16																										6	increase in work related accidents
	Dometic water supply			20	20																										2	Temporary reduction due to lowering of ground water
	Cultivation			20																											2	Temporary reduction due to lowering of ground water
	National Economy																										25				1	reduce carbon fuel/foreign exchage savings
	Local economy																					16						16	16	16	4	injection of capital to the local economy

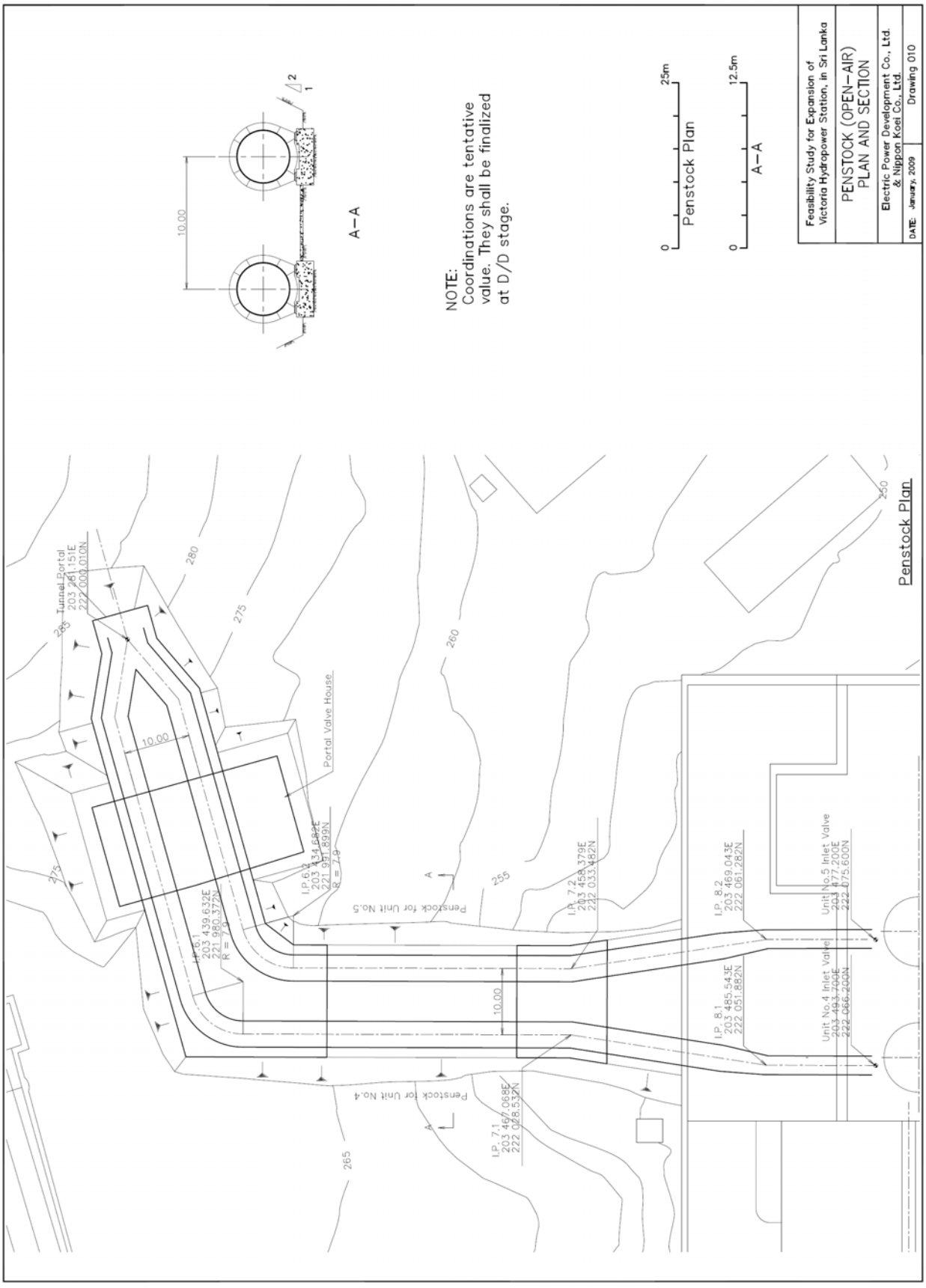
2. Design Drawing

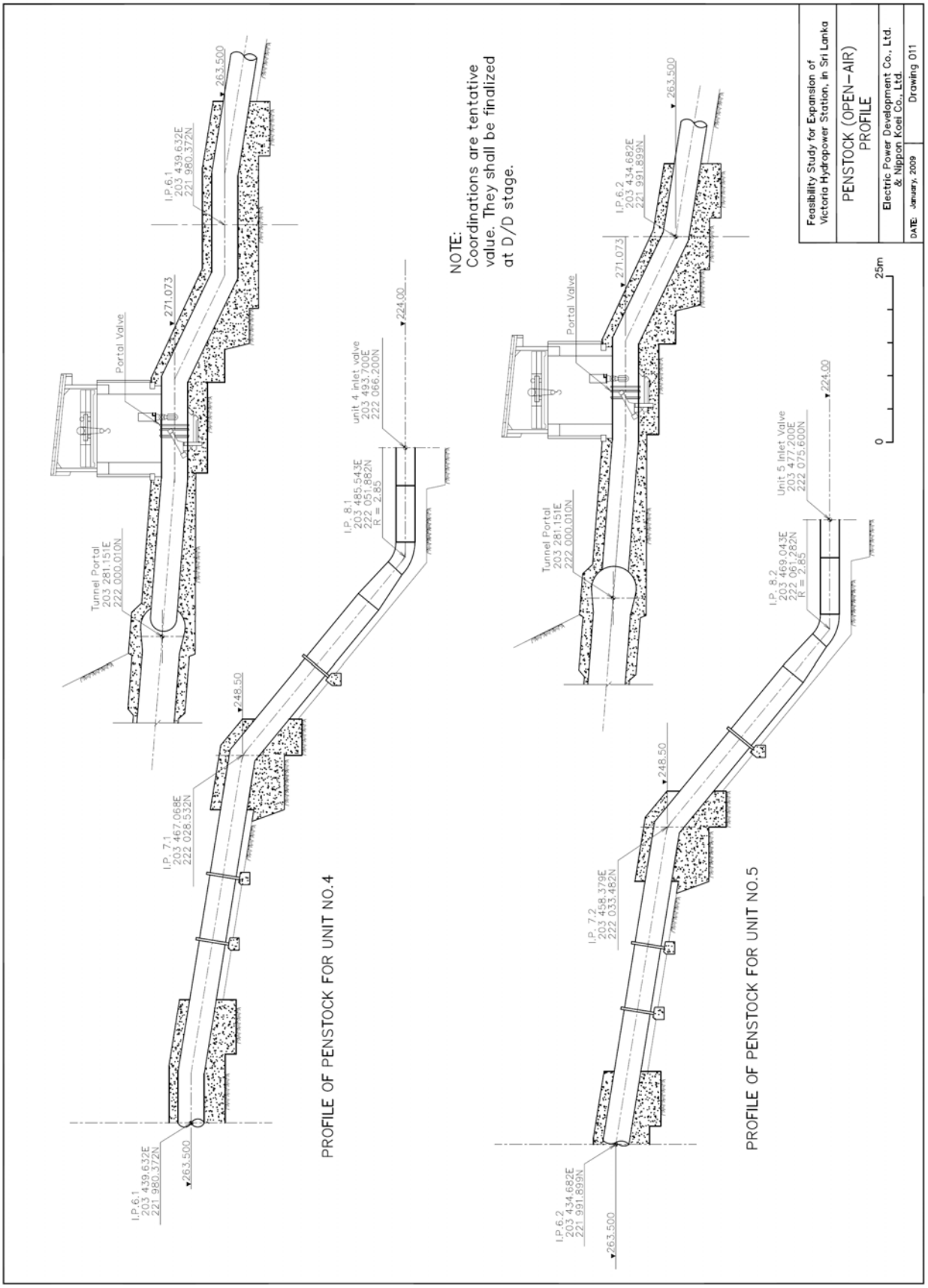


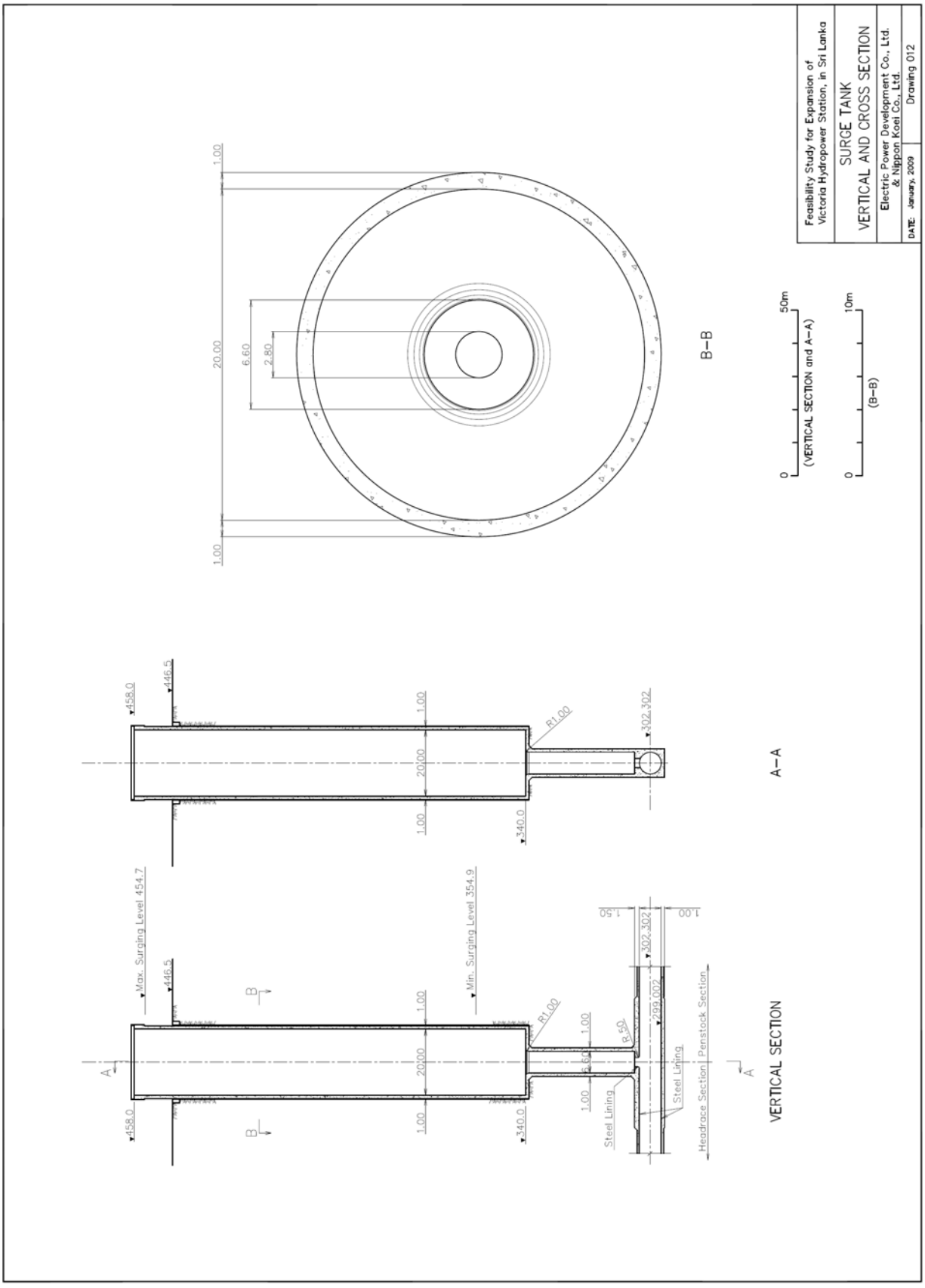
	E	N	Bend Radius (m)	Holizontal Chainage (m)	Center EL. (m)
Intake screen (Existing)	201,081.44	226,643.99		0.000	
Gate shaft (Existing)	201,008.01	226,552.62		109.606	358.100
T.P.1 (A)	-	-		135.512	357.979
I.P.1	200,961.08	226,515.37	50.000	-	-
T.P.1 (B)	-	-		203.821	357.598
Adit junction	202,092.79	224,803.53		2,215.245	348.250
T.P.2 (A)	-	-		2,908.350	336.743
I.P.2	202,482.73	224,213.70	70.000	-	-
T.P.2 (B)	-	-		2,935.920	336.279
I.P.3	202,622.33	223,488.85		-	-
Change in Gradient	202,836.10	222,183.44		4,982.916	302.302
Start of Steel Lining	202,836.10	222,183.44		4,982.916	302.302
T.P4 (A)	-	-		4,987.916	302.302
Surge tank	202,847.41	222,151.53	70.000	5,002.497	302.302
I.P.4	202,844.37	222,132.97	70.000	-	-
T.P.4 (B)	-	-		5,069.580	302.302
Start of Contraction	202,889.16	222,121.87		5,069.580	302.302
End of Contraction	202,894.69	222,120.50		5,069.580	301.967
Tunnel portal	203,381.15	222,000.01		5,576.437	272.496

