THE 2nd MALAYSIA NATIONAL SEWERAGE CONFERENCE

APPLICATION OF GREEN TECHNOLOGY IN EXISTING SEWAGE TREATMENT PLANTS:

CASE STUDIES OF FIVE STPs IN KL AND SELANGOR.

12 AUGUST 2015

JABATAN PERKHIDMATAN PEMBETUNGAN

Universiti Kebangsaan Malaysia
The National University of Malaysia

KeTTHA
KEMENTERIAN TENAGA, TEKNOLOGI HIJAU DAN AIR

Ranhill
ranhill consulting sdn bhd

SCOPE OF STUDIES

- INSPECTION OF STPs
- IDENTIFY SUITABLE GREEN TECHNOLOGIES
- PROPOSE GREEN TECHNOLOGY APPLICATIONS
- DESIGN OF PILOT PROJECT
- TENDER DOCUMENTATION FOR PILOT PROJECT

STUDY LOCATIONS

STP BANDAR TUN RAZAK (KLR 129)

- PROCESS SYSTEM - SBR
- DESIGN CAPACITY – 100,000 PE
- CURRENT OPERATION – 71,200 PE

STP SUNGAI BESI (KLR 340)

- PROCESS SYSTEM - ORBAL
- DESIGN CAPACITY – 82,500 PE
- CURRENT OPERATION – 58,512 PE
- SLUDGE TREATMENT FACILITIES INCLUDE ANAEROBIC DIGESTER

STUDY LOCATIONS

STP PUCHONG (KLR 336)

- PROCESS SYSTEM - ADVANCED CAS
- DESIGN CAPACITY – 150,000 PE
- CURRENT OPERATION – 161,341 PE

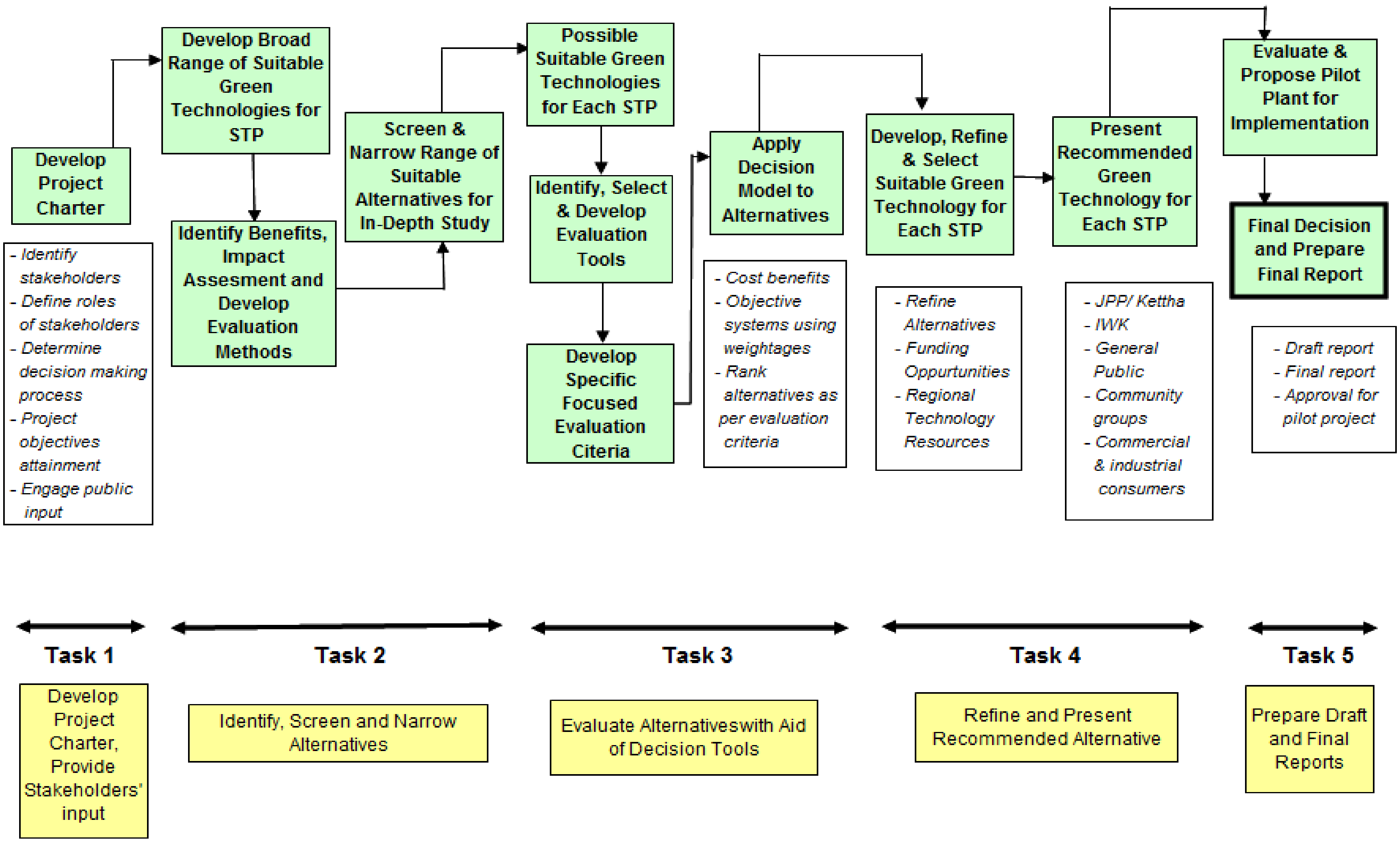
STP DAMANSARA (KLR 354)

- PROCESS SYSTEM - OXIDATION DITCH
- DESIGN CAPACITY – 100,000 PE
- CURRENT OPERATION – 70,701 PE

STP CYBERJAYA A (GSG 109)

- PROCESS SYSTEM - EXTENDED AERATION
- DESIGN CAPACITY – 100,000 PE
- CURRENT OPERATION – 30,000 PE

STUDY PROCESS FLOW CHART



Summary of Finding on Plants Operation

Specific Process at STP	Puchong STP Conventional Sludge (ACAS) Advanced Activated			Cyberjaya STP A Extended Aeration (EA)			Bandar Tun Razak STP Sequencing Batch Reactor (SBR)			Sungai Besi STP Modified Oxidation Ditch (MOD)			Damansara STP Advanced Oxidation Ditch (AOD)		
Stability of Influent Characteristics															
Flow [m³/d] Flow per Pe.day (l/Pe.day)	21,467 133			9,211 263			17,920 251			8,787 150			11,872 168		
BOD [mg/L]	106	Consistent		50-74	Consistent		98-162	Consistent		40-227	Vary		35-39	Consistent	
BOD/COD	0.37	Sewage		0.30-0.47	Sewage		0.32-0.52	Sewage		0.11-0.53	Mixed sewage + industrial wastewater		0.05-0.10	Mixed sewage + industrial wastewater	
TSS [mg/L]	114	Vary		63-170	Vary		52-120	Consistent		108-680	Vary		74-292	Vary	
Aeration Basin Environment															
	Design value	Obtained value		Design value	Obtained value		Design value	Obtained Value		Design value	Obtained Value		Design value	Obtained value	
F/M [kgBOD/kgMLVSS.day]	0.25-0.50	0.075	√	0.05-0.15	0.22	×	0.05-0.30	0.12	√	0.05-0.15	0.052	√	0.05-0.10	0.017	√
DO [mg/L]	>1.0	0.79-5.484	√	>1.0	3.50-4.78	√	>1.0	0.72-0.80	√	>1.0	1.83-1.86	√	>1.0	0.20-1.98	√
MLSS [mg/L]	1500-3000	2108-4333 (3574)	√	2500-5000	364-472 (459)	×	3000-6000	2190-3650 (2888)	√	2500-5000	3000	√	2500-5000	1770-2760 (2440)	√
SRT [day]	5-10	9.71	√	15-25	19.29	√	10-30	33.93	√	20-30	5.27	×	20-30	34.56	√
HRT [hour]	5-14	11.87	√	20-35	22.19	√	15-40	20.42	√	15-35	13.66	√	20-35	31.54	√
Clarifier Conditions															
SVI [mL/g]	80-200	321-558	×	80-200	208-373	×	80-200	182-212	√	80-200	345-962	×	80-200	128-358	×
Sludge Generation															
Dewatered sludge [tonne/day]	20			No generation			6.07			**8.18			6.55		
Production rate [kg/m³ treated influent]	0.932						0.339			0.931			0.551		
** Note: *estimated based on flow and F/M ratio of Puchong STP															

