Decentralized Wastewater Management:

Port Blair

Visit Report and Recommendations

National Institute of Urban Affairs &

Ecosan Services Foundation

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EXECUTIVE SUMMARY

The report is prepared after a visit by NIUA team from 23-25th July 2019, to the city of Port Blair and a review of the Sewerage Plan prepared by WAPCOS.

The report details out sewerage zone wise observations made and recommends the way forward for the city of Port Blair for adoption of decentralized waste water treatment systems considering the high cost of electricity and pumping in Port Blair and suitability of decentralized solutions.

Key considerations of the Sewerage DPR of WAPCOS for Port Blair;

1. The Sewerage DPR prepared by WASPCOS(only estimates of Treatment Plant are given, not DPRs of the 2 Plants) and shared with the NIUA team was prepared in 2016 for the town of Port Blair. With a CAPEX of Rs. 364 crores and a design capacity of 26.2 MLD waste water treatment. It has a very high a=annual O&M cost Rs. 11 crore/year mostly for pumping of sewerage across the hilly terrain of Port Blair.
2. The Sewerage DPR breaks down the city in 12 sewerage zones.
3. The DPR proposed THREE STPs for the town(only TWO for implementation by PWD). One STP of design capacity 1.2 MLD for Zone D (where the Indian Navy is going to set up the STP, hence this no more falls under the planning purview of PBMC/PWD). So the first STP proposed is of design capacity 10 MLD, located in the Zone C(serves Zone A, B and C). The second STP of design capacity 15 MLD, located in Zone G and serves the remaining zones.
4. The DPR recommends phase wise sewerage construction. Phase 1 consists of laying of sewerage lines for 10 MLD STP in Zone D. Phase 2 consists of laying of sewerage leading for the 15 MLD STP in Zone G.

Key Observations and Recommendations

1. **A combination of decentralised waste water and sewerage treatment solutions are appropriate for the town of Port Blair**. This combination can include ;
    a. A Non Sewered Faecal Sludge Treatment Plant(42 KLD, already tendered) and
    b. Smaller sized STPs that can be connected with shallow sewers(without septic tanks) or small bore sewers(with Septic Tanks).
2. The 25 MLD waste water treatment of Port Blair can be done by a combination of **at least SIX decentralized STPs plus a Faecal Sludge Treatment Plant(FSTP),** to meet current and

projected (30 years) needs of waste water treatment of Port Blair. It is recommended that a detailed assessment be done for each Zone and DPR preparation for each zone tendered out by PWD/PBMC within a 6 month period.

3. **The Faecal Sludge Treatment Plant(FSTP) of 42 KLD sludge treatment** can be constructed first and through a system of regular/scheduled de sludging operations, cater to all parts of the town for at least 5 years.
4. **Potential decentralized wastewater treatment plant(s)** through small sized STPs assessment needs to be done. Based on the one day visit to all the Zones, the following observations and potential for small STPs based on a combination of shallow sewers and small bore sewer systems was noted(subject to more detailed study of topography, flows and land availability);
   a. **Plant 1 in Zone A.** Appropriate (size and location) needs to be found. A suitable land with area of atelast1500 m^2 should be made available for the construction of a decentralized small sized STP in Zone A. We were shown a plot of land belonging to the Police department in this Zone where a small sized STP may be viable and a DPR prepared, provided the land allocation is done.

      In absence of suitable land in Zone A, preparation of DPR for STP (design capacity 10 MLD based on SBR technology) and tendering of the project for implementation of sewerage scheme can be started immediately. The proposed STP should have co treatment facilities for handling additional septage and sewage sludge from the resorts.

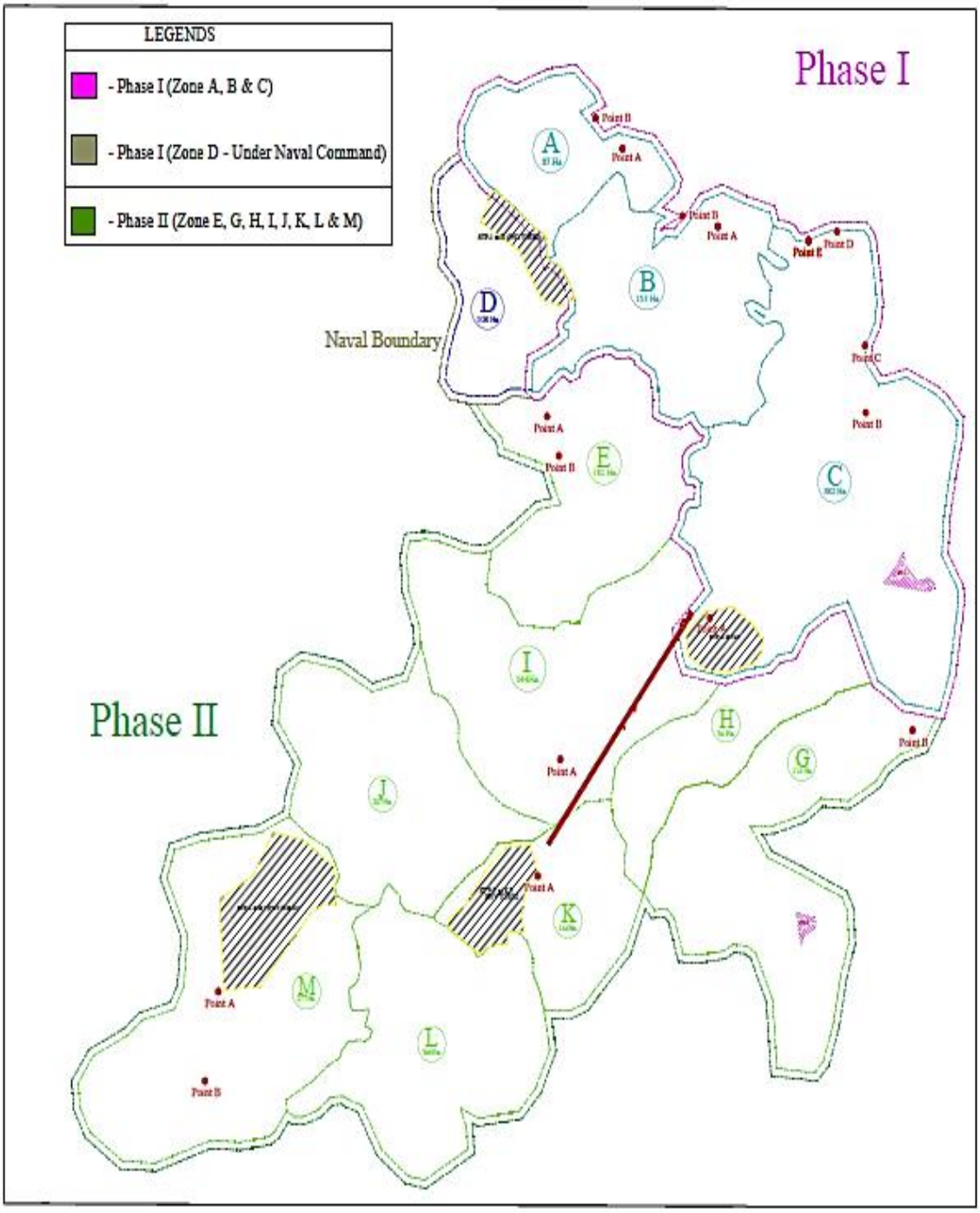
      The remaining zones are relatively less densely populated and hence there is potential of having decentralised STPs or FSTP operations, instead of pumping the sewage to centralized STP in Zone G where the identified land is located on the hill top.
   b. **Plant 2 in Zone E**. This zone shows a high potential for a decentralized STP with design capacity of 4 MLD. Appropriate land (size and location) from the STP was also shown to the NIUA team by PBMC officials during the visit. Further investigation in the form of feasibility study will be required for preparation of DPR (sewerage and STP) for this Zone.
   c. **Plant 3 in Zone I.** Since Zone J drains into the Zone I under gravity a combined STP (design capacity 3 MLD) can be planned in Zone I provided appropriate land is made available. Further investigation in the form of feasibility study will be required for preparation of DPR (sewerage and STP).
   d. **Plant 4 in Zone M, outside the city limits currently.** Zone M is the farthest of all zones, and currently the identified land for pumping station is not suitable(located in a

hospital higher than the catchment area of the sewerage flow). Since the development in this zone is at an early stage, decentralized STP can be planned at a later stage for the zone, when the Port Blair Municipal limits are expanded. The FSTP can serve as a septage treatment solution.