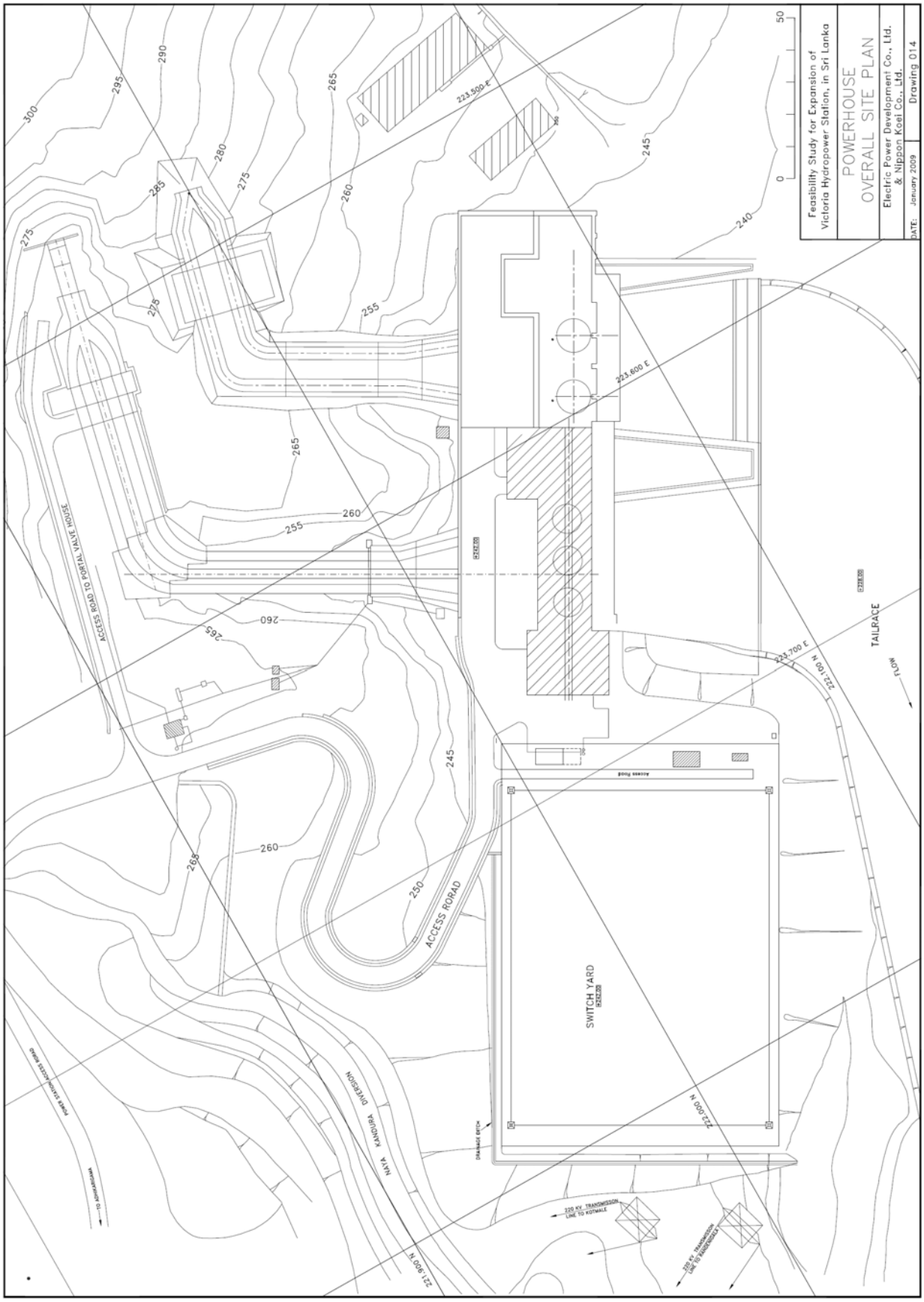

Rock Bolt (L=3m @ 1.5m Staggered)
Shotcrete (t=50mm)
TYPE – II
Lining Concrete
TYPE – I
Rock Bolt (L=4m @ 1.5m Staggered)
Shotcrete (t=100mm) with Wire Mesh
Steel Lib
TYPE – IV
TYPE – III
6.60
0.60
20°
35°
0
5m
Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
HEADRACE
TYPICAL SECTION
Electric Power Development Co., Ltd.
& Nippon Koei Co., Ltd.
DATE: January, 2009
Drawing 008

