



## TAISEI-CSCEC P103

## **EARTH CONTROL MEASURES**

for

**CONTRACT P103** 

DESIGN & CONSTRUCTION OF RIVIERA
INTERCHANGE STATION AND TUNNELS FOR CROSS
ISLAND LINE- PUNGGOL EXTENSION

Client LTA Builder
TAISEI – CSCEC JV

Designer T.Y LIN

Architect
GreenHilli Pte Ltd

QECP BG&E TOH CK





### **CONTENT**

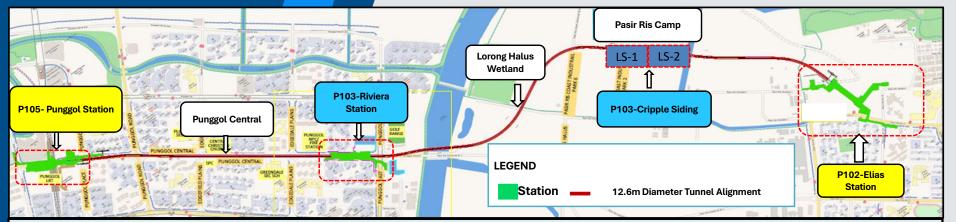




- Project Overview
- Water Ways
- **ECM Design**
- **ECM Measures**
- > Innovative Solutions and Technologies
- Recycling of Treated Water
- Inspection, Monitoring and Maintenance for ECM
- > SIDS : Quality of Final Discharge from Site
- Challenges and Mitigation Measures



## PROJECT OVERALL PLAN



#### **PROJECT SUMMARY: CONTRACT P103**

#### > Scope of Work:

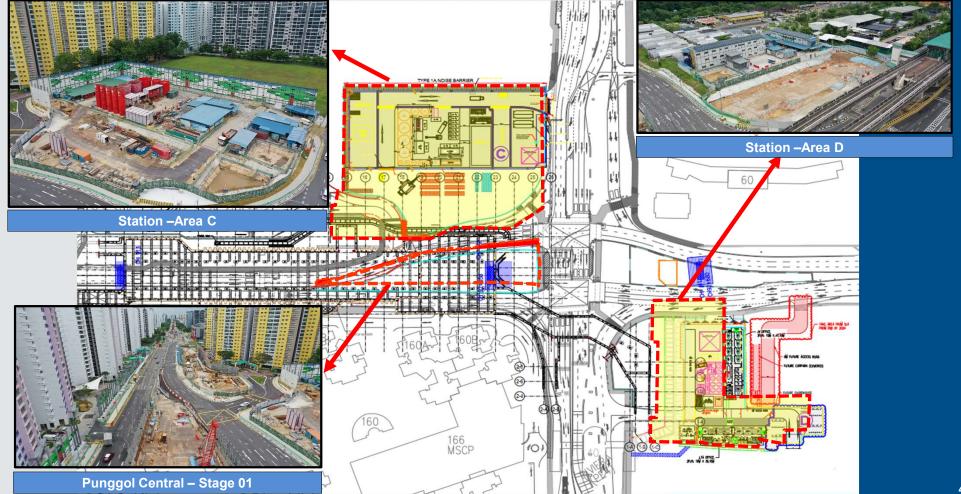
- ➤ Riviera Interchange Station Construction with 4 Entrances & 2 Service Structures
- > Cripple Siding Cut & Cover Tunnel Construction with 2 Launching Shafts at East & West ends
- > Bored Tunnel: LS1 to P105 (Large Diameter, 3.5 km) with 10 Cross Passages
- ➤ Bored Tunnel:LS2 to P102 (Large Diameter, 0.9 km) with 2 Cross Passages
- > Shallow Ground Improvement works for Bored Tunnelling along Punggol Central from Edge Field Plains to Punggol Plains
- > Demolition and Reconstruction of POBs & RCBC drains to facilitate the Bored Tunnelling