FINDINGS ON EFFLUENT QUALITY

Average concentration of various parameters in the influent and effluent of the STPs

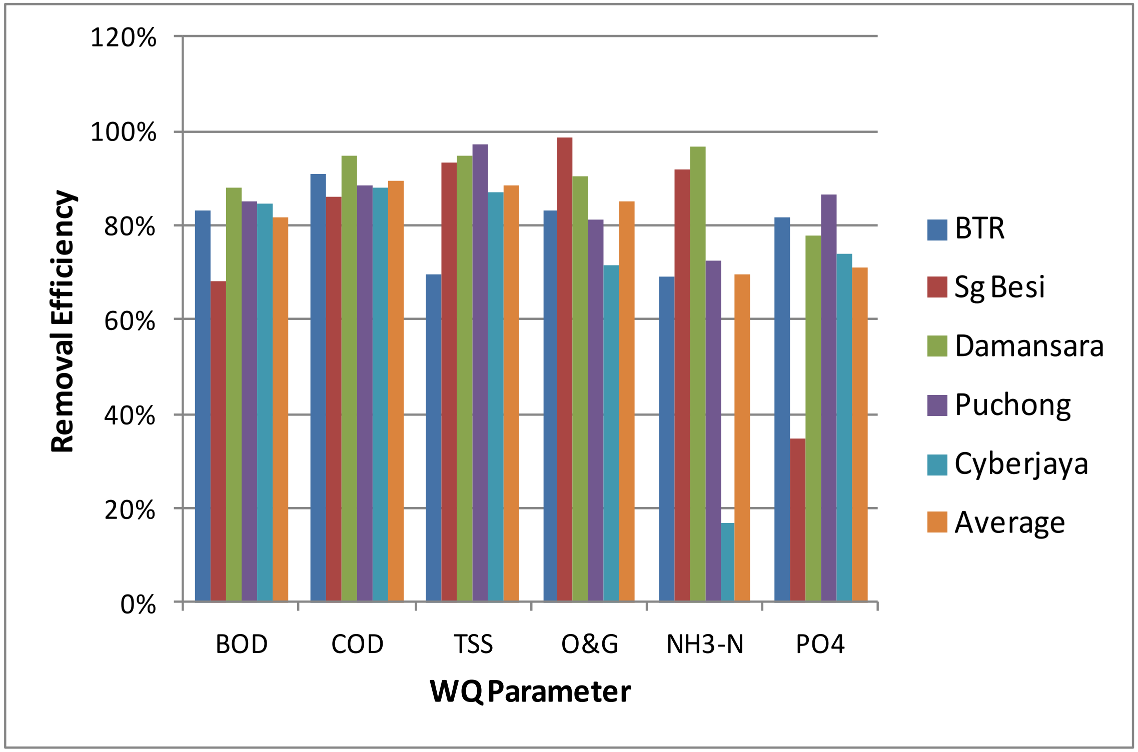
Parameters	Unit	Bandar Tun Razak		Sg Besi		Damansara		Puchong		Cyberjaya	
		Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent	Influent	Effluent
Biochemical Oxygen Demand @ 20^0C, 5 days	mg/l	108	18	71	22.5	37	4.5	53	8	75.5	11.5
Chemical Oxygen Demand	mg/l	259	23.5	642	90	558	29.5	285	33	219	26.5
Total Suspended Solids	mg/l	82	25	394	27	183	10	3550	106	170	22
Oil & Grease	mg/l	12	2	64	1	46	4.5	10.5	2	3.5	1
Ammoniacal Nitrogen (NH_3-N)	mg/l	27	8.4	137	11.2	31.43	0.98	32.3	8.96	21.995	18.27
Total Phosphorus	mg/l	12.03	2.215	17.775	11.625	10.77	2.37	7.745	1.035	4.86	1.265

Source: UiTM - A&A Laboratory, 2013

FINDINGS ON EFFLUENT QUALITY

Removal efficiency of various WQ parameters by respective STPs

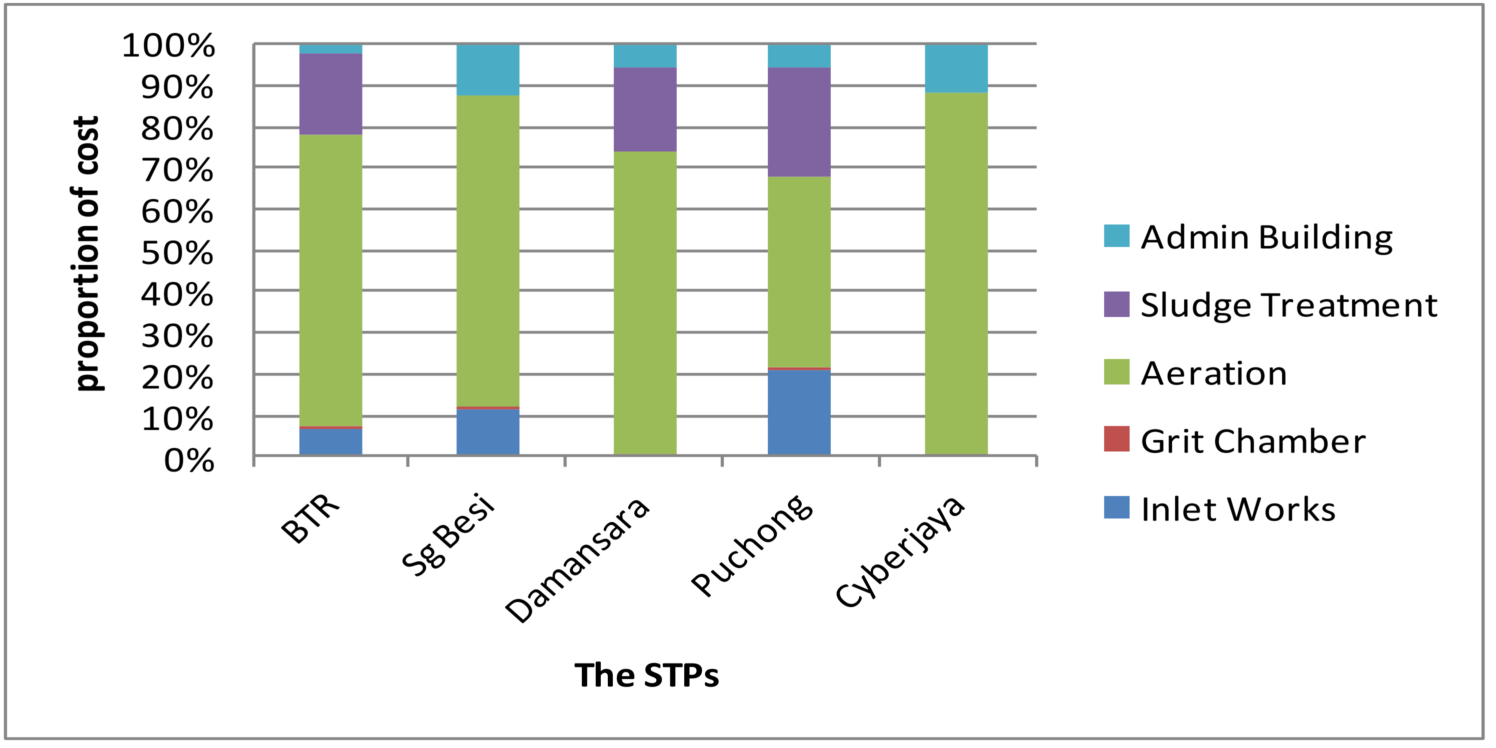
STPs	BOD	COD	TSS	O&G	NH_3-N	PO_4
BTR	83%	91%	70%	83%	69%	82%
Sg Besi	68%	86%	93%	98%	92%	35%
Damansara	88%	95%	95%	90%	97%	78%
Puchong	85%	88%	97%	81%	72%	87%
Cyberjaya	85%	88%	87%	71%	17%	74%
Average	82%	90%	88%	85%	69%	71%



