Detailed Work Program

and

Site Specific Environmental & Social Management & Monitoring Plan for Construction of Quarry Site

for

Nam Ngiep 1 Hydropower Project

Document No.: NNP1-MS-MD-005-A2

OBAYASHI Corporation

Submitted By:

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Project Manager
Nam Ngiep Project Office
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<td>A2</td>
<td>2nd Submission for Owner’s Review</td>
<td>30th/September/2014</td>
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<td>26th/November/2014</td>
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</table>
PART 1

DETAILED WORKS PROGRAM

(DWP)
1. GENERAL

This detailed works program focuses on the preparation and operation works of Quarry. First of all, the quantity of topsoil that is estimated of 0.2m depth shall be removed and sent to Disposal Area No.6. The next, the quantity of weathered rock that is estimated of 7.65m depth shall be removed and sent to Disposal No.7. Finally, the blasting activity shall be applied to the rock for Aggregate and weathered Rock. The quantity of rock that is got from blasting shall be transported to Aggregate Plant for production immediately. The blasting activity shall be conducted day by day until CVC and RCC concrete works are completed.

The location of Quarry is provided from the Owner. This location is the downstream of Main dam and the right bank side of NNP River. Quarry will be constructed on the vicinity of Road T9 from STA.0+720 to STA.1+000 km and STA.0+020km of Road T11 with total average area of 7 hectares and 4.82 km away from the village of Hatsaykham.

The general location map plan of Quarry is shown in Fig. 1 below.

The major quantities for the preparation and operation work of Quarry are shown in Table 1 below.
<table>
<thead>
<tr>
<th>No</th>
<th>Description</th>
<th>Quantities</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clearing</td>
<td>70,000</td>
<td>m²</td>
</tr>
<tr>
<td>2</td>
<td>Remove Top Soil</td>
<td>14,000</td>
<td>m³</td>
</tr>
<tr>
<td>3</td>
<td>Overburden removal</td>
<td>536,000</td>
<td>m³</td>
</tr>
<tr>
<td>4</td>
<td>Rock to be Blasted Rock and Excavated</td>
<td>1,784,553</td>
<td>m³</td>
</tr>
<tr>
<td>5</td>
<td>Slope Protection</td>
<td>61,000</td>
<td>m²</td>
</tr>
<tr>
<td>6</td>
<td>Approach road No.1 (Refer to Appendix 9.12)</td>
<td>550</td>
<td>m</td>
</tr>
<tr>
<td>7</td>
<td>Approach road No.2 (Refer to Appendix 9.12)</td>
<td>110</td>
<td>m</td>
</tr>
<tr>
<td>8</td>
<td>Open Ditch (Outside) (Refer to Appendix 9.7)</td>
<td>949</td>
<td>m</td>
</tr>
<tr>
<td>9</td>
<td>Open Ditch (Inside) (Refer to Appendix 9.7)</td>
<td>946</td>
<td>m</td>
</tr>
<tr>
<td>10</td>
<td>Sediment Pond for inside open ditch with 28<em>23.2</em>5.0 (m) (Refer to Appendix 9.7)</td>
<td>1</td>
<td>Nos.</td>
</tr>
<tr>
<td>11</td>
<td>HDPE Pipe (ф 300mm, L=5m) (Refer to Appendix 9.7)</td>
<td>2</td>
<td>Nos.</td>
</tr>
</tbody>
</table>

Note: *The above quantities are estimation based on the design drawing and might be changed subject to actual geological condition.
*Sediment pond and inside open ditch temporary will be changed by layout of cross section.

The plan of Quarry is shown in Fig. 2.

Fig. 2 – Plan of Quarry
2. REFERENCE

Referenced Specifications:
- Preparation and Operation work of Quarry: TS 1.8, 2.3, 2.4, 5, 6

3. MATERIAL

This main works for preparation of the Quarry are clearing, overburden peeling and construction of the approach roads. Topsoil, Excavated soil, overburden soil and weathered rock are transported to the Disposal Area No.6. Source of transportation material for the preparation and operation of Quarry is summarized in Table 2 and 3.

Table 2 – Source of Excavation and Transportation Material

<table>
<thead>
<tr>
<th>Description</th>
<th>Bank Volume (m3)</th>
<th>Transport to Aggregate Crushing Plant</th>
<th>Disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Swell (%)</td>
<td>Volume (m3)</td>
</tr>
<tr>
<td>Top Soil Removal</td>
<td>14,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Excavated Soil</td>
<td>268,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Overburden Rock</td>
<td>268,000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Basted Rock and Excavated</td>
<td>1,784,553</td>
<td>100</td>
<td>1,784,553</td>
</tr>
<tr>
<td>Total</td>
<td>2,352,553</td>
<td>-</td>
<td>1,784,553</td>
</tr>
</tbody>
</table>

Table 3. Material to be used for blasting and water drainage

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Q'TY</th>
<th>Use for</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Detonator (Aluminium Cartridge)</td>
<td>28,000Pcs</td>
<td>Blasting</td>
</tr>
<tr>
<td>2</td>
<td>ANFO (ZBG 21007-90)</td>
<td>455 ton</td>
<td>Blasting</td>
</tr>
<tr>
<td>3</td>
<td>Dynamite φ32x200g</td>
<td>32 ton</td>
<td>Blasting</td>
</tr>
<tr>
<td>4</td>
<td>Dynamite φ90x2500g</td>
<td>682 ton</td>
<td>Blasting</td>
</tr>
<tr>
<td>5</td>
<td>Electric Detonator</td>
<td>44,000 Pcs</td>
<td>Blasting</td>
</tr>
<tr>
<td>6</td>
<td>Drain Pipe (φ300mm, L=5m)</td>
<td>2</td>
<td>Water drainage for the approach road</td>
</tr>
</tbody>
</table>

*Note:  
- 570g/m³: ANFO + Dynamite.  
- 75 m³ / Pcs: Detonator
4. RESOURCES TO BE USED

4.1. Equipment and Tool

Equipment and tool for the preparation work of Quarry are shown in Table 3

<table>
<thead>
<tr>
<th>Item</th>
<th>Equipment / Tool</th>
<th>Capacity</th>
<th>Nos.</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Excavator</td>
<td>1.6 m³</td>
<td>3</td>
<td>Excavation</td>
</tr>
<tr>
<td>2</td>
<td>Dump Truck</td>
<td>20 ton</td>
<td>6</td>
<td>Disposal / Hauling</td>
</tr>
<tr>
<td>3</td>
<td>Bulldozer TY320 Class</td>
<td>13 ton</td>
<td>1</td>
<td>Spreading Material</td>
</tr>
<tr>
<td>4</td>
<td>High air pressure drill CM-351, Φ105</td>
<td>20 m³/min</td>
<td>2</td>
<td>Drilling Blasting hole</td>
</tr>
<tr>
<td>5</td>
<td>Pneumatic drill YT-28 Φ42</td>
<td>-</td>
<td>2</td>
<td>Air-leg rock drills</td>
</tr>
<tr>
<td>5</td>
<td>Water Truck</td>
<td>6,000 Liter</td>
<td>1</td>
<td>Approach Road Compaction</td>
</tr>
</tbody>
</table>

4.2. Nominated Subcontractor and Manpower Distribution

Nominated Subcontractor: **SINOHYDRO BUREAU 8 CO., LTD. & TCM ENGINEERING CO., LTD. BUSINESS CORPORATION CONSORTIUM.**

The subcontractor above is nominated, concerning not only the price/rate but also the following conditions described below.

1) Technical competence  
2) Financially stability  
3) Administrative competence  
4) Past project experience and reference  
5) Ability to meet construction schedule  
6) Quality and skill of works  
7) Capacity (equipment, staff, worker) and organization  
8) Ability to meet safety and environment requirements

And then, the evaluation for subcontractor will be done and recorded for next reference.

Manpower distribution for the preparation and operation of Quarry is shown in Table 5 below.
Table 5 – Manpower Distribution for Quarry Site.

<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Planned Number</th>
<th>Duty</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engineer</td>
<td>1</td>
<td>Site management</td>
</tr>
<tr>
<td>2</td>
<td>Engineer</td>
<td>1</td>
<td>Deputy Site management</td>
</tr>
<tr>
<td>3</td>
<td>Engineer</td>
<td>6</td>
<td>Chief and Site Engineer (2 shift)</td>
</tr>
<tr>
<td>4</td>
<td>Equipment Operator</td>
<td>28</td>
<td>Clearing, Drainage, Cut and Fill (2 shift)</td>
</tr>
<tr>
<td>5</td>
<td>Common worker</td>
<td>18</td>
<td>Grass cutter, Watchman, Safety Watchman (2 shift)</td>
</tr>
<tr>
<td>6</td>
<td>Chief Surveyor</td>
<td>1</td>
<td>Survey chief</td>
</tr>
<tr>
<td>7</td>
<td>Assistant Surveyor</td>
<td>2</td>
<td>Survey assistant (2 shift)</td>
</tr>
<tr>
<td>8</td>
<td>Mechanic</td>
<td>3</td>
<td>Maintenance of equipment (2 shift)</td>
</tr>
<tr>
<td>9</td>
<td>Driver</td>
<td>14</td>
<td>Transportation of materials (2 shift)</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>74</td>
<td></td>
</tr>
</tbody>
</table>

*Note: 2 shift works as shown below will be applied for preparation and operation of Quarry.

From: 8AM to 21PM
1st shift: 07:00 AM to 14:00 PM
2nd shift: 15:00 PM to 21:00 PM

4.3. Temporary Facilities

The location and layout plan for temporary facilities of this work are shown in Table 6 and Fig.3 below respectively.

Table 6 – Location of Temporary Facilities

<table>
<thead>
<tr>
<th>No.</th>
<th>Facilities</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Contractor’s Camp</td>
<td>STA.4+900 (P1 Road)</td>
</tr>
<tr>
<td>2</td>
<td>Sub-Contractor’s Camp No.5</td>
<td>STA.7+400 (P1 Road)</td>
</tr>
<tr>
<td>3</td>
<td>Quarry Site</td>
<td>From STA.0+720 to STA.1+000 T9 Road to STA.0+020 T11 Road</td>
</tr>
<tr>
<td>4</td>
<td>Sino Worker’s Camp for Quarry Site</td>
<td>Location at Aggregate Plant Area STA.0+140</td>
</tr>
<tr>
<td>5</td>
<td>Disposal Area No.6</td>
<td>STA.1+500km (T8 Road)</td>
</tr>
<tr>
<td>6</td>
<td>Disposal Area No.7</td>
<td>STA. 0+340km (T8 Road)</td>
</tr>
</tbody>
</table>

*Excess materials for soil will be transported and filled in Disposal area No.6 of Road T8.
*Excess materials for Rock will be transported and filled in Disposal area No.7 of Road T8.
Fig. 3 – Layout Plan for Temporary Facilities of Quarry Site.
5. CONSTRUCTION PROCEDURE

Work procedure for the preparation and operation of Quarry is shown in Fig. 5 below. The drainage systems mentioned below, which consists of sediment pond, open ditches and pipe culvert.

Fig. 5 – Work procedure for preparation and operation of Quarry site.
5.1 Survey Work

1) Temporary benchmarks for confirmation of elevation and coordinate shall be established at some locations. Then, the boundary points for Quarry shall be identified on site with offset pegging considering the required alignment and elevation.

2) Quarry location can be identified based on the survey result and shall be marked with stake and ropes for clearing work. Then, stake guider shall be set for cut and fill work at Quarry site.

3) Survey instrument shall be calibrated in accordance with the section 5.3.3 testing equipment and facilities of the Quality Assurance Program (Document No. NNP1-PRG-DrQAP-A3) in the NNP1-PCL-00086, dated 16th January 2014.

5.2 Clearing Work

1) Before clearing works, working area for Quarry shall be indicated clearly by marking.