## **CURRENT PROGRESS AT STATION**







### **CURRENT PROGRESS AT LAUNCH SHAFT**











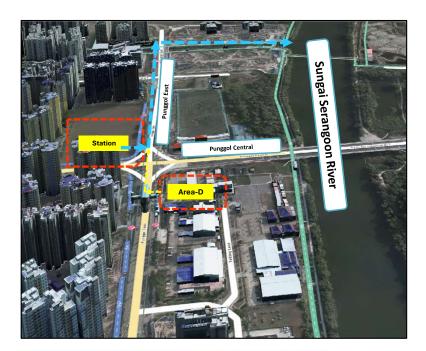




### **MATERWAYS**











Sungai Serangoon



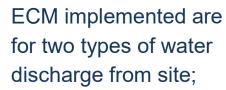


# EARTH CONTROL MEASURES DESIGN & IMPLEMENTATION

### **STATION ECM DESIGN**



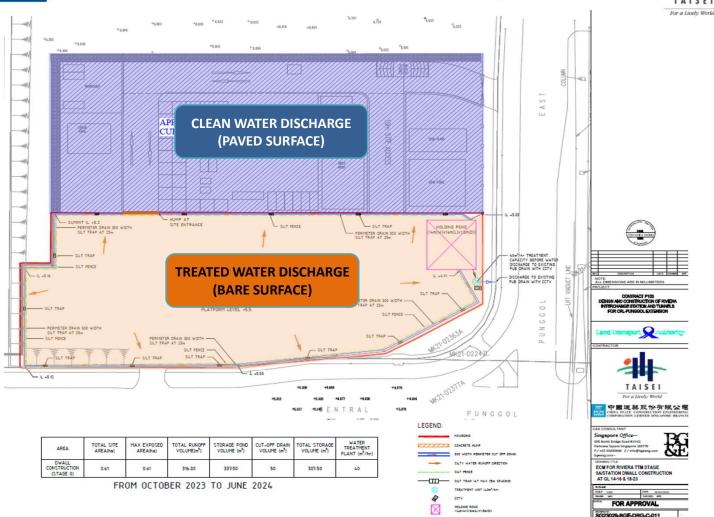




- Treated water and;
- Surface water runoff

This is largely due to space constraints and to reduce chemical treatment usage





### **ECM IMPLEMENTATION AT STATION**















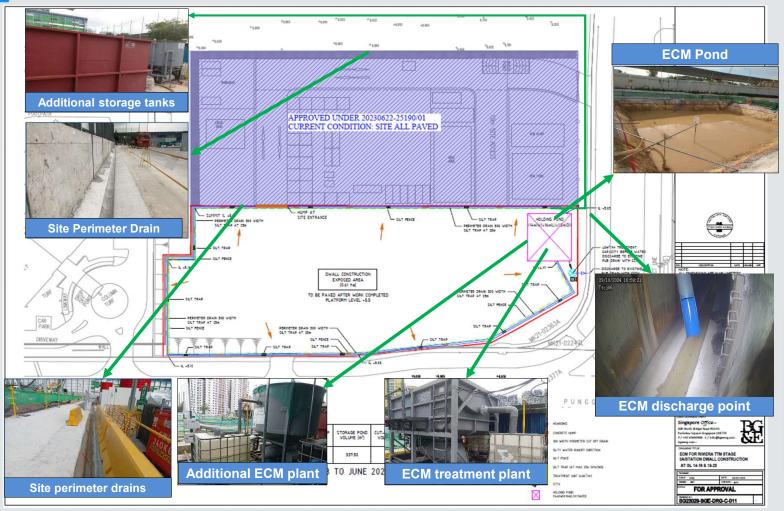




### **STATION ECM**







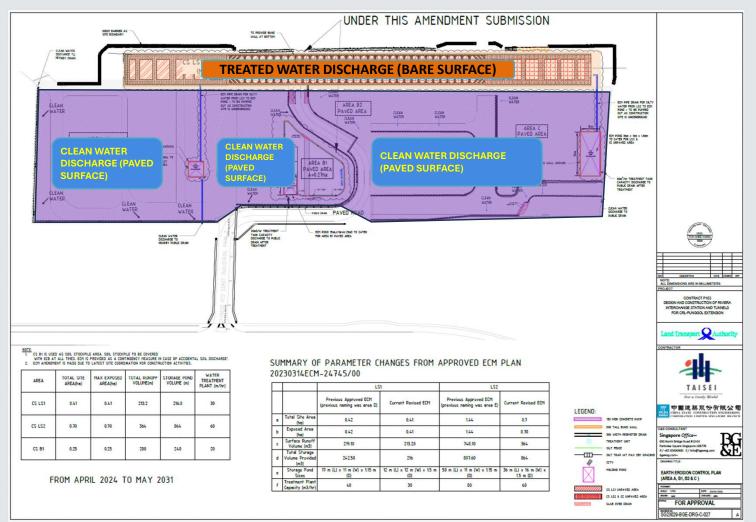
ECM Design
ECM Pond Capacity
=33m3
Treatment Plant
Capacity =40m3
Additional Storage
Capacity =12m3
Additional Treatment
Plant Capacity =20m3

TCSJV P103
provide additional
measures to
ensure poor silty
discharge are
avoided