SUMMARY OF ENERGY COST

Percentage energy consumption by various components of the STPs

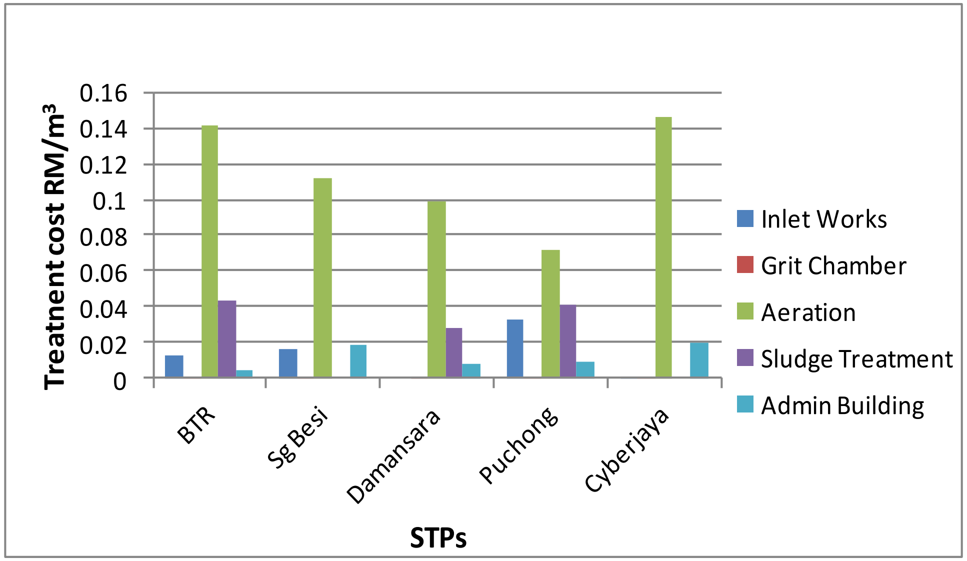
	% of Average Daily Energy Consumption				
STP Component	BTR	Sg Besi	Damansara	Puchong	Cyberjaya
Inlet Works	6.60	11.25		20.99	0.10
Grit Chamber	0.40	0.76	0.29	0.75	0.36
Aeration	70.92	75.45	73.46	46.41	87.55
Sludge Treatment	20.07		20.56	26.09	
Admin Building	2.02	12.54	5.70	5.76	11.99
Overall	100.00	100.00	100.00	100.00	100.00

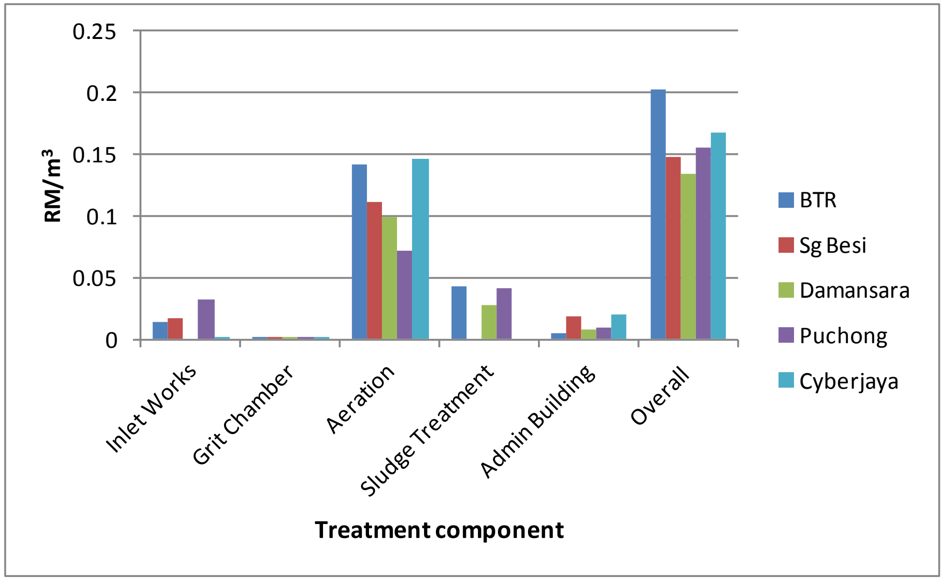


SUMMARY OF ENERGY COST

Average energy cost of various components of the STPs (RM/m³)

	Energy cost of various components (RM/m³)				
	BTR	Sg Besi	Damansara	Puchong	Cyberjaya
Inlet Works	0.0132	0.0166		0.0326	0.0002
Grit Chamber	0.0007	0.0011	0.0004	0.0012	0.0006
Aeration	0.1416	0.1115	0.0986	0.0722	0.1461
Sludge Treatment	0.0433		0.0276	0.0406	
Admin Building	0.0044	0.0185	0.0077	0.0090	0.0200
Overall	0.2032	0.1478	0.1342	0.1556	0.1669





GUIDING PRINCIPLES IN ADOPTING GREEN TECHNOLOGY

1 <u>Process intensification & optimisation</u>, via:

- Ensuring high MLSS concentrations without affecting effluent clarity
- Generating denser sludge for easier sludge management
- Generate biogas from sludge, saving on offsite disposal costs.
- Ensuring more reliable and higher nutrient removal for both N and P to meet the required limits
- Process control to ensure stability and minimised chemical requirement, if any
- Optimised equipment usage to ensure longer life and lower energy requirement
- Operator friendly SOP to ensure optimised operation and monitoring for continuous improvement.