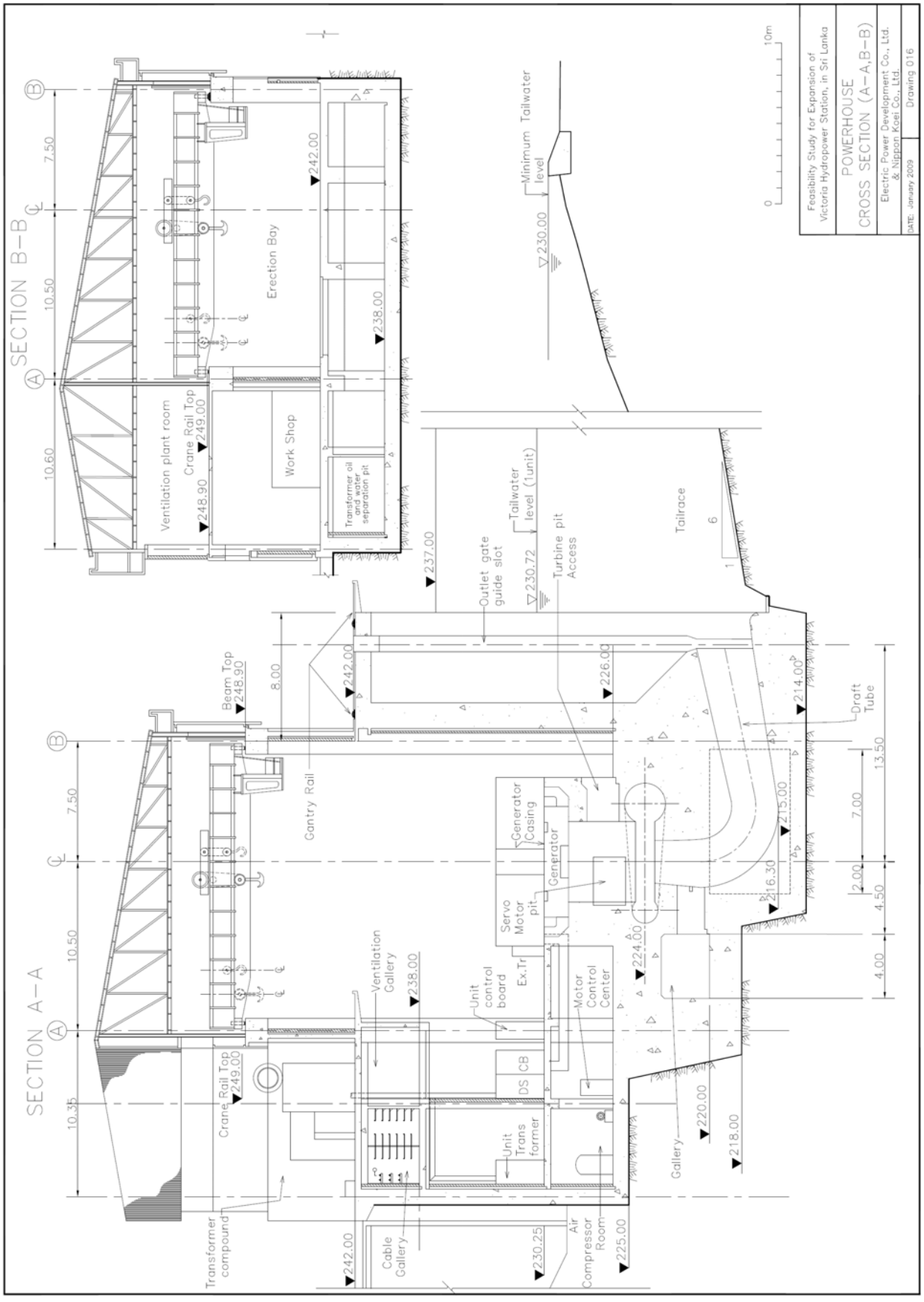

Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
PENSTOCK (TUNNEL) TYPICAL SECTION
Electric Power Development Co., Ltd. & Nippon Koei Co., Ltd.
DATE: January, 2009
Drawing 009
0
5m
TYPE – I
TYPE – II
TYPE – III
TYPE – IV
Lining Concrete
Steel Pipe
Drainage Pipe
Rock Bolt (L=3m @1.5m Stsggered)
Shotcrete (t=50mm)
Rock Bolt (L=4m @1.5m Stsggered)
Shotcrete (t=100mm) with Wire Mesh
Steel Lib
5.60
0.60
20°
35°