### **LAUNCH SHAFT ECM DESIGN**







### **ECM IMPLEMENTATION LAUNCH SHAFT**











**ECM Sedimentation Pond** 



Silt Trap



**ECM Treatment Plant** 



**Concrete hump at site entrances** 



**ECM Discharge point** 

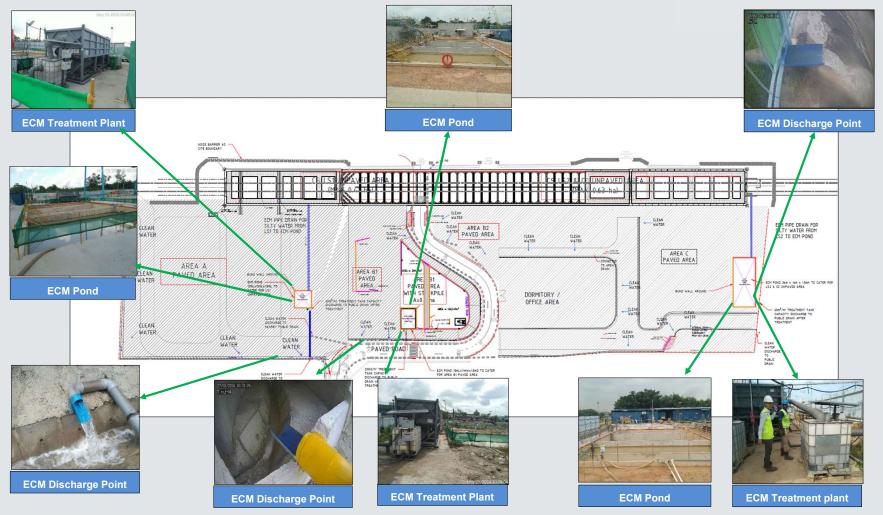


SIDS

### **LAUNCH SHAFT ECM**











## **INNOVATIVE SOLUTIONS AND TECHNOLOGIES**





### **SMART SWITCH CONTROL SYSTEM**

#### **Smart Switch Control**



Smart Switch Control Box

CCTV Camera at Sampling Tank



#### TSS Monitoring System







Discharge to Public Drain

Implementation of automatic cut off for silty water discharge.



Implementation of automatic cut off for silty water discharge





### **SMART SWITCH CONTROL SYSTEM**



**Control Panel** 



**TSS Sensor** 



If TSS level reaches 30mg/L treatment plant will automatically shutdown.

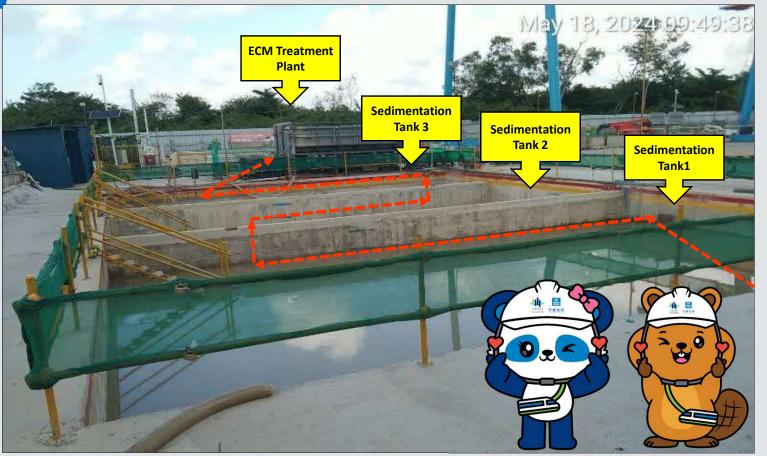


**Sampling Tank and CCTV** 









Sedimentation Tank 1
Sedimentation Tank 2
Sedimentation Tank 3
ECM Treatment plant

By adopting this baffle flow method, the core silt will settle in the individual tanks. This aids treatment plants to be more efficient in the treatment of fine silt, reducing chemical consumption and facilitating easier maintenance





### **PAVED SURFACES**









80% of site surface is paved with concrete to reduce silty water generation.

Runoff from the paved surfaces flows directly into the public drains.



# RECYCLING OF TREATED WATER FOR DUST CONTROL







**Sprinkler System** 



**Sprinkler System** 



**Collection pond & sprinkler pump** 



ECM treated water is used for dust control onsite.





# INSPECTION, MONITORING AND MAINTENANCE OF ECM





#### Simple pictorial operating procedures for ECM operators' ease of reference



Check the Chemical Level before start the ECM Plant



Check water treatment Condition



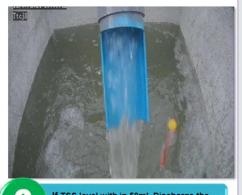
Start the ECM Plant



Check TSS level



Check the chemical dosage



If TSS level with in 50ml, Discharge the water into public drain



Acknowledged by CM / PM



#### **ECMO DAILY INSPECTION CHECKLIST FOR EACH AREA**

Are	a Location:	P103- CS [LS-1 & LS-2]		Date	e:	10-10-2024
Ins	pected By:	Surendran ECO			e:	9-30 AM -
S/N		Description	1	×	NA	Remark/Follow up
1	Perimeter Cut	-off drain silted	V			Clear all the perimeter down :
2	Silt traps silted	1		×		Control of the party of the par
3	Silt fence dam		1			
4		properly embedded		×		
5	120000000000000000000000000000000000000	lopes and stockpiles with close turfing	~			To minture the holding for is during Emply.
6		plant in functional	1			3
7		ull (muddy water)	V			
8	Sludge pool fu	ıll	0	X		
9	TSS continuor functional	us monitoring system turn on and	V			
10	Sufficient stoo on site	k of sedimentation chemicals available	~			
11		uate size and number of sedimentation age tanks before treatment of silty	1			
12		uate size and number of sedimentation age tanks before discharge and along cut-off drain	~			
13		nent unit/coagulant unit to treat silty discharge into public drain	1			
14		instruction access and bare surfaces milled waste, etc	1			

