

# **REVISED SAFE CLOSURE AND REHABILITATION PLAN**

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***CITY CONTROLLED DUMPSITE***

***Upper Dagong, Carmen, Cagayan de Oro City***

## **I. INTRODUCTION**

Section 37 of Republic Act No. 9003 otherwise known as Ecological Solid Waste Management Act of 2000 provides that no open dumps shall be allowed three (3) years following the effectivity of the Act, further, controlled dumpsite shall be allowed five (5) years following the effectivity of the Act. Therefore, all open and controlled dumpsites should have been phased out and closed as of February 16, 2006.

Pursuant to the Act, the City Government of Cagayan de Oro submitted a Closure and Rehabilitation Plan, 2006-2010 for the City Dumpsite located at Upper Dagong, Carmen on May 2010. Then, an Authority to Close (ATC) was issued by the Environmental Management Bureau (EMB) – 10 on June 2, 2010 to institute the components of the closure and rehabilitation and the post closure land use of the dumpsite. However, the SCRP was not implemented that the existing controlled dumpsite threatens the livability and sanitation of the city likewise not compliant to the Act.

### **1.1 Purpose**

The controlled dumpsite has already reached and continued beyond its intended solid waste storage capacity of 1.9 cubic meter (or 13 hectare-area capacity). As of 2013, the accumulated volume of solid waste deposited in the controlled dumpsite had already reached 4,012,566.40 cubic meter (or 112 %) of the intended storage capacity of the dumpsite.

It is empirical for the City Government to revise the Closure and Rehabilitation Plan for the City Controlled Dumpsite to comply with the requirements of RA 9003 and to resolve the issues and problems of the city's disposal facility. The data and information detailed in the previous Closure and Rehabilitation Plan had already been taken over by more recent events. In addition, the entire area of 17 hectares had since been filled with garbage. Likewise, the cost estimates of the previous plan could no longer compensate the closure and rehabilitation activities as of this time.

### **1.2 Objectives**

The Revised Safe Closure and Rehabilitation Plan (SCRP) aims to promote public health and good sanitation in the city while attaining sustainable ecological balance and compliant to RA 9003. It specifically seeks to achieve the following:

1. To establish workable strategies and parameters for the proper closure and rehabilitation of the long overdue city dumpsite in compliance to Section 37 of RA 9003.
2. To ascertain closure requirements and schedule of rehabilitation activities based on the present conditions of the dumpsite.

3. To allocate resources in carrying out the safe closure and rehabilitation plan.
4. To promote and expedite the establishment of sanitary landfill

### **1.3 Approach**

The revised SCRP is within the context of comprehensive, systematic and participative solid waste management approach of the city. The City Government through the City Environment and Natural Resources Office (CLENRO) shall facilitate the implementation of closure and rehabilitation activities. But since the City has limited resources and equipment, the implementation of the activities stipulated in this Plan shall be going to be contracted out to a private entity that has the capacity and integrity in the closure of waste disposal facility.

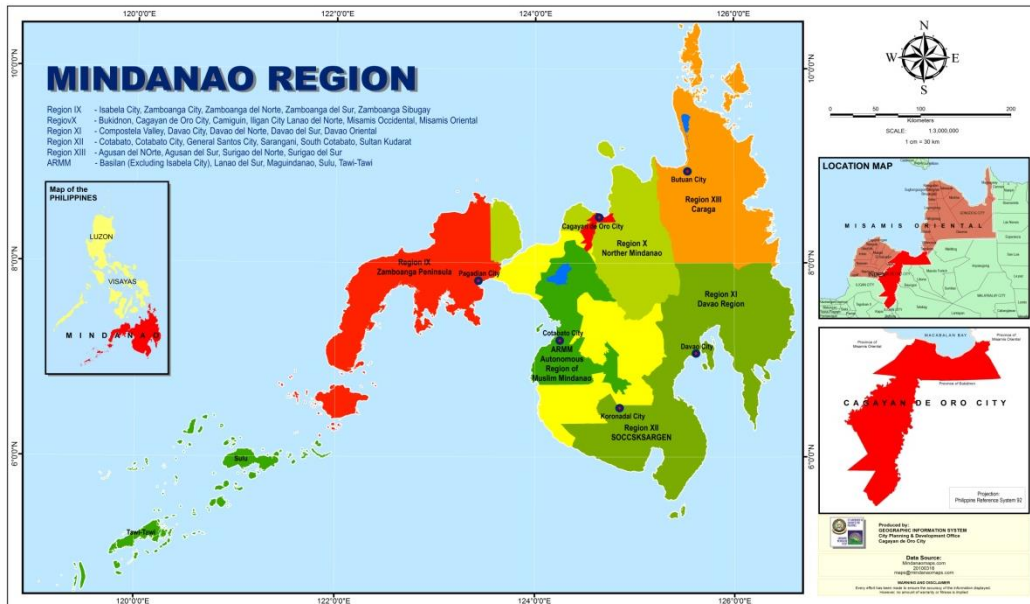
The closure of the city controlled dumpsite would expedite the establishment of sanitary landfill. In parallel, a siting of possible areas for landfill shall be done. Likewise, waste reduction and minimization at source shall be implemented at barangay level.

## II. GENERAL INFORMATION

### 2.1 City Profile

Cagayan de Oro City is the regional center in Northern Mindanao. It is bordered by the municipalities of Opol to the west of the city and Tagoloan to the east and by the provinces of Bukidnon and Lanao del Norte to the South-West and South-East respectively.

Figure 1. Cagayan de Oro Map



Source: City Planning and Development Office (CPDO)

The City is composed of 80 barangays with 17 rural barangays and 63 urban barangays. It has a total land area of 56,966.62 hectares. The city has a population of 602,088 inhabitants as of 2010 NSO census. The population growth trend has been increasing with 2.54 percent growth rate. The urban population is 555,605 while 46,483 are the rural populace.

Cagayan de Oro is classified as a Highly Urbanized City (HUC), with construction, manufacturing, wholesale and retail trading, food and service industry, community, social and personal services are present. The city is also engaged in export and import of goods and commodities. Tourism and other recreation industries are the most extended businesses in the city. In addition, banking is among the most active businesses with about 57 banks operating within the city. These businesses contribute to the city's economy growth likewise cause the increasing volume of solid waste generation.

### 2.2 Solid Waste Generation

The waste generation is calculated through the waste collected and received in the City Dumpsite. It is estimated by the number and type trucks entering the dumpsite. From 1993 to 2013, a total estimated volume of 4,012,566.4 cubic meters of solid waste

disposed in the City Dumpsite. Table 1 shows annual volume of waste disposed at the dumpsite.

Table1. Solid Waste Generation, 1993 - 2013

YEAR	VOLUME (CU.M.)	YEAR	VOLUME (CU.M.)
1993	80,347.60	2004	265,617.40
1994	97,438.90	2005	200,308.00
1995	126,154.10	2006	166,291.00
1996	134,378.80	2007	87,366.50
1997	141,087.70	2008	79,831.90
1998	174,594.70	2009	158,171.10
1999	219,387.00	2010	179,630.10
2000	270,782.50	2011	272,826.00
2001	296,922.00	2012	327,951.00
2002	308,558.50	2013	193,942.80
2003	310,810.70		
<b>TOTAL</b>			<b>4,012,566.40</b>

Source: PFS on Solid Waste Management, ADB, 2012 and CLENRO Report

Based on 2011 solid waste generation data, the residential had the highest volume of solid waste disposed at controlled dumpsite as shown in table 2.

Table2. Sources of Solid Waste, 2011

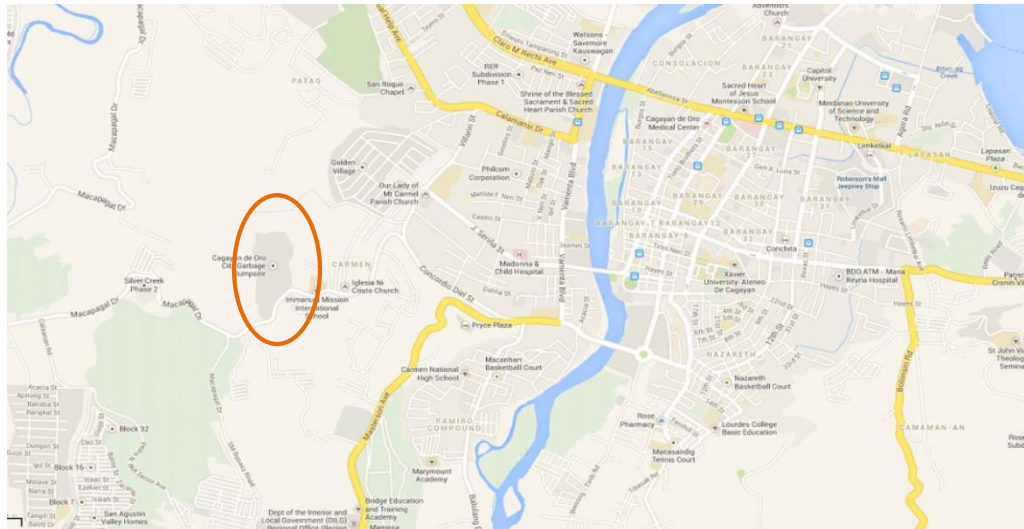
WASTE CATEGORY	% SHARE	BY WEIGHT (ton/day)
Biodegradable Waste	50.00	99.28
Residual Waste	20.00	39.71
Cellophane (plastic bags)	19.40	38.52
Plastic (plastic containers)	1.20	2.38
Cans	1.20	2.38
PVC	0.04	0.08
Paper	1.00	1.98
Wire	0.006	0.02
Iron	0.20	0.40
Carton	5.60	11.12
Empty Sack	0.40	0.80
Empty Bottle	0.80	1.59
Alloy cans	0.15	0.30
<b>Total</b>	<b>100.00</b>	<b>198.56</b>

Source: PFS on Solid Waste Management, ADB, 2012

## 2.3 City Controlled Dumpsite

The City Controlled Dumpsite is located at Upper Dagong, Carmen, Cagayan de Oro City. It is 3.5 kilometers from the City proper. It has a total land area of seventeen (17) hectares with an estimated capacity of 1.9 million cubic meters. Since 1993 – 2013 the accumulated volume of mixed solid waste deposited in the dumpsite had reached to 4,012,566.40 cubic meters which is beyond the estimated capacity of the dumpsite.