2) After inspection by Owner on the clearance area and Owner’s approval, clearing works shall be started. Clearing shall consist of removal and disposal of tree, stump, logs, bush, undergrowth, grass, crops and loose vegetable material on the ground level especially embankment area. Clearing plan for Quarry is shown in Appendix 9.6.

3) Cleared materials will be removed by excavator and bulldozer (see Table 4) to the edge of Quarry as shown in Appendix 9.11 and be transported to disposal area No.6 immediately after the clearance. Clearing shall be done by manpower (see Table 5) in areas which cannot be removed by excavator and bulldozer.

4) Basically, it is confirmed that commercial timber along Quarry site has been already cleared by the Lao government, however if commercial timber is found on site, the branch shall be trimmed, and the timber trees shall be cut into a suitable size and delivered to commercial timber stockpile as shown in Appendix 9.6.
5.3 Drainage by pipe culvert in T7, T9 & T11 road during clearing and overburden stripping (See Appendix 9.7 and 9.8)

Pipe culvert installation was be carried out during construction of T7, T9 & T11 Road (hauling road). The Flow quantity of area 1 and area 2 will be discharged by D600 pipe culvert at Km0+350 & Km0+640 of T7 road. And then the total flow quantity of area 1, area 2, area 9 & area 11 will go in D600 pipe culvert at Km0+350 of T9 road.

It is similar to area 3 and area 4 with D600 pipe culvert at Km0+900 & Km1+000 of T7 road. And then the total flow quantity of area 3, area 4, area 7, area 8 & area 10 will go in D800 pipe culvert at Km0+300 of T11 road.

For area 5 and area 6, it shall be discharged by D600 pipe culvert at Km1+400 of T7 road and at Km0+480 of T11 road.

The drainage capacity was satisfied by pipe culvert system and was calculated in detailed (Refer to Appendix 9.8a).

1) The reinforced concrete pipe shall be the groove and tongue type. It shall be all in accordance and compliance to TIS (Thai Industrial Standards) 128 Class 3 or equivalent. Pipes shall be free of fractures, large or deep cracks, and surface roughness.

2) All concrete culvert pipes shall be laid on the bedding gravel.

3) Backfilling shall be carried out with material free from rubbish, vegetable matter or other unsuitable material and as indicated on the drawing. Special care shall be taken to ensure that backfill will be brought up evenly on both side of the pipe. Backfill material will be followed to embankment in section 5.4.

4) In order to keep proper water flow, the catchment basin will be provided around inlet of pipe culvert if necessary.

5) The slope at outlet side will be protected by stones to avoid erosion if necessary. The typical section of pipe culvert installation and arrangement are shown in Fig.6 below.

6) Inside Quarry, two (02) location for D300 of HDPE pipe will be installed temporary on Approach road that is designed for internal transportation and will be change one by one layer of blasting depth for Quarry site. Its typical arrangement is shown in Fig.6 below. The flow quantity shall be drained by inside open ditch and D300 of HDPE (high-density polyethylene) prior to connection to Sediment Pond. Its calculation sheet is attached as Appendix 9.8. Besides, its location is estimated in Appendix 9.12 relatively.
5.4 Open Ditch

1) The ditch shall be constructed with proper alignment and size based on the calculation result. (Refer to Appendix 9.8b).

2) The ditch without lining shall be maintained during construction period, if a drainage surface is seriously damaged by water flow, the ditch surface will be repaired.

3) Inside of a ditch shall be cleaned and repaired before rainy season if necessary.

4) The typical section of the open ditch is shown in Fig. 7 below.

5) Earthwork shall be started after making the open ditch.
5.5 Topsoil Removal

1) Basically, the topsoil shall be removed and disposed including stumps and roots. Any suitable topsoil which is free from roots and vegetables shall be stockpiled at the specified area and used for planting and/or embankment.

2) Removed topsoil will be stored separately in order to prevent mixing with other unsuitable materials as shown in Appendix 9.12.

5.6 Approach Road (Excavation and Embankment)

1) This approach road is temporary road in order to ensure to access to the top of quarry. The location of approach road will change in accordance with the progress of the quarry development.

2) This approach road will be constructed on the cutting area.

3) The Approach road construction shall be implemented in accordance with the “Road Design Policy” dated 20th February 2014 submitted by Contractor.

4) The excavation shall be started after completion of installations of necessary drainage systems which consists of the outside open ditch, sediment pond mentioned in clause
5.3 to 5.4 and 5.7 to prevent turbid water due to the earth works from flowing out of the construction area.

5) All excavation shall be conformed to the designed gradient of slope and levels as shown in Appendix 9.3. The design gradient and level might be reviewed based on actual geological condition on site.

6) If the soft or unsuitable material is found, it shall be removed and replaced with suitable embankment materials.

7) In the event of sudden heavy rain, excavation works shall be suspended. The soil condition shall be confirmed first before the resumption of excavation work.

8) The embankment shall be implemented in accordance with the “Road Design Policy” dated 20\(^{th}\) February 2014 submitted by the Contractor.

9) The embankment material which will be produced by excavation work for quarry will be free from branches of tree, root and any harmful material.

10) The embankment material will be spread and compacted by bulldozer and vibratory compactor as shown in Table 4.

11) Proper implementation and inspection shall be carried out by Contractor’s engineer to ensure sufficient compaction in each layer.

12) In the case of possible heavy rain, excavation and hauling shall be stopped, and then the spread loose embankment material will be compacted.

### 5.7. Sediment pond

1) One sediment pond shall be installed to protect and prevent turbid water (due to the preparation and operation work of quarry) from flowing out of the construction area. All the turbid water within quarry shall be collected by inside open ditch and shall be treated and separated from clean water from mountainous areas and natural water courses (Refer to Appendix 9.7).

2) The sediment pond shall be constructed with proper dimension based on the calculation result. (Refer to Appendix 9.8c).

3) One sediment pond shall be provided in Quarry with dimension of 28.0m*23.2m*5.0m. The location of sediment pond shall be changed follow up every excavation elevation accordingly but dimension should be kept.
5.8. Overburden Stripping

1) Basically, the topsoil and soft rock shall be removed and disposed including stumps and roots. Any suitable topsoil which is free from roots and vegetables shall be stockpiled at the specified area and used for planting and/or embankment.

Removed topsoil will be stored separately in order to prevent mixing with other unsuitable materials as shown in Appendix 9.12.

5.9. Blasting Rock, Excavation and Transportation to Aggregate Plant

5.9.1 Blasting works

- The blasting activity must comply with Safety Regulation that is prescribed in item 5.10.2 below properly.
- The rock’s quality that was suitable for RCC and ordinary concrete as Technical Specification in section 5 and section 6 should be confirmed. The parameters that are tested for confirmation of rock quality were listed in Appendix 9.9 (Inspection and Test Plan).
- The blasted rock that could meet requirements for RCC and ordinary concrete shall be transported to Aggregate Plant through the approach roads and T9 road. On the other hand, Unsuitable blasted rock shall be transported to Disposal No.6 and No.7 through T8 road.
- The blasting materials will be stored at allowed area. The location map of blasting material is shown in Appendix 9.15.

5.9.2 Blasting schedule for Quarry site

- Daily blasting time will be fixed one time per day and maximum two time per day (if necessary) at (e.g. 12:00PM and/or 6:00PM) for every blasting basically. However blasting time is likely of being changed by rock and talus rock condition.
- Blasting cycle time shall be carried out and shown in table 7.

Table 7- Typical cycle time for blasting work

<table>
<thead>
<tr>
<th>Work Item / Time</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling &amp; Blasting</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>
• First time per day of Blasting
  1) Drilling blasting hole
  2) Installation blasting materials
  3) Evaluation blasting
  4) Blasting
  5) Checking blasted area

• Second time per day of Blasting
  6) Drilling blasting hole
  7) Installation blasting materials
  8) Evaluation blasting
  9) Blasting
  10) Checking blasting area.

5.10. Incidentals

5.10.1. Slope treatment

• The slope of Quarry site shall be monitoring every day after blasting works.
• Loose rocks on the slope shall be removed with Excavator or Manpower.

5.10.2. Blasting

Blasting location is 4.82km away from Hatsaykham village, therefore it is basically more than 400m, the required minimum distance to carried out blasting work without sand bag cover.

Typical Blasting work procedure is described as follows:

1) Drilling work will be carried out by High Air Pressure Drill CM-351 and Pneumatic drill YT-28(Refer to Table 4- Equipment List).

2) After completion of drilling, the blasting material will be charged into the hole immediately, such as ANFO, dynamite, detonator. Typical drilling section and explosive materials are shown in Fig. 8 and 9 below respectively.
Fig. 8 - Typical Section View of Blasting
3) Electric shot method will be applied to blasting work for Quarry site. The blasting will be conducted at the bunker located far 100~200m from blasting area based on army’s advice.

4) Pre-split blasting will be used for keeping of finishing slope surface along the design excavation line. Typical blast hole diameter will be φ 65mm, and typical hole spacing will be 0.80m. Pre-split / production holes distance will be approx. 2m. The typical pattern will be changed in accordance with the condition of rock. Pre-split blasting will be used as sub-bench blasting at dam foundation area and as bench blasting at upstream and downstream slope. This blasting method will be used for CH class rock and excavation of the powerhouse only.

5) The blasting procedure is to follow the section 6.6 of the Safety Control Program dated Dec.10th 2013. Safety management for blasting is described as follows.

- Safety management for blasting is described as following. And the blasting procedure will be followed to the section 6.6 of the latest Safety and Security Program (Document No. NNP1-PRG-SSP-A3) enclosed with Contractor's letter NNP1-PCL-00044, dated 10th December 2013.
- Before conduction of blasting work, the location and time shall be informed to villager near the blasting location.
- Before conduction of blasting work shall be provided warning sign board to inform the detail of blasting schedule (date, time, location).
- Daily blasting will be fixed at a certain time (e.g. 12:00 PM and/or 6:00 PM) for every blasting. However blasting time is likely of being changed by rock and talus rock condition.
- Safety radius of the evacuation area shall be set out on site min. 100m (for equipment) and more than 400m (for people) from blasting points (see attached Fig. 11).
- In order to prevent the diffusion of blasted rock, sand bag will be placed on the drilled hole as necessary. The staffs and workers except watchman will evacuate to site office where the distance 400m is located from blasting point.
- 2 hour before blasting time, the safety man will be arranged for each point, and provide signal voice (whistle, and or some siren).
• 1 hour before blasting time, all vehicles and people will be stopped at the point that safety man is controlling and provide signal voice by siren or whistle.

• All equipment working at blasting location shall be removed from blasting location at 100m radius.

• 30minutes, 10min, 5min, 1min and 10 to 1 second before blasting time, siren voice shall be provided.

• After confirmation and response from blasting man and after blasting dust decreasing then traffic will be allowed to pass blasting area.

• The safety control for blasting will be changed, revised and added as necessary in accordance with site conditions.

• The blasting material shall be stored on approved location by relevant authorities. (The storage location below has been approved). Always (24hrs), two security guards will be at the storage yard. The location of materials and sketch layout of blasting area are shown in Fig. 10 and Fig. 11 below respectively. The location storage area for blasting materials as facilities layout, building shown in Appendix 9.16.

Fig. 10 Location for Blasting Storage of Quarry Site.
6. SAFETY CONTROL

Safety control for site works shall follow the latest Safety and Security Program (Document No. NNP1-PRG-SSP-A3) enclosed with Contractor’s letter NNP1-PCL-00044, dated 10th December 2013.

Before commencement of work, safety training shall be carried out to relevant staffs and workers. The emergency action plan is attached in Appendix 9.4.

The following potential incident shall be observed in Quarry area.

Especially for Quarry excavation works area, the following issues shall be concerned.