Are	a Location:	P103- Station [RECB-1 to 4]		Date	<b>:</b>	11-10-2024
Ins	pected By: Surendran ECO T				e:	13.00 Hus.
S/N		Description	1	×	NA	Remark/Follow up
1	Perimeter Cut-	off drain silted		x		
2	Silt traps silted			×		
3	Silt fence dama		1			Towertify my demand soll frue
4	Silt fence not p	properly embedded		×		
5	a state occupantation and	opes and stockpiles with close turfing trol blanket or lean concrete	1			
6	Sedimentation	plant in functional	/			
7	Holding pool fu	ill(muddy water)		X		
8	Sludge pool fu	I		X		
9	TSS continuou functional	s monitoring system turn on and	1			
10	Sufficient stock on site	of sedimentation chemicals available	/			
11		ate size and number of sedimentation age tanks before treatment of silty	V			
12		ate size and number of sedimentation ige tanks before discharge and along out-off drain	V			
13		ent unit/coagulant unit to treat silty ischarge into public drain	/			
14		nstruction access and bare surfaces milled waste, etc	/			

TA1	esse.	DAILY CHECKLIST OF EARTH CO	NTF	ROL	MEA	SUR	Land Transport Author We keep Tear Place Physics ES	
Are	a Location:	P103- Station [Area-C,D & Y]	T	Date	):		11-10-2024	
Inspected By:		Surendran ECO			e:	9.30 AM -		
S/N		Description	1	×	NA	Ren	nark/Follow up	
1	Perimeter Cut	-off drain silted		X		Aut		
2	Silt traps silted			x				
3	Silt traps silted		1			10 nz	place he damped sitter	
4		properly embedded	~			TOW	of the dampe land at the y	
5	Protect bare s	lopes and stockpiles with close turfing	1				,	
6	0. 0.00.0	plant in functional	V					
7	101 S22 - 52	ull(muddy water)		X				
8	Sludge pool fu	and the same of th		K				
9	TSS continuor functional	us monitoring system turn on and	*	X		10	clean the denser gularly at aven.D	
10	Sufficient stoc	k of sedimentation chemicals available	1					
11		uate size and number of sedimentation age tanks before treatment of silty	1					
12		uate size and number of sedimentation age tanks before discharge and along cut-off drain	1					
13		nent unit/coagulant unit to treat silty discharge into public drain	1					
14		instruction access and bare surfaces milled waste, etc	1					