e. **Plant 5 in Zone K or L**. The delineation of the Zone K and Zone L needs to be further investigated as the layout of the sewers is not clear from the DPR prepared by WAPCOS.

f. **Plant 6 in Zone or G**. The delineation of Zone H and G is correct, however as the identified location of the 15 MLD STP is at higher level, the water needs to be pumped against the gravity to reach to the STP. As per the DPR, approximately 14 MLD of sewage will be pumped to the main pumping station of the STP. In zone G, one of the rising mains of the lift station passes through ecologically sensitive area. Laying of this rising main will be a tough challenge.

Map of the sewerage zones and locations of the points visited for preliminary survey


LEGENDS
- Phase I (Zone A, B & C)
- Phase I (Zone D - Under Naval Command)
- Phase II (Zone E, G, H, I, J, K, L & M)
Phase I
Phase II
Naval Boundary
A
B
C
D
E
F
G
H
I
J
K
L
M
Point A
Point B
Point C
Point D
Point E

Priority Actions and Timeline ;

1. A quick decision taken on Decentralised (2 plants) vs Large sized STP(10 MLD) for Zone A, B and C. Time : within 3 months. Tender floated.
2. Assessment done for remaining 4 decentralised STPs and their sewerage plans. Tender floated for preparation of DPRs for these plants. Time : 4 months.
3. FSTP constructed and operationalised. Time : 6 months
   a. Drafting/revision of the byelaws for solid – liquid waste management across the city of Port Blair done on priority. Estimated timelines for the same is 3 months.
   b. To improve the wastewater quality flowing into the stormwater drains, scheduled desludging plan put in place and immediately implemented : Zones A, B and C.
   c. Sludge from the residential, institutional and commercial properties to be safely handled at the Faecal Sludge and Septage Treatment located at Brookshabad.
   d. GOs issued for institutional level small STPs and discharge standards. Monitoring of discharged treated waste water is done, put to ensure treatment is done.
4. To improve the water quality at the outfalls of the storm water drains, certain in situ solutions can be implemented. Further investigation for assessing the suitability of the solutions needs to be done.
5. Digitalisation of the data with respect to the topography, natural (forest, surface water bodies, drains etc.) and built environment (road, public utility buildings and prominent places etc) will be done. This base data can be updated with household data after 2021 census. Such data will be helpful for preparation of planning documents and DPRs for developing infrastructure for water, wastewater and solid waste management.
6. A vision document detailing out the Decentralized Wastewater Management System should be made for the 8 zones included in the second phase. This document will serve as a feasibility report for choosing appropriate system and an invest plan to develop the required infrastructure.
7. Scheduled desludging can then extended to the other zones where shallow sewers and small bore sewers are to be implemented.
8. The potential delineated zones for Decentralized Wastewater Management will have to be prioritized depending upon the urbanization rate. Individual DPR to be prepared for the individual zones for Decentralised Wastewater Management System (sewerage and treatment plant combined). This activity can be phased our over a period of 3 years.
9. Entire town waste water treatment completed over a period of 3-5 years. A systematic, logical approach for achieving 100% sanitation in Port Blair.

Timeline

Sr. No.	Activity	Y1 (2019)			Y2 (2020)												Y3 (2021)											
		Q4			Q1			Q2			Q3			Q4			Q1			Q2			Q3			Q4		
		M10	M11	M12	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12
1	Identification of land for decentralized STP in Zone A																											
2	Drafting of byelaws for solid-liquid waste management for Port Blair																											
3	Tendering for DPR for STP of Phase 1 serving Zone A, B and C																											
4	Tendering of the Implementation of Sewerage Scheme in Zone A, B and C																											
5	Preparation of DPR for STP of Phase 1																											
6	Implementation of Sewerage Scheme in Phase 1																											
7	Digitalisation of the data for natural and built environment																											
8	Tendering for construction of STP of Phase 1																											
9	Construction of STP of Phase 1																											
10	Implementing scheduled desludging in Zone A, B and C																											
11	Vision document for Decentralized Wastewater Management System for Port Blair																											
12	Implementing scheduled desludging based on the vision document																											
13	Tendering for preparation of DPR for Decentralized Wastewater Management System as per the vision document																											
14	Preparation of DPR for Decentralized Wastewater Management System																											
15	Tendering for implementation of decentralized Wastewater Management System																											
16	Implementation of Decentralized Wastewater Management System (will continue over to year 4)																											

1 Impressions from the site visit

Andaman and Nicobar Islands are archipelago and are one of the major tourist destinations in India. Port Blair is the union territory situated in South Andaman and annually receives tourists equal to the number of the residents. Currently the city of Port Blair does not have infrastructure for liquid waste management. The city is practicing Hybrid Sanitation system where in each household is connected to containment system i.e. septic tank. Typically, the toilets are connected to septic tank and the grey water along with the septic tank effluent is discharged into the storm water drains.

WAPCOS was engaged to prepare the DPR for sewerage for Port Blair. Team of NIUA and their consultant Ecosan Services Foundation. The team was assisted by officials from APWD. Locations of the pumping stations along with potential areas where decentralized wastewater treatment system could be installed were visited.

1.1 Zone A

Zone A is one of the most densely populated zone as seen in the picture below. The houses are situated on the hill slope and the main roads are ridge of the hill and along the coast.