1) Accident by heavy equipment
   - For all staffs and workers, the safety training shall be carried out.
   - Warning sign board will be arranged.
• Basically all workers and staffs are prohibited from approaching the working radius of equipment.
• In case that the worker needs to approach the equipment, they shall request the operator to stop operation and confirm the stopping.
• Watch man shall be arranged and footpath will be displayed.
• When equipment parks on site, stopper shall be set.
• The watch man shall be monitoring every day and every time after blasting and rainy season.
• The slope treatment shall be carried out for the safety control is necessary of construction works of Quarry site.

2) Falling down from steep slope
• Barricade or taping will be set for attention.
• Warning sign board will be arranged.
• Blasting area shall be arranged by flash.

3) Safety measure for rainy season
• To inform all worker “Mind Your Step” and “Slippery Rock Surface”
• When thunderstorm comes, the worker shall evacuate.
• Designed watch man always monitored all area Quarry and Slope treatment of Quarry.
• The Excavator working inside Quarry shall be covered by safety bucket.

The safety control on site will be changed, revised and added every time in accordance with the occurrence of a dangerous situation and/or the Owner’s comments.

7. QUALITY ASSURANCE

Quality Assurance shall be followed to the Quality Assurance Program (Document No. NNP1-PRG-DrQAP-A3) enclosed with Contractor’s letter NNP1-PCL-00086, dated 16th January 2014.

Basically, Quality Control works shall be conducted by the contractor whereby proper implementation and inspection of this work shall be made to ensure that the quality is maintained.

Inspection request shall be done prior to actual inspection and material test on site will be performed with the Owner for confirmation before the implementation of each work.
PART 2
SITE SPECIFIC ENVIRONMENTAL AND SOCIAL MANAGEMENT AND MONITORING PLAN
(SS-ESMMP)
For
PREPARATION AND OPERATION OF QUARRY
8. Site Specific Environmental and Social Management and Monitoring Plan

8.1. Introduction

This Site Specific Plan has been prepared to highlight environmental and social conditions prior to the beginning of each construction activity and will be used as a tool to ensure the particular activity follows the correct management and mitigation procedures. Sub-Plans will be used to detail mitigation methods for each of the activities associated with the construction or excavation works.

The following site specific plan is to detail preparation (earthworks) and operation of Quarry Site that will produce aggregate material used for Main Dam construction. The Quarry will be between access roads T9 (STA.0+720km to STA.1+000km) to access road T11 (STA.0+020) on the upper right bank of Nam Ngiep. Material from the Quarry site will be transported to the Aggregate Plant for processing. It is expected that the Quarry will be in operation for the life of the Civil Works phase and will produce aggregate as needed, see table 2 of the DWP for production quantities.

Table 8.1 below shows the referential linkages of documents regarding environmental matters in the NNP1 Project. The Owners (NNP1) documents use references and information from the Concession Agreement. This SS ESMMP (Contractor) uses references and information from Owners EIA/ESMMP and Owners ESMMP-CP.

Table 8.1 List of Main Documents and Approving Authority

<table>
<thead>
<tr>
<th>Item</th>
<th>Hierarchy of Documents</th>
<th>Approving Authority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Concession Agreement</td>
<td>GOL</td>
</tr>
<tr>
<td>2</td>
<td>NNP1 EIA/ESMMP</td>
<td>GOL</td>
</tr>
<tr>
<td>3</td>
<td>ESMMP-CP</td>
<td>GOL</td>
</tr>
<tr>
<td>4</td>
<td>Contractors ESMMP</td>
<td>NNP1</td>
</tr>
<tr>
<td>5</td>
<td>SS ESMMP</td>
<td>NNP1</td>
</tr>
</tbody>
</table>

The Contractor documents are; Contractors ESMMP (Item 4) and SS ESMMP (Item5) which have used applicable information extracted from the Owners documents which are Concession Agreement (Item 1), NNP1 EIA/ESMMP (Item 2) and ESMMP-CP (Item 3).

All obligations of the Contractor are stated in the Civil Works Contract (CWC) which includes Schedule 9 (Concession Agreement Pass Through Obligations) and is the only governing document for the Contractor.

8.2. Environmental and Social Pre-Construction description

*Land and Water Use in the Area*

Previous land use in the Quarry site was largely agricultural land, consisting of shifting cultivation and seasonal plantations i.e., rice, corn, bananas and pineapples. Currently there is no agricultural activities within the area, and natural vegetation cover has been left re grow.
The main water source is the Nam Ngiep River however during rainy seasons small streams form around the site.

**Proximity to Villages and Cultural Sites**

The closest village to the project site is Ban Hatsaykham, over 4km west of the construction site. There are no temples or cemeteries in the vicinity of the site.

Table 8.2 below is a pre-construction checklist to identify any major environmental impacts that may occur during excavation works. After completion of the checklist the Sub-Plans can be selected accordingly.

**Table 8.2 Environmental Assessment Checklist – For Pre Construction**

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will the site require UXO clearance?</td>
<td></td>
<td>X</td>
<td>UXO clearance for the Quarry site and access road T9 has already been completed by NNP1</td>
</tr>
<tr>
<td>Is there surface water located in close proximity to the site?</td>
<td></td>
<td>X</td>
<td>Approx. 500m from Nam Ngiep</td>
</tr>
<tr>
<td>Is there a village or community located in close proximity to the site?</td>
<td></td>
<td>X</td>
<td>Closest Village is Ban Hatsaykham, approx. 4km east of site.</td>
</tr>
<tr>
<td>Is the site located in a vegetated area?</td>
<td></td>
<td>X</td>
<td>Secondary re-growth with small to medium size shrubs.</td>
</tr>
<tr>
<td>Is the site located in agricultural land?</td>
<td></td>
<td>X</td>
<td>Previously agricultural land</td>
</tr>
<tr>
<td>Are there any PCR sites in the area?</td>
<td></td>
<td>X</td>
<td>No confirmed PCR on site, but previously removed artifacts adjacent to temporary bridge. Chance Find Procedures were used.</td>
</tr>
<tr>
<td>Is there an existing access road to the site?</td>
<td></td>
<td>X</td>
<td>Access road T9 runs along the length of the Quarry Site.</td>
</tr>
<tr>
<td>Can the site be viewed from public viewpoints?</td>
<td></td>
<td>X</td>
<td>Can be viewed from Nam Ngiep</td>
</tr>
<tr>
<td>Question</td>
<td>Likelihood (Yes/No)</td>
<td>Mitigation measure to be Implemented</td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Is the site located within an existing Construction Area?</td>
<td>X</td>
<td>Along access road T9, while road T7 is above</td>
<td></td>
</tr>
<tr>
<td>Will the site development require the construction of a sub-camp, office and storage? (if yes, provide a list)</td>
<td>X</td>
<td>All construction materials storage and office will be at Worker camp No.1</td>
<td></td>
</tr>
<tr>
<td>Other Comments:</td>
<td></td>
<td>Temporary toilet facilities will need to be installed as part of the preparation stage. Workers will be highly encouraged to use the facilities.</td>
<td></td>
</tr>
<tr>
<td>Environmental Impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the site development result in increased dust generation at near-by villages?</td>
<td>No</td>
<td>No Village within close proximity to Quarry Site</td>
<td></td>
</tr>
<tr>
<td>Will the site development result in increased noise generation at near-by villages?</td>
<td>No</td>
<td>Nearest Village is over 4km away</td>
<td></td>
</tr>
<tr>
<td>Will the site development result in surface water contamination?</td>
<td>Yes</td>
<td>Pipe culverts and drainage ditches will be constructed to maintain as much natural drainage as possible</td>
<td></td>
</tr>
<tr>
<td>Will the site development result in changes to drainage patterns?</td>
<td>Yes</td>
<td>Soil compaction will be carried out during earth works</td>
<td></td>
</tr>
<tr>
<td>Will the site result in erosion?</td>
<td>Yes</td>
<td>Minimize as much clearing as possible, by limiting to within Quarry site working area.</td>
<td></td>
</tr>
<tr>
<td>Will vegetation clearing be required?</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Will the site be setting up hazardous components? (storage, workshop)</td>
<td>No</td>
<td>All fuels and oils for machinery will be stored at worker camps.</td>
<td></td>
</tr>
<tr>
<td>Will the site generate waste?</td>
<td>Yes</td>
<td>Mainly organic waste from vegetation clearance. These will be transported to designated disposal sites. Rubbish bins will be provided for Workers.</td>
<td></td>
</tr>
<tr>
<td>Site closure plan:</td>
<td></td>
<td>Will provide a plan a plan closer to closing date.</td>
<td></td>
</tr>
</tbody>
</table>
Figure 8.1 Showing access road T9 to the left, with proposed Quarry Site on the right.

Figure 8.2 Looking up access road T9 with view of Quarry site on the left.
Table 8.3 identifies the relevant list of Sub Plans required for earthworks and operation of the Quarry Site. The Sub Plans were selected after a review of the following:

- Detailed Works Program (DWP)
- Pre-Construction Assessment (8.2 Environmental Checklist)
- NNP1 EIA and ESPMPs

### Table 8.3 Relevant Sub Plans for Quarry Site

<table>
<thead>
<tr>
<th>Sub-Plan</th>
<th>Item</th>
<th>Environmental</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>SP01</td>
<td>Erosion and Sediment Control</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP02</td>
<td>Water Availability and Pollution Control</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>SP03</td>
<td>Emission and Dust Control</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP04</td>
<td>Noise and Vibration</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP05</td>
<td>Waste Management</td>
<td>X</td>
<td>-</td>
</tr>
<tr>
<td>SP06</td>
<td>Hazardous Material Management</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP07</td>
<td>Vegetation Clearing</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP08</td>
<td>Landscaping and Re-vegetation</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SP09</td>
<td>Biodiversity Management</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>SP10</td>
<td>Spoil Disposal</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP11</td>
<td>Quarry and Construction Layout</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>SP12</td>
<td>Unexploded Ordinance (UXO) Survey and Disposal</td>
<td>-</td>
<td>X</td>
</tr>
<tr>
<td>SP13</td>
<td>Construction of Work Camps</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>SP14</td>
<td>Traffic and Access</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP15</td>
<td>Training Awareness</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP16</td>
<td>Project Personal Health Program</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP17</td>
<td>Emergency Preparedness</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>SP18</td>
<td>Cultural Resource</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Detailed descriptions are found in the relevant sections relating to Environmental or Social Management and Monitoring Plans. See Contractors EMMP-CP Appendix 2.1 “Sub-Plan for Civil Works”

A detailed Environmental Management Activity Schedule for the Quarry Site can be referred to in Appendix 9.14 of this DWP.

### 8.3. Sub-Plan Detail for Preparation and Operation of Quarry Site - Environment

Environmental mitigation plan shall be established based on Sub-plans stated in the Owners ESMMP-CP. In order to minimize the environmental impact of Quarry Site construction, the following plans shall be implemented.

**SP01 Erosion and Sediment Control**

- The control of sedimentation and erosion will be carried out by drainage pipe culverts and side ditches.
- Location of pipe culverts and water-flow can be referred to Appendix 9.12 of the DWP.
- As mentioned in Section 5.7 of the DWP, a Sediment pond shall be installed to reduce turbid run-off, see Appendix 9.12 for location.
• All embankment and slopes shall be compacted by excavator bucket and shall be covered with top soil as shown in Appendix 9.3. Re-vegetation for the embankment slope shall be decided through discussion with the Owner.
• Rip-rap structures will be installed on the slope surface of pipe culvert inlet and outlets.
• No unnecessary clearing will take place, as natural vegetation improves soil stability.
• All topsoil and cleared vegetation will be stockpiled at designated sites (Timber and Topsoil stockpile Appendix 9.12 of DWP).
• An erosion and sediment control map detailing, flow direction, location of sediment ponds and ditches can be referred to in Appendix 9.7b.
• Weekly monitoring of open ditches or after heavy rain periods to evaluate flow, ditches can be modified if necessary.
• Silt fencing may be installed in areas where potential sediment run-off is high. This can be decided depending on actual site conditions.
• Sediment discharge will be minimized by the existing road drainage i.e. T9 and T11 open ditches and bunds. This will reduce the risk of uncontrolled run-off and vegetation damage down the slope along the riverside.