Inspected by ECO/ ECMO



#### Weekly / Ad-hoc ECM inspection carried out by LTA

































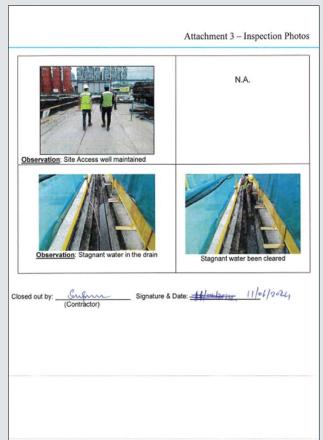




#### **ECM INSPECTION MONTHLY REPORT BY QECP**

of Inspection:	SIN	BEST MANAGEMENT	INSPECTION	COMPLIANCE		ACTIONS	on Checkl
05/2024 ne of Inspecting Officer:	1	PRACTICES	Clearing of construction areas carried		200		
ANG WEE PING		Sequence & Scheduling	out in phases?				
ointment CP REP	2	Stockpiles of Earth Materials	Stockpile location according to ECM.	Yes/No(NA)			
e & Time of Site Visit: 05/2024 10:00 Hrs	-3	Stabilization through	Location according to ECM	Ges Dis/NA			
ether Condition:		laying of milled waste, lean concrete,	schedule? Construction according to ECM	(ee) No/NA			
INY	1	turfingets	details? Any signs of damage at lean	Yes (So Yes			
ect Title:	1		concrete areas?  Any signs of damage at milled waste	Yes / No /SUA			
(TRACT-P103 DESIGN & CONSTRUCTION			areas? Any signs of damage at turied areas?	Yes/NoGNA			
RIVIERA INTERCHANGE STATION AND INELS FOR CRL - PUNGGOL EXTENSION	4	Stockpiles of Earth Materials	Stockpile location according to ECM plan?	Yes/NoCND			
		Materials	Protected against erosion?	Yes/No RID			
ation of Site :	5	***	Protected against sedimentation?	Yes/No CLD			
IGGOL CENTRAL	1 2	SR Trape	Installation of sit traps including location according to ECM schedule?	@DNo/NA			
ect Duration: Months	1		Installation of silt traps according to ECM plan including no.s & size?	GED No/NA			
e of Present Construction Activity:	1		Sit Traps damaged?	Yes (Sp.) NA			
IGGOL EAST SITE OFFICE AREA (Localized	6	Sedimentation	Installation of basins   ponds	CTEDY NO / NA			
f) rim ECM at Area-C	1	Basins / Storage Ponds	including location according to ECM schedule?				
			Installation of basins / ponds according to ECM plan including	SAST NO / NA			
R Permit Number:	1		10.17				
M9/2023/07/25190/01	1		Concentration of TSS in effluent; (outlet of discharge) < 50mg/t?	Yes ASD NA			
ner / Developer:	1		Sedment (Bind to within 500mm of	Yes (SONA			
	1		water discharge level of outflow structure?				
for Project:	1		Sedmentation basins inlet / outlet choked?	Yes (No.) NA			
OP for ECN:			Protected against sedimentation?	YHENDINA			
TOH CHEE KIONS	,	Treatment Units / Polymer Blocks	Treatment unit(s) in operation?	CED No / NA			
RENDRAN	_		Polymer blocks used / adequate/?	Yes/Notab			
ner / Developer's Representative on-site:	8	Parlmeter cut-off drains	Installation of out-off drains including location according to ECM schedule?	(10 No / NA	Localized EC	OM .	
ARA	1		Installation of out-off drains according to ECM plan including lengths?	GED No/NA			
	1		Out-off drain lined?	CED No/NA			
e of ECM Plan; y (2023	1		Any signs of inadequate capacity?	Yes COD NA			
t Date of ECM Plan Review:	1		(flooding) Any obstruction / sediment?	Yes/65/34A			
	_		Any signs of damage?	Yes Qip XXX			
ADDITIONAL INFORMATION	. 9	Wheeled wash areas, entrylexit points	Location according to ECM plan? Construction according to details?	Ess No/NA Ess No/NA			
& Time of Previous Site Visit:	1		Any signs of damage?	Yes (So )NA			
04/2024	1		Run-off (from wheeled wash preas) and overflow / discharge channeled	Yes@DNA			
e Of Last Inspection Report:	1		to exhable areas for proper (beatment?)				
04/2024	1		Any signs of sity water from these	Yes Alla NA			
ues Identified In Previous Site Visit:			areas into public drains (drains / roads / etc)?				
	10	Others	Any areas without inedequate ECM?	Yes Nas /NA			
	1		Public drains at docharge points silted?	ANCED ROY			
its inspection has been certified by:	1		Public drains in vicinity of site silted / obstructed?	Yes Ranks			
/ QECP:	1		Run-off from site not channeled	Yes TANA / NA			
neture:	1		through silt fences / cut-off drains / silt traps?				
E 11/00/2024			Any discharge of water into public	Yes Palo PNA			
ntractor: TCSJV	1		drains? Earth surfaces / slops adjacent to any	Yes Qia DIVA			
nature: Supremform			drain not furled, poved or covered?				
11/06/2014	Any of	ther observations / o	comments;				
men'Developer; LTA		Occupier to ensure	all erosion & sedimentation contro	I measures are i	n place to o	revent any silty dis-	charge into
ner/Developer; LTA nature: CMT		public drains					
# 18/06/2024		All exposed & bare	d surfaces to be laid with lean con-	rets or covered	with carryan	sheet /ECB	
te							
th Control Measures is for the treatment of							
water due to rain water. Construction							









