# CHAPTER - 9
# DRAINAGE AND ENVIORNMENTAL MANAGEMENT PLAN

## 9.1: Drainage

### 9.1.1 Introduction

This section of this Chapter of the planning report states about the development plan proposals made for drainage of Narail Paurashava. In each part the Consultants move with goals and objectives followed by evaluation of existing conditions. After that development proposals have been set for each component.

Following are the objectives of drainage management plan in Narail Paurashava:

A. To allow smooth drainage of storm water and the waste water of the town.
B. To develop a comprehensive drainage network with area coverage and capacity.
C. To prevent encroachment to natural drainage system.
D. To create awareness about disposing of solid waste in the drainage system.

### 9.1.2 Existing Drainage Network

Three tier drainage network systems is found in Narail Paurashava as under

a. Primary Drain
b. Secondary Drain
c. Tertiary Drain

Following are the brief description of the existing network system.

**a. Primary drain**

The primary drain – Chitra River passes eastern portion of the project area. It has been observed from the survey that 15.03 km of rivers passing through the project area. The Chitra River which is the border of Narail Paurashava passes through Ward no. 01, 02, 03, 04, 05, 06, 07, 08 and 09 of the Project area. The Paital Beel and Raghunathpur canal are now illegally being encroached by people. Water flow is not continuous in Chitra River throughout the year. During rainy season it became continuous for some days. Both the water channels have served the purpose of primary drains of the Paurashava.

**b. Secondary drain**

About 0.78 Km secondary drains have been identified in Narail Paurashava. These secondary drains were constructed piece meal and without planning in Narail Paurashava. Secondary drains are expected to be RCC for its size and shape and covered with slab to avoid accident.

**c. Tertiary drain**

Tertiary drainage systems provide the initial localized control, collection and treatment of storm water runoff. Tertiary water flow consists of runoff from buildings, streets, parking lots, driveways, lawns and other saturated surfaces. Typical tertiary drainage structures include retention and detention ponds, ditches, culverts, small sized open brick or RCC drains. Tertiary drainage systems serve a spectrum of development types including residences, shopping malls, industrial parks and planned communities. Almost all man made drains of Narail Paurashava are tertiary in nature. The total length of tertiary drain is 7.86 Km.

The drainage network of Narail Paurashava is not well-organized and there are areas which are annually inundated by water logging for significant duration and several times in a year. Absence of natural khals and beels establishment of good drainage system in Narail is quite complicated. The drainage network is contributing to the pollution of the Chitra River. Though the river water is not found heavily polluted in the present context the continual untreated discharge may further aggravate the level of pollution.

Apart from the drainage system, large number of ponds and ditches (1551) are being observed in the area covering an area of 308.31 acre. These also play an important role to retain the storm water during monsoon and contribute to make the area free from water logging. Ward wise distribution of water/bodies (pond and ditches) has been shown in the following table.

Table-9.1: Ward wise distribution of Drainage Components

| Ward No. | Area of different water bodies and channels ( in Acre ) | | | | | |
|---|---|---|---|---|---|---|
| | Pond | Ditch | Marchland | Khal | River | Total |
| Ward 01 | 32.12 | 3.42 | 0.00 | 2.46 | 6.20 | 44.21 |
| Ward 01(ext) | 11.93 | 1.74 | 0.00 | 2.39 | 2.09 | 18.15 |
| Ward 02 | 12.28 | 4.01 | 1.32 | 0.00 | 77.59 | 95.18 |
| Ward 03 | 10.27 | 3.29 | 0.00 | 0.00 | 18.51 | 32.07 |
| Ward 04 | 70.59 | 12.28 | 0.00 | 4.50 | 1.37 | 88.74 |
| Ward 05 | 26.93 | 5.52 | 0.00 | 0.00 | 2.04 | 34.49 |
| Ward 06 | 23.09 | 1.83 | 0.00 | 0.00 | 6.39 | 31.32 |
| Ward 06(ext) | 8.68 | 1.14 | 0.00 | 0.00 | 0.00 | 9.83 |
| Ward 07 | 14.16 | 2.52 | 0.00 | 0.00 | 9.53 | 26.20 |
| Ward 07(ext) | 17.33 | 1.86 | 0.00 | 1.86 | 0.00 | 21.05 |
| Ward 08 | 19.20 | 5.32 | 0.00 | 0.00 | 49.03 | 73.55 |
| Ward 09 | 15.93 | 2.88 | 0.00 | 0.00 | 122.32 | 141.13 |
| **Total Area** | **262.52** | **45.80** | **1.32** | **11.21** | **295.07** | **615.91** |

Source: Physical Feature Survey, 2009.