GUIDING PRINCIPLES IN ADOPTING GREEN TECHNOLOGY

2 Energy savings, via:

- Optimisation of aeration and pumping,
- Lowering of aeration requirements
- Substitution of equipment with lower energy units
- Power generation from biogas (sludge)
- Solar power generation
- Microturbines' generation

GUIDING PRINCIPLES IN ADOPTING GREEN TECHNOLOGY

3 **Resource recovery**, via:

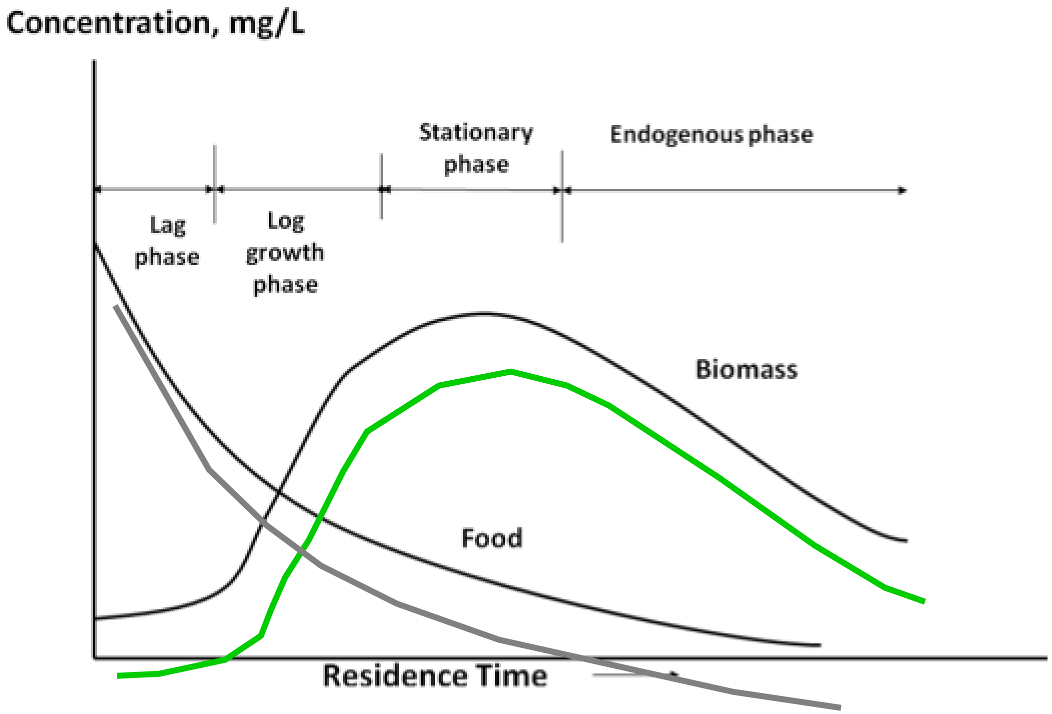
- Energy recovery from sludge
- Effluent polishing for reuse using green technology
- Biofertiliser production using green technology from final sludge

4 **Emission minimisation**

- Emission of effluent meeting desired standard with respect to organics and nutrients N and P
- Minimisation of aerosols
- Minimisation of odour if any

PATHWAYS OF ORGANIC DESTRUCTION

Conventional STP:	Organics → CO_2 + sludge
Green STP:	Organics → Biogas → Energy + CO_2 + sludges → Biofertiliser



Variation of biomass yield with food availability

NOTE: Biomass yield is fastest at the log growth phase, where the content of volatiles of biomass is at highest concentration

BRIEF CONFIGURATION OF STP WITH BIOGAS, FERTILISER AND WATER RECOVERY FACILITIES

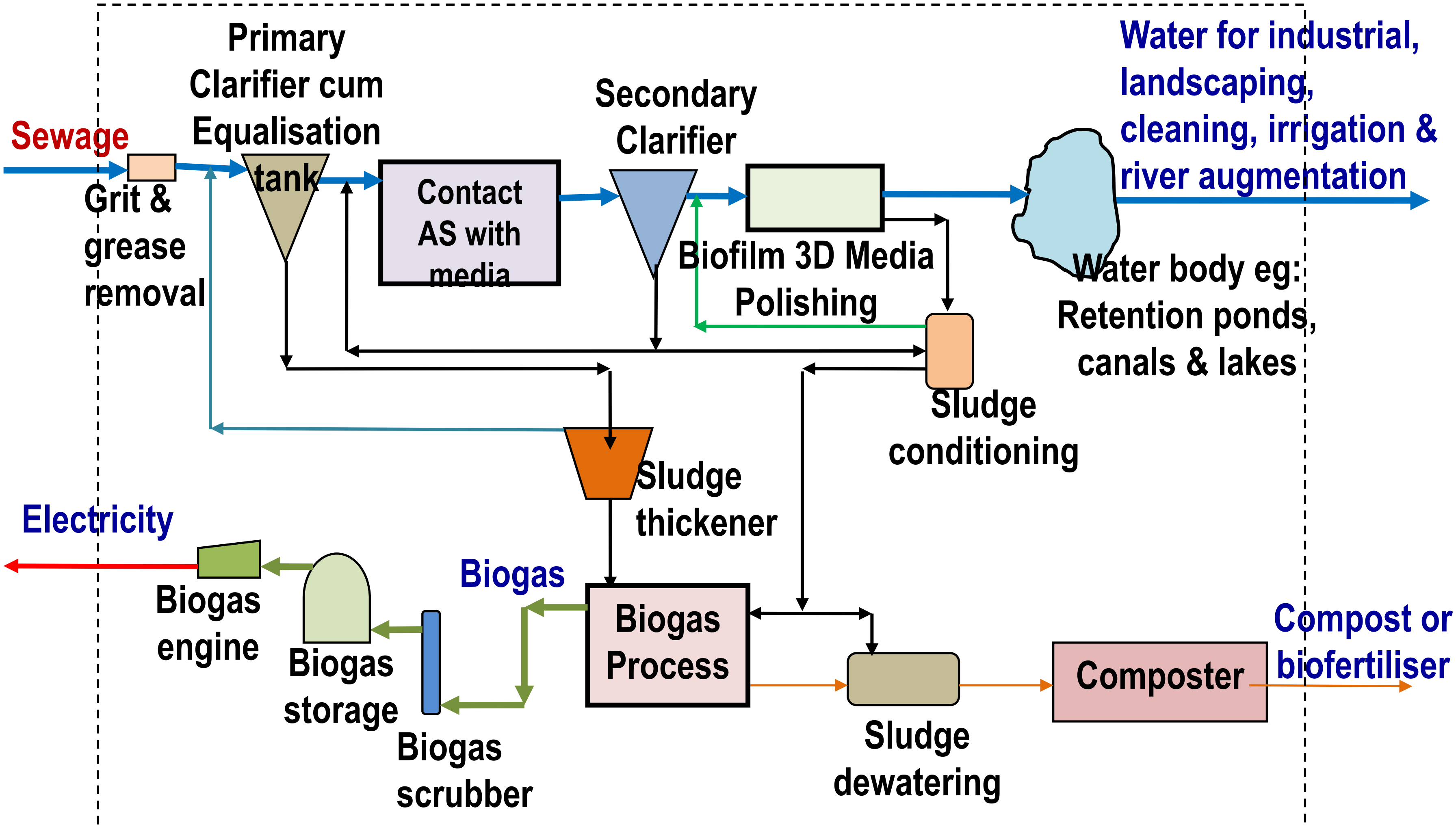
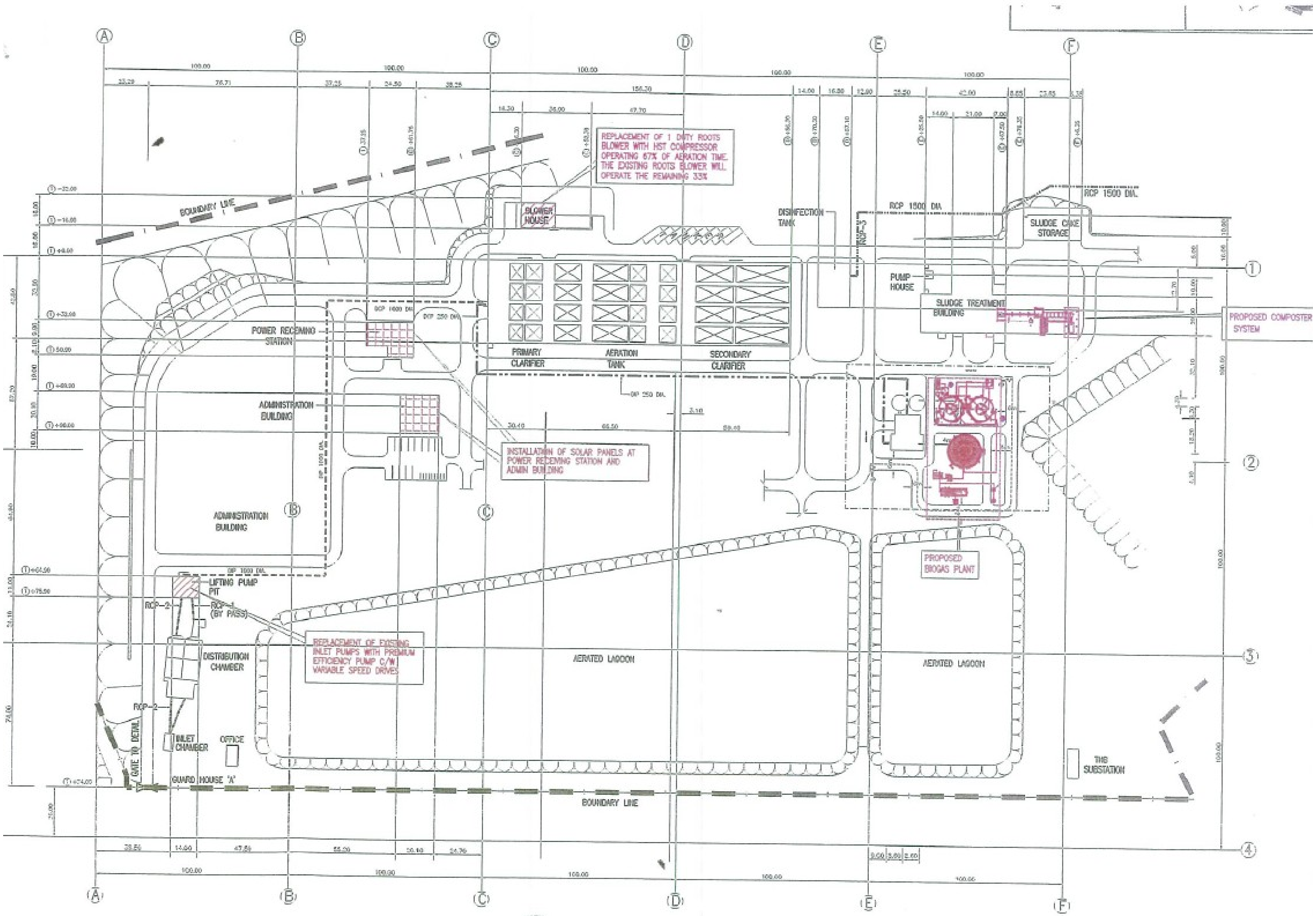