## ECM INSPECTION MONTHLY REPORT BY QECP

PRACTICES Controlled C	Obsering of portectation was a cereated only placed and protectation was a cereated only placed and	TO NO INA TO SO NO INA TO SO INA	Loodran ECM
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Stabilization through spain of miled writin, has concrete, being of miled writin, has concrete, being of miled writin, has concrete, being of the spain of the sp	Leadina recording in ECM  checkled- control in ECM  checkled- schedule- control in ECM  checkled- schedule- control in ECM  checkled- schedule- sc	TO NO INA  Ves (S) NO INA  Ves (S) NO INA  Ves (S) NO INA  Ves (S) NO INA  NO INA  NO INA  Ves (S) NO INA  Ves	Loodined ECM
wate, last cocycts, being	Constitution according to ICOA  Annual Constitution according to ICOA  Annual Constitution according to ICOA  COA  COA  COA  COA  COA  COA  COA	Yes 1 No (No )  No (No )  No (No )  Yes 2 No (No )  Yes 3 No (No )  Yes 4 No (No )  Yes 4 No (No )  Yes 6 No (No )  Yes 1 No (No )	Looding ECW
Stodgées of Earth Matrinis  Salt Trays  Sadarentation  Santon (Storage  Ponds  Treatment Units )  Polymer Bisches  Treatment Units )	And styre of demany at hem- criteriate press; an arrange of selection and con- press; and control of selection and con- trol of selection and control of selection. Producted appart code mention of Producted appart code mention of Producted appart code mention of Producted appart code mention of the selection of all these according to Code desire for the selection of a selection of the selection of the selection of the selection of the selection of the selection of the selection of the s	Yes I No Fig.)  Yes I No Fig.	Loodran ECM
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Sadmentation Basins (Storage Poods Treatment Units / Polymer Blocks	Probleming agents excellent Probleming agent and excellent Probleming agent and exemption Probleming agent and exemption Souther security is 1004 strateful Souther security is 1004 strateful COM print schooling in 0.54 step 1004 traps demanged in relating bootine secondrip is 1004 Southern secondrip in 1004 Southern	Yes (C) NA	Localized ECM
Sadmentation Basins (Storage Poods Treatment Units / Polymer Blocks	Invalidation of sit htree invidence consortium control position according to CDM straight and consortium control position. CDM plan involved process a size?  CDM plan involved process a size?  CDM plan involved process a size?  Devaluation of finance in process process and consortium control process. CDM plan involved process and plan in CDM plan involved plan inv	Yes (C) NA	Looding ECM
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Basins ( Storage Ponds  Treatment Units / Polymer Blocks  Perimeter cut-off	Invalidation of tester's press including location processing to CDM included location processing to CDM included location of testers's press secoring to ECDM invalidation of the invalida	Yes CONA YES	Loosteed ECM
Basins ( Storage Ponds  Treatment Units / Polymer Blocks  Perimeter cut-off	including location according in ECM schedulor. Immilliation of totals is prosed from the ECM plan including model, the economic plan including model, the economic plan including economic plan including content of destinage of 90 ppg. Generated fields to within Sickmen of souther destinage plant and souther destination between which of producing agents and emerations? Producing agents and emerations? Producing agents and emerations? Related to the economic plant plant and expension of Related and plant and emerations of the entire contains according to ECM accordables producing according to ECM accordables.	Yes GONA	Loodined ECM
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Polymer Blocks Perimeter cut-off	Concentrate of TSS in efficient [ journal of destinate] of Stright   Socient of destinate] of Stright   Socient (fleet in within 300mm of waker discharge level) of settlere structures; Socienteristism bears inhal / outlet obstacle; Prolocide against addimentation? Trestinent units) in operation? Polymer blodus used adequate? Polymer blodus used adequate? Invalidation of out-out of sinise including location according to ECMs schoolse? Invalidation of out-off sinise societies of sinise sind units and un	Yes (No DAA Yes (No DAA Yes (No NA Yes (No DAA Yes (No DAA	Loodine ECM
Polymer Blocks Perimeter cut-off	Bedereer (flast to within SCOrre of water discharge is evil of cell-flow shudare? Sectionation bearin intel context chicked? Producted against addinentation? Treatment untiply in operation? Probleme titolice used? adequate? Installation of our off shares including location according to ECM schoolse? Installation of our off shares including location according to ECM schoolse?	Yes (No.) NA Yes (No.) NA Yes (No.) NA Yes (No.) NA	Loodland ECM
Polymer Blocks Perimeter cut-off	Sedimentation bears intel / outlet cheker? Protected apprint sedimentation? Treatment unit(s) in operation? Polyment blocks used / adequate? Installation of out-off drains including location according to ECM schodule? Installation of out-off drains according to cattor according or of drains according to the control of the cont	YEOUNG NA  YEOUNG NO / NA  YEOUNG NO / NA	Loow/zed/ECM
Polymer Blocks Perimeter cut-off	Protected against sedimentation? Treatment unit(s) in operation? Polymen blocks used / adequate? Prostillation of out off shallo including location according to ECN schoolse? Installation of out-off shallo according	Yes I No I NA	Loostzed ECM
Polymer Blocks Perimeter cut-off	Treatment unit(s) in operation?  Polymer blocks used / adequate?  Installation of out off drains including location according to ECM schedule?  Installation of out-off drains according	Yes I No I NA	Loodized ECM
Perimeter cut-off	Installation of out off drains including location according to ECM schoolule? Installation of out-off drains according	CO No/NA	Localized ECM
	Installation of out off drains including location according to ECM schoolule? Installation of out-off drains according	CO No/NA	Localized ECM
	location according to ECM schedule? Installation of out-off drains according		Localized ECM
	to FCM clan includes language?		
		Geo No/NA	
	Cut-off drain lined? Any signs of inadequate capacity?	Yes (No./ NA	
	(flooding)		
	Any obstruction / sediment?	Yes Qio INA	
	Any signs of damage?	Yes (Co.DIA	
Wheeled wash troas,	Location according to ECM plan?	(es3No/NA	
entrylexit points	Construction according to details?	Esp No / NA	
	Any signs of damage?	Yes / No.LNA	
	Run-off (from wheeled work areas) and overflow / discharge channeled to suitable areas for proper treatment?	YesDONA	
	Any signs of sity water from these areas into public drains (drains /	Yes Olo MA	
Others	roads / eld/? Any areas without in adequate ECM?	Yes Nip Pin	
	Public drains at discharge points silted?	Yes Alig MA	
	Put 4c drains in vicinity of site sitted /	Yes Alip PAA	
	Run-off from site not channeled through sitt fences / cut-off drains /	Yes (S) NA	
	Any discharge of water into public	Yes Qio NA	
	Earth surfaces / slops adjacent to any	Yes (TG)NA	
_	diserror solver, panels of contract?		L
public drains			
	d surfaces to be laid with lean con-	crete or covered	with canvas sheet /ECB
All exposed & bare			
	Occupier to ensure public drains	Packe dawn in ceitig of dies bladd; chatacterised? Raund time be out disparation of the stand; chatacterised? Raund time be out disparation of the dawn of the daw	Finish data in social of this shall obtained to the control of the