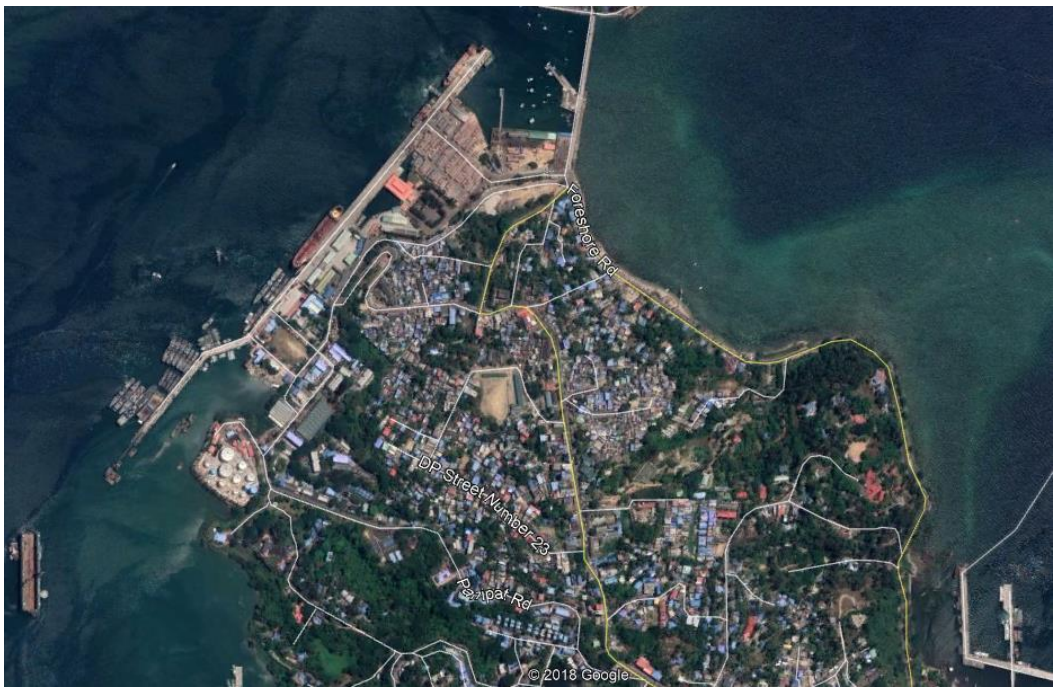


FIGURE 1: GOOGLE IMAGE OF ZONE A WITH THE LAYOUT OF THE ROADS AND HOUSES ZONE A

Visit to the location of the pumping station along with some inspection of the stormwater drains in the lanes connecting to the main road were done. The two locations visited are shown in the map below.

FIGURE 2: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE A

At point A the households discharging septic tank effluent and grey water were observed. It was also observed that the location of the toilets and the width of the road is not favourable for laying of sewerage pipes and other appurtenances such as manholes.

The network of storm water drains consisting of small and big drains convey the wastewater to the main road where it crosses and finally meets the sea. Challenges and issues observed were,

- The solid waste was dumped into the storm water drains and was going to the sea.
- Laying of gravity sewers will be difficult and pose difficulties since at most places the road either the top slab over the drain or laid in concrete.

FIGURE 3: DISCHARGE OF SEPTIC TANK AND GREY WATER FROM HOUSEHOLDS INTO THE STORM WATER DRAIN OBSERVED AT POINT A (RED CIRCLES SHOWS THE SEPTIC TANK OUTLET AND YELLOW CIRCLE DENOTES GREY WATER OUTLET)

- Small bore sewers can be implemented in the existing storm water drains, however anchoring them will be an issue to protect them against the heavy storm water flow.
- Septic tank emptying is not done regularly, which is essential requirement for operation of small-bore sewers.

FIGURE 4: (A) CONCRETE ROAD AT POINT B (B) SOLID WASTE DUMPED IN THE DRAINS AT POINT A (C) OUTFALL OF THE STORMWATER DRAINS IN TO THE SEA AT POINT B

1.2 Zone B

Zone B is the second most densely populated zone which includes residential area and main market area of the city as seen in the picture below. The houses are situated near the fisheries jetty and the main roads are through the main market area of the city.

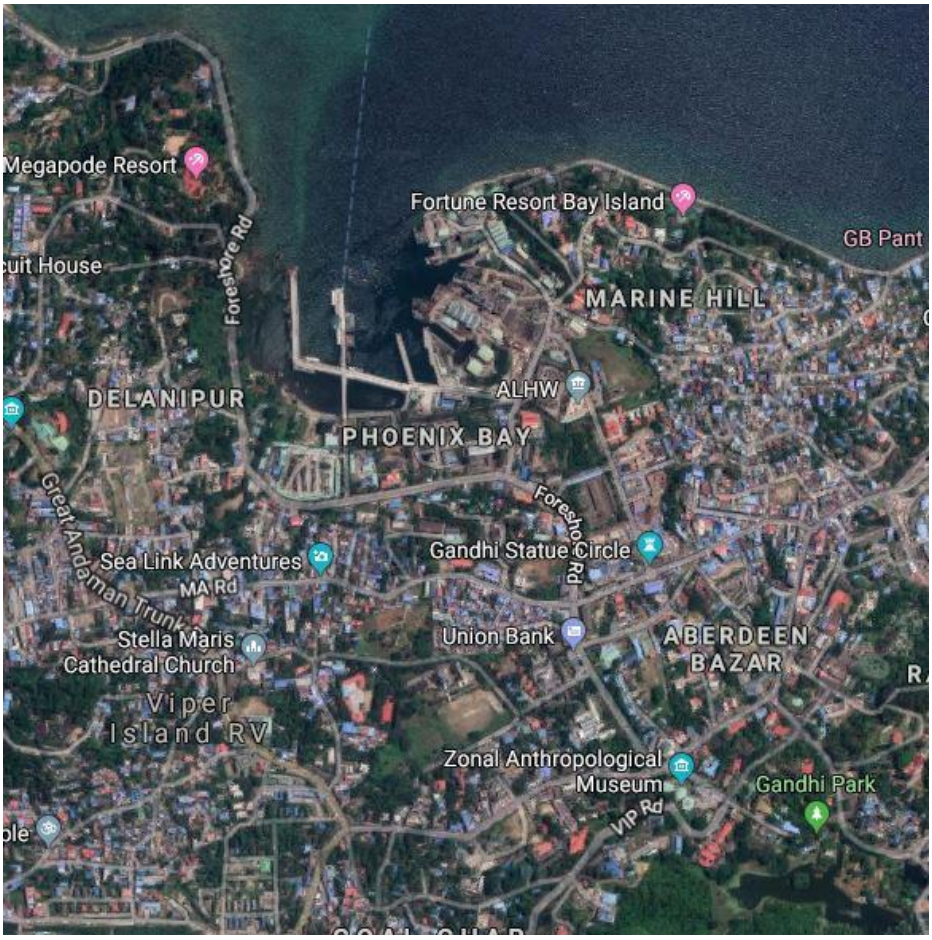


FIGURE 5: GOOGLE IMAGE OF ZONE B WITH THE LAOUT OF THE ROADS, HOUSES AND MARKET ZONE B

Visit to the location of the pumping station along with some inspection of the major drain coming towards the fisheries jetty were observed. The two locations visited are shown in the map below.

At point A the households, institutes discharging septic tank effluent and grey water were observed at a bigger drain. The area covers households, commercial or market areas and restaurants which discharges their wastewater into the drains directly. The point A has the location of pumping station as proposed in the DPR.