Figure 1. Brief configuration of zero discharge Green STP with Biogas and Biofertiliser Units and water recovery

EVALUATION OF STP SITE FOR PILOT PLANT IMPLEMENTATION
SCORE MATRIX

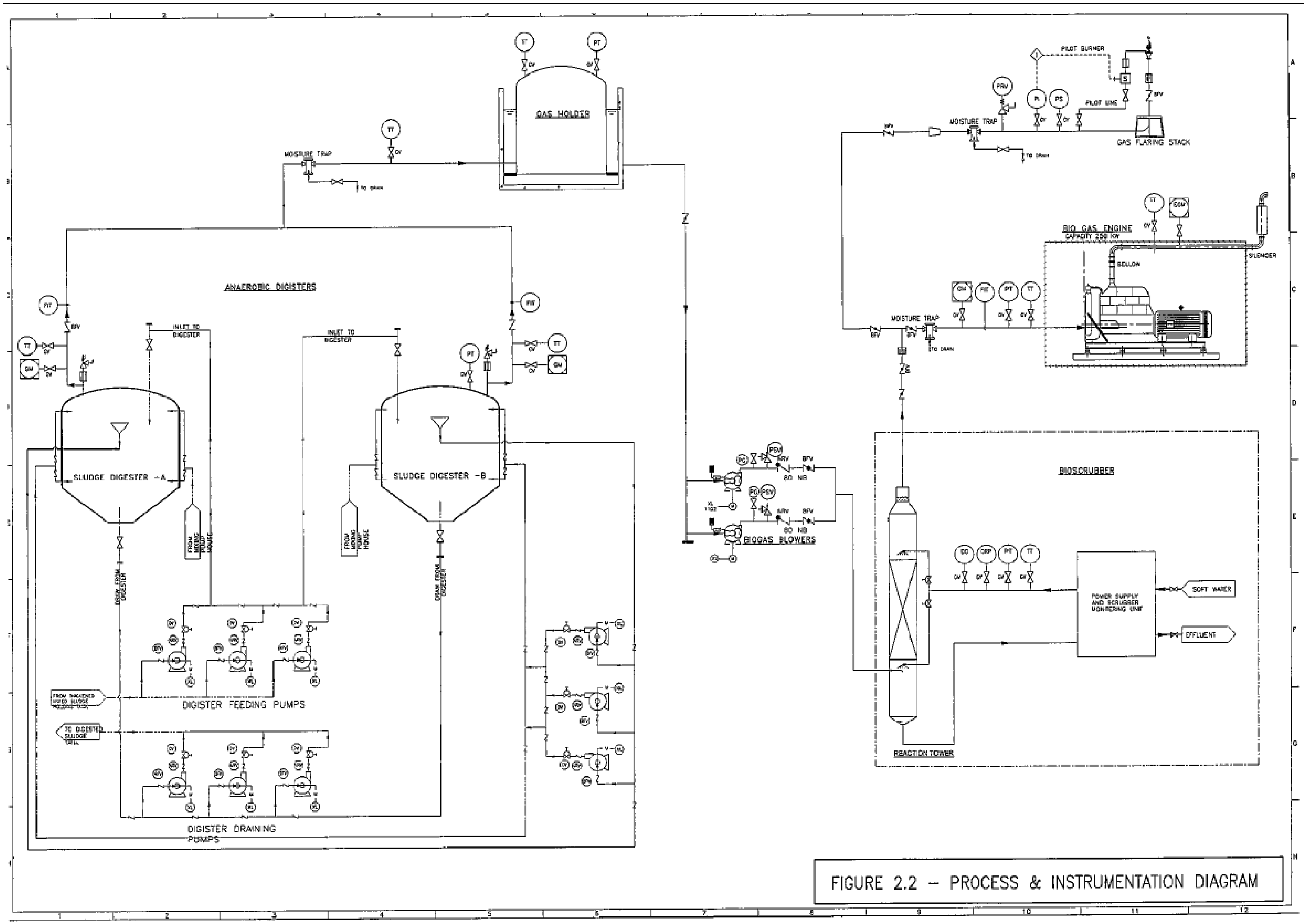
No.	Factor	Maximum Score	Cyberjaya	Puchong	Bandar Tun Razak	Sg Besi	Damansara
1	Space availability	35	20	30	5	8	5
2	Sewage and Sludge Characteristics	20	5	10	12	15	10
3	Disruptions to STP Operations	15	8	12	5	5	5
4	Impact on Surroundings	10	3	7	4	8	8
5	Ease of Construction	10	8	6	4	4	3
6	Expansion Potential	5	2	5	1	2	1
7	Potential for Use of Compost	5	3	3	2	2	4
	Total Score	**100**	**49**	**73**	**33**	**44**	**36**