SP02 Water Availability and Pollution Control

• During earthworks and site preparation an open ditch will be created around the perimeter of the site, this will reduce the amount of surface and rain water run-off that will enter the Quarry. Appendix 9.7b illustrates site drainage and sediment pond location.
• Pumping may be necessary to create dry working conditions if large amounts of water collect in the Quarry after heavy rain. Water quality testing prior to any pumping will be required, parameters to monitor include; pH, Dissolved Oxygen (DO) and Turbidity (TD). Measurement of Total Suspended Solids (TSS) and/or other parameters may also be required.

SP03 Emission and Dust Control

• Water spraying vehicle will be provided in and along roads to the Quarry Site as necessary.
• All vehicles, while parked on site, will be required to have their engines turned off.
• All ground staff will be required to wear the correct PPE, such as head, eye and ear protection.

SP05 Waste Management

• Excavated rock will be transported to Disposal Site No.7 as shown in Appendix 9.11. Top soil and vegetation from earth works will be temporarily stockpiled on site, see Appendix 9.12 Facility Layout, this will be later transported to Disposal Area No.6.
• Sedimentation ponds will be monitored regularly and cleared after heavy rain periods.
• General waste bins will be provided on site, these will then be collected and transported to Worker Camps for disposal.
• Temporary toilets facilities with septic tank will be installed on site, all workers will be highly encouraged to use these.

SP06 Hazardous Material Management

• Blasting work is necessary for the excavation works of the Quarry. The work procedure and material store will be followed as described in Part 1, Section 5.8.2 of the DWP.
• Explosives needed for blasting will be kept in secure bunker near access road T7 (STA. +870), as shown in Appendix 9.15. A detailed design of the storage bunker can be referred to in Appendix 9.16
• All fuels for road works machinery are stored at worker camp sites in specially designed areas.
• Mobile fueling trucks will be used to re-fuel excavation machinery on site.
• Spill response kits will be provided for all on site fuel or oil storage areas.
• All self-powered fixed plant and equipment (i.e. diesel generators) must have oil trays and/or bunding. Roofing may be installed if required.

SP07 Vegetation Clearing

• Vegetation clearing will follow steps outlined in Part 1, Section 5.2 of the DWP. After final inspection by the Owner, clearing work shall begin to remove trees, stumps, shrubs and loose material.
• The clearing map is attached in Appendix 9.6. The work procedure for clearing will be followed as stated in Section 5.2 of the DWP.
• The extent of areas to be cleared shall be minimized to Quarry site only and vegetation outside will not be disturbed.
• Vegetation will be stockpiled separately on site (see Appendix 9.12 Timber Stockpile), then later transported to Disposal Site No.6. All commercial timber has been cleared by GOL.

SP10 Spoil Disposal

• All soil and topsoil from earthworks will be stockpiled separately on site (see Appendix 9.12 for Temporary Topsoil Stockpile). Area will be cleared prior to operation stage, where spoil will be transported to Disposal Area No.6 and used for backfilling.
• Considering close proximity to the Main River; Disposal Area No.7 (see Appendix 9.11) will be used to stockpile larger rocks and boulders.
8.4. Sub-Plan Detail for Preparation and Operation of Quarry Site - Social

SP04 Noise and Vibration

- The distance of the Quarry Site to the nearest village is Ban Hatsaykham more than 4km east from the site. There will be no influence of noise and vibration on local Villages.
- All construction workers on ground will be required to wear PPE, such as ear, head and eye protection, these are especially important when hand drilling large boulders to set dynamite charges.

SP12 Unexploded Ordinance (UXO) Survey and Disposal

- UXO clearance has been conducted prior to earthworks of the Quarry site, NNP1 confirmed that there were no UXO's within the area and that land clearing was able to commence.
- If any UXO’s are uncovered during earthworks, all works will stop immediately and the Owner (NNP1) will be notified. No works will be allowed to resume without approval from NNP1.

SP14 Traffic and Access

- Traffic signs and notice boards will be installed at sensitive locations to inform workers and visitors of blasting schedule.
- Watchmen on the ground will control local traffic and ensure safety of excavators and earth moving machines.
- Regularly monitoring of traffic conditions will be conducted as part of the routine Environmental, Health and Safety inspection.
- Even though the distance between the Quarry and Aggregate Plant is a short distance haul trucks carrying aggregate material must not be over loaded.
- Installation of notice board near entrance of work site to inform workers and visitors of local hazards and blasting schedule.
- Warning signs will be used to restrict public access to the Quarry excavation area.
- When Quarry is on standby or temporary close, fencing/barriers will be used to mark out boundary and hazardous areas.

SP15 Training and Awareness

- All new employees will be required to complete Induction Training from OC/NNP1 prior to commencing any work on site.
- In this training, the Contractor will highlight site rule/regulation and safety & environmental issues.
- A register of induction training will be maintained and can be provided to NNP1 on request.
- Monthly safety mass meetings will be conducted with all employees, and will cover all relevant health and safety issues on site.
• Daily tool box meetings will also be conducted to bring further awareness to environmental health and safety issues.

**SP16 Project Personnel Health Program**

• Regarding the content of Section 6 in Part 1 of the DWP in this document a tool box meeting will also be carried out weekly and before commencement of any new works.
• Health Awareness Training will be carried out for all personnel in the monthly mass meeting.
• The register for each item above can be provided to NNP1 on request
• First aid kits will be prepared on site and in sub-contractor vehicles.
• First Aid kits include:
  - Individually wrapped sterile adhesive dressing,
  - Crepe bandage (5.0 cm), Crepe bandage (7.5 cm),
  - Absorbent Gauze (packet of 10 pcs),
  - Adhesive plaster roll (1.25 cm width),
  - Triangular bandages,
  - Scissors,
  - Safety Pins,
  - Disposable gloves (pairs),
  - One-way valve transparent mask or 2-way mouthpiece,
  - Sterile water or saline in 100 ml disposable container (only where tap water is not available).
• Workers and machine operators will use toilet and lunch areas at the aggregate plant site.

**SP17 Emergency Preparedness**

• Referring to the emergency action plan in Appendix 9.4, the emergency response procedures, emergency contact numbers and communication and reporting procedures will be clearly displayed.
• First aid kits will be prepared at each site and in Sub-Contractor vehicles.
• All Contractor and Sub-contractors will be trained in to respond according to the emergency action plan.

**SP18 Cultural Resource**

According to the EIA document, a preliminary survey of the Project Area was conducted by the Lao PDR Department of Museums and Archaeology (DMA) in October of 2007. In September 2013 local villagers informed NNP1 of Buddha images located in caves near the NNP1 Temporary Bridge site (adjacent to Quarry Site). On the 30th November 2013 the images were successfully relocated to the local Temple at Ban Hat Gniun. The relocation was complemented by traditional Buddhist ceremonies, which involved Lao department and authorities including; Head of Hat Gniun Village, Representative from NNP1, Representative from Bolikharmxay Province, Representative from Bolikhhan District and RMU.
If the Contractor is to find any new physical or cultural resources during Quarry construction, the Contractor shall stop the works and inform the Owner immediately and follow the Chance Find Procedures.

8.5. Chance Find Procedures

Objectives of Chance Find Procedures are to; (a) minimize impacts to resources from all NNP1 related activities and (b) to ensure that any artifacts uncovered are appropriately recorded, documented and reported to the appropriate line agencies.

If any fossil or cultural item of significance is found the Contractor will promptly give notice to the owner. This follows the guidelines stated in the Civil Works Contract “CWC” Clause 4.25 regarding Fossil and Artifacts. The Contractor will work with the Owner to ensure the safe removal of artifacts, as directed by the Owner who will implement the Chance Find Procedures, with a variation order.

Chance Find Procedures as described in Contractors EMMP-CP Sub-plan Appendix 2.1 Sub-Plan for Civil Works, “21:Cultural Resources” The following steps will be implemented in the event that previously unidentified artifacts are identified:

(i) The Contractor shall immediately cease operations in areas where artifacts/archaeological finds are unearthed and immediately inform NNP1 Site Manager.

(ii) The Owner will consult the Head of Village and Culture and Tourism Administration Office to obtain advice regarding the next steps.

(iii) The contractor to recommence work only after the Culture and Tourism Office has provided official notification accordingly.
9 APPENDIX

9.1 Organization Chart
9.2 Construction schedule of Quarry
9.3 Working Drawing
9.4 Emergency Action plan
9.5 Resource
9.6 Clearing Plan
9.7 Erosion and Sediment Pond Control Plan
9.8 Calculation for Drainage by Culvert, Open Ditch and Sediment Pond of Quarry
9.9 Inspection and Test Plan (ITP)
9.10 Slope Treatment
9.11 Site Condition Map
9.12 Facilities Layout for Site Development
9.13 Sub Plan for ESMMP-CP
9.14 Environmental Management Activity table for Quarry
9.15 Site Condition Map for Blasting Storage at Quarry
9.16 Facilities Layout & Building for Blasting Storage of Quarry.
Appendix 9.1

Organization Chart
Appendix 9.2

Construction Schedule
### 9.2 Construction Schedule for Quarry Site.

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Qty</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Survey and Making boundary line</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Clearing</td>
<td></td>
<td>m²</td>
</tr>
<tr>
<td>2</td>
<td>Open Ditch (outside)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Transport Road and Overburden Removal</td>
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<td>m³</td>
</tr>
<tr>
<td>4</td>
<td>Sediment pond</td>
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<tr>
<td>5</td>
<td>Open Ditch (inside)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Overburden removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>During Operation</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Slope protection</td>
<td></td>
<td></td>
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<tr>
<td>9</td>
<td>Monitoring Erosion and Sediment Control</td>
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<td></td>
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<tr>
<td>10</td>
<td>Monitoring for Quarry During Operation</td>
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<td>11</td>
<td>Disassembly of Plan Facilities</td>
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</table>

#### B Environmental Mitigation

| SP01 | Erosion and Sediment Control                     |     |      |
| SP02 | Emission and Dust Control                        |     |      |
| SP03 | Noise and Vibration                              |     |      |
| SP04 | Waste Management                                 |     |      |
| SP05 | Hazardous Material Management                    |     |      |
| SP11 | Spoil Disposal                                   |     |      |
| SP15 | Traffic and Access                               |     |      |
| SP16 | Training and Awareness                           |     |      |
| SP17 | Project Personnel Health and Program             |     |      |
| SP18 | Public Safety                                    |     |      |
| SP20 | Emergency Preparedness                           |     |      |

**Note:**
1. According to the Schedule 2 of CWC, Milestone Payment for excavation work of Quarry site.
2. In case that the delay is observed, the countermeasure shall be considered immediately.
3. Quantity is estimation. In accordance with the actual site condition, it will be changed. And the materials for maintenance are excluded.
4. Above schedule is not included the period of maintenance. The maintenance works will be stored until the completion of Quarry Site.
Appendix 9.3

Working Drawing (Reference Only)
# SUMMARY LIST DRAWINGS FOR QUARRY

<table>
<thead>
<tr>
<th>DRAWING NO.</th>
<th>Rev. No.</th>
<th>DRAWING NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>NNP1 - WD - DT - QA - 00001</td>
<td>A2</td>
<td>Quarry - Plan layout</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00002</td>
<td>A2</td>
<td>Quarry - Cross section 1 and 2</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00003</td>
<td>A2</td>
<td>Quarry - Cross section 3 and 4</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00004</td>
<td>A2</td>
<td>Quarry - Cross section 5 and 6</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00005</td>
<td>A2</td>
<td>Quarry - Cross section 7 and 8</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00006</td>
<td>A2</td>
<td>Quarry - Cross section 9 and 10</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00007</td>
<td>A2</td>
<td>Quarry - Cross section 11 and 12</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00008</td>
<td>A2</td>
<td>Quarry - Cross section 13 and 14</td>
</tr>
<tr>
<td>NNP1 - WD - DT - QA - 00009</td>
<td>A2</td>
<td>Quarry - Cross section 15 and 16</td>
</tr>
</tbody>
</table>
Planning Drawing for Quarry Excavation

Note:

1. The elevation is calculated by meter.
2. There are 8 steps in the quarry. And one 3m pack way will be arranged for every 10m including an 8m pack way on EL270m platform.
3. The highest slope is 60m. The excavation ratio of slope is 1:0.5.
4. The end elevation of quarry is EL330 with about 2370000m³. The material in the quarry from EL230m to EL220m will be used as backup material.
Appendix 9.4

Emergency Action Plan
Emergency Plan for Nam Ngiep 1 Hydropower Project

**ACCIDENT INCIDENT**

**TAKE ACTION**
- Send injured person to hospital
- Urgent countermeasure
- Inform and explain to authorities
- Record
- etc.