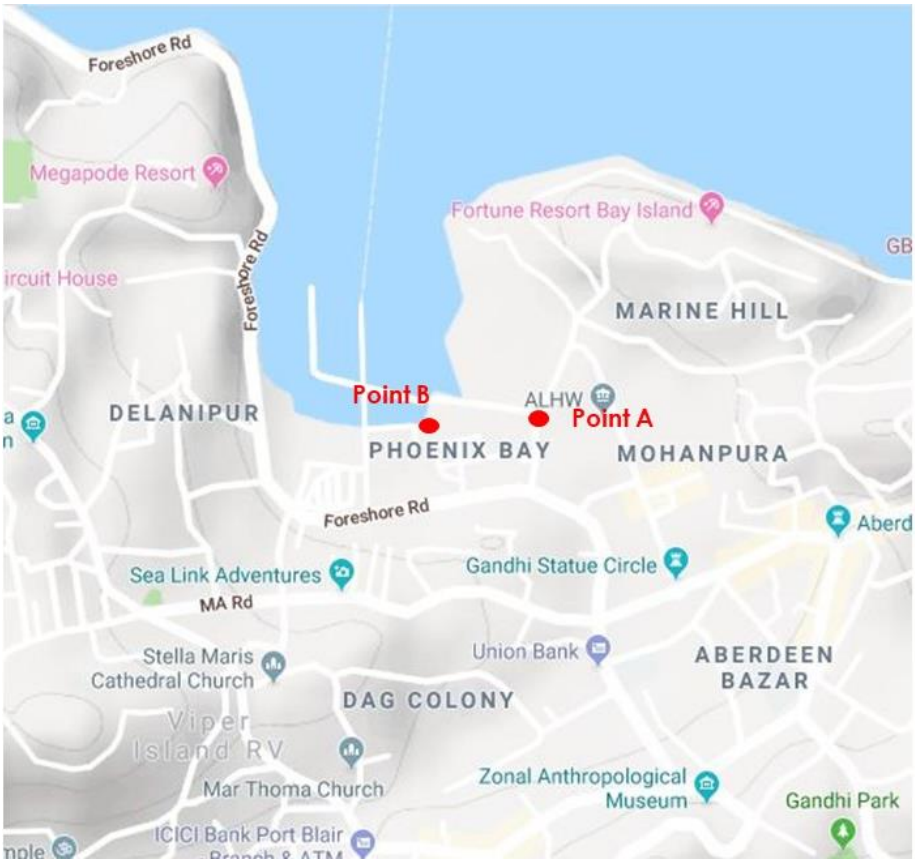


FIGURE 6: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE B

The network of storm water drains consisting of small and big drains convey the wastewater to the main road where it crosses and finally meets the sea at the fisheries jetty (Point B). Challenges and issues observed were,

FIGURE 7: A) BIGGER STORM WATER DRAIN WHICH HAS WASTEWATER DISCHARGE B) OUTFALL IN THE SEA NEAR FISHERIES JETTY

- Laying of gravity sewers in the middle of the road will be challenging and it will disrupt the traffic. Most of the main roads here are bituminous road and the

internal roads are RCC. This will increase the complexity of the laying of gravity sewers.

- The flood gates were broken and hence the storm water drains near the fisheries jetty has effect of backflow of sea water in the drain
- After observing the water quality in the storm water drain, it was quite evident that the drains carries much more than the septic tank effluent and grey water from the houses. It is believed that small scale industries along with fish and meat markets are disposing their waste into the drains.

1.3 Zone C

Zone C is the larger zone which includes residential area and educational institutes of the city as seen in the picture below. The houses are situated on the hill slope and the main roads are ridge of the hill and along the coast. There are few educational institutes and governmental departments along the coast and internal main roads of the city.

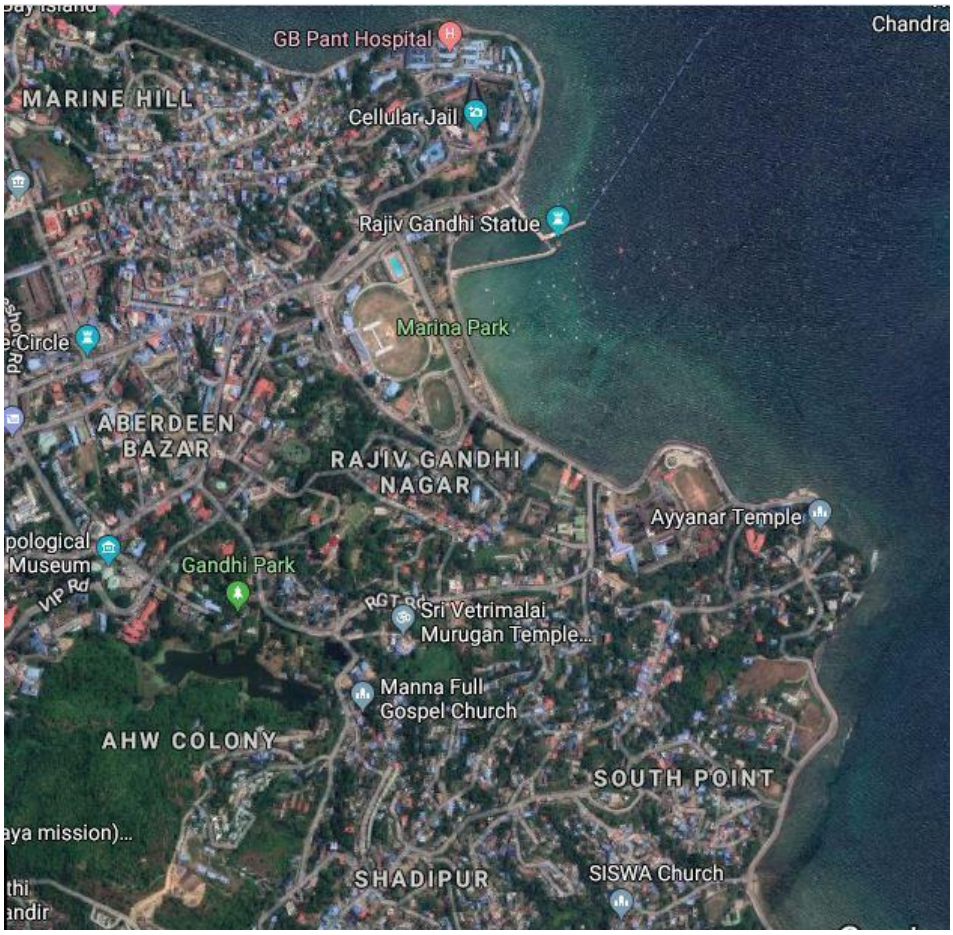


FIGURE 8: GOOGLE IMAGE OF THE ZONE C WITH THE LAYOUT OF THE ROADS, HOUSES AND EDUCATIONAL INSTITUTES OR ADMINISTRATIVE DEPARTMENTS, ZONE C

Visit to the location of the proposed pumping station and Sewage Treatment Plant (STP) along with some inspection of the major drain coming towards main roads along the coast were observed. The five locations visited are shown in the map below.

FIGURE 9: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE C

At point A, the households situated near the airport hill area are discharging septic tank effluent and grey water were observed. It was also observed that the location of the toilets and the width of the road is not favourable for laying of sewerage pipes and other appurtenances such as manholes. We have consulted the people residing at the area and it is observed that the septic tank emptying is not done regularly which is essential requirement for operation of small-bore sewers. There are few households within police colony which has modified septic tanks connected with soak pits.

At point B, the Sewage Treatment Plant is located as per the previous DPR. It was observed that the location is on hill which demands an additional pumping station at the last point of main sewer line. At point D, one of the pumping stations is proposed considering the partly coverage of wastewater from zone C.

At point C & E, the bigger storm water drains were observed. The network of storm water drains consisting of small and big drains convey the wastewater to the main road along the coast where it crosses and finally meets the sea. The outfall of these bigger storm water drains directly discharged in the sea.

FIGURE 10: A) STORM WATER DRAIN COVERED WITH CONCRETE ROAD B) & C) DISCHARGE OF GREY WATER AND BLACK WATER DIRECTLY INTO THE STORM WATER DRAINS

Challenges and issues observed were,

- Laying of gravity sewers will be difficult and pose difficulties since at most places the road either the top slab over the drain or laid in concrete.
- Decentralised STP proposed but there is no land available for the main sewage pumping station for the STP.
- The solid waste was dumped into the storm water drains and was going to the sea. Small bore sewers can be implemented in the existing storm water drains, however anchoring them will be an issue to protect them against the heavy storm water flow.

FIGURE 11: A) THE BIGGER STORM WATER DRAINS WITH SOLID WASTE B) BIGGER STORM WATER DRAIN NEAR CITY GARDEN

1.4 Zone E

Zone E is also moderately populated zone which includes residential area of the city as seen in the picture below. The houses are situated near the Jangali Ghat port area and main highway of the city is passing through the zone.

FIGURE 12: GOOGLE IMAGE OF THE ZONE E WITH THE LAYOUT OF ROADS AND HOUSES, ZONE E

Visit to the location of the proposed decentralised Sewage Treatment Plant (STP) along with some inspection of the bigger stormwater drain near the Jangali Ghat port were done. The two locations visited are shown in the map below.