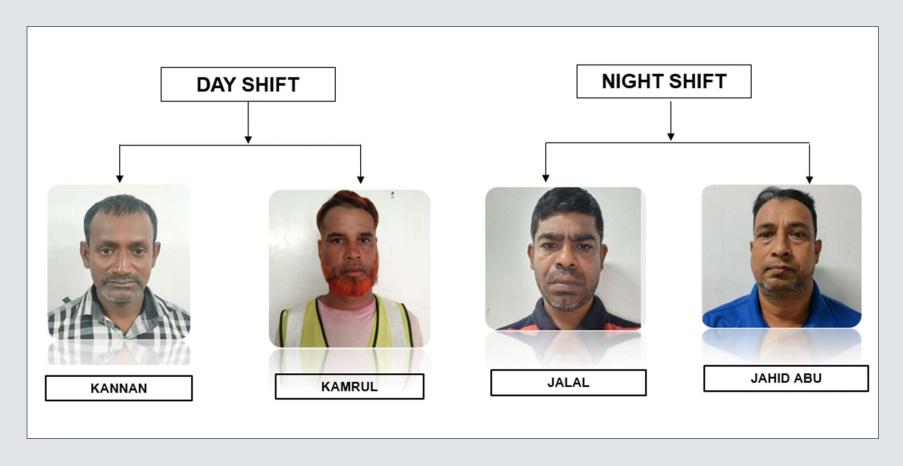
Robust maintenance regime guides provided for easy reference







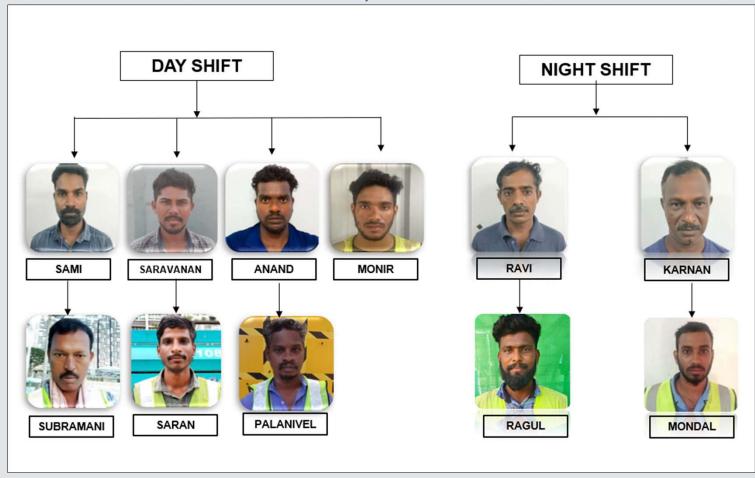
**DEPLOYED COMPETENT ECM OPERATORS AT LAUNCH SHAFT** 







**DEPLOYED COMPETENT ECM OPERATORS AT AREA-C,D & Y** 







Maintenance of the ECM treatment plant is carried out after <u>every</u> plant operation.

















#### Regular maintenance at perimeter drains













#### Regular sludge removal from ECM Ponds





















Regular maintenance of site access and paved surfaces at site



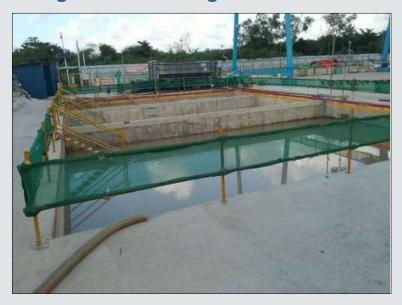








Regular monitoring of water / silt levels.