**Discoverer**

**Site Engineer**

**Construction Manager (Japanese)**

**Managing Director** Mr. Yamabayashi

**Deputy Managing Director** Mr. Tsutsui

**Project Manager** Mr. Chabayashi

**Safety Chief Engineer**

**Administration Manager** Mr. Harada

**OBAYASHI Corporation Overseas Division (Tokyo)** +81-3-5769-1254

**OBAYASHI Corporation**

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**Mr. Nagasaka** 020-59-888-205

**Mr. Tsushihashi** 020-59-888-206

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**Mr. Ishiguro** 020-59-888-217

**Mr. Dodo** 020-22-422-582

**Mr. Sasaki**

**Mr. Ishiguro**

**Mr. Tsuchihashi**

**Mr. Dodo**

**Mr. Sasaki**

**Mr. Ishiguro**

**Mr. Tsuchihashi**

**Mr. Dodo**

**Hospital / Immigration / Embassy / Others**

**Hospital (Lao)** Bolikhamsay Provincial Hospital

**Hospital (Thai)** Bangkok Hospital Ubon Ratchathani

**Hospital (Thai)**

**Embassy of Japan**

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**Lao Skyway** Tel: 021-512-027+81-3-3811-8153

**Mr. S. Yamabayashi**

**Mr. Chabayashi**

**Mr. Kimura**

**Mr. Harada**

**Mr. Ishii**

**Mr. Nagasaka**

**Mr. Tsushihashi**

**Mr. Sasaki**

**Mr. Ishiguro**

**Mr. Dodo**

**Mr. Sasaki**

**Mr. Ishiguro**

**Mr. Tsuchihashi**

**Mr. Dodo**
Appendix 9.5

Resources
### 9.5 Resources for Preparation and Operation Work of Quarry

<table>
<thead>
<tr>
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<td>High air pressure drill</td>
<td>2</td>
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<td>Pneumatic drill</td>
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<td>Excavators</td>
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<td>4</td>
<td>Bulldozer</td>
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<td>2</td>
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<tr>
<td>5</td>
<td>Dump truck</td>
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<td>15</td>
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<td>1</td>
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Appendix 9.6

Clearing Plan
CLEARING PLAN

QUARRY PLAN (Road T9 - STA.0+729m to STA.1+000m )

<table>
<thead>
<tr>
<th>Description</th>
<th>Volume (m³)</th>
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<tbody>
<tr>
<td>Remove Top Soil (m³)</td>
<td>14,000.00</td>
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<tr>
<td>Overburden removal (m³)</td>
<td>530,000.00</td>
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<tr>
<td>Blasting rock and excavated (m³)</td>
<td>1,784,053.00</td>
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<tr>
<td>Slope treatment (m²)</td>
<td>61,000.00</td>
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<tr>
<td>Approach road No. 1 (m)</td>
<td>550.00</td>
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<tr>
<td>Approach road No. 2 (m)</td>
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<tr>
<td>Open ditch outside (m)</td>
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</tr>
<tr>
<td>Open ditch inside (m)</td>
<td>946.00</td>
</tr>
<tr>
<td>HDPE Pipe (mm) (Location)</td>
<td>2.00</td>
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<tr>
<td>Sediment (Location)</td>
<td>1.00</td>
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<tr>
<td>Return period (Years)</td>
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</table>
Appendix 9.7

Erosion and Sediment Control Plan
Appendix 9.8

Calculation for Drainage by Culvert, Open Ditch and Sediment Pond
Appendix 9.8a

Calculation for Drainage by Pipe Culvert in T7; T9 & T11 Road
During Clearing and overburden stripping
of Quarry
9.8a Catchment Area 1 is drained by 0.6m Pipe Culvert at Km0+350 of T7 road and then flow quantity shall go in 0.6m Pipe Culvert at Km0+350 of T9 road

Catchment Area 2 is drained by 0.6m Pipe Culvert at Km0+640 of T7 road and then flow quantity shall go in 0.6m Pipe Culvert at Km0+350 of T9 road

Catchment Area 9 and Area 11 are drained by 0.6m Pipe Culvert at Km0+350 of T9 road

Necessary Capacity:

Rainfall: \( q = 56.3 \text{ mm/day (1.5-year probability)} \)

Catchment Area:

- Area 1: \( A_1 = 101,000 \text{ m}^2 \)
- Area 2: \( A_2 = 73,000 \text{ m}^2 \)
- Area 9: \( A_9 = 26,099 \text{ m}^2 \)
- Area 11: \( A_{11} = 23,976 \text{ m}^2 \)
- \( A(1+2+9+11) = 224,075 \text{ m}^2 \)

Penetration rate of design flow: \( P = 0.8 \)

Total quantity of flow:

\[
Q_1 = \frac{(q \cdot A_1 \cdot P)}{(864 \times 10^5)} = 0.053 \text{ m}^3/\text{s}
\]

\[
Q_2 = \frac{(q \cdot A_2 \cdot P)}{(864 \times 10^5)} = 0.038 \text{ m}^3/\text{s}
\]

\[
Q = Q(1+2+9+11) = \frac{(q \cdot A(1+2+9+11) \cdot P)}{(864 \times 10^5)} = 0.117 \text{ m}^3/\text{s}
\]

Designed Quantity of Flow:

Condition:

- Pipe Culvert Diameter \( D = 0.600 \text{ (m)} \)
- Coefficient of roughness \( n = 0.013 \)
- Gradient of channel \( I = 1.000 \text{ (\%)} \)
- Rate of Design Flow \( \alpha = 0.800 \)

Calculation:

- Area \( A = (\psi - 1/2 \cdot \sin(2\psi)) \cdot D^2 / 4 = 0.276 \text{ (m)} \)
- Wetted perimeter \( P = \psi \cdot D = 2.639 \times 0.600 = 1.583 \text{ (m)} \)
- Hydraulic radius \( R = A / P = 0.276 / 1.583 = 0.174 \text{ (m)} \)
- Velocity of a flowing \( V = I^{1/2} \cdot R^{2/3} / n = 2.397 \text{ (m/s)} \)
- Max Q'ty of flow \( Q_{\text{max}} = A \cdot V = 0.662 \text{ (m}^3/\text{s}) \)
- Design Q'ty of flow \( Q_a = \alpha \cdot Q_{\text{max}} = 0.800 \times 0.662 = 0.529 \text{ (m}^3/\text{s}) \)

\[ Q \leq Q_a \text{ OK!} \]

In the case of a circular waterway, the maximum flow occurs on the depth of the water of \( h \cong 0.938D \), not full flow. On this condition, \( \psi \cong 2.639 = 151^\circ 12' \)

Note:

- Drainage capacity of 0.6m Pipe Culvert at Km0+350 of T7 road for Area 1: \( Q_1 \leq Q_a \text{ OK!} \)
- Drainage capacity of 0.6m Pipe Culvert at Km0+640 of T7 road for Area 2: \( Q_2 \leq Q_a \text{ OK!} \)
- The most harmful case: The four (04) areas (A1; A2; A9 and A11) are flooded and drained by 0.6m Pipe Culvert at Km0+350 of T9 road: \( Q \leq Q_a \text{ OK!} \)
9.8a Catchment Area 3 is drained by 0.6m Pipe Culvert at Km0+900 of T7 road and then flow quantity shall go in go in 0.8m Pipe Culvert at Km0+300 of T11 road

Catchment Area 4 is drained by 0.6m Pipe Culvert at Km1+000 of T7 road and then flow quantity shall go in go 0.8m Pipe Culvert at Km0+300 of T11 road

Catchment Area 7, Area 8 and Area 10 are drained by 0.8m Pipe Culvert at Km0+300 of T11 road

Necessary Capacity:

Rainfall: \[ q = 56.3 \text{ mm/day (1.5-year probability)} \]

Catchment Area:
- Area 3: \[ A_3 = 93,000 \text{ m}^2 \]
- Area 4: \[ A_4 = 111,000 \text{ m}^2 \]
- Area 7: \[ A_7 = 66,117 \text{ m}^3 \]
- Area 8: \[ A_8 = 8,861 \text{ m}^3 \]
- Area 10: \[ A_{10} = 29,494 \text{ m}^3 \]
- \[ A_{(3+4+7+8+10)} = 308,472 \text{ m}^2 \]

Penetration rate of design flow: \[ P = 0.8 \]

Total quantity of flow:
\[ Q_3 = \frac{q \cdot A_3 \cdot P}{864 \times 10^6} = \frac{0.048}{s} \]
\[ Q_4 = \frac{q \cdot A_4 \cdot P}{864 \times 10^6} = \frac{0.058}{s} \]
\[ Q = \frac{q \cdot A_{(3+4+7+8+10)} \cdot P}{864 \times 10^6} = \frac{0.161}{s} \]

Designed Quantity of Flow of 0.6m pipe culvert on T7 road:

Condition:
- Pipe Culvert Diameter \[ D = 0.600 \text{ (m)} \]
- Coefficient of roughness \[ n = 0.013 \]
- Gradient of channel \[ I = 1.000 \text{ (%)} \]
- Rate of Design Flow \[ \alpha = 0.800 \]

Calculation:
- Area \[ A = (\psi-1/2*\sin(2\psi)) \cdot D^2/4 = 0.276 \text{ (m)} \]
- Wetted perimeter \[ P = \psi \cdot D = 2.639 \cdot 0.600 = 1.583 \text{ (m)} \]
- Hydraulic radius \[ R = A/P = 0.276/1.583 = 0.174 \text{ (m)} \]
- Velocity of a flowing \[ V = I^{1/2} \cdot R^{2/3} \cdot 1/n = 2.397 \text{ (m/s)} \]
- Max Q'ty of flow \[ Q_{\text{max}} = A \cdot V = 0.662 \text{ (m}^3/\text{s)} \]
- Design Q'ty of flow \[ Q' = \alpha \cdot Q_{\text{max}} = 0.800 \cdot 0.662 = 0.529 \text{ (m}^3/\text{s)} \]

Designed Quantity of Flow of 0.8m pipe culvert on T11 road:

Condition:
- Pipe Culvert Diameter \[ D = 0.800 \text{ (m)} \]
- Coefficient of roughness \[ n = 0.013 \]
- Gradient of channel \[ I = 1.000 \text{ (%)} \]
- Rate of Design Flow \[ \alpha = 0.800 \]

Calculation:
- Area \[ A = (\psi-1/2*\sin(2\psi)) \cdot D^2/4 = 0.490 \text{ (m)} \]
- Wetted perimeter \[ P = \psi \cdot D = 2.639 \cdot 0.800 = 2.111 \text{ (m)} \]
- Hydraulic radius \[ R = A/P = 0.490/2.111 = 0.232 \text{ (m)} \]
- Velocity of a flowing \[ V = I^{1/2} \cdot R^{2/3} \cdot 1/n = 2.904 \text{ (m/s)} \]
- Max Q'ty of flow \[ Q_{\text{max}} = A \cdot V = 1.423 \text{ (m}^3/\text{s)} \]
- Design Q'ty of flow \[ Q' = \alpha \cdot Q_{\text{max}} = 0.800 \cdot 1.423 = 1.138 \text{ (m}^3/\text{s)} \]

\[ Q \leq Q' \text{ OK!} \]
In the case of a circular waterway, the maximum flow occurs on the depth of the water of \( h \approx 0.938D \), not full flow. On this condition, \( \psi \approx 2.639 = 151^\circ 12' \)

**Note:**
- Drainage capacity of 0.6m Pipe Culvert at Km0+900 of T7 road for Area 3: \( Q_3 \leq Q_a \) OK!
- Drainage capacity of 0.6m Pipe Culvert at Km1+000 of T7 road for Area 4: \( Q_4 \leq Q_a \) OK!
- The most harmful case: The five (05) areas (A3; A4; A7; A8 and A10) are flooded and drained by 0.8m Pipe Culvert at Km0+300 of T11 road: \( Q \leq Q_a \) OK!