**Identification of problems concerning drainage**

Narail Paurashava was supposed to be flood free for long time until year 1988. Special attention is needed to solve the water logging problem. Water logging and drainage is the main problem for Narail that causes sufferings of the peoples. Every year other than Chitra River, there are other canals (Paital Beel, Raghunathpur). They are found to be dysfunctional due to encroachment within the Paurashava that could be served as Primary Drain. The numbers of Secondary drains are very insignificant. To solve the overall drainage problem of the Narail Paurashava and to make it free from water logging a 'Drainage Plan' as integral part of Paurashava Master Plan is an imperative. In addition to the existing natural and man made drains, there are total of about 1551 numbers of ponds and ditches in the Paurashava. Special attentions should also be given to protect the khas lands of the Chitra River, Garu Chira khal, Paital Beel and Raghunathpur Khal from illegal encroachment. Special attentions were also given to protect Chitra River from the liquid wastes of factories and saw Mills. The rivers are to be rehabilitated with proper section to increase their storage capacity so that during wet season they can accommodate the rainwater of the Paurashava. For secondary and tertiary drains these rivers will be their outfalls. The most important water logging areas are shown in the following map no. 9.3.

Main problem concerning drainage network is that it is not well designated. As an old town this Paurashava there should have been well designated primary secondary and tertiary drains. But drains are made without any hierarchical order and do not support the area properly. This is why the calculation of capacity shortfall and slope problem couldn't be done. This may hamper the design of the area.

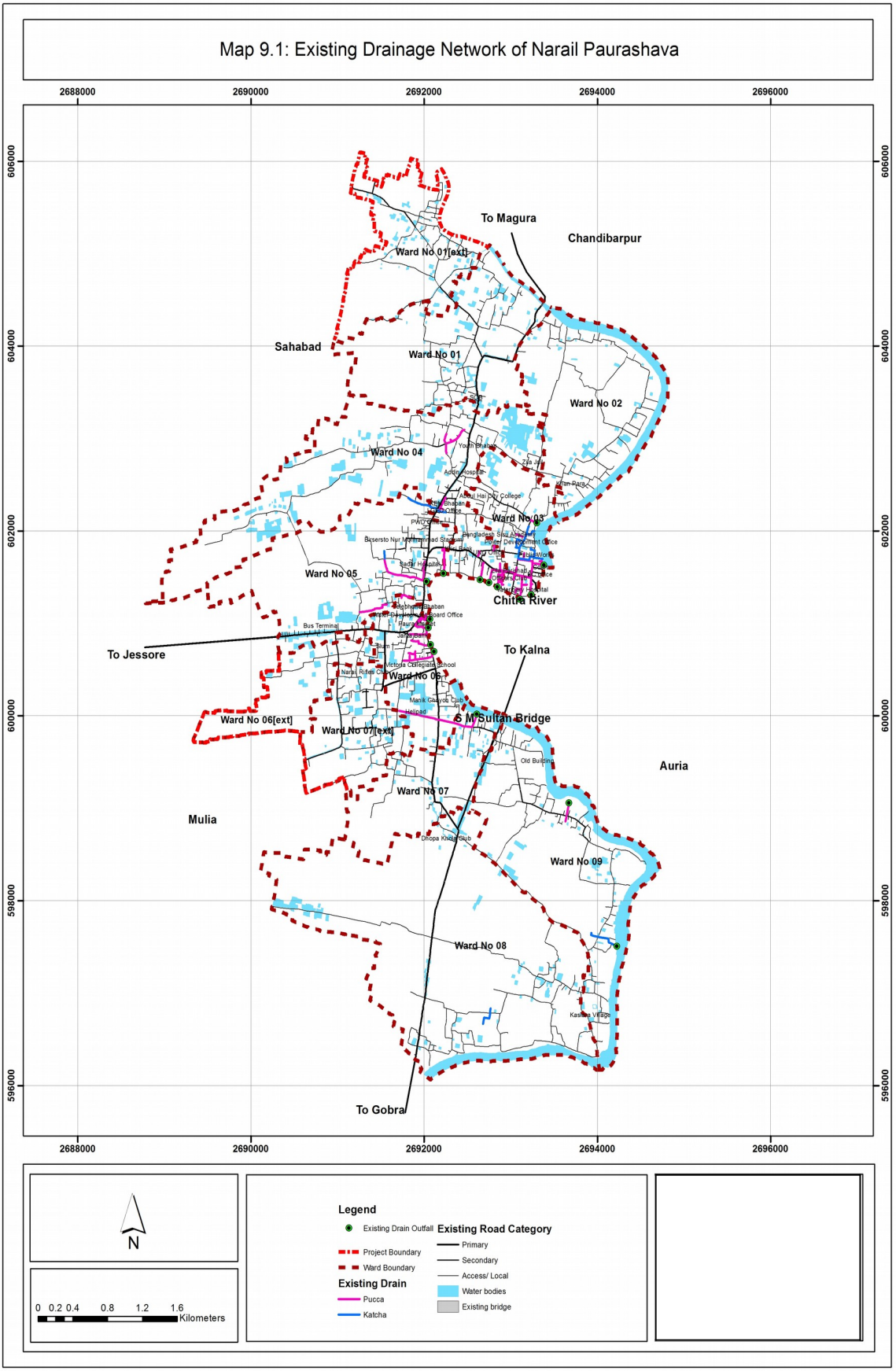
### 9.1.3 Plans for Drainage Management and Flood Control

Drain as the structure is generally develops to free our living area from household waste water and rain water of storm water. The daily waste water discharge from a household is negligible so for the drainage design it is necessary to calculate the storm water.