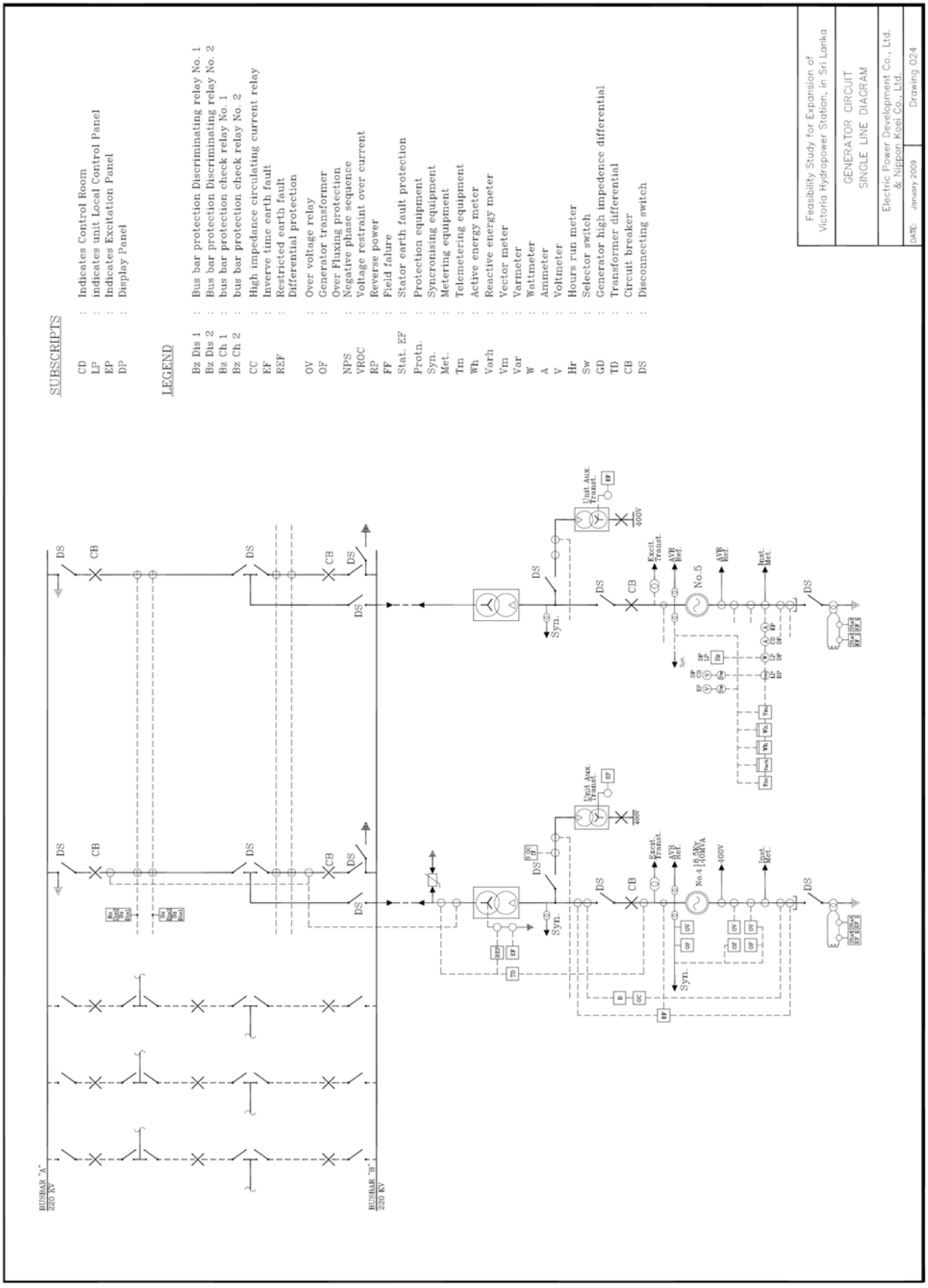

Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
PENSTOCK (OPEN-AIR) PLAN AND SECTION
Electric Power Development Co., Ltd. & Nippon Koei Co., Ltd.
DATE: January, 2009
Drawing 010
Penstock Plan
A-A
NOTE:
Coordinations are tentative value. They shall be finalized at D/D stage.
Tunnel Portal
Portal Valve House
Penstock for Unit No.5
Penstock for Unit No.4
Unit No.5 Inlet Valve
Unit No.4 Inlet Valve


Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
PENSTOCK (OPEN-AIR) PROFILE
Electric Power Development Co., Ltd. & Nippon Koei Co., Ltd.
DATE: January, 2009
Drawing 011
NOTE:
Coordinations are tentative value. They shall be finalized at D/D stage.
PROFILE OF PENSTOCK FOR UNIT NO.4
PROFILE OF PENSTOCK FOR UNIT NO.5
I.P.6.1
203 439.632E
221 980.372N
263.500
271.073
Portal Valve
Tunnel Portal
203 281.151E
222 000.010N
I.P. 7.1
203 467.068E
222 028.532N
248.50
I.P. 8.1
203 485.543E
222 051.882N
R = 2.85
unit 4 inlet valve
203 493.700E
222 066.200N
224.00
I.P.6.2
203 434.682E
221 991.899N
I.P. 7.2
203 458.379E
222 033.482N
I.P. 8.2
203 469.043E
222 061.282N
R = 2.85
Unit 5 Inlet Valve
203 477.200E
222 075.600N
0
25m


Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
SURGE TANK
VERTICAL AND CROSS SECTION
Electric Power Development Co., Ltd. & Nippon Koei Co., Ltd.
DATE: January, 2009
Drawing 012
B–B
A–A
VERTICAL SECTION
(VERTICAL SECTION and A–A)
(B–B)
50m
10m
0
Max. Surging Level 454.7
Min. Surging Level 354.9
446.5
458.0
340.0
302.302
299.002
20.00
6.60
2.80
1.00
20100
20000
R1.00
8.50
5.00
1.50
Steel Lining
Headrace Section
Penstock Section


Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
POWERHOUSE
OVERALL SITE PLAN
Electric Power Development Co., Ltd.
& Nippon Koei Co., Ltd.
DATE: January 2009
Drawing 014
0
50
223,500 E
223,600 E
223,700 E
222,100 N
222,000 N
221,900 N
ACCESS ROAD TO PORTAL VALVE HOUSE
ACCESS RORAD
SWITCH YARD
TAILRACE
FLOW
NAVA KANDURA DIVERSION
220 KV TRANSMISSION LINE TO KOTMALE
220 KV TRANSMISSION LINE TO RANDENIGALA
300
295
290
285
280
275
270
265
260
255
250
245
240


SECTION B–B
SECTION A–A
Erection Bay
Ventilation plant room
Crane Rail Top 249.00
248.90
Work Shop
Transformer oil and water separation pit
242.00
238.00
7.50
10.50
10.60
Minimum Tailwater level
230.00
Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
POWERHOUSE
CROSS SECTION (A–A,B–B)
Electric Power Development Co., Ltd.
& Nippon Koei Co., Ltd.
DATE: January 2009
Drawing 016
0
10m
237.00
Outlet gate guide slot
Tailwater level (1unit)
230.72
Turbine pit Access
Tailrace
6
1
Beam Top 248.90
8.00
226.00
214.00
Draft Tube
Gantry Rail
Generator Casing
Generator
215.00
216.30
13.50
7.00
2.00
4.50
4.00
Servo Motor pit
Ventilation Gallery
238.00
224.00
Unit control board
Ex.Tr
Motor Control Center
DS
CB
Crane Rail Top 249.00
10.35
Unit Trans former
220.00
218.00
Gallery
Transformer compound
242.00
Cable Gallery
230.25
Air Compressor Room
225.00


SUBSCRIPTS
CD : Indicates Control Room
LP : indicates unit Local Control Panel
EP : Indicates Excitation Panel
DP : Display Panel
LEGEND
Bz Dis 1 : Bus bar protection Discriminating relay No. 1
Bz Dis 2 : Bus bar protection Discriminating relay No. 2
Bz Ch 1 : bus bar protection check relay No. 1
Bz Ch 2 : bus bar protection check relay No. 2
CC : High impedance circulating current relay
EF : Inverve time earth fault
REF : Restricted earth fault
Differential protection
OV : Over voltage relay
OF : Generator transformer
Over Fluxing protection
NPS : Negative phase sequence
VROC : Voltage restraint over current
RP : Reverse power
FF : Field failure
Stat. EF : Stator earth fault protection
Protn. : Protection equipment
Syn. : Syncronising equipment
Met. : Metering equipment
Tm : Telemetering equipment
Wh : Active energy meter
Varh : Reactive energy meter
Vm : Vector meter
Var : Varmeter
W : Wattmeter
A : Ammeter
V : Voltmeter
Hr : Hours run meter
Sw : Selector switch
GD : Generator high impedence differential
TD : Transformer differential
CB : Circuit breaker
DS : Disconnecting switch
Feasibility Study for Expansion of Victoria Hydropower Station, in Sri Lanka
GENERATOR CIRCUIT SINGLE LINE DIAGRAM
Electric Power Development Co., Ltd. & Nippon Koei Co., Ltd.
DATE: January 2009
Drawing 024
BUSBAR "A" 220 KV
BUSBAR "B" 220 KV
No.5
No.4
Unit Aux. Transf.
400V
Excit. Transf.
AVR Ref.
Inst. Met.
Syn.