At point A, the bigger storm water drain was observed which convey the wastewater to the main road where it crosses and finally meets the sea near the Jangali ghat port.

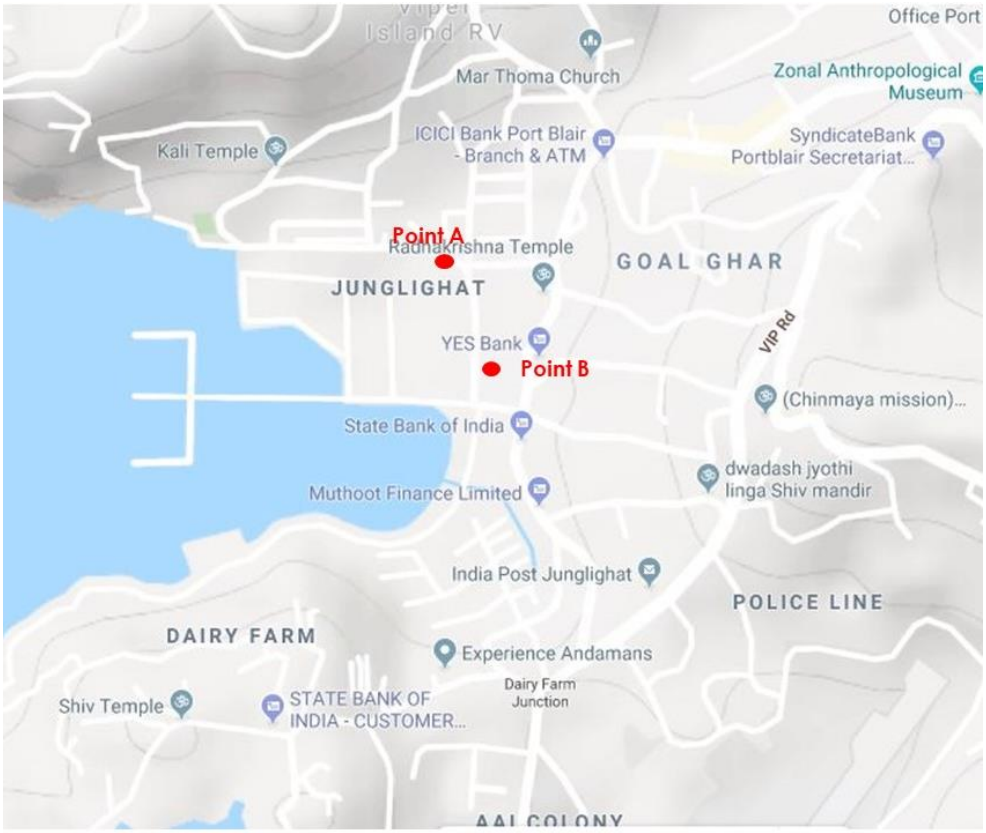


FIGURE 13: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE E

FIGURE 14: A) DISCUSSION WITH MR. ARUN KUMAR, PWD B) MAJOR STORM WATER DRAIN CONVEYING WASTEWATER

As per the Sewerage DPR, the sewage from zone E (**approximately 4 MLD**) is to be pumped four times to reach to the 15 MLD STP proposed in the second phase. To reduce the CAPEX as well as OPEX, it is recommended to have a decentralized STP for this zone. At point B, a potential vacant land was identified for location of decentralised STP for zone E. The identified land had a temporary fish market which now has been shifted.

FIGURE 15: POTENTIAL LAND FOR DECENTRALISED STP

1.5 Zone I

Zone I has moderate population density. Most of the area is covered under green patch, reservoir and mangroves and the development along the airstrip is occupied by mostly commercial properties such as hotels and shops. The dairy farm area is the area with high population density which mostly houses the fishing community of Port Blair.

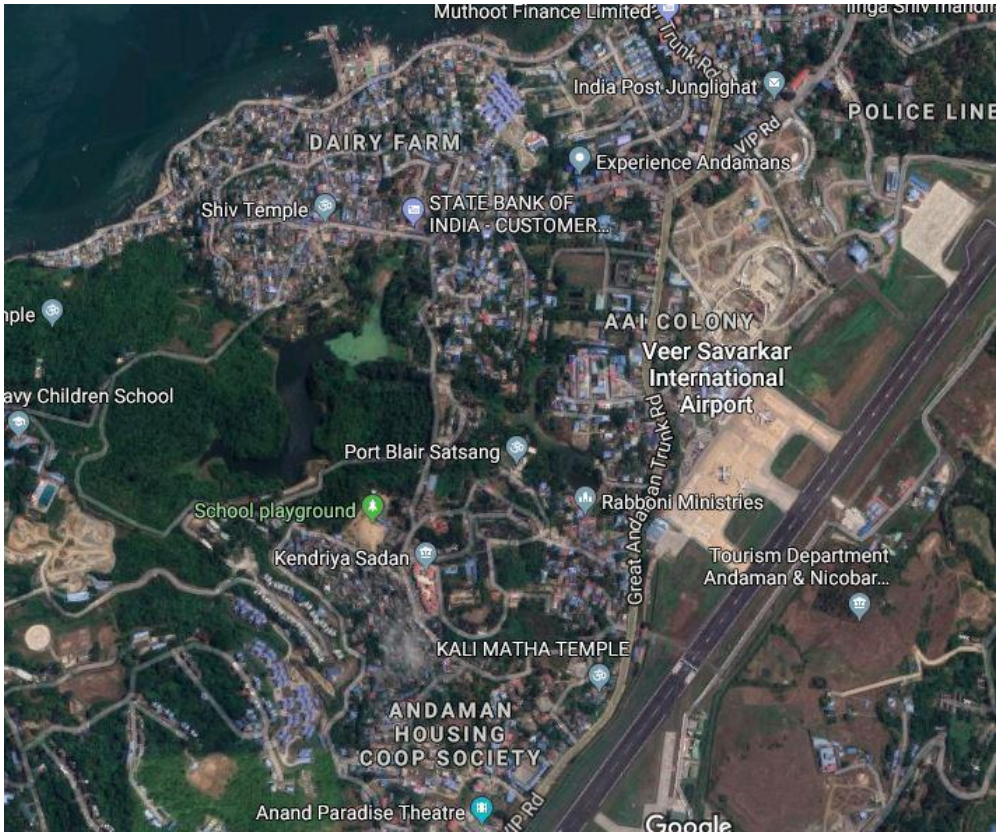


FIGURE 16: GOOGLE IMAGE OF THE ZONE I WITH THE LAYOUT OF THE ROADS AND HOUSES, ZONE I

Visit to Zone I covers the location of pumping station near the airport wall. Currently, the wastewater conveying through minor and major storm water drains connects to another bigger storm water drain flowing from the other side of the airport.

As per the sewerage DPR, the sewage in the Zone I will have to be pumped three times before it reaches the 15 MLD STP. Hence it is recommended that the STP should be set up for the zone separately.