Figure2. Vicinity Map, City Controlled Dumpsite



Source: Google Earth

### 2.3.1 Topography

Two ravines form the site, which extends to approximately four (4) hectares.

### 2.3.2 Geology

Quaternary alluvium is found in the dumpsite area consisting of unconsolidated gravel, silts and clays.

### 2.3.3 Hydrogeology

There are several aquifers in the alluvium along the coastline and in Cagayan de Oro River Valley. Interconnections (leakage) between the aquifers are believed to exist in several places, but there are indicators that three (3) major aquifers dominate.

### 2.3.4 Depth of Ground Water

Run-off from the storms and rains is the only surface water present in the dumpsite. Table 3 shows the water level status which determines the depth of water level to four (4) pumping wells (PW) located nearby the dumpsite.

Table3. Well Field, Calaanan, Cagayan de Oro Water District (COWD)

Well Identification	Location	Depth (Meter)	Water Level (Meter)	
			Static	Pumping
PW #10	PN Roa Subdivision	123.0	8.90	30.16
PW #12	PN Roa Subdivision	139.0	6.20	52.10
PW #15	CDO Resettlement	104.3	11.00	37.50
PW #18	Pueblo de Oro	132.0	18.90	33.90

Source: Proposed Cagayan de Oro City Closure and Rehabilitation Plan, 2006-2010

## 2.4 Medical Waste Disposal Facility

One (1) Medical Waste Disposal pits accommodates medical and hazardous wastes from Red Cross, Saint Ignatius, Polymedic Hospital and Diagnostic Centers and Laboratories. The CDO Medical Waste Processing Facility project is operated by BasuraAtbp. Inc. with Environment Compliance Certificate (ECC) issued on January 2013 and Permit to Operate (PTO) one (1) unit Pyroclave issued on December 2013. The facility has been operating without a Treatment, Storage and Disposal (TSD) Registration Certificate pursuant to Republic Act no. 6969 otherwise known as Toxic Substances and Hazardous and Nuclear Waste Act of 1990.

Figure3. Medical Waste Facility



Photos taken during Joint Monitoring with EMB-10, CLENRO and City Health Office (CHO)



## 2.5 Informal Sector in Recycling

Informal sector in recycling is present in the city dumpsite. The waste pickers belong to two (2) groups organized into association with a total of 700 members. Accordingly, there are about 317 families of waste pickers working in City Controlled Dumpsite. They assign around one hundred waste pickers daily on a rotating basis so as not to fill the dumpsite with scavengers and to make waste picking an organized activity to prevent fighting among them.

Since they continuously work in the open dumpsite without any protective covering, their activities greatly expose them to hazardous gases and other vectors of diseases in the dumpsite.

Figure4. Informal Sector in Recycling at City Dumpsite



*Photos taken during dumpsite monitoring*



### III. COMPONENTS OF THE CLOSURE AND REHABILITATION OF THE CITY DUMPSITE

The whole area of the city dumpsite shall be divided into twelve (12) sections. The closure and rehabilitation activities shall be done by sections so that the other sections can still accommodate the solid waste generated in the city while the establishment of an area for sanitary landfill is on-going. The SCRP has the following components:

#### 3.1 Site Clearing

All structures and other facilities within the boundaries of the disposal site shall be removed including the Medical Waste Processing Facility, shed houses of the waste pickers, equipment storage areas and all damaged heavy equipment being junked in the area.

#### 3.2 Stabilization of Critical Slopes

The existing operational procedures done in the controlled dumpsite results in precariously high heaps of garbage. It is necessary to re-profile the waste mound to the designated grade, elevations and slopes. This means cutting the protruding crest of waste and filling up depressions as shown in the topographic survey conducted by the city surveyor (See Annex 2).

The volume of cut will be about 23,000 cubic meters, while the volume of fill needed for the depressed area will be about 190, 000 cubic meters. The slopes shall be ranging from two (2) to four (4) percent to prevent ponding and promote natural drainage. And the cut side slopes shall have the ratio of 1 vertical to 3 horizontal.

In the absence of an existing sanitary landfill for the waste disposal in the area, materials to fill the depress areas will come from the daily waste collection of the city. Based from the daily waste generation of 150 TPD, the filling duration will be for a period of one (1) year. The completion of the fill will be to the design grade and elevations.

#### 3.3 Final Cover

The final cover is applied to a completed disposal facility to act as a barrier to reduce infiltration of water into disposal area, reduce gas migration, prevent the emergence of insects and rodents, and minimize the escape of odor and support vegetation.

The placing of soil cover to areas where the re-profiling is completed will be covered with 600 mm of top soil which is resistance to erosion and suitable for vegetation growth. Top soil shall be spread and compacted by dozer to the design grade, elevation and slopes. Top of soil cover shall have a minimum top slope of five (5) percent to ensure draining and prevent ponding and seeping-in of rain water into the garbage mound.

### **3.4 Drainage Control System**

Run-on and runoff of surface waters can cause erosion and scouring of the final cover as well as water ponding. Therefore, drainage control system must be installed in and along the periphery of the disposal area. Accordingly, the surface waters shall be diverted away from the disposal site at the shortest distance possible to prevent the contact of waste pile with water thereby reducing the potential for leachate generation.

The surface run off drainage system shall be installed at the lowest portion of the mound and above the leachate pipes. An open canal will be excavated to catch the rain surface run off coming from the mound. Water will be collected at the collection pump pit for discharge to the outfall area.

### **3.5 Leachate Management**

Leachate from the waste pile may contaminate the surface water that might drain into the creeks, stream and other natural water bodies. The existing controlled dumpsite is quite far from any water bodies, however, the seepage might contaminate the ground water considering the time where garbage have been deposited in the dumpsite.

Perforated leachate collection system at the lowest bottom of the waste mound 1500mm diameter perforated leachate pipes will be buried one (1) meter below the lower toe of the mound. Concrete Collection man holes shall be installed to collect leachate generated from the waste mound. A portable water pump will pump out the leachate from the manhole and recirculate into the mound to water the vegetation.

### **3.6 Gas Management System**

Landfill gas, such as methane and carbon dioxide, will continue to be generated as long as waste decomposition occurs. Methane is highly combustible gas and may cause explosions. It is necessary to collect the gas and vent it freely, flare it, or recover it for energy use. Extracting gas from the dumpsite has an advantage of reducing the concentration of various chemicals in the leachate.

Gas vents shall be installed at fifty (50) meters apart upon completion of spreading and compacting of soil cover. Perforated 150 mm diameter pipes shall be buried at least 4 meters down the waste mound with perimeter of the buried pipe filled with gravel around the pipe perforation until about half meter from the surface. The remaining half meter will be back filled with soil. The top of the protruding pipes will be a double elbow U bend so that the gas will escape to the atmospheres.

### **3.7 Prevention of Illegal Dumping**

It is possible that there will be some individuals and private haulers may attempt to dispose their wastes and stray animals may enter the closed dumpsite. The following control measures shall be installed:

1. Perimeter fence shall be constructed around the dumpsite consisting of concrete post and barbed wire with cyclone wire gate to enclose the area to prevent strangers and stray animals from entering the closed dumpsite.
2. Signage/billboards shall be installed at conspicuous places prohibiting the burning, squatting and entry of children and stray animals.

### **3.8 Vegetation and Greening**

Vegetation and greening shall be done upon completion of the gas vents installation, grass and vegetation will be planted in areas where the slopes are steeper than 1:3. This is intended to prevent soil erosion. Vetiver grass shall be planted because it has extensive and thick root system that can control erosion and stabilize the slope.

### **3.9 Social Action Plan**

Informal sectors (waste pickers/scavengers) are present in the city dumpsite. Swamping over the thrash has been their main source of livelihood. The closure of the dumpsite impacts their livelihood and in the long run their family's need shall suffer. Moreover, the economic impact of Barangay Carmen is also at risk.