Urban storm drainage primarily concerns this surface run-off .The primary objective of urban drainage system design is to drain out this storm water either through open surface drains or through underground sewers. An important parameter for the design of storm water systems is the rate and volume of run-off to be conveyed through the system as a consequence of storms.

Run-off estimates are carried out based on knowledge of the occurrences of heavy rainstorms and a relation between rainfall and the corresponding run-off. The quantity of run-off again depends on the geometry and physical properties of the catchments.

Rainfall occurs at irregular intervals, and intensities, and frequency and duration vary within catchments. Due to this random nature of occurrence of rain events, the storm drainage system is designed considering estimated run-off based on the analyses of past rainfall records. A widely used statistical description of heavy rainfall is that of intensity–duration–frequency curves that are developed by processing the data for a large number of storm events observed over a number of years, considering the time variation of the rainfall intensity.


Map 9.1: Existing Drainage Network of Narail Paurashava
2688000
2690000
2692000
2694000
2696000
606000
604000
602000
600000
598000
596000
To Magura
Chandibarpur
Ward No 01[ext]
Sahabad
Ward No 01
Ward No 02
Ward No 04
Ward No 03
Ward No 05
Chitra River
To Jessore
To Kalna
Ward No 06
Ward No 06[ext]
Ward No 07[ext]
S M Sultan Bridge
Auria
Ward No 07
Mulia
Ward No 09
Ward No 08
To Gobra
N
0 0.2 0.4 0.8 1.2 1.6
Kilometers
Legend
Existing Drain Outfall
Project Boundary
Ward Boundary
Existing Drain
Pucca
Katcha
Existing Road Category
Primary
Secondary
Access/ Local
Water bodies
Existing bridge

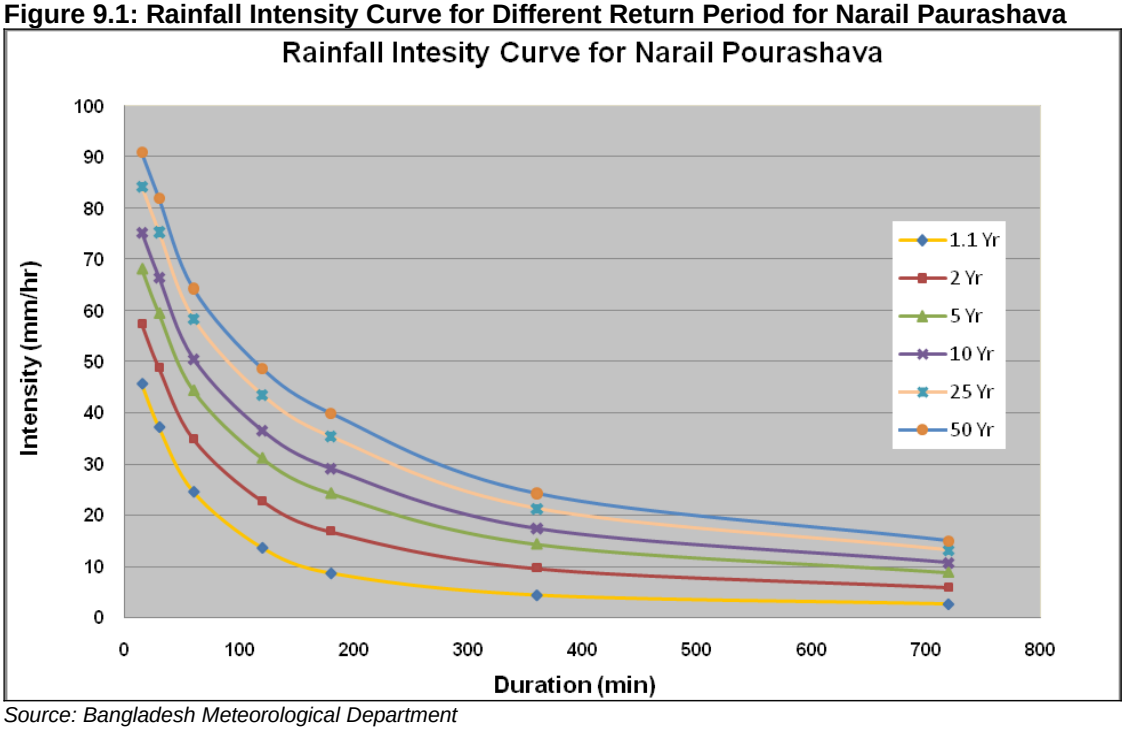
Following table and figure illustrate the rainfall intensity of Narail Paurashava. Detail can be found in the interim report.