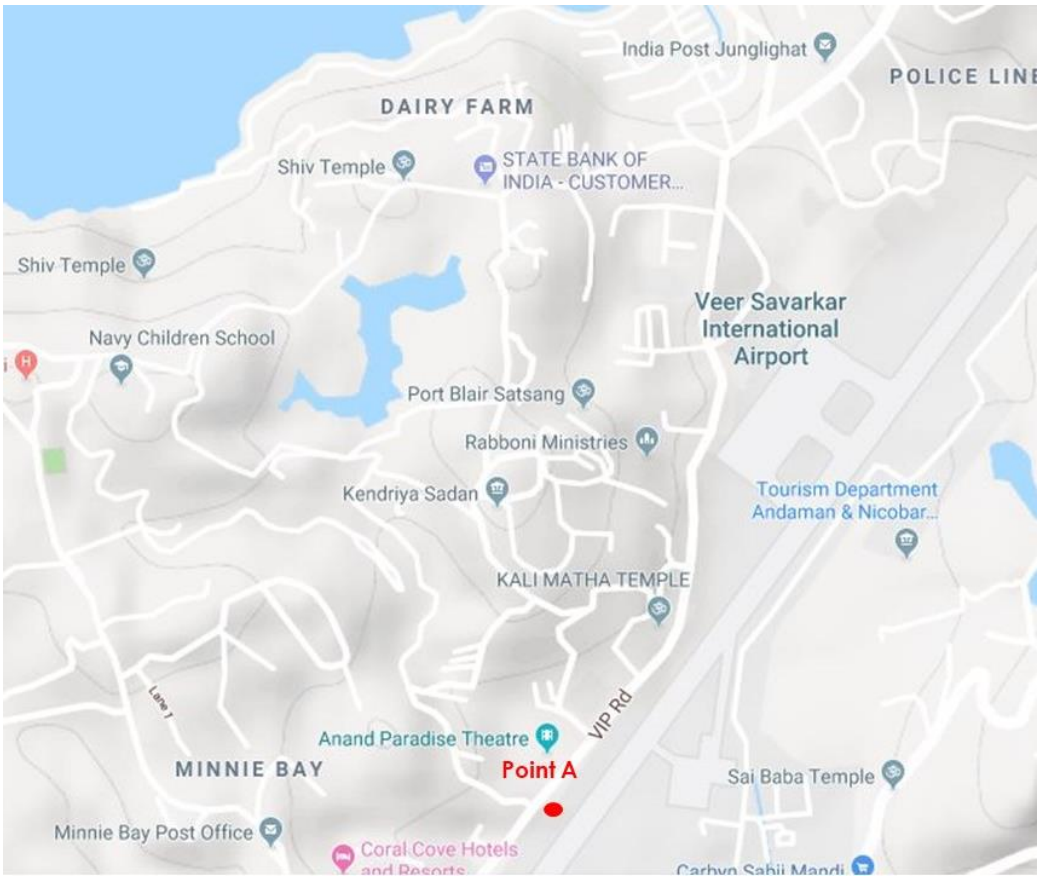


FIGURE 17: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE I

FIGURE 18: A) PROPOSED LOCATION OF PUMPING STATION B) STORM WATER DRAIN

1.6 Zone M

Zone M is sparsely populated zone which includes residential area in the peri urban area of Port Blair. This area was merged into the PBMC administration. Hence, the area is under development. Topographically it is mildly undulating and main highway of the city is passing through this zone.

FIGURE 19: GOOGLE IMAGE OF ZONE M WITH LAYOUT OF THE ROADS AND HOUSES, ZONE M

At Point A, the location of proposed decentralised STP was observed. It is located on hill region which covers sparsely populated section of Zone M. The second Point B of pumping station has located near the district hospital.

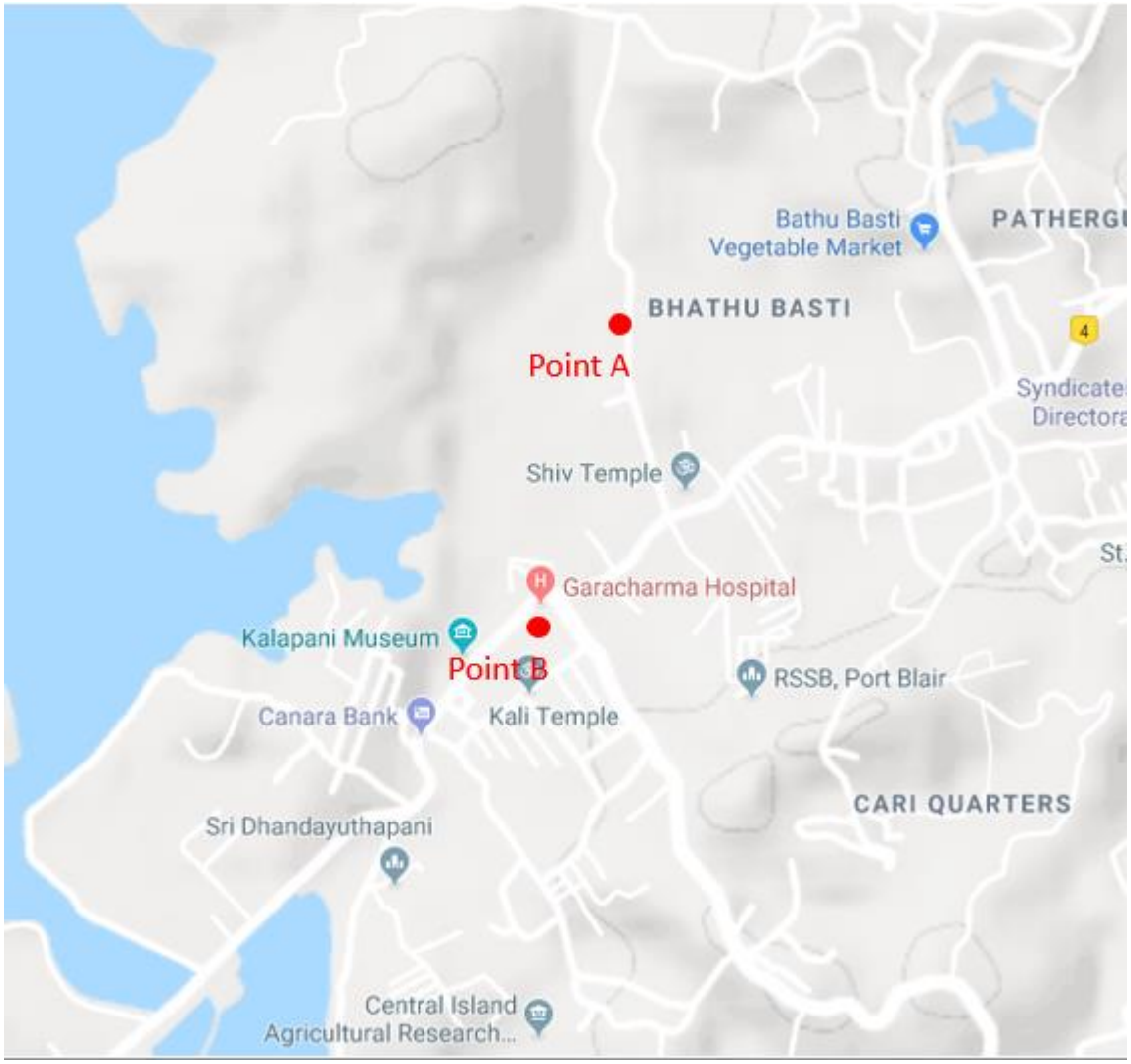


FIGURE 20: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE M

The key challenges in this zone is its distance from the 15 MLD STP and its undulating nature. Since, suitable land was not available for pumping station at the lowest level of the sewerage system, it has been shifted to the point B where the difference in the level of the pumping station and level of the sump well will be significant.

The sewage from this zone will be pumped at least three times before it reaches the STP. Hence, *it is recommended that an appropriate piece of land should be identified and a decentralized STP should be constructed for this zone.*

1.7 Zone L

Zone L have sparsely populated zone which includes residential area at the right side of flight runway as seen in the picture below. This area is undergoing development as more and more residential properties are coming up.