In order to facilitate the smooth implementation of the closure and rehabilitation of the dumpsite, the following activities shall be done:

- a. Rapid Assessment of the affected community including the local barangay of Carmen.
- b. Public Consultation with the barangay and community on the result of the assessment done. In this manner, the issues and concerns of the affected individuals will be eared out so that it will be addressed accordingly.
- c. Organization and Institutionalization of the Barangay Solid Waste Management Committee (BSWMC) of barangay Carmen to facilitate the affected constituents.
- d. Strengthening the existing landfill associations through capacity building on environmental laws, values formation and livelihood trainings.
- e. Provision of capital build up for the associations for their enterprise development.
- f. Relocation of affected families.

## **IV. POST CLOSURE LAND USE PLAN**

The post closure land use plan is necessary to ensure the protection of public health and safety and the environment. This includes inspection, maintenance and monitoring after the implementation of closure activities which shall maintain the integrity and compliance of the closed dumpsite. Likewise, the land shall be utilized into other land use.

## **4.1 Site Management**

### **4.1.1 Final Cover Monitoring and Maintenance**

During the post-closure of the site, the final cover will be inspected regularly. Monitoring and maintenance activities shall be performed in order to maintain the integrity and effectiveness of the final cover system. The quarterly monitoring and assessment shall include inspection of the final cover for vegetation, erosion, and the surface water drainage system. The erosion, cuts, and depressions in the final cover and the damage, debris and sediment build-up in the drainage system shall be noted. The maintenance activities will include final cover repairs to fill erosion cuts and low areas. As necessary, drainage systems will be cleared of debris and sediment to facilitate continued performance. Maintenance shall be carried out as needed prior to the next scheduled quarterly inspection.

### **4.1.2 Groundwater Monitoring**

Groundwater monitoring activities shall continue throughout the post-closure care period. Groundwater sampling and analysis shall be done as the need arises. Maintenance of the ground water monitoring system will be performed as needed. The need for maintenance will be determined through inspection of the wells during the regular monitoring.

### **4.1.3 Gas Monitoring**

Dumpsite gas monitoring shall continue throughout the post-closure care period. Gas vents shall be monitored regularly. The need for maintenance shall be based on the result of the monitoring and shall be done prior to the next monitoring.

## **4.2 Land Utilization**

The closed dumpsite shall be having another land use. The following land uses and projects are possible in the area:

1. Ecological Park (Eco Park) is an alternative facility in the absence of a sanitary landfill. The solid waste collected in the city shall be properly managed and items with value shall be recycled and be made marketable to provide source of income to the people living near the city controlled dumpsite.
2. Waste-to-Energy Project is utilizing the methane gas from the dumpsite to generate electricity.
3. Other uses

## **4.3 Environmental Monitoring Framework**

As stated in ATC issued on June 2010, the progress of the closure and rehabilitation of the dumpsite is subject to periodic compliance monitoring and validation. The City Government of Cagayan de Oro is mandated to submit a monthly report to EMB – 10

using the Checklist for Site and Operational Improvements and Environmental Monitoring. A Project Monitoring Team (PMT) shall be created in order to have a transparent project implementation.

Figure5. Organization Structure, PMT

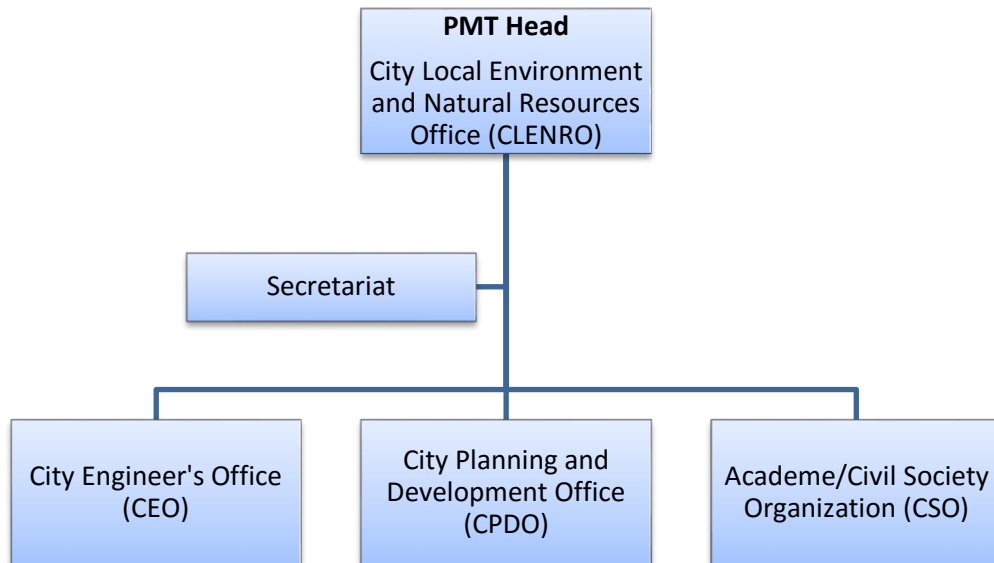
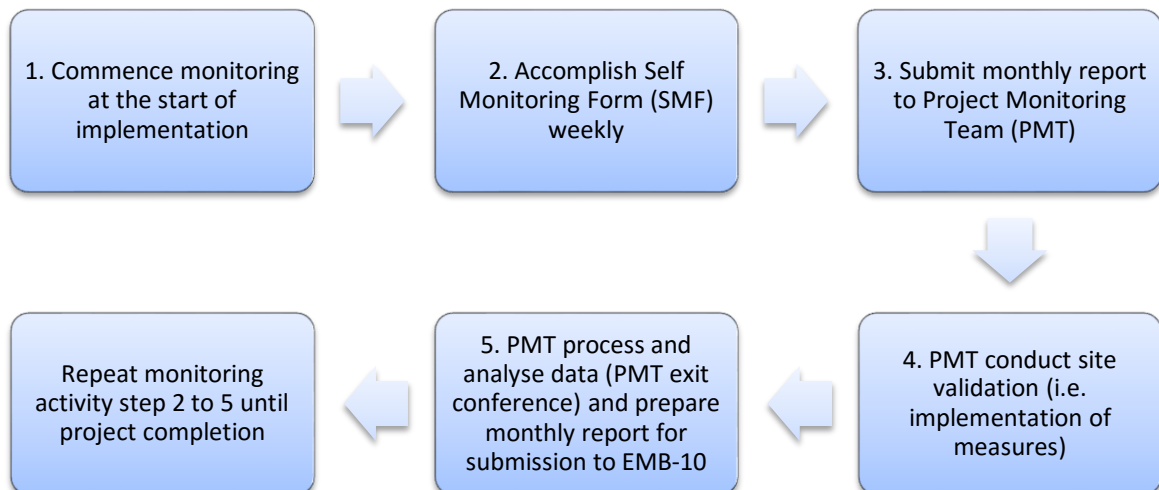


Figure6. Compliance Monitoring and Reporting Framework



**V. IMPLEMENTATION SCHEDULE**

The Closure and rehabilitation of the City Dumpsite will be completed in one (1) year. The plan and implementation of a regular sanitary landfill has to be undertaken so that upon completion of the closure, waste will be disposed to the sanitary landfill.

Table3. Proposed Schedule of Activities for Implementation

COMPONENT	ACTIVITIES	DURATION (Month)												
		1	2	3	4	5	6	7	8	9	10	11	12	
<b>A. CLOSURE AND REHABILITATION</b>														
<b>1. Site Clearing</b>	<ul style="list-style-type: none"> <li>Removal of structures</li> </ul>													
<b>2. Stabilization of Critical Slopes</b> (Re-profiling Existing Waste with 3:1 Side Slope)	<ul style="list-style-type: none"> <li>Cut side slopes 3:1</li> <li>Spreading, backfilling, leveling and compaction</li> </ul>													
<b>3. Drainage Control System</b>	<ul style="list-style-type: none"> <li>Construction of open drain ditch</li> </ul>													
<b>4. Leachate Management</b>	<ul style="list-style-type: none"> <li>Installation of leachate pipes                             <ul style="list-style-type: none"> <li>Excavation</li> <li>Pipe laying</li> <li>Gravel bedding</li> <li>Backfilling and compaction</li> </ul> </li> </ul>													
	<ul style="list-style-type: none"> <li>Installation of leachate collection station (manhole)                             <ul style="list-style-type: none"> <li>Installation of concrete manhole</li> <li>Installation of water</li> </ul> </li> </ul>													

	pump																		
<b>5. Gas Management</b>	<ul style="list-style-type: none"> <li>• Installation of vent pipes                             <ul style="list-style-type: none"> <li>- Excavation</li> <li>- Pipe laying</li> <li>- Gravel bedding</li> <li>- Backfilling and compaction</li> </ul> </li> </ul>																		
	<ul style="list-style-type: none"> <li>• Installation of monitoring wells                             <ul style="list-style-type: none"> <li>- Pipe laying and drilling</li> <li>- Gravel bedding</li> </ul> </li> </ul>																		
<b>6. Prevention of Illegal Dumping</b>	<ul style="list-style-type: none"> <li>• Construction of perimeter fence</li> </ul>																		
	<ul style="list-style-type: none"> <li>• Public awareness program</li> </ul>																		
	<ul style="list-style-type: none"> <li>• Putting up of signage/billboards</li> </ul>																		
	<ul style="list-style-type: none"> <li>• Dumpsite maintenance office/shed</li> </ul>																		
<b>7. Vegetation and Greening</b>	<ul style="list-style-type: none"> <li>• Planting and growing of vetiver</li> </ul>																		
<b>8. Social Action Plan</b>	<ul style="list-style-type: none"> <li>• Assessment of impacted community</li> </ul>																		
	<ul style="list-style-type: none"> <li>• Public Consultation (stakeholders- BLGU Carmen, Landfill Associations,</li> <li>• Organizing and Institutionalization of the BSWM Committee</li> </ul>																		