Table-9.2: Short Duration Rainfall Data for Narail
Conversion factor = 0.62

| Return Period | Rainfall Intensity (mm/hr) in given duration (Converted from Dhaka) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 15 min | 30 min | 1 hour | 2 hour | 3 hour | 6 hour | 12 hour |
| 1.1 | 45.69 | 37.24 | 24.62 | 13.68 | 8.70 | 4.41 | 2.67 |
| 2 | 57.44 | 48.86 | 34.94 | 22.81 | 16.78 | 9.57 | 5.84 |
| 5 | 68.19 | 59.49 | 44.38 | 31.14 | 24.24 | 14.30 | 8.76 |
| 10 | 75.28 | 66.51 | 50.60 | 36.61 | 29.15 | 17.41 | 10.75 |
| 25 | 84.29 | 75.40 | 58.50 | 43.58 | 35.37 | 21.32 | 13.18 |
| 50 | 90.94 | 82.06 | 64.34 | 48.74 | 39.97 | 24.24 | 14.98 |

Source: Bangladesh Meteorological Department

**Figure 9.1: Rainfall Intensity Curve for Different Return Period for Narail Paurashava**




*Source: Bangladesh Meteorological Department*

**Table-9.3: Ward wise Drainage coverage in the project area**

| Ward No. | Drainage Catchment Area (acre) | Built up area (acre) | Deficiency (acre) | Deficiency (%) |
|---|---|---|---|---|
| Ward 01 | 0.00 | 201.47 | 201.47 | 100.00 |
| Ward 02 | 0.00 | 141.06 | 141.06 | 100.00 |
| Ward 03 | 18.17 | 143.54 | 125.37 | 87.34 |
| Ward 04 | 14.04 | 264.72 | 250.68 | 94.70 |
| Ward 05 | 14.25 | 181.86 | 167.61 | 92.16 |
| Ward 06 | 12.29 | 213.70 | 201.41 | 94.25 |
| Ward 07 | 2.33 | 201.69 | 199.36 | 98.84 |
| Ward 08 | 2.25 | 131.26 | 129.01 | 98.29 |
| Ward 09 | 5.14 | 148.01 | 142.87 | 96.53 |
| **Total** | **68.47** | **1627.32** | **1558.85** | **95.79** |

*Source: Drainage and Environmental survey 2009*

### 9.1.3.1 Drain Network Plan

**Future Assessment**

The future drainage system in the Narail Paurashava should have provision of following standards in the drainage network with a view to achieving an effective and efficient drainage system: the drainage network shall comprise of three tier network:

1. Tertiary drain
2. Secondary drain and
3. Primary drains.

Tertiary drain is a localized drain which collects runoff from the catchment lying adjacent to the tertiary roads and discharges into the recipient drain, the secondary zone. Tertiary drain also takes care of road drainage and passes along the road network.

Secondary drain receives runoff from the tertiary drains as well as from its own catchment including road drainage and discharges finally into the river, khal or lowlands. It passes along the main roads and may be either on one or both sides of the roads depending on catchment area.

Primary drain comprises the natural khal or river and is often unlined or kutcha drain. It is considered as outfall of the drainage network. The outfall should be provided with sluice gate or controlled structure if there is any tidal effect in order to control any backflow. Further Pumping Station should be provided at or near the outfall point in case the river/khal water level is higher than the drain water level, otherwise there will be backflow and water logging in the upstream area. To protect river water from pollution hazards the outfall has to be equipped with treatment plant.

**Outline of Proposed Drainage Improvement Plan**

Open drainage system is followed in Narail as it is cheaper than piped drain and easy to maintain. Piped storm water drainage system could not develop as it is expensive to construct, operate and maintain such system and also beyond the affordable limit of the Paurashava. However, few congested area where there is no provision of road side drainage development, piped or underground drain has been proposed in those areas.

The existing drainage system will provide a basis for a comprehensive drainage scheme in which the khal network, pucca/kutcha drains and borrow-pits may be up-graded to act as the main framework for improved and integrated as well as viable drainage system for the Narail Structure Plan area which will serve the drainage need during the peak monsoon period when the drainage stands critical.