9.8a Catchment Area 5 is drained by 0.6m Pipe Culvert at Km1+400 of T7 road and then flow quantity shall go in 0.6m Pipe Culvert at Km0+480 of T11 road

Catchment Area 6 is drained by 0.6m Pipe Culvert at Km0+480 of T11 road

**Necessary Capacity:**

Rainfall:
- \( q = 56.3 \text{ mm/day (1.5-year probability)} \)

Catchment Area:
- Area 5: \( A_5 = 295,000 \text{ m}^2 \)
- Area 6: \( A_6 = 47,857 \text{ m}^2 \)
- \( A_{(5+6)}: \) \( A_5 + A_6 = 342,857 \text{ m}^2 \)

Penetration rate of design flow:
- \( P = 0.8 \)

**Total quantity of flow:**

\[
Q_5 = \frac{q \times A_5 \times P}{864 \times 10^5} = 0.154 \text{ m}^3/\text{s}
\]

\[
Q = Q_{(5+6)} = \frac{q \times A_{(5+6)} \times P}{864 \times 10^5} = 0.179 \text{ m}^3/\text{s}
\]

**Designed Quantity of Flow:**

Condition:
- Pipe Culvert Diameter \( D = 0.600 \text{ (m)} \)
- Coefficient of roughness \( n = 0.013 \)
- Gradient of channel \( I = 1.000 \text{ (%)} \)
- Rate of Design Flow \( \alpha = 0.800 \)

Calculation:
- Area \( A = (\psi - \frac{1}{2} \sin(2\psi)) \times D^2 / 4 = 0.276 \text{ (m}^2) \)
- Wetted perimeter \( P = \psi \times D = 2.639 \times 0.600 = 1.583 \text{ (m)} \)
- Hydraulic radius \( R = A / P = 0.276 / 1.583 = 0.174 \text{ (m)} \)
- Velocity of a flowing \( V = I^{1/2} \times R^{2/3} \times 1/n = 2.397 \text{ (m/s)} \)
- Max Q'ty of flow \( Q_{max} = A \times V = 0.662 \text{ (m}^3/\text{s)} \)
- Design Q'ty of flow \( Q_a = \alpha \times Q_{max} = 0.800 \times 0.662 = 0.529 \text{ (m}^3/\text{s)} \)

\( Q \leq Q_a \) OK!

In the case of a circular waterway, the maximum flow occurs on the depth of the water of \( h \approx 0.938D \), not full flow. On this condition, \( \psi \approx 2.639 = 151^\circ 12' \)

**Note:**
- Drainage capacity of 0.6m Pipe Culvert at Km1+400 of T7 road for Area 5: \( Q_5 \leq Q_a \) OK!
- The most harmful case: The two (02) areas (A5 and A6) are flooded and drained by 0.6m Pipe Culvert at Km0+480 of T11 road: \( Q \leq Q_a \) OK!
Appendix 9.8b

Calculation for Open Ditch of Quarry
9.8b Catchment Area 5 is drained by 0.6m Pipe Culvert at Km1+400 of T7 road, and then the total of flow quantity of Area 5 and Area 6 shall be drained by 0.6m pipe culvert at Km0+480 of T11 road. This case was calculated in detail and satisfy (Please refer to Appendix 9.8a).

Catchment Area 3 is drained by 0.6m Pipe Culvert at Km0+900 of T7 road and then flow quantity shall go in 0.8m Pipe Culvert at Km0+300 of T11 road. This case was calculated in detail and satisfy (Please refer to Appendix 9.8a).

Catchment Area 4 is drained by 0.6m Pipe Culvert at Km1+000 of T7 road and then flow quantity shall go in 0.8m Pipe Culvert at Km0+300 of T11 road. This case was calculated in detail and satisfy (Please refer to Appendix 9.8a).

70% of Catchment Area 7 is drained by 0.8m Pipe Culvert at Km0+300 of T11 road and 30% go in outside open ditch. The most harmful case is 100% flow quantity of Area 7 that will go in outside open ditch.

Area 7: outside Open Ditch (rain water from mountain)

Necessary Capacity:
Rainfall: q = 56.3 mm/day (1.5-year probability)
Catchment Area: A = A7 = 66,117 m²
Penetration rate of design flow: P = 0.8
Total quantity of flow:
Q = Q7 = (q*A*P)/(864*10^5) = 0.034 m³/s

Designed Quantity of Flow:
Condition:
- Open Ditch without lining
- Upper width W1 = 0.800 (m)
- Bottom width W2 = 0.400 (m)
- Height H = 0.400 (m)
- Water Depth Dw = 0.9*H = 0.360 (m)
- Coefficient of roughness n = 0.030
- Gradient of channel I = 6.000 (%)
- Rate of Design Flow α = 0.800

Calculation:
- Water surface width Ws = W2 + (W1 - W2) * Dw/H = 0.760 (m)
- Area A = (Ws + W2) * 2 * Dw = 0.209 (m²)
- Wetted perimeter P = (H^2 + (W1 - W2) / 2)^1/2 / H * Dw * 2 * W2 = 1.205 (m)
- Hydraulic radius R = A/P = 0.209 / 1.205 = 0.173 (m)
- Velocity of a flowing V = I^(1/2) * R^(3/2) * 1/n = 2.535 (m/s)
- Max Q'ty of flow Qmax = A * V = 0.529 (m³/s)
- Design Q'ty of flow Qa = α * Qmax = 0.800 * 0.529 = 0.423 (m³/s)

Q ≤ Qa OK!

Remark: Capacity of 0.8m Pipe Culvert at Km0+300 of T11 road:
Qb = 1.138 (m³/s)
(Calculated in Appendix 9.8a)
Qa ≤ Qb OK!

The most harmful case: three (03) areas are flooded and drained by 0.8m pipe culvert at Km0+300 of T11 road. This case was calculated in Appendix 9.8a and satisfy.
9.8b Catchment Area 1 is drained by 0.6m Pipe Culvert at Km0+350 of T7 road, and then the total of flow quantity of Area 1 and Area 9 shall be drained by 0.6m pipe culvert at Km0+350 of T9 road. This case was calculated in detail and satisfy (Please refer to Appendix 9.8a)

Catchment Area 2 is drained by 0.6m Pipe Culvert at Km0+640 of T7 road. The next, the total of flow quantity of Area 2 and Area 8 shall go in outside open ditch and then drained by 0.6m pipe culvert at Km0+350 of T9 road.

Area 2 and Area 8: outside Open Ditch (rain water from mountain)

Necessary Capacity:

Rainfall: \( q = 56.3 \text{ mm/day (1.5-year probability)} \)

Catchment Area:

- Area 2: \( A_2 = 73,000 \text{ m}^2 \)
- Area 8: \( A_8 = 8,861 \text{ m}^2 \)
- \( A(2+8): A_2 + A_8 = 81,861 \text{ m}^2 \)

Penetration rate of design flow: \( P = 0.8 \)

Total quantity of flow:
\[
Q = \frac{q(A(2+8)P)}{864 \times 10^5} = 0.043 \text{ m}^3/\text{s}
\]

Designed Quantity of Flow:

Condition:

- Open Ditch without lining
  - Upper width \( W_1 = 0.800 \text{ (m)} \)
  - Bottom width \( W_2 = 0.400 \text{ (m)} \)
  - Height \( H = 0.400 \text{ (m)} \)
  - Water Depth \( D_w = 0.9^* H = 0.360 \text{ (m)} \)
  - Coefficient of roughness \( n = 0.030 \)
  - Gradient of channel \( I = 1.000 \text{ (m/m)} \)
  - Rate of Design Flow \( \alpha = 0.800 \)

Calculation:

- Water surface width \( W_s = W_2 + (W_1 - W_2) \cdot D_w / H = 0.760 \text{ (m)} \)
- Area \( A = (W_s + W_2) / 2 \cdot D_w = 0.209 \text{ (m)} \)
- Wetted perimeter \( P = (H^2 + ((W_1 - W_2) / 2)^2)^{1/2} / H \cdot D_w / 2 + W_2 = 1.205 \text{ (m)} \)
- Hydraulic radius \( R = A / P = 0.209 / 1.205 = 0.173 \text{ (m)} \)
- Velocity of a flowing \( V = I^{1/2} \cdot R^{2/3} / 1 = 1.035 \text{ (m/s)} \)
- Max Q'ty of flow \( Q_{\text{max}} = A \cdot V = 0.216 \text{ (m}^3/\text{s)} \)
- Design Q'ty of flow \( Q_a = \alpha \cdot Q_{\text{max}} = 0.800 \cdot 0.216 = 0.173 \text{ (m}^3/\text{s)} \)

\( Q \leq Q_a \leq Q_b \text{ OK!} \)

Remark: Capacity of 0.6m Pipe Culvert at Km0+350 of T9 road: \( Q_b = 0.529 \text{ (m}^3/\text{s)} \)

(Calculated in Appendix 9.8a)

Qa \leq Qb \text{ OK!}

The most harmful case: Area #1, #2, #8 and area #9 are flooded and drainage by out side open ditch and 0.6m pipe culvert at Km0+350 of T9 road.