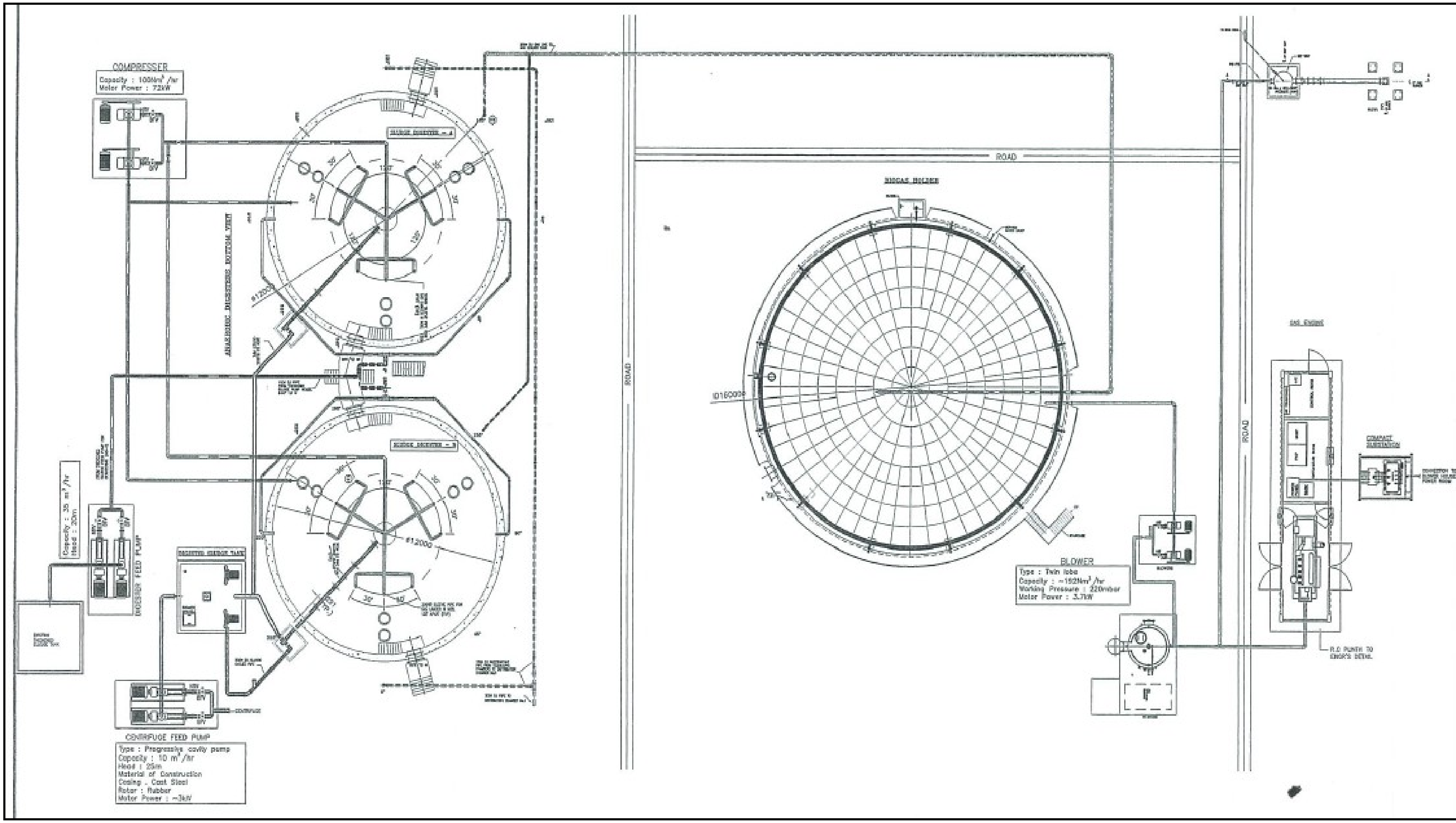
PROPOSED PILOT PROJECT AT PUCHONG STP GREEN TECHNOLOGY APPLICATIONS



NOTES:
1. ALL DIMENSIONS IN METRES AND PIPE DIAMETERS IN MILLIMETRES UNLESS NOTED OTHERWISE.