**Formulation of Storm Water Drainage Management Plan**

In order to develop a practical and affordable solution to the storm water drainage problem, formulation of a drainage management plan for the whole area for storm water drainage and flood control measures may be proposed. For this purpose the following tasks have been accomplished:

i) topological survey of the area including levels of existing drains and culverts;
ii) assessment of extent and frequency of flood damage to the flood affected areas;
iii) design of secondary and tertiary drains, and retention areas required;
iv) review of technical, environmental, institutional, economic and social feasibility of the proposed works;
v) planning of implementable phases;
vi) detailed design;
vii) provision of adequate drainage reserves and right-of-way;
viii) maintenance program including assessment of manpower requirements;
ix) funding mechanisms for construction phases and operation and maintenance of the system;
x) application of practical standards for storm water drainage;
xi) selection of realistic return periods of rainfall and river water levels based on the experiences from the BWDB projects;
xii) system design following existing drains and culverts as much as possible and natural topography of the area, keeping land acquisition to an absolute minimum.

It is very important to point out that the Paurashava should develop its own ability to clean and maintain the drainage systems. Therefore, institutional and technical strengthening of the Narail Paurashava and planned maintenance procedures will be an important factor for any drainage improvement project.

**Conceptual Plan for Phase-wise Implementation of Drainage Management Plan**

Priority areas has first identified during preparation of comprehensive topographical surveys and outline plan, through observed physical conditions, discussions with the local residents, and detailed discussions with different authorities. Specific attention has given to the improvement of drainage systems in the town centre and in the densely populated residential, commercial and in the densely populated areas in the structure plan area. The priority for the proposed works should be grouped into different priority levels for phase-wise development. The Paurashava Authority will confirm the local priorities and select the remaining improvement works as Second Priority Works on the basis of availability of funds. The sluice with flap gate at outfall point of proposed main outfall has needed to construct to control backflow during dry season or over flow during flooding time. Re-excavation, regarding, deepening, widening of drainage khals comprising the network of khals should be done on priority basis. Non-structural measures prescribed for site development and plinth levels of different structures to be followed as prescribed. The existing agricultural lands/ lowlands lying in the fringe and semi-core areas of the structure plan area is not only serving as good retention basins but also playing an important role in decreasing magnitude of flood in the core/semi-core areas.

Further it may be noted here that though urbanization is in progress, the lands including agricultural lands within the structure plan area will not be urbanized by the year 2030 and that some low and agricultural lands will exist beyond this period, which will serve as storage basins/ retention pond and reduce magnitude of flood significantly during monsoon season.

**9.1.3.2 Proposal for improvement of the existing drain networks**

**Improvement of Environmental Situation through Improved Drainage System**

Improvement in the drainage system will improve the environmental situation in the water logged areas by eliminating stagnant water and associated problems, like, odors from decaying solid wastes, insects, scams and disease vectors as well as the incidence of local flooding due to rainfall.

Although the drains are intended to remove storm water, but they also receive sullage flow, septic tank effluent and other locally contaminated water. For the above problem the following mitigating measures may be taken:

(i) Paurashava will educate and take action against polluters;

(ii) Provide better sanitation for low-income and town center areas through construction of pit latrines and public toilets respectively;

(iii) Protect the outlet of drains by providing Oil and Silt Traps as necessary and Trash Racks and Sumps in the drainage system to reduce cost of routine cleaning and maintenance work;

**Complementary Non-structural Measures to Protect Right of Way and Other Aspects**

In addition to physical works program Paurashava should adopt complementary procedures and policies in maintaining a proper drainage system within its jurisdiction. In the long-run these "non-structural measures" will improve the drainage situation and resolve the drainage problems. The following non - structural measures are recommended:

(a) provide adequate funds in all annual budgets for carrying out routine maintenance programmes;

(b) identify, on the basis of the Drainage Improvement Plan, all areas existing main drains are located or will be required in future and enforce existing legislation to prevent unauthorized development or encroachment on the drain alignments;

(c) identify, on the basis of the Drainage management Plan, all low-lying areas which are prone to regular flooding due to age congestion and cannot be economically drained by gravity systems; inform residents and building control regulations to prevent development at levels which would be dangerous for future residents;

(d) Introduce following building control regulations which specify for any new developments:

- (i) Minimum allowable elevation for site development works shall be 2-year recurrence level plus 0.50 m, or 5-year recurrence level plus 0.25 m, whichever is higher,
- (ii) minimum allowable elevation for plinth of residential buildings and low-value commercial properties shall be 2-recurrence flood level plus 0.50 m, or 5-year recurrence level plus 0.25 m, whichever is higher, minimum allowable elevation of plinth levels for high value commercial properties, industrial developments and institutions shall be 10-year recurrence flood level plus 0.50 m, or the -25 year recurrence level plus 0.25 m, whichever is higher.