3. Simulation of Water Level between Powerhouse and Randenigala Reservoir

3.1 Current Fluctuation of Water Level at Randenigala Reservoir

Fluctuation of Randenigala Reservoir water level measured at the first day of each month is shown in **Figure 3-1**. Maximum water level appears in March and minimum water level appears in September. This tendency is shown in past 8 years. Then, Low Water Level (L.W.L.) is set at 209 m, Mean Water Level (M.W.L.) is set at 218.3 m and High Water Level (H.W.L.) is set at 232 m.

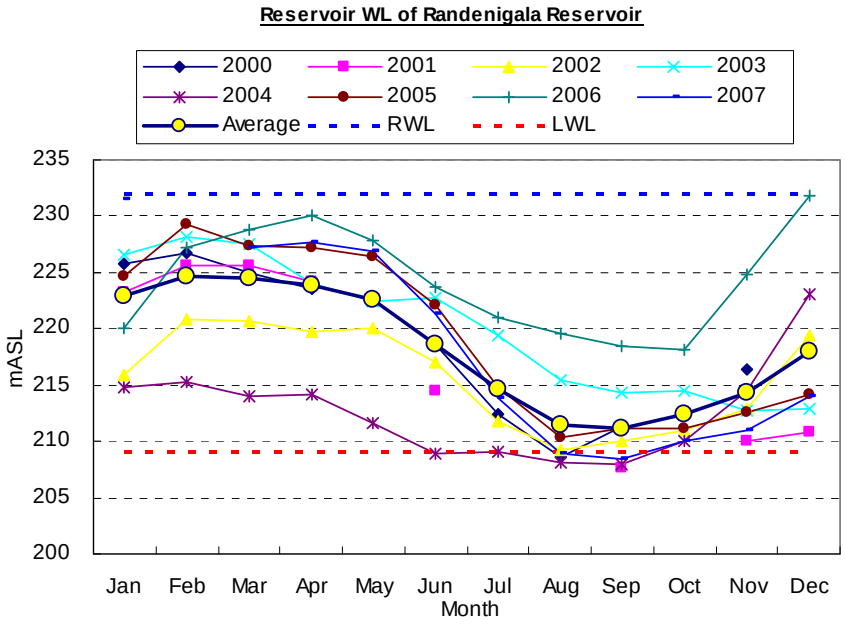


Figure 3-1 Water Level in Randenigala Reservoir

3.2 Estimated Water Level between Power Plant and Randenigala Reservoir

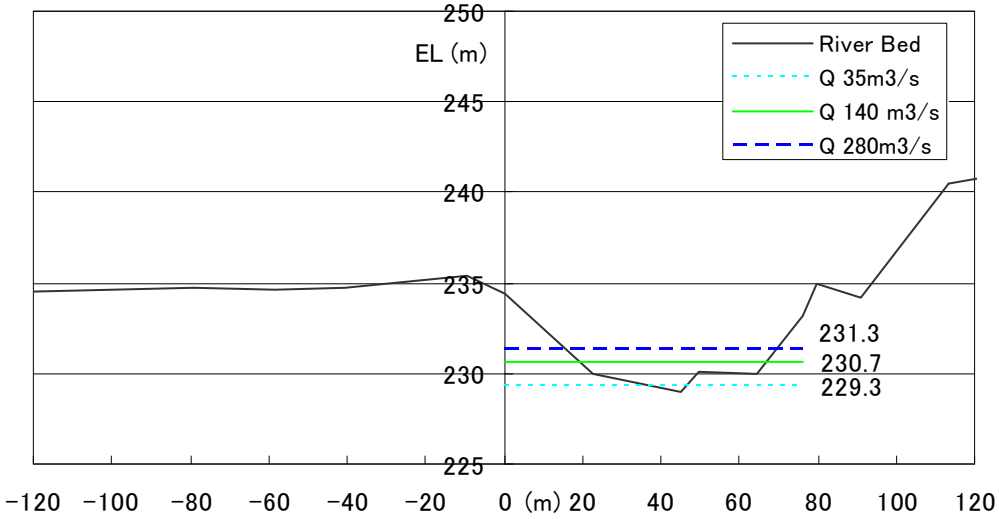


Figure 3-2 Water Level at Sec.0 (Ch.0) Case1 (LWL)

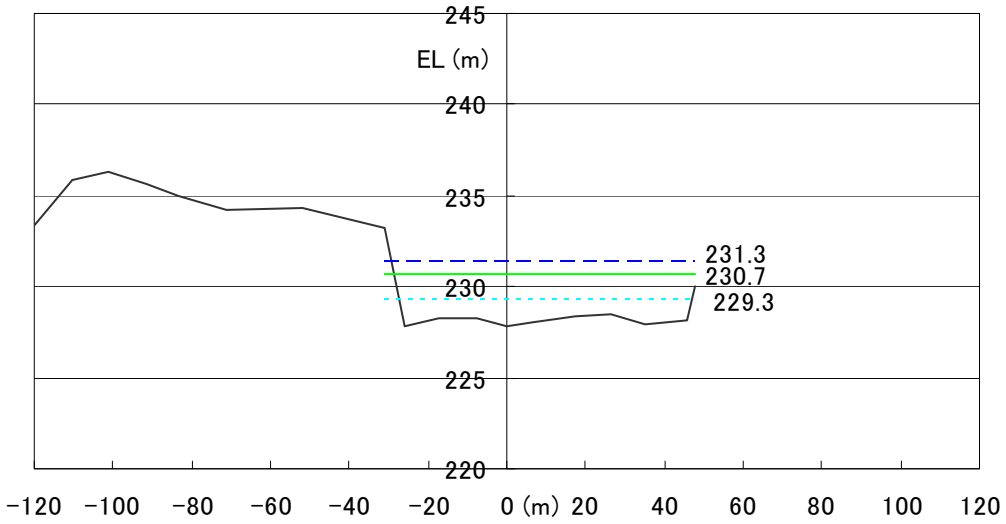


Figure 3-3 Water Level at Sec.1 (Ch.67.7) Case1 (LWL)