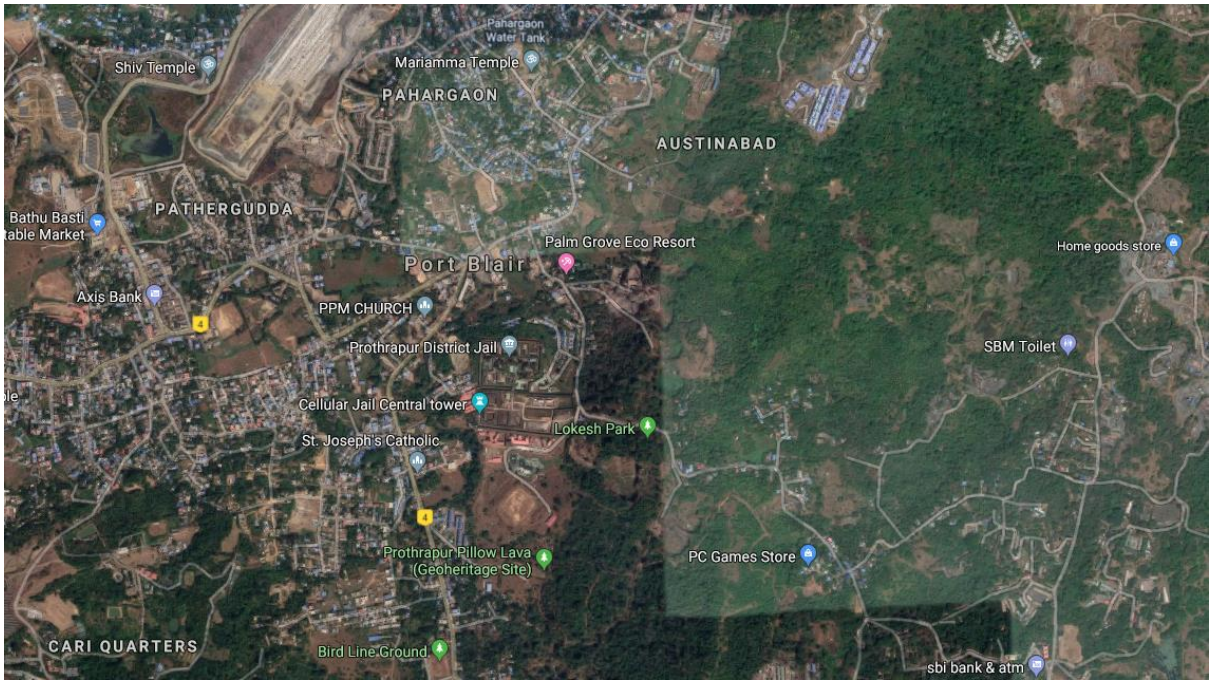


FIGURE 21: GOOGLE IMAGE OF ZONE L WITH LAYOUT OF ROADS AND HOUSES ZONE L

According to the sewerage DPR, the sewage from the Zone I will be pumped to L, however, there is a potential to transferring it directly to Zone K there by reducing the length of rising main.

1.8 Zone K and G

The Zone K and G is relatively less dense and mostly occupied by hill and green cover. Zone K is under development due to its proximity to the airport and upcoming bus station.

Two locations were visited in these zones. The Point A represents approximate location of the decentralized STP. However, looking closely into the levels of the sewer pipes, there seems to be some discrepancy with the delineation of the zone.

Due to the recent development, the levels of the road might have changed significantly. The same can be observed with the sewerage map produced by WAPCOS. The length of the air strip is shown to be quite small and the location of the STP is to the south of the air strip. However, through the google map it can be seen that the actual location of the STP is to the east of the airstrip.

FIGURE 22: GOOGLE IMAGE OF ZONE M WITH LAYOUT OF THE ROADS AND HOUSES ZONE K & G

The other location visited was site for the 15 MLD STP, which is situated on top of the hill. The location was chosen since, adequate area was not available anywhere else. However, if load from Zone E, I, J and M can be reduced then considerably smaller area will be required.

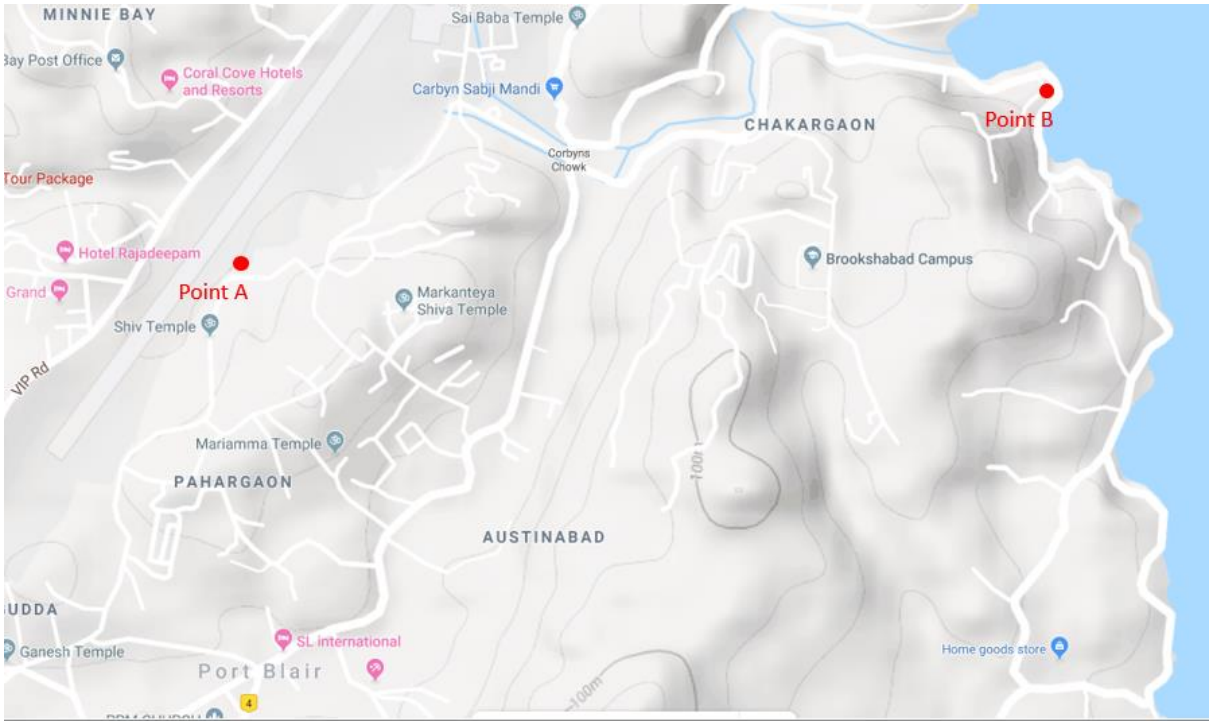


FIGURE 23: GOOGLE TERRAIN MAP REPRESENTING THE LOCATIONS OF POINTS VISITED IN ZONE K AND G

2 Way forward

Currently there are various challenges which are faced by the city of Port Blair. The impact of not addressing these challenges is the deteriorating ecology of the sea near the cost. Following are few way forward points for the city of Port Blair for improving the wastewater management at the city level.

2.1 Sewerage system

In wards which have high population density and construction of soak pits and drain fields is not possible, should be connected to sewer system. Sewerage system are installed with a purpose to collect liquid waste (black water, grey water, septic tank effluent) from the residential properties.