(e) Undertake a long range program to reduce the source of intrusion of sludge, silt, garbage and effluent into the drainage system, thereby reducing the cost of the long term maintenance operations, by:

a. Prohibiting dumping of garbage into the drains by enforcing regulations;
b. Providing convenient local collection points and more efficient removal services;
c. Prohibiting dumping of night soil/wastes into the drains by enforcing regulations and efficient removal services;
d. Prohibiting direct septic tank connections to the drainage system by enforcing regulations to prevent this;
e. Installing trash racks and sumps at convenient locations to facilitate collection of silts and floating garbages;

(f) Introduce public information campaign to make people more aware of the problems, hazards and unacceptable practices,

(g) Ensure proposed channel geometry to keep waterway free from all unwanted intrusion, encroachment etc..

#### 9.1.3.3 Distribution of proposed new drains

The consultant has been proposed total 98.97 km of drainage network in Narail Paurashava. From the proposed drainage network 59.65 km has been proposed as secondary drains and 39.32 as tertiary drains. The detail proposed drainage inventory is listed in the annexure. Following are the proposed drainage network in Narail Paurashava:

Table-9.4: Proposed secondary drainage network in Narail Paurashava

| Phase No. | Ward No. | Number of Drain | Length (m) | Length (km) |
|---|---|---|---|---|
| | Ward No. 1 | 2 | 1950 | 1.95 |
| | Ward No. 1(Ext) | 2 | 2180 | 2.18 |
| | Ward No. 2 | 2 | 2970 | 2.97 |
| | Ward No. 3 | 7 | 782 | 0.782 |
| | Ward No. 4 | 2 | 1746 | 1.746 |
| | Ward No. 5 | 6 | 2448 | 2.448 |
| | Ward No. 6 | 5 | 1244 | 1.244 |
| | Ward No. 6(Ext) | 2 | 467 | 0.467 |
| | Ward No. 7 | 4 | 1156 | 1.156 |
| | Ward No. 7(Ext) | 3 | 1530 | 1.53 |
| | Ward No. 8 | 2 | 1720 | 1.72 |
| | Ward No. 9 | 2 | 2270 | 2.27 |
| **Phase 01** | **Total** | **39** | 21498 | **21.498** |
| | Ward No. 1 | 1 | 805 | 0.805 |
| | Ward No. 1(Ext) | 1 | 896 | 0.896 |
| | Ward No. 2 | 1 | 583 | 0.583 |
| | Ward No. 3 | 1 | 589 | 0.589 |
| | Ward No. 4 | 2 | 496 | 0.496 |
| | Ward No. 5 | 1 | 296 | 0.296 |
| | Ward No. 6 | 1 | 836 | 0.836 |
| | Ward No. 7 | 1 | 820 | 0.82 |
| | Ward No. 8 | 1 | 2390 | 2.39 |
| | Ward No. 9 | 1 | 530 | 0.53 |
| **Phase 02** | **Total** | **12** | 8336 | **8.336** |
| | Ward No 1 | 2 | 647 | 0.647 |
| | Ward No 1(Ext) | 2 | 418 | 0.418 |
| | Ward No 2 | 2 | 289 | 0.289 |
| | Ward No 3 | 1 | 749 | 0.749 |
| | Ward No 4 | 4 | 875 | 0.875 |
| | Ward No 5 | 2 | 754 | 0.754 |
| | Ward No 6 | 6 | 1878 | 1.878 |
| | Ward No 6(Ext) | 1 | 81 | 0.081 |
| | Ward No 7 | 2 | 1130 | 1.13 |
| | Ward No 7(Ext) | 2 | 880 | 0.88 |
| | Ward No 8 | 2 | 1490 | 1.49 |
| | Ward No 9 | 2 | 2940 | 2.94 |
| **Phase 03** | **Total** | **28** | 12314 | **12.314** |
| **Phase 04** | Ward No 2 | 4 | 1770 | 1.77 |
| | Ward No 3 | 11 | 1550 | 1.55 |
| | Ward No 4 | 4 | 7720 | 7.72 |
| | Ward No 5 | 2 | 4603 | 4.603 |
| | Ward No 6 | 2 | 413 | 0.413 |
| | Ward No 6(Ext) | 1 | 239 | 0.239 |

| Phase No. | Ward No. | Number of Drain | Length (m) | Length (km) |
|---|---|---|---|---|
| | Ward No 7(Ext) | 1 | 754 | 0.754 |
| | Ward No 8 | 1 | 1020 | 1.02 |
| | Ward No 9 | 1 | 250 | 0.25 |
| | **Total** | **31** | 17500 | **17.5** |
| **Grand Total** | | **110** | 59650 | **59.65** |