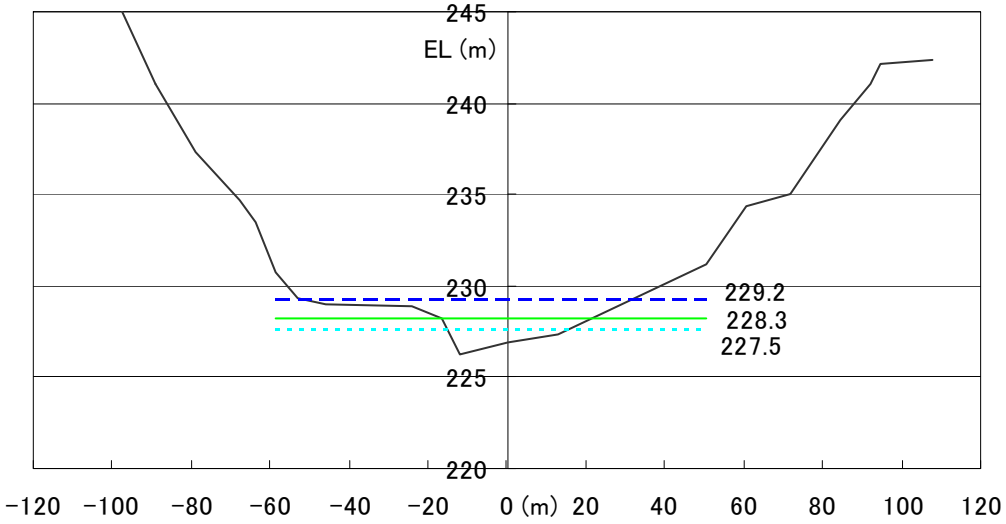


Figure 3-4 Water Level at Sec.2 (Ch.271.0) Case1 (LWL)

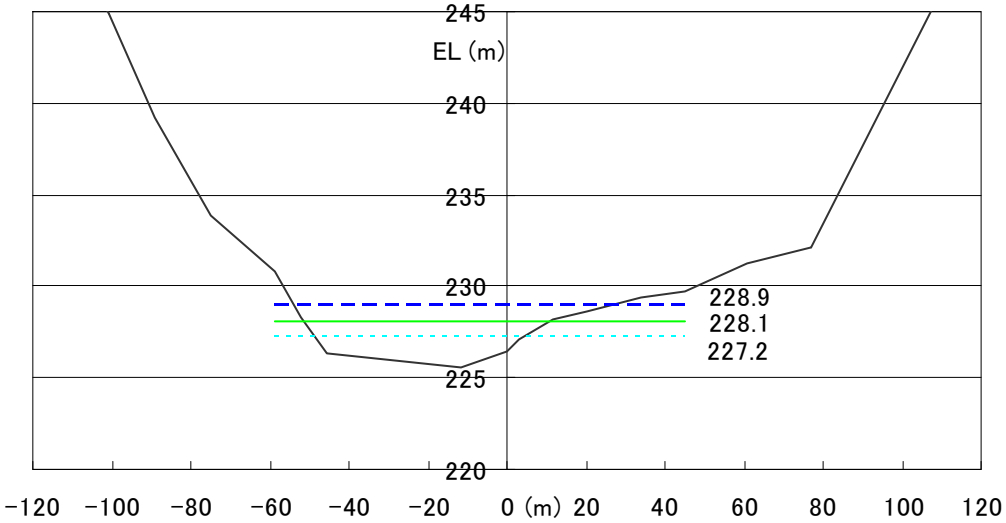


Figure 3-5 Water Level at Sec.3 (Ch.338.6) Case1 (LWL)

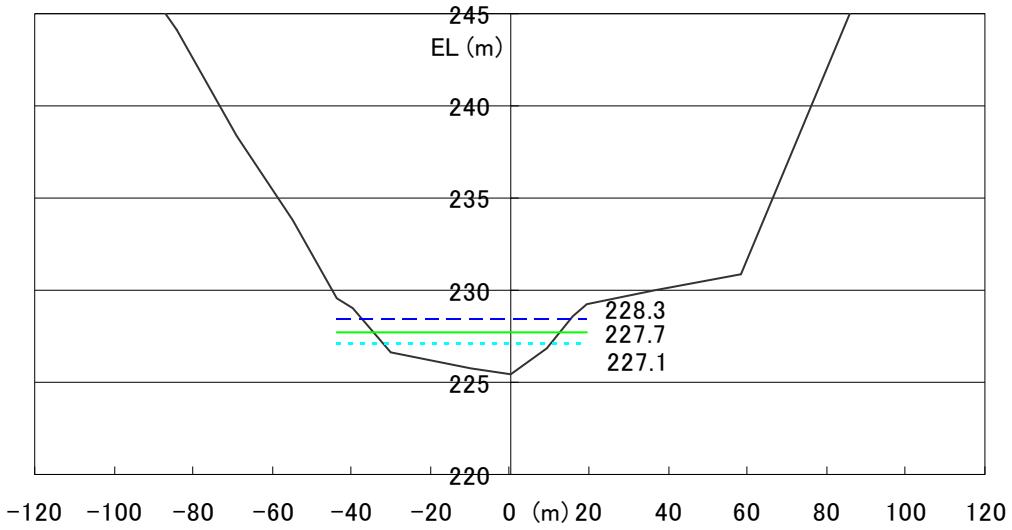


Figure 3-6 Water Level at Sec.4 (Ch.407.1) Case1 (LWL)

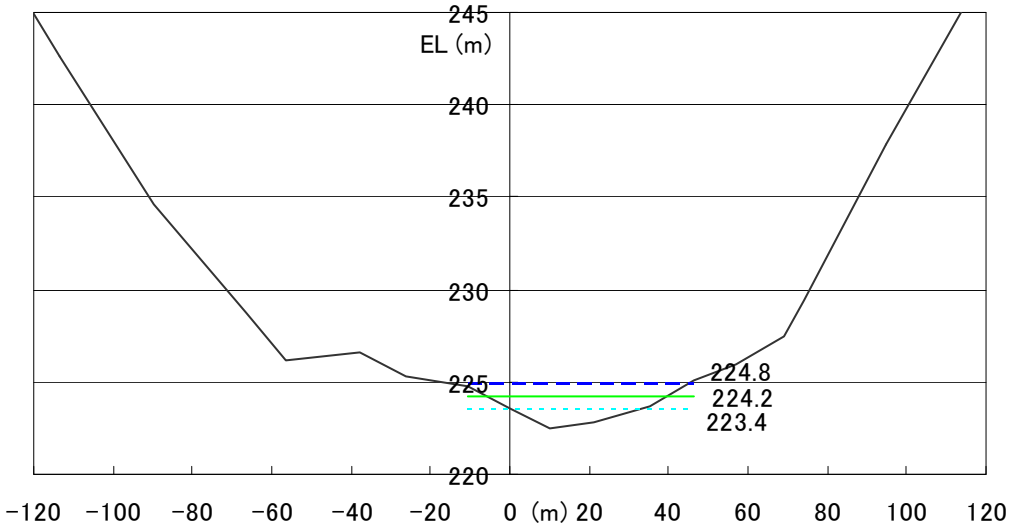


Figure 3-7 Water Level at Sec.5 (Ch.664.1) Case1 (LWL)