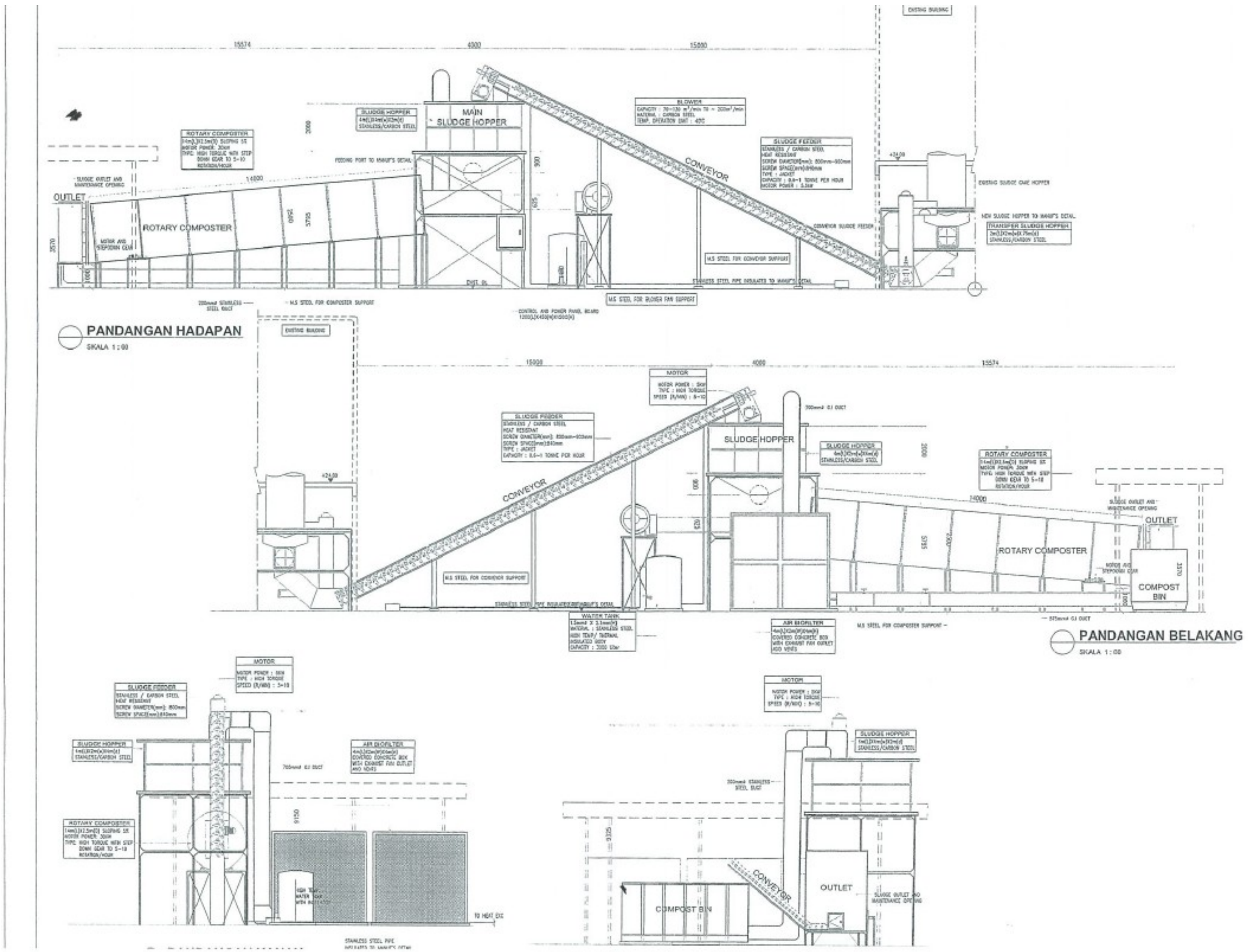
ELECTRICITY GENERATION FROM BIOGAS





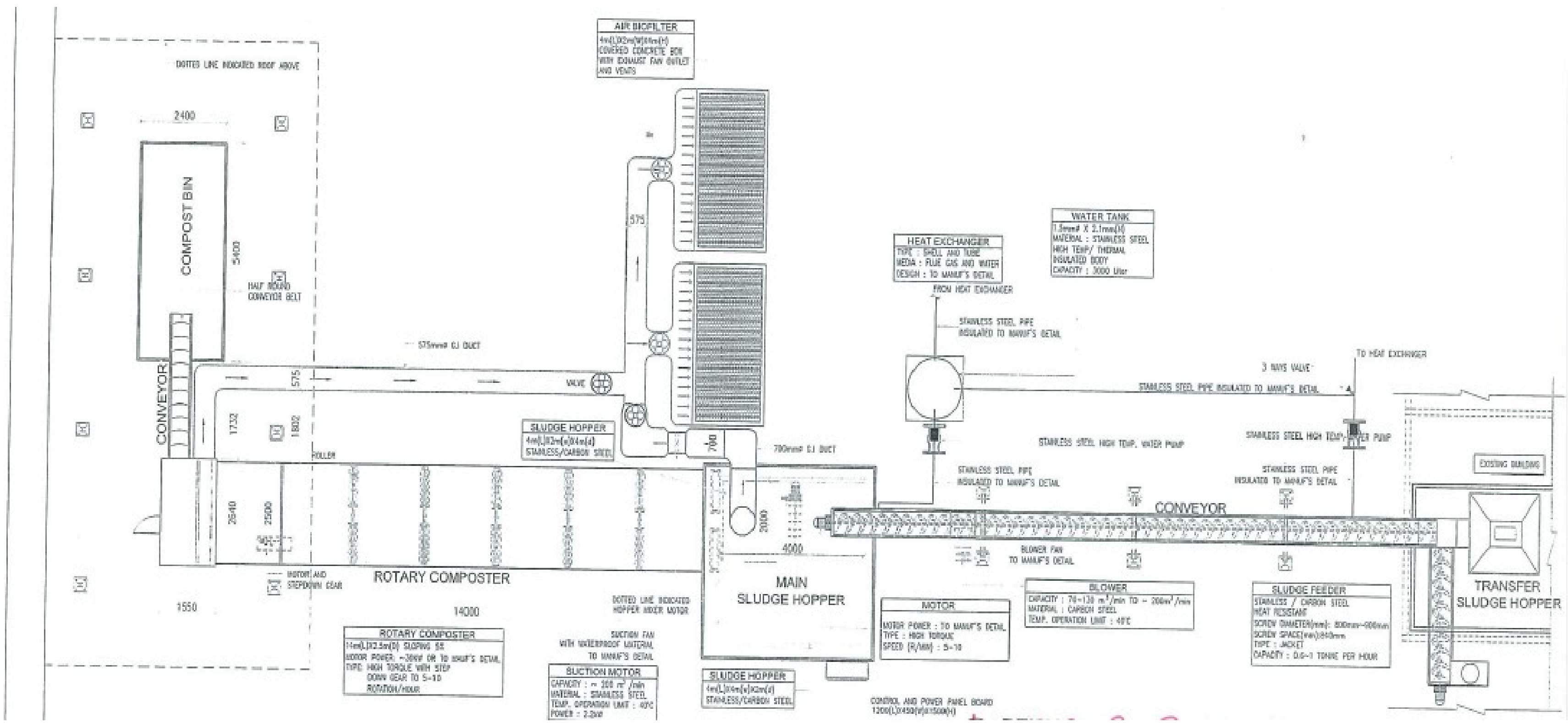
GENERAL LAYOUT PLAN OF PROPOSED BIOGAS SYSTEM

COMPOST PRODUCTION FROM SLUDGE



ELEVATIONS OF PROPOSED COMPOST SYSTEM

COMPOST PRODUCTION FROM SLUDGE



GENERAL ARRANGEMENT

PROPOSED BLOWER REPLACEMENT

- Industry game changer in North America and Europe, using the centrifuge technology

- The energy efficient and silent alternative is based on the innovative design with proven magnetic bearing and high speed motor driven through a built in variable speed drive (VSD)

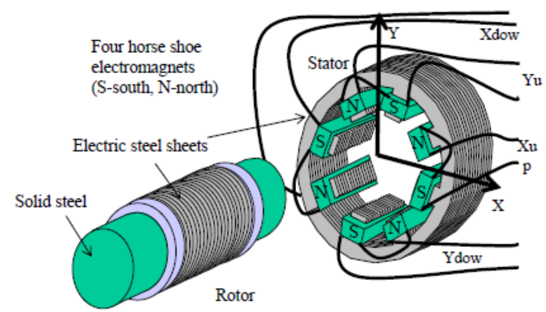
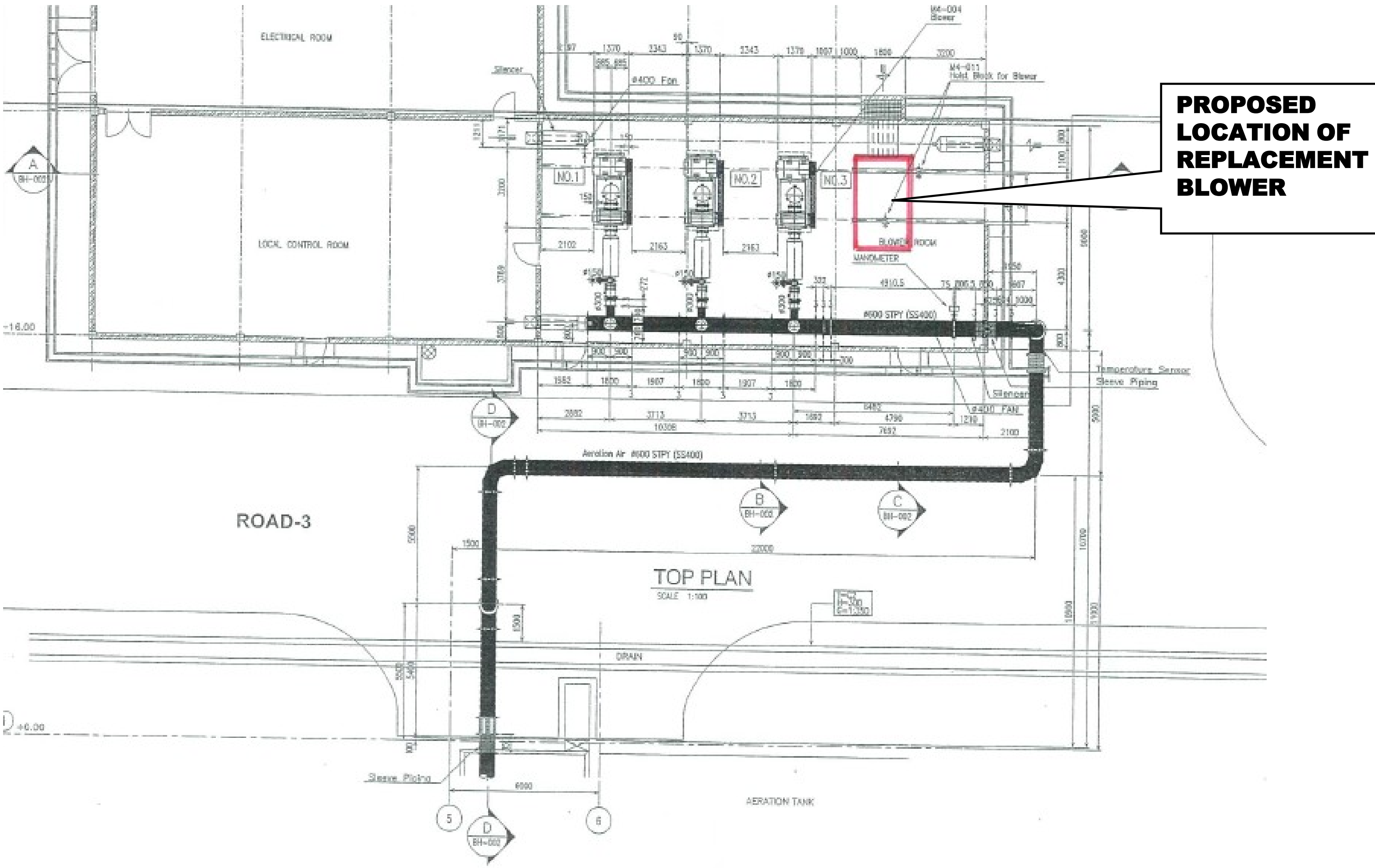