Table-9.5: Proposed tertiary drainage network in Narail Paurashava

| Phase No. | Ward No. | Number of Drain | Length (m) | Length (km) |
|---|---|---|---|---|
| | Ward No 1 | 5 | 2079 | 2.079 |
| | Ward No 1(Ext) | 2 | 1103 | 1.103 |
| | Ward No 2 | 5 | 2647 | 2.647 |
| | Ward No 3 | 5 | 1131 | 1.131 |
| | Ward No 4 | 2 | 296 | 0.296 |
| | Ward No 5 | 6 | 1981 | 1.981 |
| | Ward No 6 | 5 | 1505 | 1.505 |
| | Ward No 6(Ext) | 1 | 238 | 0.238 |
| | Ward No 7 | 1 | 1514 | 1.514 |
| | Ward No 7(Ext) | 2 | 424 | 0.424 |
| | Ward No 8 | 3 | 1858 | 1.858 |
| | Ward No 9 | 11 | 2580 | 2.58 |
| **Phase 01** | **Total** | **52** | 17619 | **17.619** |
| | Ward No 1 | 4 | 1327 | 1.327 |
| | Ward No 1(Ext) | 2 | 641 | 0.641 |
| | Ward No 3 | 4 | 998 | 0.998 |
| | Ward No 4 | 2 | 634 | 0.634 |
| | Ward No 5 | 4 | 1000 | 1 |
| | Ward No 7 | 1 | 146 | 0.146 |
| | Ward No 7(Ext) | 1 | 332 | 0.332 |
| | Ward No 9 | 1 | 460 | 0.46 |
| **Phase 02** | **Total** | **20** | 5544 | **5.544** |
| | Ward No 1 | 2 | 770 | 0.77 |
| | Ward No 1(Ext) | 1 | 202 | 0.202 |
| | Ward No 3 | 1 | 342 | 0.342 |
| | Ward No 4 | 3 | 1291 | 1.291 |
| | Ward No 5 | 2 | 419 | 0.419 |
| | Ward No 6 | 4 | 1596 | 1.596 |
| | Ward No 6(Ext) | 1 | 738 | 0.738 |
| | Ward No 7 | 3 | 1184 | 1.184 |
| | Ward No 7(Ext) | 1 | 699 | 0.699 |
| | Ward No 8 | 1 | 783 | 0.783 |
| **Phase 03** | **Total** | **22** | 8356 | **8.356** |
| | Ward No 1 | 1 | 439 | 0.439 |
| | Ward No 2 | 2 | 880 | 0.88 |
| | Ward No 3 | 3 | 844 | 0.844 |
| | Ward No 4 | 6 | 2068 | 2.068 |
| | Ward No 5 | 1 | 347 | 0.347 |
| | Ward No 6 | 3 | 1003 | 1.003 |
| | Ward No 6(Ext) | 1 | 376 | 0.376 |
| | Ward No 8 | 2 | 1460 | 1.46 |
| **Phase 04** | **Total** | **20** | 7805 | **7.805** |
| **Grand Total** | | **114** | 39326 | **39.326** |

The detail Drain list has been provided in the annexure.

#### 9.1.3.4 List of Infrastructure measures for Drainage and Flood Control Network

Following is the list of proposed new infrastructure:

Table-9.6: Proposed new bridge and culvert

| Ward No. | Number of Proposed Culverts | Number of Proposed Bridge |
|---|---|---|
| 1 | 20 | 0 |
| 1 (Ext) | 12 | 0 |
| 2 | 11 | 0 |
| 3 | 13 | 1 |
| 4 | 37 | 0 |
| 5 | 27 | 0 |
| 6 | 15 | 0 |
| 6 (Ext) | 5 | 0 |
| 7 | 9 | 0 |

| | | |
|---|---|---|
| 7 (Ext) | 17 | 0 |
| 8 | 22 | 0 |
| 9 | 30 | 0 |
| **Total** | **218** | **1** |

The typical plan and elevation of box-culvert has been presented below for Narail Paurashava.