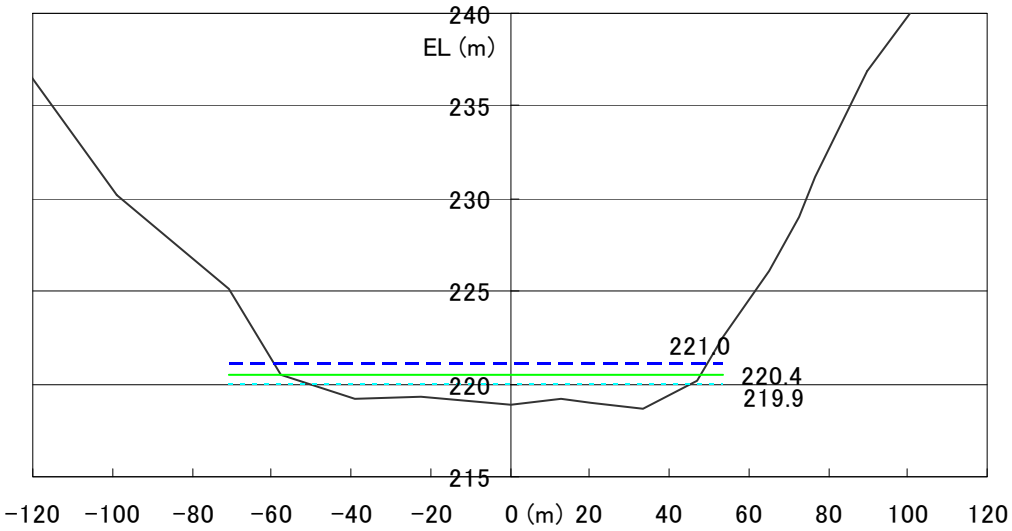


Figure 3-8 Water level at Sec.6 (Ch.907.8) Case1 (LWL)

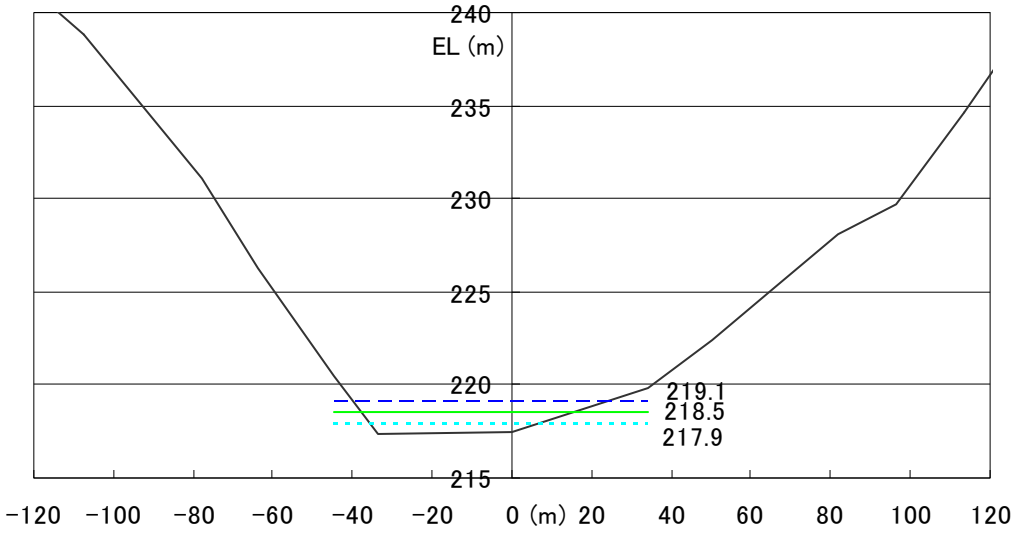


Figure 3-9 Water Level at Sec.7 (Ch. 1039.8) Case1 (LWL)

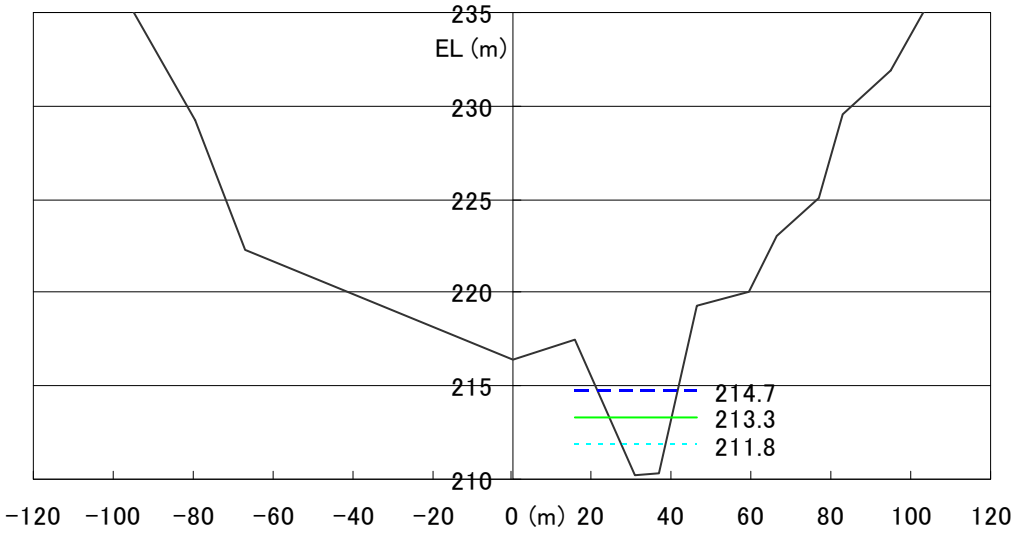


Figure 3-10 Water level at Sec.8 (Ch.1182.1) Case1 (LWL)