Flow quantity of Area #1, #2, #8 and area #9:

Rainfall: \( q = 56.3 \text{ mm/day (1.5-year probability)} \)

Catchment Area (m\(^2\)):

- Area 1: \( A_1 = 101,000 \text{ m}^2 \)
- Area 2: \( A_2 = 73,000 \text{ m}^2 \)
- Area 8: \( A_8 = 8,861 \text{ m}^2 \)
- Area 9: \( A_9 = 26,099 \text{ m}^2 \)

Penetration rate of design flow: \( P = 0.8 \)

Total quantity of flow:
\[
Q(\text{total}) = \frac{q(A_1 \cdot P)}{864 \times 10^5} = 0.109 \text{ m}^3/\text{s}
\]

\( Q(\text{total}) \leq Q_a \leq Q_b \text{ OK!} \)
9.8b Catchment Area 10 and Area 11, drainaged by inside open ditch & D300 HDPE pipe and then flow quantity shall go in Sediment Pond

Area 10 and Area 11: inside Open Ditch (Quarry)

Necessary Capacity:
Rainfall: \( q = 56.3 \text{ mm/day (1.5-year probability)} \)

Catchment Area:

\[
\begin{align*}
\text{Area 10:} & \quad A_{10}= 29,494 \text{ m}^2 \\
\text{Area 11:} & \quad A_{11}= 23,976 \text{ m}^2 \\
\text{A=}(A_{10}+A_{11}): & \quad A_{10}+A_{11}= 53,470 \text{ m}^2 \\
\end{align*}
\]

Penetration rate of design flow: \( P = 0.8 \)

Total quantity of flow:
\[
Q = Q(10+11) = (q \times A_{10+11}) \times P / (864 \times 10^5) = 0.028 \text{ m}^3/\text{s}
\]

Designed Quantity of Flow for inside Open Ditch:

Condition:

- Open Ditch without lining
- Upper width \( W_1 = 0.800 \text{ (m)} \)
- Bottom width \( W_2 = 0.400 \text{ (m)} \)
- Height \( H = 0.400 \text{ (m)} \)
- Water Depth \( D_w = 0.9 \times H = 0.360 \text{ (m)} \)
- Coefficient of roughness \( n = 0.030 \)
- Gradient of channel \( I = 1.000 \text{ (%)} \)
- Rate of Design Flow \( \alpha = 0.800 \)

Calculation:

- Water surface width \( W_s = W_2 + (W_1 - W_2) \times D_w / H = 0.760 \text{ (m)} \)
- Area \( A = (W_s + W_2) / 2 \times D_w = 0.209 \text{ (m)} \)
- Wetted perimeter \( P = (H^2 + ((W_1 - W_2) / 2)^2)^{1/2} / H \times D_w \times 2 + W_2) = 1.205 \text{ (m)} \)
- Hydraulic radius \( R = A / P = 0.209 / 1.205 = 0.173 \text{ (m)} \)
- Velocity of a flowing \( V = I^{1/2} \times R^{2/3} \times 1/n = 1.035 \text{ (m/s)} \)
- Max Q'ty of flow \( Q_{max} = A \times V = 0.216 \text{ (m}^3/\text{s)} \)
- Design Q'ty of flow \( Q_a = \alpha \times Q_{max} = 0.800 \times 0.216 = 0.173 \text{ (m}^3/\text{s)} \)

\( Q \leq Q_a \text{ OK!} \)

Designed Quantity of Flow for D300 HDPE pipe inside of Quarry:

Condition:

- Pipe Culvert Diameter \( D = 0.300 \text{ (m)} \)
- Coefficient of roughness \( n = 0.013 \)
- Gradient of channel \( I = 1.000 \text{ (%)} \)
- Rate of Design Flow \( \alpha = 0.800 \)

Calculation:

- Area \( A = (\psi - 1/2 \times \sin(2\psi)) \times D^2 / 4 = 0.069 \text{ (m)} \)
- Wetted perimeter \( P = \psi \times D = 2.639 \times 0.300 = 0.792 \text{ (m)} \)
- Hydraulic radius \( R = A / P = 0.069 / 0.792 = 0.087 \text{ (m)} \)
- Velocity of a flowing \( V = I^{1/2} \times R^{2/3} \times 1/n = 1.510 \text{ (m/s)} \)
- Max Q'ty of flow \( Q_{max} = A \times V = 0.216 \text{ (m}^3/\text{s)} \)
- Design Q'ty of flow \( Q_b = \alpha \times Q_{max} = 0.800 \times 0.104 = 0.083 \text{ (m}^3/\text{s)} \)

\( Q \leq Q_b \text{ OK!} \)
Appendix 9.8c

Calculation for Sediment Pond

of Quarry
9.8c Waste water drainaged by Sediment Pond (28'23.2'5) in Quarry

Necessary Capacity:

Quantity of rainfall (1.5 years probability) = 56.30 mm/day

Catchment Area:

<table>
<thead>
<tr>
<th>Area</th>
<th>A10</th>
<th>A11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 10:</td>
<td>29,494 m²</td>
<td>23,976 m²</td>
</tr>
<tr>
<td>Area 11:</td>
<td>53,470 m²</td>
<td></td>
</tr>
</tbody>
</table>

Discharge Point = 1.00 location

Penetration rate of design flow α = 0.80

Necessary capacity of Sedimentation Pond

V1 = 2,408.29 m³/day

Designed Quantity of Flow of Sedimentation Pond:

- Upper width: W1 = 23.20 (m)
- Bottom width: W2 = W1 - 7 = 16.20 (m)
- Height: H = 5 (m)
- Water Depth: Dw = V1 / ((W1*L1 + W2*L2)/2) = 4.87 (m)
- Upper length: L1 = 28.00 (m)
- Bottom length: L2 = L1 - 7 = 21.00 (m)
- Capacity of Sedimentation Pond: V2 = ([(W1+W2)/2]*[L1+L2]/2)*H = 2,413.25 (m³)

V1 ≤ V2 OK!

Note:
The most harmful case is total of flow quantity of Area 1 & Area 9, Area 2 & Area 8 (after gathered in outside open ditch, Area 10 & Area 11 (after gathered in sediment pond) drainaged by 0.6 pipe culvert at Km0+350 of T9 road. This calculation is shonwned as below.

Necessary Capacity:

Rainfall: q = 56.3 mm/day (1.5-year probability)

Catchment Area:

<table>
<thead>
<tr>
<th>Area</th>
<th>A1</th>
<th>A2</th>
<th>A9</th>
<th>A11</th>
<th>A8</th>
<th>A10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area 1:</td>
<td>101,000 m²</td>
<td>73,000 m²</td>
<td>26,099 m²</td>
<td>23,976 m²</td>
<td>8,861 m²</td>
<td>29,494 m²</td>
</tr>
<tr>
<td>Area 2:</td>
<td>262,430 m²</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Penetration rate of design flow: P = 0.8

Total quantity of flow:

Q = (q*A(1+2+9+11+8+10)*P)/(864*10^5) = 0.137 m³/s

Designed Quantity of Flow:

Condition:

- Pipe Culvert Diameter D = 0.600 (m)
- Coefficient of roughness n = 0.013
- Gradient of channel I = 1.000 (%)
- Rate of Design Flow α = 0.800

Calculation:

- Area A = (ψ+1/2*sin(2ψ))*D²/4 = 0.276 (m²)
- Wetted perimeter P = ψ*D = 2.639×0.600 = 1.583 (m)
- Hydraulic radius R = A/P = 0.0276/1.583 = 0.174 (m)
- Velocity of a flowing V = I¹/²*R¹/³/n = 2.397 (m/s)
- Max Q'ty of flow Qmax = A*V = 0.662 (m³/s)
- Design Q'ty of flow Qa = α*Qmax = 0.800×0.662 = 0.529 (m³/s)

Q ≤ Qa OK!

In the case of a circular waterway, the maximum flow occurs on the depth of the water of ψ ≃ 0.938D, not full flow.

On this condition, ψ ≃ 2.639 = 151°12’
Appendix 9.9

Inspection and Test Plan (ITP)
### 9.9 INSPECTION AND TEST PLAN FOR PREPARATION AND OPERATION WORK OF QUARRY

<table>
<thead>
<tr>
<th>Item</th>
<th>Testing / Inspection Items</th>
<th>Description (Properties to be tested)</th>
<th>Specification</th>
<th>Inspection and Test Method</th>
<th>Acceptable Criteria</th>
<th>Inspection by</th>
<th>Testing Location</th>
<th>Frequency</th>
<th>Verifying Document</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rock Quality confirmation</td>
<td>Rock Appearance, color, status (weathered or not weathered yet)</td>
<td>Accordance with TS 2.12</td>
<td>Visual inspection</td>
<td>S/C I, OC I, Own I</td>
<td>On Site</td>
<td>Every Blasting Batch</td>
<td>Checklist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Legend:**
- **S/C:** Subcontractor & The Contractor
- **OC:** The Owner
- **Own:** The Owner
- **H:** Hold Point
- **I:** Inspection
- **W:** Witness by Owner
- **R:** Document Review

**Accredited Laboratories:**

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TBA</td>
<td></td>
</tr>
<tr>
<td>2. TBA</td>
<td></td>
</tr>
<tr>
<td>3. TBA</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 9.10

Slope Treatment
Appendix 9.11

Site Condition Map
**General Layout of Access Roads**

**REV.**

**DRAWN**

**RECOMMENDED**

**CONCURRED**

**APPROVED**

**DATE**

**JOB NO.**

**REV.NO.**

**DATE : November. 2013**

**JOB DESCRIPTION**

**NAM NGIEP1 POWER COMPANY LTD.**

<table>
<thead>
<tr>
<th>Road Name</th>
<th>Start point</th>
<th>Mid point</th>
<th>End point</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 (To Dam Top)</td>
<td>A</td>
<td>T1, B, A1, E, I, A2, S</td>
<td>P</td>
<td>9.32km</td>
</tr>
<tr>
<td>P2 (To Power house)</td>
<td>E</td>
<td>G, H, W</td>
<td>N</td>
<td>1.84km</td>
</tr>
<tr>
<td>T1, T2 (Haul road EL 230 and 250m)</td>
<td>I</td>
<td>V</td>
<td>O</td>
<td>1.58km</td>
</tr>
<tr>
<td>T3 (RCC &amp; CVC plant road)</td>
<td>G</td>
<td>-</td>
<td>D</td>
<td>0.55km</td>
</tr>
<tr>
<td>T4 (Upstream approach road)</td>
<td>P</td>
<td>-</td>
<td>Q, R</td>
<td>1.94km</td>
</tr>
<tr>
<td>T5 (Temporary access road)</td>
<td>B</td>
<td>-</td>
<td>H</td>
<td>3.88km</td>
</tr>
<tr>
<td>JICA Road</td>
<td>A</td>
<td>T1, B, T2</td>
<td>X</td>
<td>9.25km</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Road Name</th>
<th>Start point</th>
<th>Mid point</th>
<th>End point</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>T6 (Jetty road)</td>
<td>H</td>
<td>-</td>
<td>U</td>
<td>0.20km</td>
</tr>
<tr>
<td>T7 (Haul road to dam top)</td>
<td>J</td>
<td>-</td>
<td>M</td>
<td>1.54km</td>
</tr>
<tr>
<td>T8 (Soil disposal road)</td>
<td>F</td>
<td>-</td>
<td>C</td>
<td>3.20km</td>
</tr>
<tr>
<td>T9 (Haul road to quarry)</td>
<td>F</td>
<td>-</td>
<td>K</td>
<td>1.00km</td>
</tr>
<tr>
<td>T10, T11 (Haul road EL 200 and 230m)</td>
<td>K</td>
<td>-</td>
<td>L</td>
<td>1.68km</td>
</tr>
<tr>
<td>T12 (Temporary Road)</td>
<td>S</td>
<td>-</td>
<td>T2</td>
<td>0.72km</td>
</tr>
<tr>
<td>T13 (Temporary Road )</td>
<td>V</td>
<td>-</td>
<td>W</td>
<td>0.52km</td>
</tr>
</tbody>
</table>

**Temporary Road : T1 ~ T13 (New Construction, Usage Period; Construction period)**

**Permanent Road : P1, P2 (New Construction, Usage Period; Construction and operation period)**

**Existing Road : JICA Road (Rehabilitation, Usage Period; Construction period)**

**JICA ROAD :**

- Temporary Road : T1 ~ T13
- Permanent Road : P1, P2
- Existing Road : JICA Road

**Quarry Area**

**Aggregate Crushing Plant**

**Disposal Area No. 7**

**Disposal Area No. 6**

**Workers Camp No. 1**

**Contractors Camp**

**Ban Hatsaykham**

**Ban Hat Gniun**

**Temporary Road : T13**

**JICA ROAD**

**Road Name**

- P1 (To Dam Top)
- P2 (To Power house)
- T1, T2 (Haul road EL 230 and 250m)
- T3 (RCC & CVC plant road)
- T4 (Upstream approach road)
- T5 (Temporary access road)
- JICA Road
- T6 (Jetty road)
- T7 (Haul road to dam top)
- T8 (Soil disposal road)
- T9 (Haul road to quarry)
- T10, T11 (Haul road EL 200 and 230m)
- T12 (Temporary Road)
- T13 (Temporary Road)
Appendix 9.12