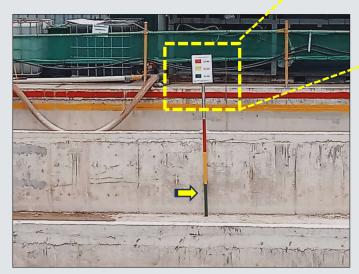
#### Legend:

Below Yellow: < 0.3m to 0.5m → 1 treatment plant will be activated during rain.

Yellow → Treatment plant will continue operation.

Red: → Silty water will be pumped to additional steel tank for temporary storage / Activate additional treatment plant to prevent overflow.

#### SILT LEVEL INDICATOR



If Silt level reach to "Green Mark" TCSJV will arrange to clear the silt







# SIDS : QUALITY OF FINAL DISCHARGE FROM SITE

### SIDS-SILTY IMAGERY DETECTION SYSTEM













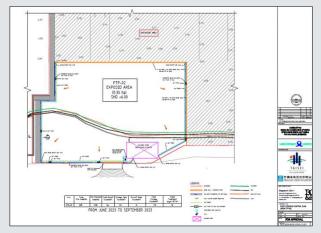




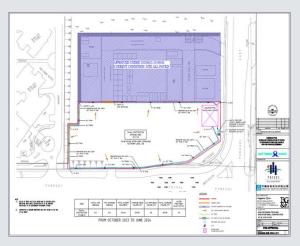




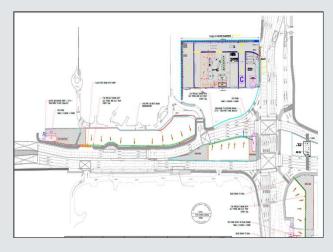
## There are 9 traffic diversions in total, with each requiring at least 3 Earth Control Measures reconfigurations—posing a significant planning and strategy challenge



**ECM IMPLEMENTATION JUN TO SEP 2023** 



**ECM IMPLEMENTATION SEP TO JUN 2024** 



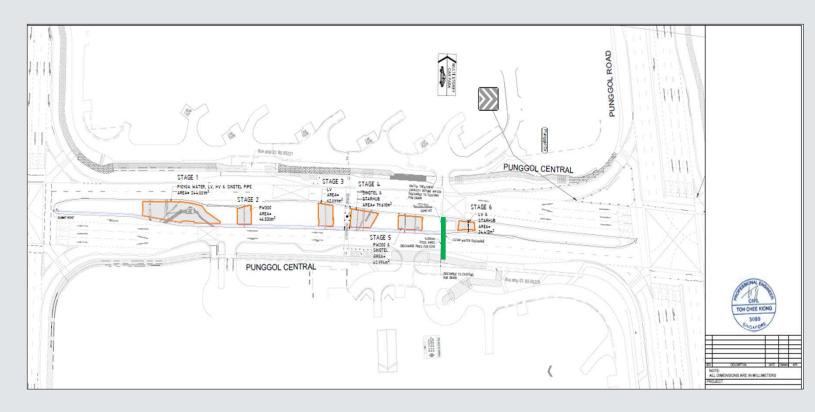
ECM IMPLEMENTATION FROM JUN 2024 TO MAY 2025



#### **Lack of Discharge Points**

"Works at road Centre median due to ground improvement works means there is no discharge point"

Solution: TCSJV lay discharge pipes under traffic road and discharge clean treated water to the side table drainage inlet chamber







#### **Future Challenges – Large Volume of Excavation**

#### **PLANNING**

Brainstorming with the construction team, design team, and QECP to develop an adequate ECM plan for this bulk excavation area

#### **IMPLEMENTATION**

To identify the suitable location for an ECM pond on-site and to procure equipment with sufficient capacity for ECM treatment, including water pumps, steel pipes, and necessary technologies

#### **MONITORING**

To deploy a dedicated team for ECM monitoring and maintenance



Total excavation volume = 252 Olympic size pools

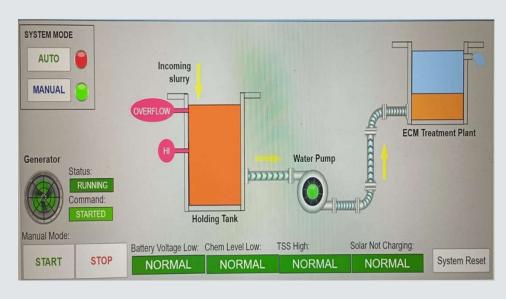




#### **Moving forward:**



**AI Camera for ECM** 



**ECM Control and Monitoring** 

**Remote Pump Monitoring System** 

Set up dewatering pumps to switch to auto mode and be controlled via mobile phone







**FOR YOUR ATTENTION**