Small bore sewers

In cases, where regular emptying of septic tank can be ensured, small bore sewer system becomes an ideal solution. Laying of small-bore sewer systems is relatively easy as compared to gravity sewers. These sewers can also be implemented along the storm water drains and follow the natural gravity to collect the water at a decentralized level where a STP can be installed to treat the water before discharging.

Shallow sewers

In cases, where regular emptying of septic tank cannot be ensured however there is potential to be able to treat the collected wastewater at a decentralised scale, shallow sewers can be installed. Unlike gravity sewers shallow sewers are laid along the road side and hence can be laid a shallow depth. In case of Port Blair, the contour not only supports the implementation of shallow sewers but also minimises the need of flushing of these sewers as routine maintenance.

2.2 Byelaws for faecal sludge and septage management

It was observed that the septic tank effluent and the greywater is discharged in to the stormwater drains which eventually meet the sea. The septic tank effluent is major contributor to the BOD pollution to the sea in this case. During the visit, while discussing

with the locals, it was seen that most of the houses do not empty their septic tank until it is needed. This means the most of the tanks are emptied only when there is nuisance created to the household such as odour or choking of the pipes. In some cases, it was told that manual emptying of septic tank is done and the septage is discharged into the nearby drains and later flushed with water to avoid stench.

Ideally the septic tanks should be emptied frequently at an interval of 2-3 years. This improves the settling efficiency of the solids in the tank there by decreasing the BOD concentration in the septic tank effluent considerably.

There is should be well defined byelaws for faecal sludge and septage management especially in the city such as Port Blair. Maintaining the efficiency of the septic tank by regularly emptying it will significantly decrease the BOD load reaching to the sea through storm water drains.

2.3 Byelaws for wastewater management

Currently the city of Port Blair lacks byelaws for liquid waste management. There is a need for PBMC to develop byelaws for liquid waste management and enforce it. These byelaws should mainly focus on two points mentioned below;

2.3.1 Bulk generators

Bulk generators such as commercial spaces – resorts, hotels, restaurants, educational institutes, malls etc and residential properties such as government quarters, housing colonies, hostels and government offices, small scale industries should be made mandatory to have their own sewage treatment plants.

These bulk generators are responsible for contribution of pollution and significant reduction in the pollution can be seen if such byelaws are enforced and acted upon.

2.3.2 Non networked sanitation

It should be recommended to have a soak pit after the septic tank so that the septic tank effluent is percolated in to the ground. The ground water table is very low and hence there will not be an issue.

A properly designed soak pit/drain field can also be used for handling the discharge of grey water. Promoting a right kind of sanitation system to handle the solid liquid

waste, supports the practice of ideal non networked sanitation. In city of Port Blair, the population relying on ground water is very low, moreover the ground water table is also low. In such cases soak pits or drain fields are ideal for percolation of partially treated water. This will reduce the effluent from the residential properties into the storm water drains and eventually reduce the BOD load.

2.4 Byelaws for solid waste management and its enforcement

It was observed that waste from the fish and meat market, small scale industry and restaurants is disposed in the storm water drains. These drains lead to the sea and are major reason for BOD pollution in the city.

Although it was told that the PBMC has solid waste management byelaws – rules and regulations, enforcement of the same seems to be an issue. If there is no regulation specific to management of the waste from the bulk generators such markets, small scale industry and restaurants, the same should be made and strictly enforced.

A carrot and stick method is proposed as a solution for this issue. A scientifically developed and targeted awareness generation program should be run by PBMC to tackle this situation. Rewards should we given to those who provides evidences of mismanagement of solid waste by the domestic and commercial properties. The properties who are not following the rules should be fined heavily depending on the kind of waste disposed.

2.5 Prioritization of the solutions

To prioritise the solutions, Eisenhover's decision matrix is used below. The solutions discussed above are classified into the urgent and important matrix as shown below.

	Important	Not Important
Urgent	**Quadrant I** •Formulation of Byelaws for Faecal Sludge and Septage Management and its enforcement.	**Quadrant III** •Revision of byelaws for SWM and its enforcement.

	•Formulation of Byelaws for liquid waste management by Bulk Generators	
Not Urgent	**Quadrant II** •Implementation of Phase 1 (Zone A, B and C) of Sewerage System (small bore/gravity) along with centralized STP. •Planning and implementing decentralised sanitation system in the geographical area of Phase 2 of sewerage DPR. •Promoting non networked sanitation systems in the areas with low population density.	**Quadrant IV** •Conceptualising an awareness generation campaign for improving Solid - Liquid Waste Management.

FIGURE 24: EISENHOVER'S DECISION MATRIX FOR PRIORITIZATION OF ACTIVITIES

The tasks given in the quadrant I need immediate attention and are important for success of the activities given in the quadrant II. The activities mentioned in the quadrant III & IV are relatively less important as compared to the other activities.

3 Proposed interventions

We propose an engagement of one year with Port Blair for providing handholding support to the authorities and officials. Following are the activities which are proposed under these one-year engagement.

3.1 Preparation of feasibility report for decentralized wastewater management

Headed by: NIUA and ESF

Team: Urban planners with GIS expertise (2 no.), Civil / Environmental Engineers (3 no.)

Rationale: This exercise is needed, to identify proper delineated urban water sheds for successful preparation of DPR for decentralised wastewater management.

Methodology:

1. Collection of data such as digital elevation map, household data, service level benchmarking data.
2. Delineation of the urban water sheds, bifurcation of the household data based on delineated zones
3. Recce survey, verification of the satellite imagery with actual ground conditions.
4. Identification of the potential areas for decentralized wastewater management.
5. Identification of appropriate collection - conveyance and treatment option for wastewater for all the potential areas.

3.2 Preparation of plan / DPR for decentralized wastewater management

Headed by: APWD and PBMC

Team: APWD and PBMC officials and sector experts (to be appointed by NIUA)

Rationale: Currently the sewerage DPR prepared by WAPCOS is outdated and the mapping of the sewerage network needs to be updated and verified with actual ground conditions. Hence, separate DPR should be created for micro urban water sheds.

Methodology:

1. Preparation of ToR by the expert for the consultants to be appointed for preparation of DPR.
2. Appointment of a consultant by APWD for preparation of the DPR for chosen area for decentralised wastewater management.
3. The consultant to verify the reduced levels of the roads for planning of sewerage system (small bore/shallow sewers).
4. Drafting of DPR for collection-conveyance system along with the treatment system.

3.3 Formulation of byelaws for liquid waste management

Headed by: NIUA

Team: Ecosan Services Foundation

Rationale: Byelaws for liquid waste management are required for proper functioning of sanitation systems. There is a high risk of infrastructure projects getting delayed or failing because of absence of appropriate byelaws supporting the operation and sustainability of the liquid management infrastructure.

Methodology:

Development plan along with the detailed project reports, policies and byelaws (if any) prepared for water, wastewater and solid waste management will be referred to and will be studied for making the first draft of the byelaws for liquid waste management.

Byelaws for liquid waste management will be drafted in conjunction with the current situation of liquid waste management and the city's vision with respect of water management.

3.4 Plan for faecal sludge and septage management- scheduled desludging

Headed by: NIUA

Team: Ecosan Services Foundation

Rationale: PBMC has shown interest towards operationalising scheduled desludging of septic tanks. Regular desludging of septic tank ensures reduction in the pollution load and proper functioning of the small bore sewer system.

Methodology:

PBMC shared the concern with installation of gravity sewers and its functioning and were ready to operationalise scheduled desludging in Port Blair. However, to operationalise scheduled desludging, a careful analysis of the city and the required assets – vacuum trucks and options for handling of septage will be needed.

In conjunction with the preparation of feasibility report, a plan for scheduled desludging will be prepared for the city of Port Blair.