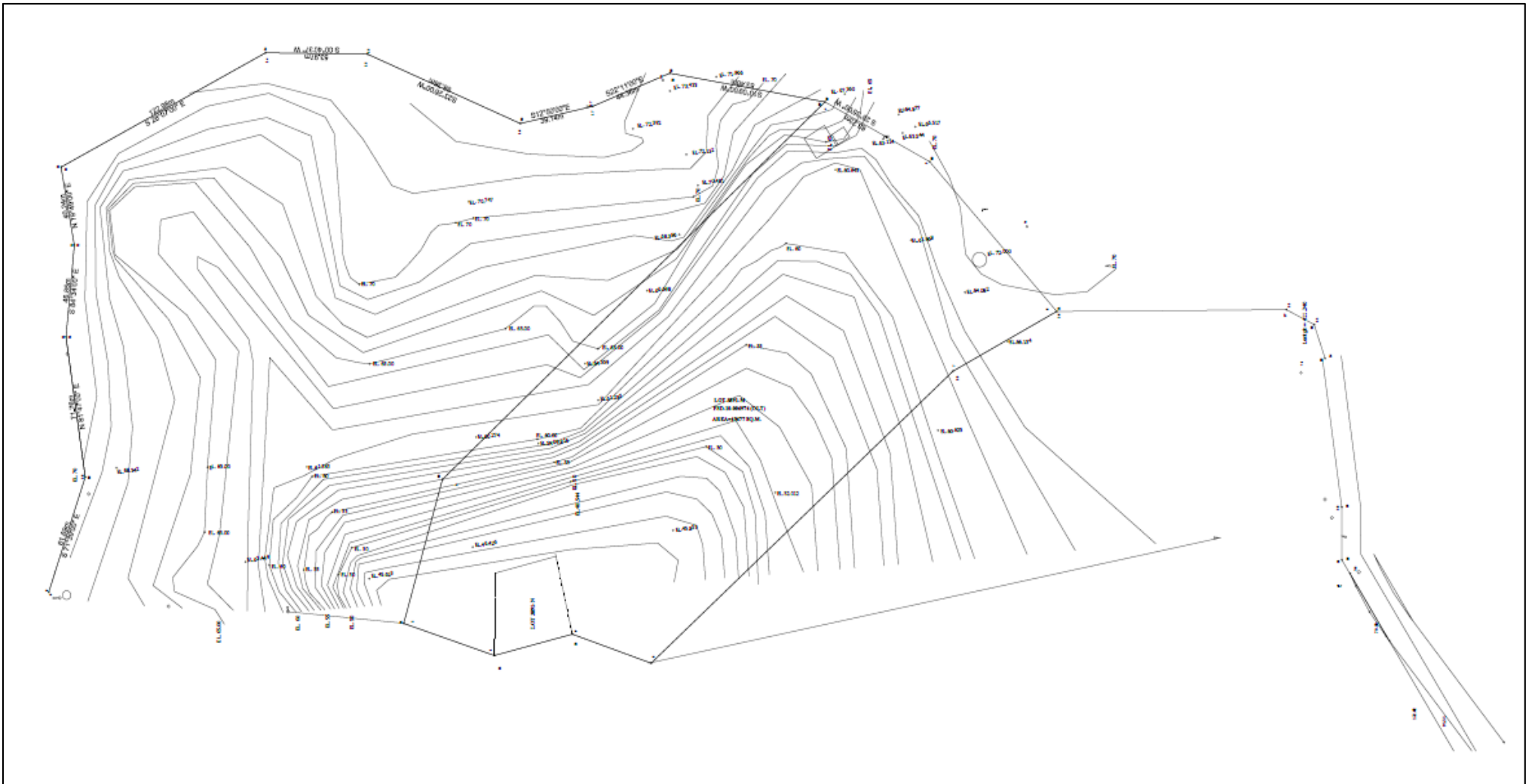


	(pilot- carmen) & Association													
	<ul style="list-style-type: none"> <li>• Capacity building</li> <li>• Enterprise development of affected individuals                             <ul style="list-style-type: none"> <li>- Household</li> <li>- Association</li> </ul> </li> </ul>													
	<ul style="list-style-type: none"> <li>• (Security and Tenure) Relocation affected families</li> </ul>													