Figure 2: *Magnetic bearing general arrangement*

REPLACEMENT OF BLOWER WITH HST COMPRESSOR



PROPOSED PUMP REPLACEMENT

1. **Premium Efficiency Motors**

   - ❑ **Electric motor technology has improved dramatically in recent times and energy efficient motors are made available for most applications including the sewerage industry.**

   - ❑ **The IE 3 standard by IEC (International Electrotechnical Commission) premium efficiency is generally considered the highest rating.**

   - ❑ **IEC has established testing and labelling requirements for IE 3 or premium efficiency motors.**

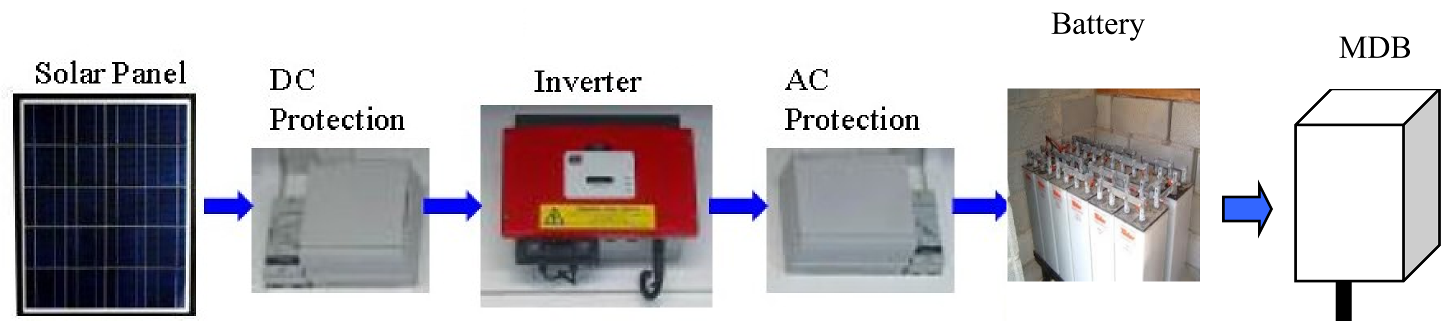
INSTALLATION OF VARIABLE SPEED DRIVES

Variable Speed Drives (VSD) provides continuous adjustment of motor speed by electronic controller to accommodate fluctuation in pumping demands.

Main advantages include:

- **Reduce energy usage**
- **Soft starting – reduce mechanical and electrical stresses**

SOLAR ENERGY SCHEMATIC

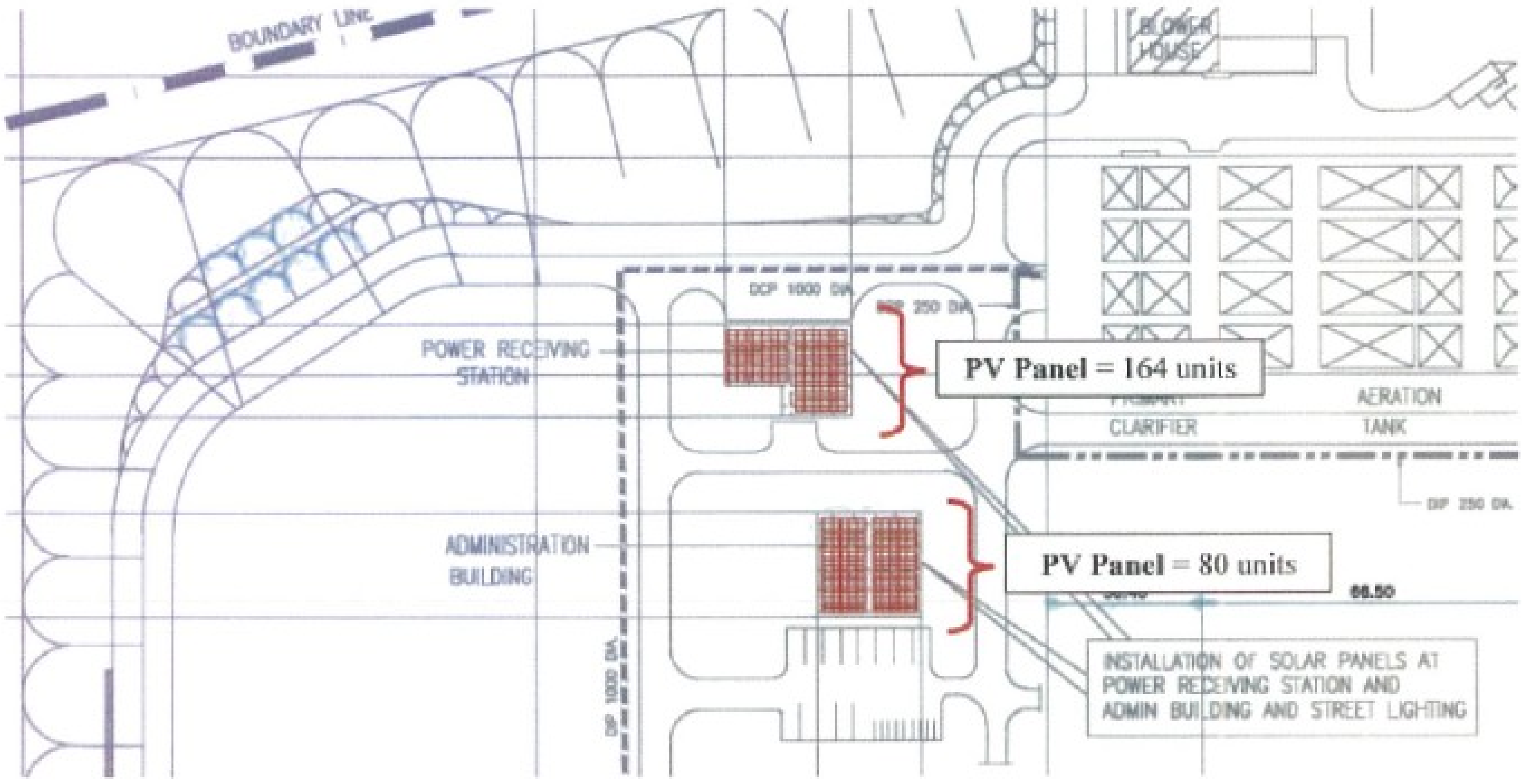


During the day, the solar panels (PV) will generate electricity to power LV appliances at the connected DB area to maximize the utilization of solar energy input, thus reducing the amount of electricity drawn from the TNB.

Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into DC electricity. Inverter is used to convert DC to AC

Solar cells produce electricity from sunlight (photon)

SOLAR PANEL INSTALLATION



PROPOSED PV PANEL LOCATIONS

THANK YOU

Prepared by:

ranhill consulting sdn bhd

Universiti Kebangsaan Malaysia

Uni10 Energy Sdn Bhd