Facility Layout for Site Development
Appendix 9.13

Sub-Plan for ESMMP-CP
SUB-PLANS for ESMMP-CP of Nam Ngiep 1 Hydropower Project

Sub-plans are proposed as guidelines for environmental implementation during construction phase and for minimizing the environmental impact of the Project. These 21 sub-plans include:

SP01: Erosion and sediment control
SP02: Water Availability and Pollution Control
SP03: Emission and dust control
SP04: Noise and Vibration
SP05: Waste management
SP06: Hazardous Material Management
SP07: Vegetation clearing
SP08: Landscaping and re-vegetation
SP09: Protected Area Management
SP10: Biodiversity Management
SP11: Spoil Disposal
SP12: Quarry and construction layout
SP13: Unexploded ordnance (UXO) survey and disposal
SP14: Construction of work camps
SP15: Traffic and access
SP16: Training and Awareness
SP17: Project personnel health program
SP18: Public Safety
SP19: Damage to Properties and Facilities
SP20: Emergency Preparedness
SP21: Cultural Resources
Appendix 9.14

Environmental Management Activity Table
## Environmental Management Activity Table for Preparation and Operation of Quarry

<table>
<thead>
<tr>
<th>Sub-plan Item</th>
<th>Monitoring Method</th>
<th>Monitoring Frequency</th>
<th>On-Site Implementation</th>
</tr>
</thead>
</table>
| SP01              | Erosion and Sediment Control | Visual                    | Weekly or Heavy rain                                                                                       | • The control of erosion and sediment will be achieved by drainage pipe culverts and side ditches.  
  • Sediment ponds shall be installed, Appendix 9.12.  
  • All slope will be compacted by excavator bucket.  
  • The location of pipe culverts and water-flow along Quarry site shall be installed on road T9 at STA.0+720km to STA.1+000km and T11 at STA.0+020km can be referred to Appendix 9.12 Facilities Layout for Site Development of Quarry site.  
  • Along the Approach road inside Quarry shall be open ditch and installed location of pipe culvert for water flow to temporary Sediment pond before discharge to River, can be referred to Appendix 9.12.  
  • No unnecessary clearing will take place, as natural vegetation improves soil stability.  
  • All topsoil and cleared vegetation will be stockpiled at designated sites (Timber and Topsoil stockpile Appendix 9.12 of DWP).  
  • An erosion and sediment control map detail, flow direction, location of sediment ponds and ditches can be referred to in Appendix 9.7b.  
  • Weekly monitoring of open ditches or after heavy rain periods to evaluate flow, ditches can be modified if necessary.  
  • Silt fencing may be installed in areas where potential sediment run-off is high. This can be decided depending on actual site conditions. |
| SP02              | Water Availability and Pollution Control | Visual (parameters to monitor include: pH, Dissolved Oxygen and Turbidity) | Weekly                                                                                                          | • During earthworks and site preparation an open ditch will be created around the perimeter of the site, this will reduce the amount of surface and rain water run-off that will enter the Quarry. Appendix 9.7b illustrates site drainage and sediment pond location.  
  • Water quality monitoring of sediment ponds will be required during preparation and operation stages,  
  • Large amounts of water may collect in the Quarry after heavy rains, so pumping may be necessary to. Water quality testing prior to any pumping will be required. |
| SP03              | Emission and Dust Control | Visual                    | Daily                                                                                                           | • Water spraying vehicle will be provided in active construction site as necessary.  
  • In case the material transportation vehicles will pass through each village, the Quarry surface shall be sprayed water periodically.  
  • All vehicles, while parked on the site works, will be required to have their engines turned off. |
| SP04              | Noise and Vibration | Visual                    | Each time                                                                                                      | • The distance from the Quarry Site to Ban Hatsbykham village is more than 4.82km. There is no influence of noise and vibration with this construction works.  
  • Personal protection equipment shall be required (safety glasses, ear plugs, hard hat) |
| SP05              | Waste Management | Visual                    | Each time                                                                                                      | • Excavated rock will be transported to Disposal Site No.7 as shown in Appendix 9.11. Top soil and vegetation from earth works will be temporarily stockpiled on site, see Appendix 9.12, Facility Layout, this will be later transported to Disposal Area No.6.  
  • Sedimentation ponds will be monitored regularly and cleared after heavy rain periods. |
<table>
<thead>
<tr>
<th>Sub-plan Item</th>
<th>Monitoring Method</th>
<th>Monitoring Frequency</th>
<th>On-Site Implementation</th>
</tr>
</thead>
</table>
| **SP06** Hazardous Material Management | Visual | Weekly | - General waste bins will be provided on site, these will then be collected and transported to Worker Camps for disposal.  
- Temporary toilets facilities with septic tank will be installed on site, all workers will be highly encouraged to use these.  
- Blasting work is necessary for the excavation works of the Quarry. The work procedure and material store will be followed as described in Part 1, Section 5.8.2 of the DWP.  
- Explosives needed for blasting will be kept in secure bunker off of access road T7 (STA. +670), as shown in Appendix 9.15.  
- All fuels for road works machinery are stored at worker camp sites in specially designed areas, refueling trucks will then travel to work site. |
| **SP07** Vegetation clearing | Visual | Each time | - The clearing map is attached in Appendix 9.6. The work procedure for clearing will be followed to the Section 5.2 of the DWP.  
- The clearing area shall be restricted to within the Quarry Site area. Any clearing outside this area will be prohibited.  
- Clearing materials will be collected and temporary stockpiled along at Quarry site as specified in Appendix 9.12. These materials may be burnt on site or transported to Disposal Area No.6. |
| **SP11** Spoil Disposal | Visual | Weekly | - Soil, top soil and rubble will be transported to the disposal area No.6. The Location of disposal areas is shown in Appendix 9.11. |
| **SP13** Unexploded Ordnance (UXO) Survey and Disposal | Visual | Each time | - UXO clearance has been carried out within the Quarry site by NNP1 before the beginning of any construction activities.  
- If any UXO's are uncovered during earthworks, all works will stop immediately and the Owner (NNP1) will be notified. No works will be allowed to resume without approval from NNP1. |
| **SP15** Traffic and Access | Visual | Routine | - Watchmen on the ground will control local traffic and ensure safety of excavators and earth moving machines.  
- Regularly monitoring of traffic conditions will be conducted as part of the routine Environmental, Health and Safety inspection.  
- Speed limit shall be 10km/h when passing along Project roads  
- Installation of notice boards near entrance of work site to inform workers and visitors of local hazards and blasting schedule.  
- Haul trucks must not be overloaded with aggregate material |
| **SP16** Training and Awareness | Visual / Verbal | Routine | - All new employees will be required to complete Induction Training from OC/NNP1 prior to commencing any work on site.  
- In this training, the Contractor will highlight site rule/regulation and safety & environmental issues.  
- A register of induction training will be maintained and can be provided to NNP1 on request.  
- Monthly safety mass meetings will be conducted with all employees, and will cover all relevant health and safety issues on site. |
<table>
<thead>
<tr>
<th>Sub-plan Item</th>
<th>Monitoring Method</th>
<th>Monitoring Frequency</th>
<th>On-Site Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Daily tool box meetings will also be conducted to bring further awareness to environmental health and safety issues.</td>
</tr>
</tbody>
</table>
| SP17          | Project Personnel Health Program | Visual / Verbal | Routine | • Regarding the content of the Section 6 of the DWP, the tool box meeting will be carried out before commencement of any works.  
• Health Awareness Training will be carried out for all personnel in the monthly mass meeting.  
• First aid kits shall be prepared at site. |
| SP18          | Public Safety     | Visual / Asking      | Routine | • Blasting materials shall be stored at the STA.0+870km of Road T7 shown in Appendix 9.15.  
• The procedure for blasting work shall be kept strictly. (refer to Section 5.8.2)  
• Traffic signage and notice boards will be installed at sensitive locations to inform workers and visitors of blasting schedule or hazardous area.  
• No unauthorized personal will be allowed to enter the construction site.  
• Warning signs will be used to restrict public access to the Quarry excavation and work area.  
• When Quarry is on standby or temporary close, fencing/barriers will be used to mark out boundary and hazardous areas. |
| SP20          | Emergency Preparedness | Visual | Weekly | • Referring to the emergency action plan in Appendix 9.4, the emergency response procedures, emergency contact numbers and communication and reporting procedures will be clearly displayed at construction area.  
• First aid kit shall be prepared on site and in Sub-Contractor vehicles. |
| SP21          | Cultural Resource | Visual | Each time | • If the Contractor is to find any new physical or cultural resources during Quarry construction, the Contractor shall stop the works and inform the Owner immediately and follow the Chance Find Procedures. |
Appendix 9.15

Site Condition Map for Blasting Storage at Quarry
Blasting Storage House

Safety Diameter for Storage Location Of Blasting Materials

Proposed Storage location Of Blasting Materials

CONTRACTOR:

DRAWING NO.

SCALE:

TITLE

OWNER:

NAM NGIEP 1 POWER COMPANY

OBAYASHI CORPORATION

REV

DESIGNED

DRAWN

CHECKED

ISSUED

NTS

NNP1-WD-MD-QA-00005

REVISION

DESCRIPTION

DATE

TITLE

NAME

DATE

NAM NGIEP 1 HYDRO POWER PROJECT

SCALE: DRAWING NO. REV

MTS

A2
Appendix 9.16

Facilities Layout & Building for Blasting Storage at Quarry
Facilities Layout & Building for Storage House of Blasting Material

Blasting Storage Boundary Coordinate:

<table>
<thead>
<tr>
<th>No.</th>
<th>X</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>344460.151</td>
<td>2061671.191</td>
</tr>
<tr>
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DATE: Nov.2014
NAME: M. Ota
SCALE: 1:250
DRAWING NO.: NNP1-WD-MD-GA-00005
REV: A2
Facilities Layout & Building for Storage House of Blasting Material

CONTRACTOR: OBAYASHI CORPORATION

DRAWING NO. NNP1-WD-MD-QA-00008

SCALE: NTS

TITLE: FACILITIES LAYOUT & BUILDING FOR STORAGE HOUSE OF BLASTING MATERIAL

OWNER: NAM NGIEP 1 POWER COMPANY

REV. A2

DESIGNED: M. LOC

DRAWN: M. JUN

CHECKED: M. KOTA

ISSUED: M. SAKAI

DATE: Nov 2014

SCALE: NTS

DRAWING NO. NNP1-WD-MD-QA-00008

REV. A2
Facilities Layout & Building for Storage House of Blasting Material

NAM NGIEP 1 HYDRO POWER PROJECT

OWNER: NAM NGIEP 1 POWER COMPANY
CONTRACTOR: OBAIASHI CORPORATION

DRAWN: M. OHTA Nov. 2014
CHECKED: M. NAKAYAMA Nov. 2014
ISSUED: M. NAKAYAMA Nov. 2014

SCALE: DRAWING NO. NNP1-WD-MG-QA-00007

REVISION DESCRIPTION DATE TITLE NAME DATE

REV A2

A-A sectional view

B-B sectional view

C-C sectional view

[Diagram of facility layout and building for storage house of blasting material]
Facilities Layout & Building for Storage House of Blasting Material

Owner: NAM NGIEP 1 POWER COMPANY
Contractor: OBAYASHI CORPORATION

Revision: A1
Description: 1st Submission
Date: Nov 20X

Title: NAM NGIEP 1 HYDRO POWER PROJECT
Scale: DRAWING NO.
Drawing No.: NNP1-ND-MD-QA-00009
Rev: A1

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