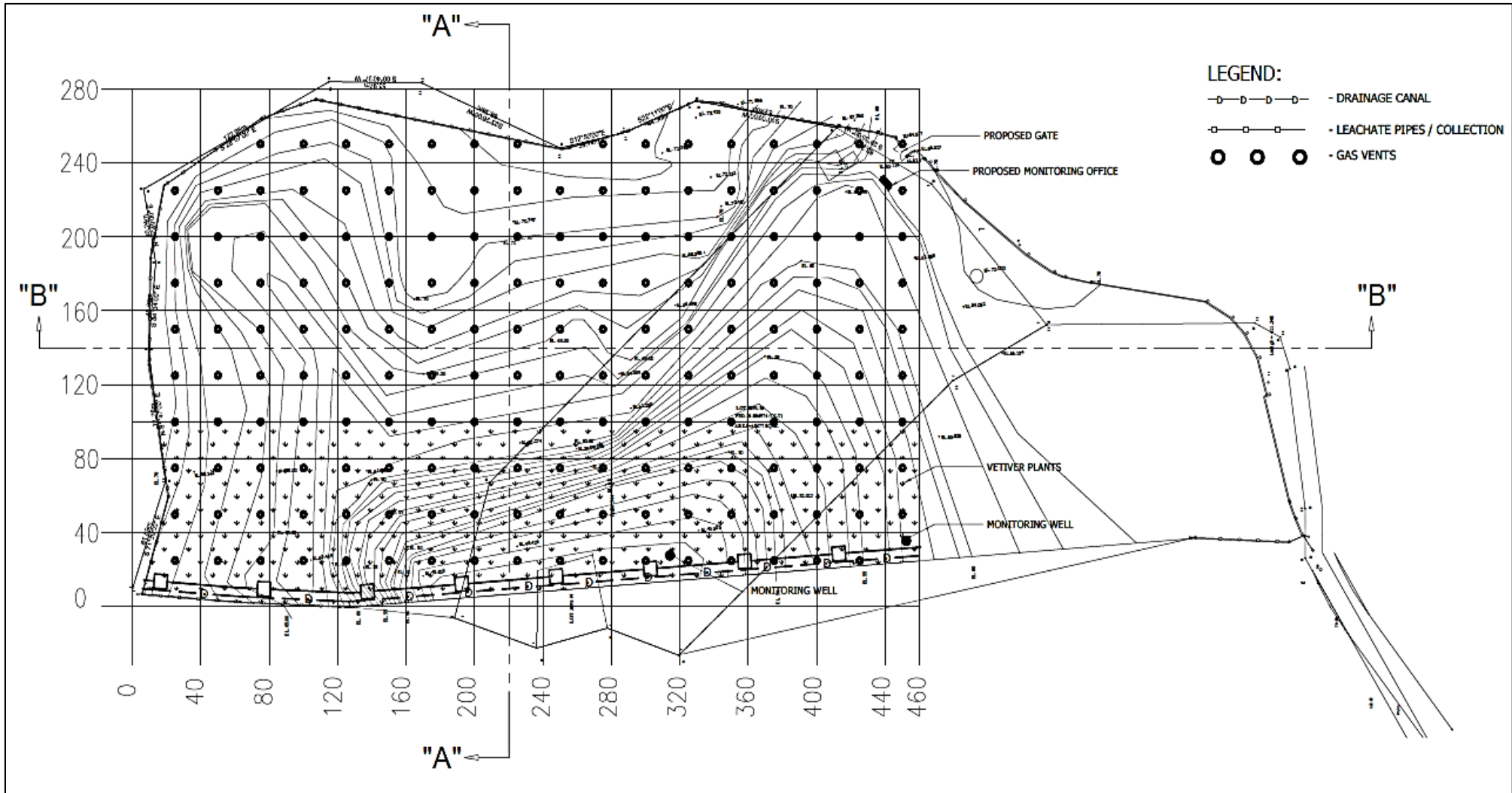
**VI. BUDGETARY REQUIREMENTS**

<b>COMPONENT</b>	<b>ACTIVITIES</b>	<b>AMOUNT (Php)</b>
Site Clearing	<ul style="list-style-type: none"> <li>• Cut side slopes 1:3</li> <li>• Spreading/Backfilling, Leveling &amp; Compaction</li> </ul>	8,769,000.00
Stabilization of Critical Slopes	<ul style="list-style-type: none"> <li>• Cut side slopes 1:3</li> <li>• Spreading/Backfilling, Leveling &amp; Compaction</li> </ul>	
Final Cover and Maintenance	<ul style="list-style-type: none"> <li>• Top Soil 600 mm (Spreading/Backfilling, Leveling &amp; Compaction)</li> <li>• Access Road (gravel) 0.25m x 6 m</li> </ul>	64,443,000.00
Drainage Control System	<ul style="list-style-type: none"> <li>• Construction of Open Drain Ditch Excavation (1.0m x 1.0m)</li> </ul>	65,250.00
Leachate Management	<ul style="list-style-type: none"> <li>• Installation of Leachate Pipes</li> <li>• Leachate Collection/ Station Manhole</li> </ul>	1,280,000.00
Gas Management	<ul style="list-style-type: none"> <li>• Installation of vent pipes</li> <li>• Installation of monitoring wells</li> </ul>	2,322,780.00
Prevention of Illegal Dumping	<ul style="list-style-type: none"> <li>• Construction of perimeter fence</li> <li>• Putting of signage/ billboards</li> <li>• Dumpsite maintenance shed house</li> </ul>	663,500.00
Vegetation and Greening	<ul style="list-style-type: none"> <li>• Planting of vetiver gras</li> </ul>	4,000,000.00
Social Action Plan	<ul style="list-style-type: none"> <li>• Community rapid assessment</li> <li>• Public consultation</li> <li>• BSWMC organization and institutionalization</li> <li>• Capacity Building</li> <li>• Enterprise Development</li> <li>• Relocation</li> </ul>	700,000.00
Post Closure Monitoring and Maintenance	<ul style="list-style-type: none"> <li>• Monitoring and maintenance (20%)</li> </ul>	16,450,016.00
<b>GRAND TOTAL</b>		<b>98,700,096.00</b>

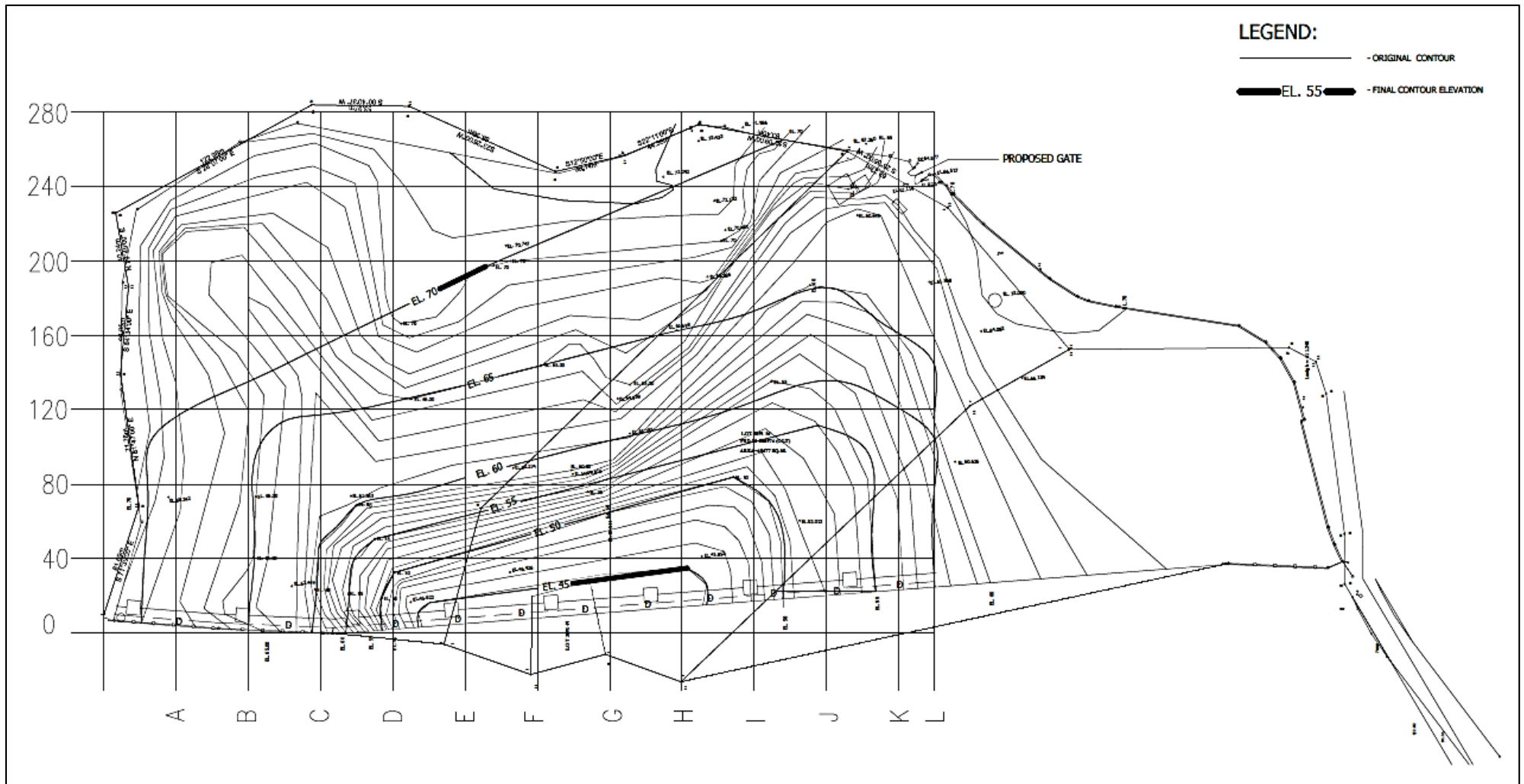
# ANNEXES



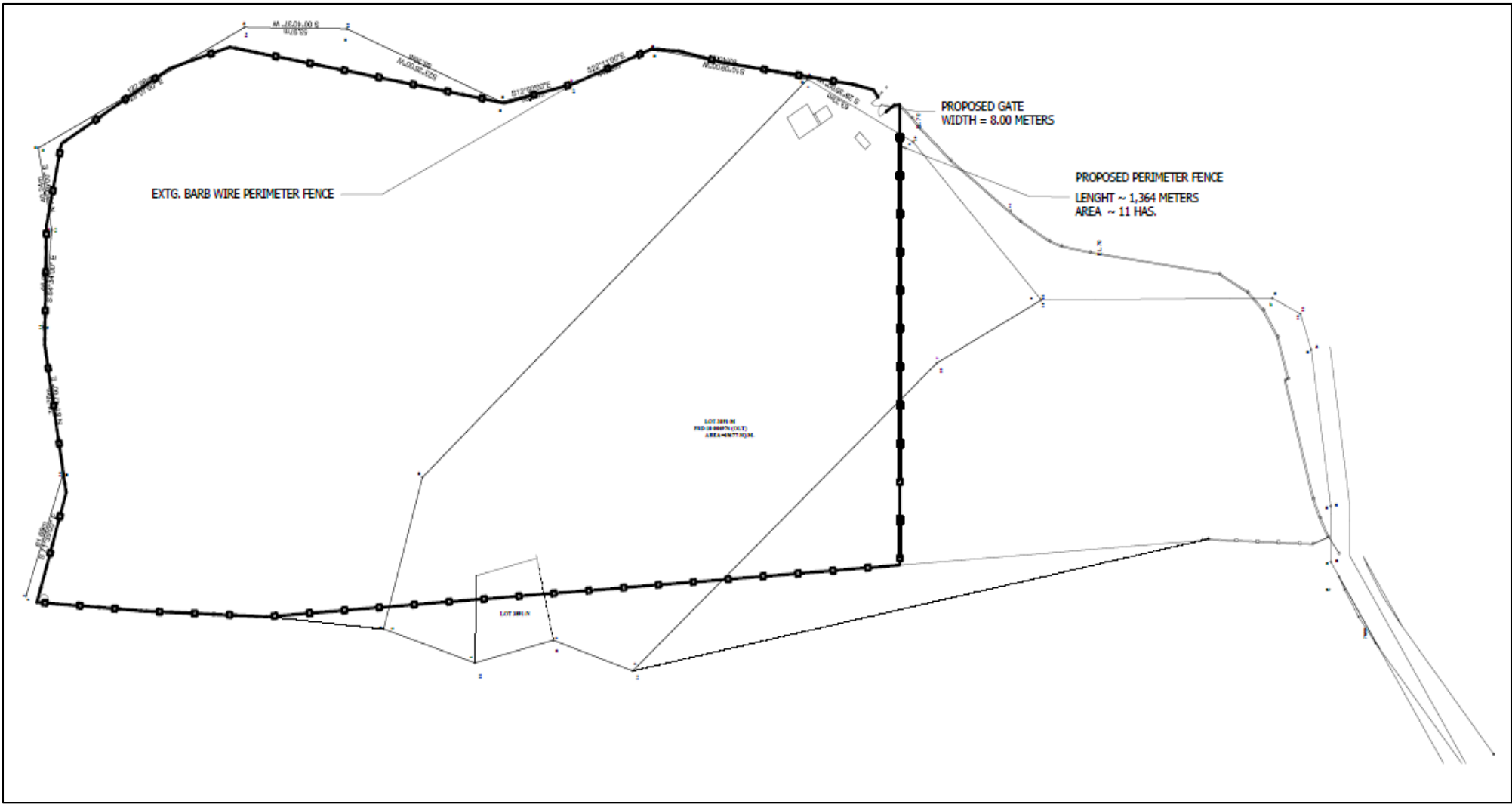
TOPOGRAPHIC PLAN



SITE DEVELOPMENT PLAN

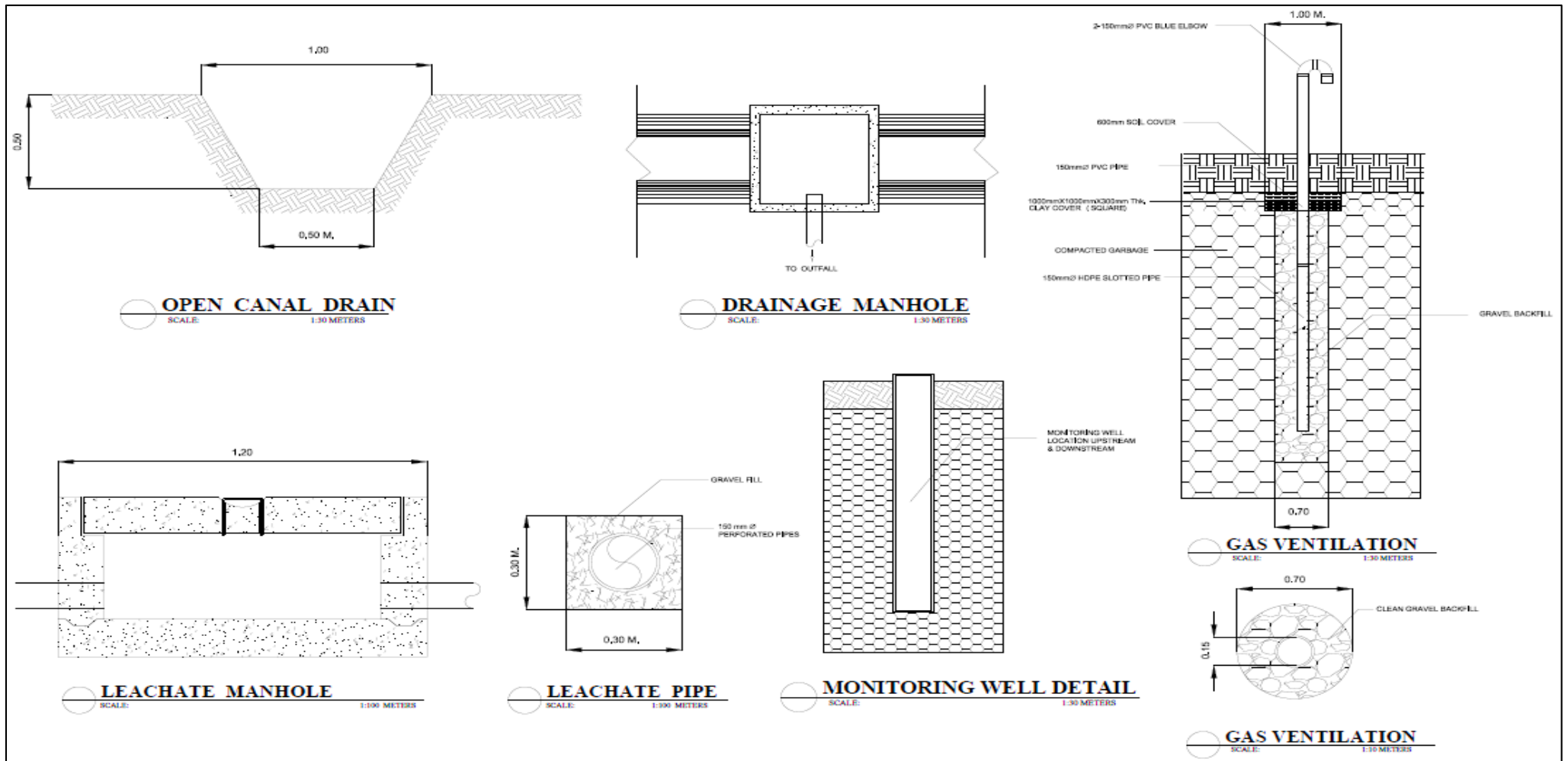


SITE GRADING PLAN

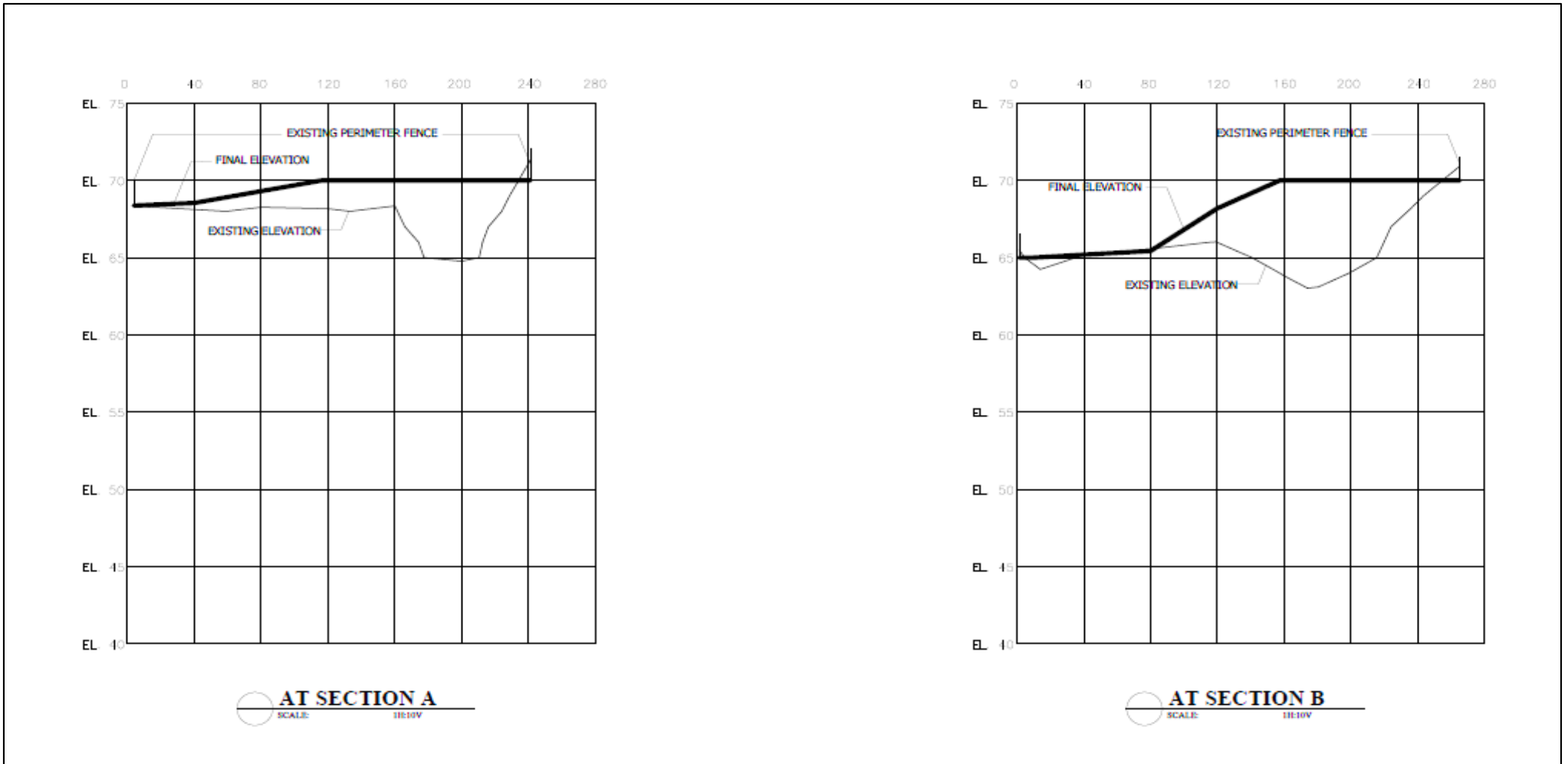


PERIMETER/FENCING PLAN

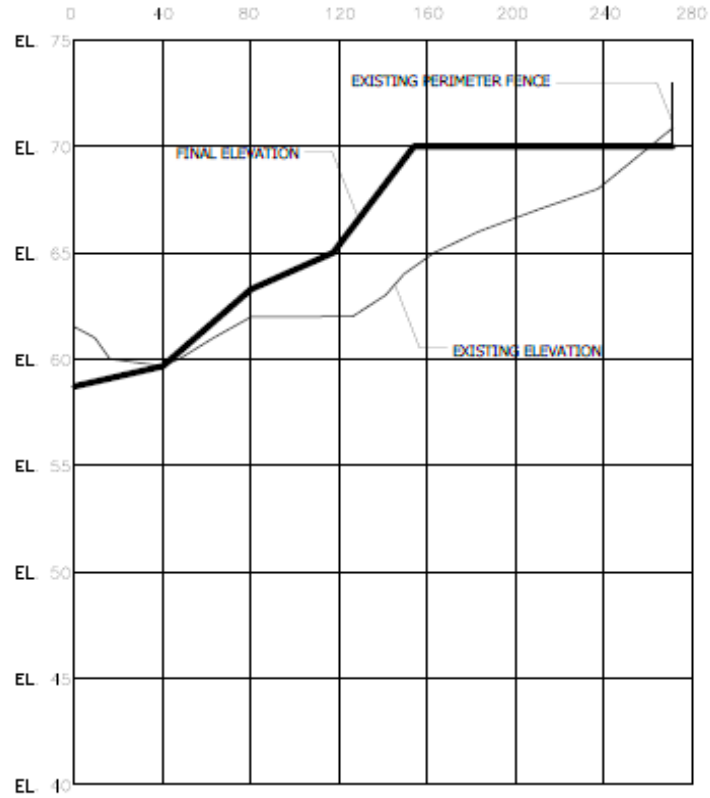




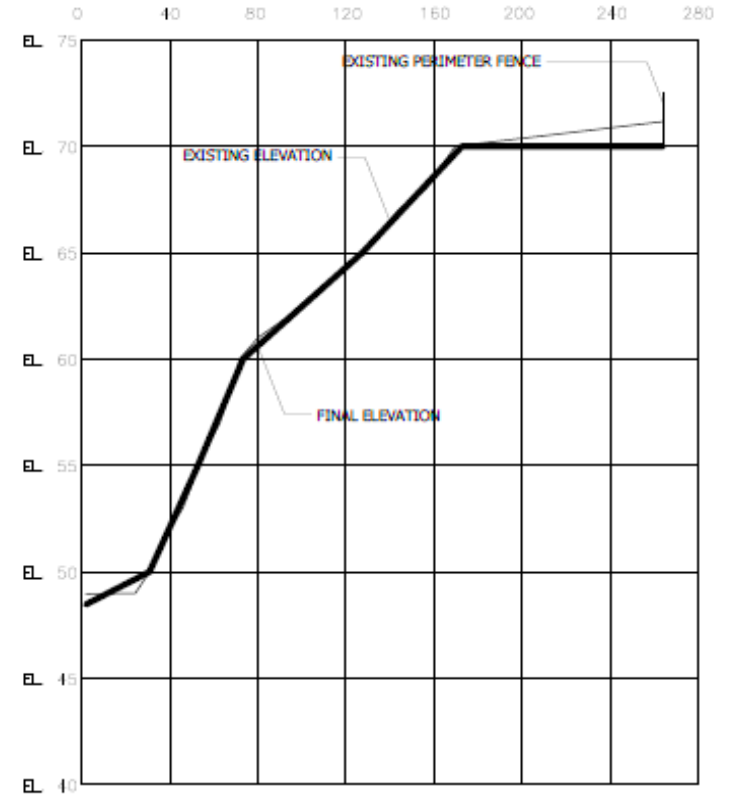
**DRAINAGE CONTROL SYSTEM, LEACHATE MANAGEMENT SYSTEM AND GAS MANAGEMENT SYSTEM**



SECTIONS A & B

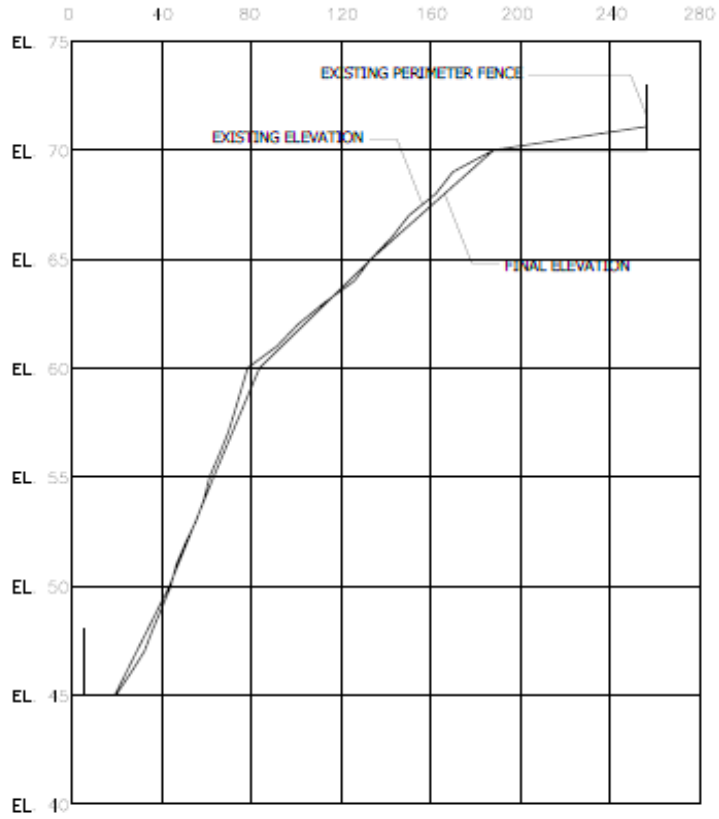


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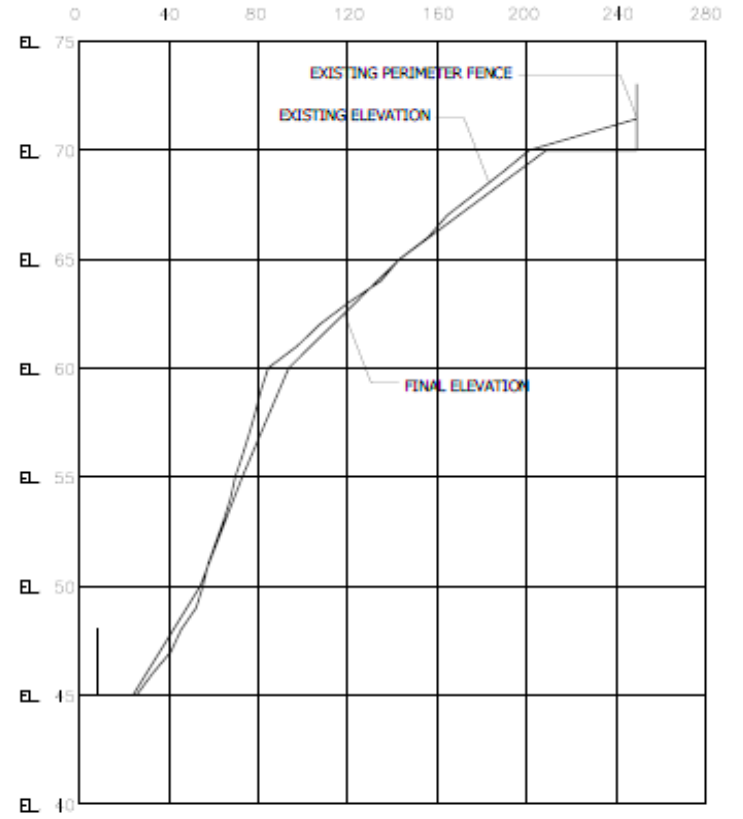


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**SECTIONS C & D**

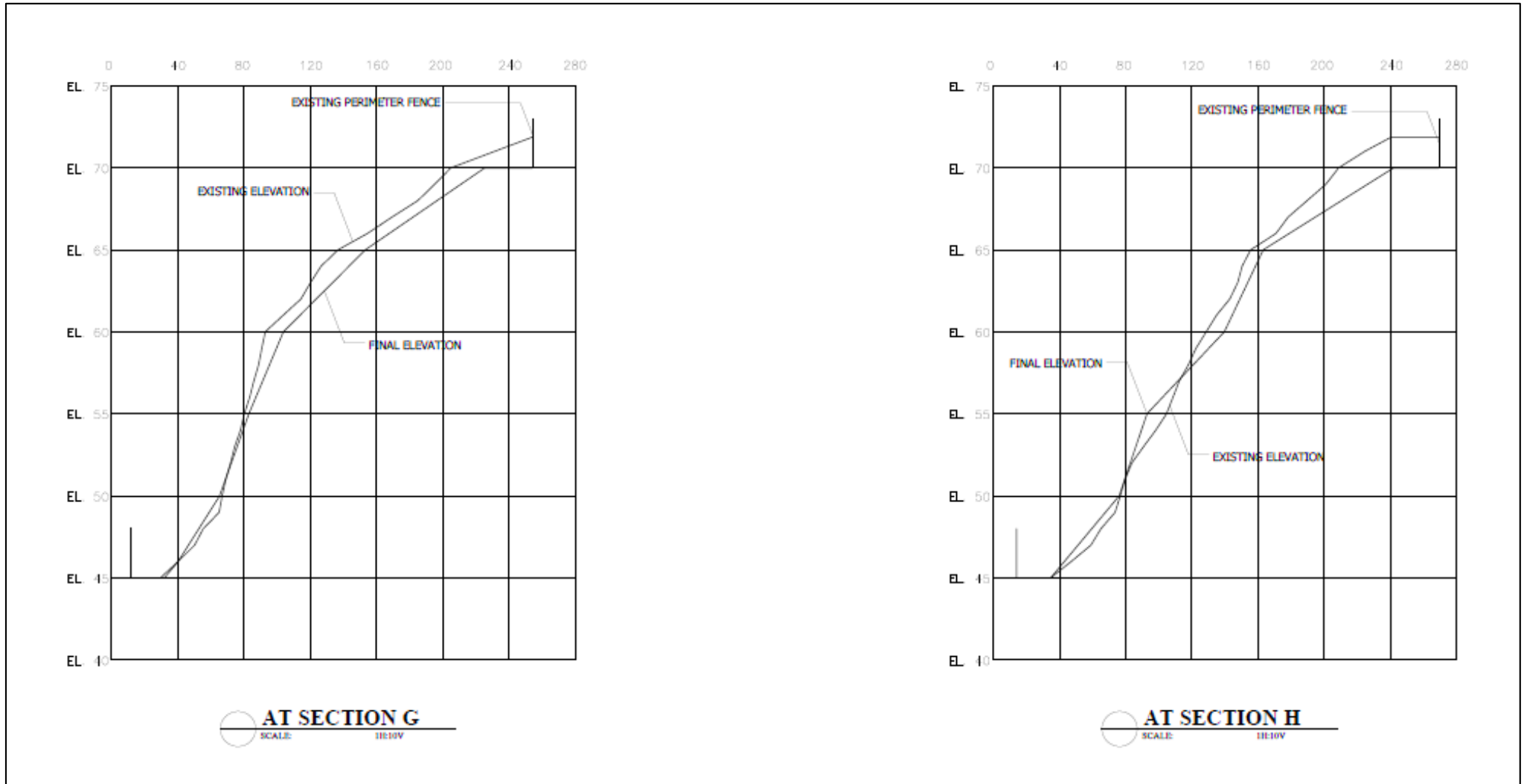


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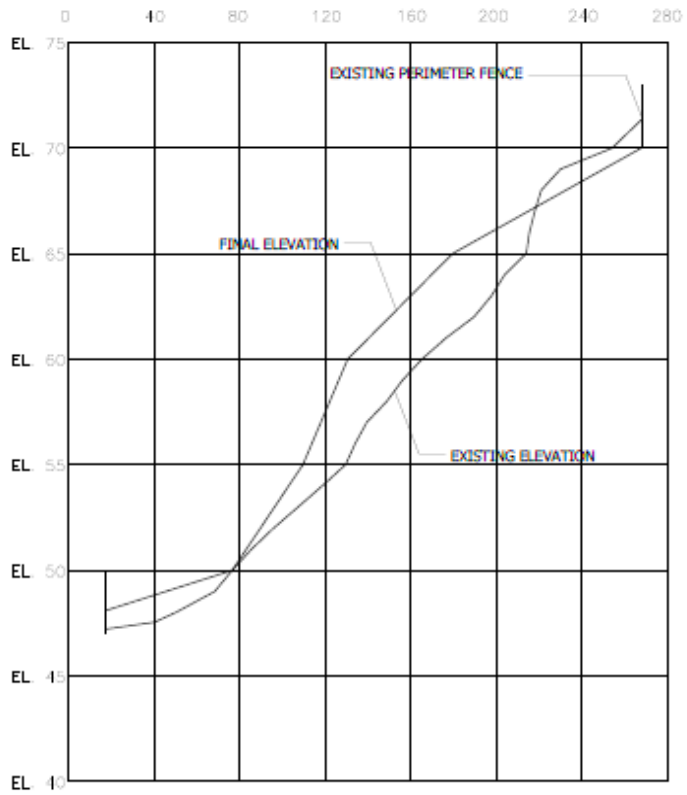


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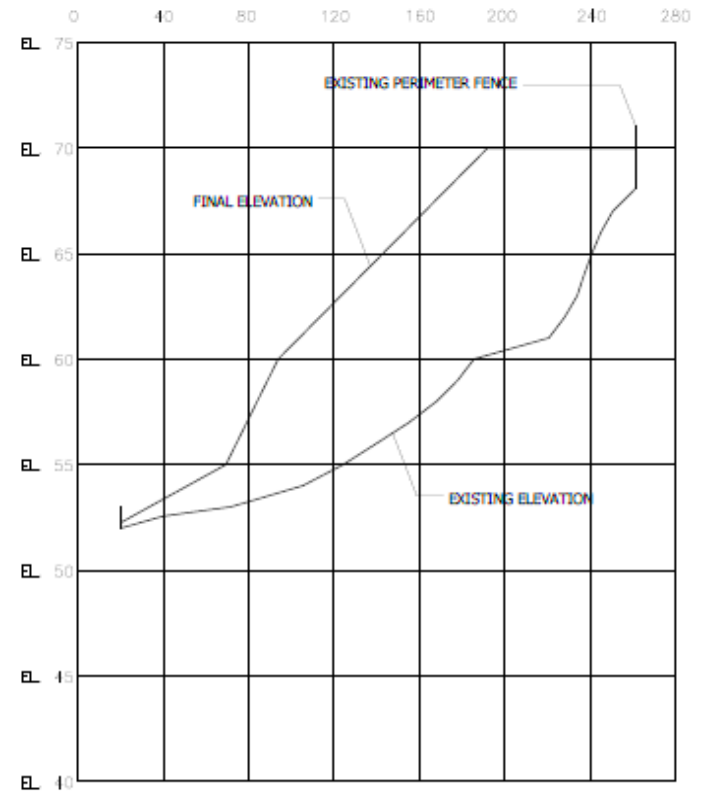
**SECTIONS E & F**



SECTIONS G & H

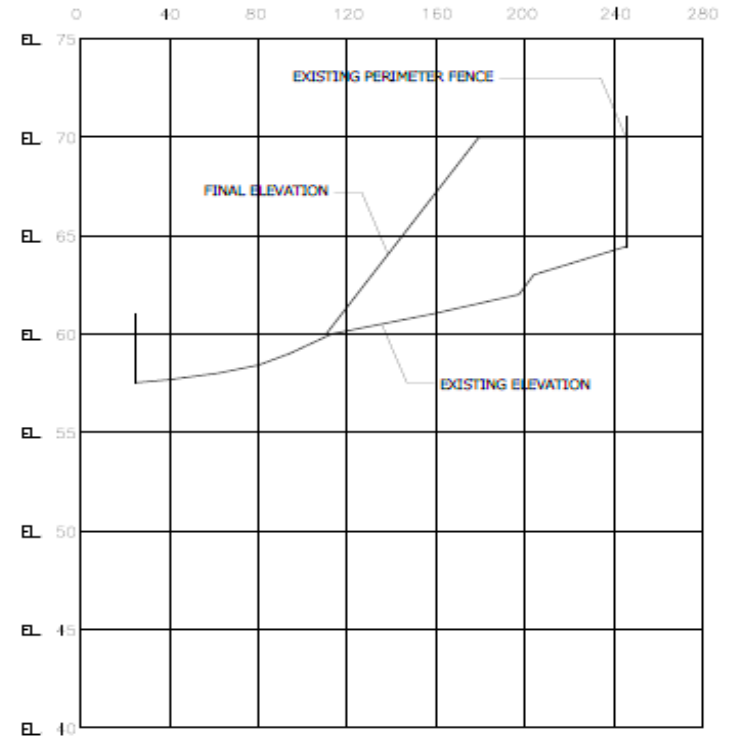
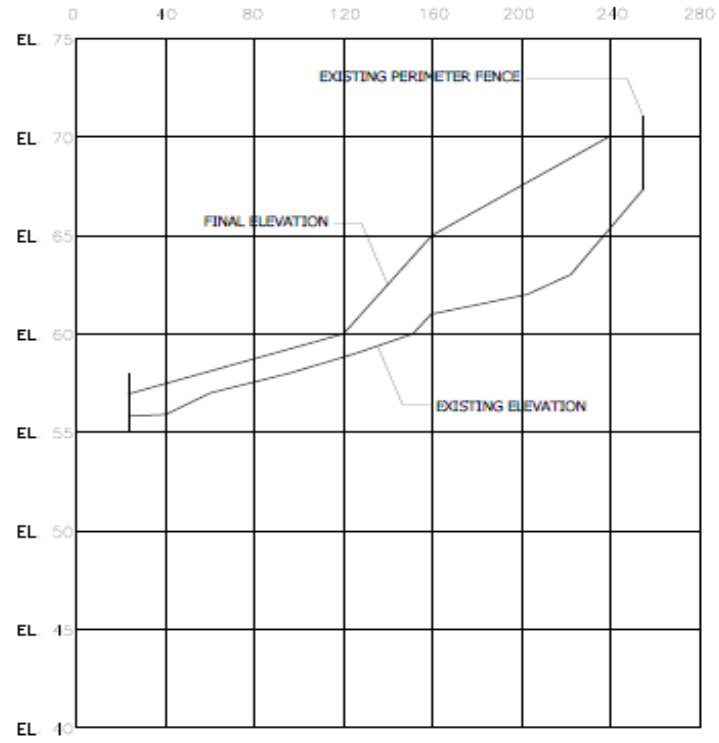


**AT SECTION I**  
SCALE: 1/8"=10'



**AT SECTION J**  
SCALE: 1/8"=10'

**SECTIONS I & J**



SECTIONS K & L