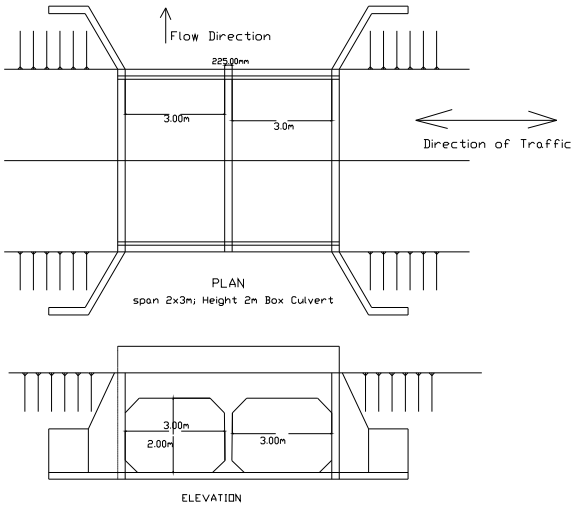



**Figure 9.2:** Plan and Elevation of Typical Box Culvert

### 9.1.4 Plan Implementation Strategies

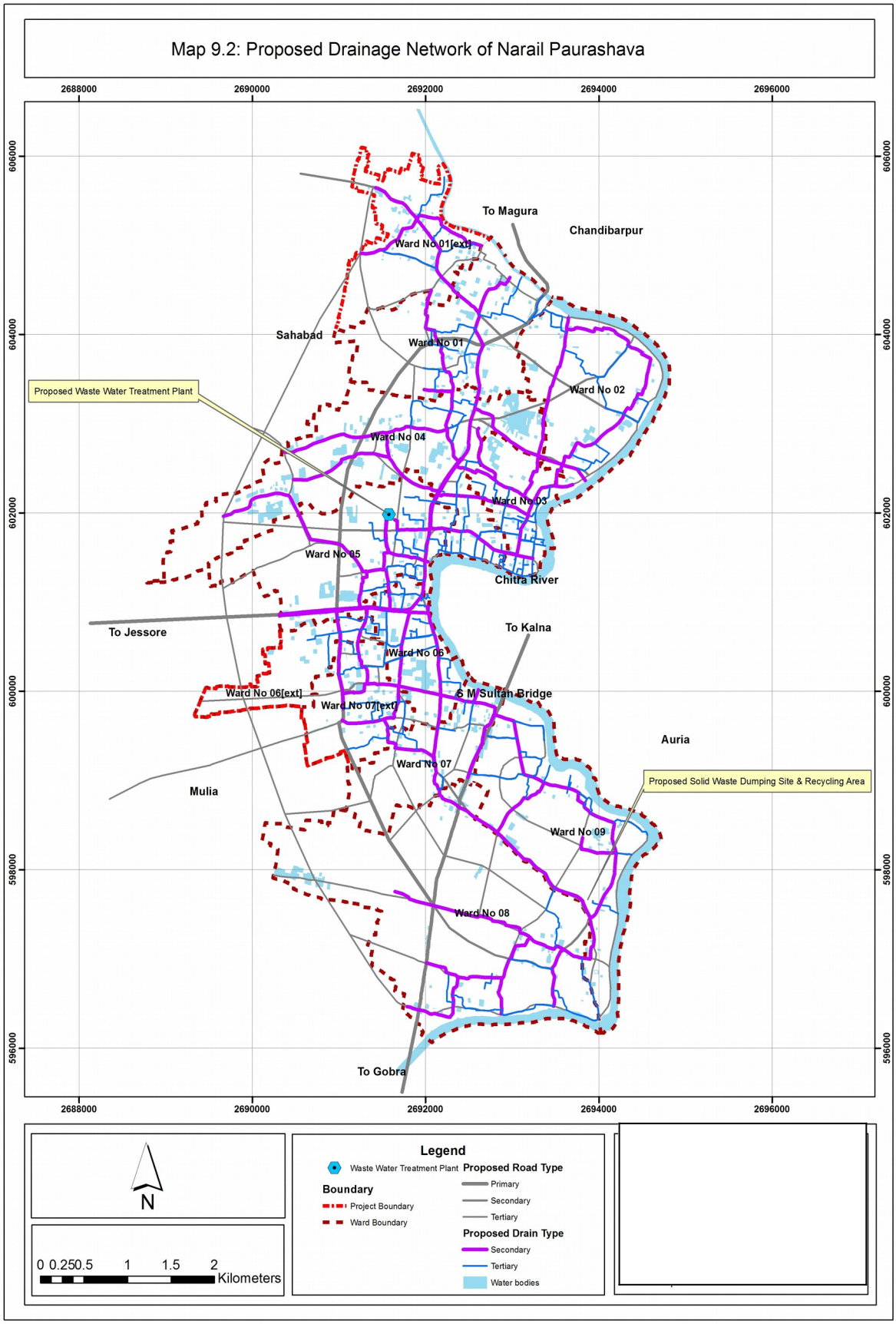
The core area of the Narail Paurashava is slightly elevated. It is not normally affected by floods from the adjacent Chitra River. On the other hand, it is affected frequently by rainfall run-off due to inability of the existing secondary and tertiary drains to drain out the run-off efficiently. There are inadequate no of secondary and tertiary drains in Narail Paurashava. Presently due to lack of adequate no of secondary and tertiary drains, most of the areas of the Paurashava are subjected to water logging during the intensive rainfall in the monsoon period. The existing secondary and tertiary drains may be improved and its different component needs to link with an overall integrated system. The existing borrow pit along the highway, secondary and tertiary drains are observed to suffer from continued negligence in respect of maintenance, clearing, removal of blocking etc.

The existing borrow pit/ drains will be incorporated into the proposed system to the extent to achieve available drainage system for the Paurashava. The drainage management plan of the Paurashava has been prepared for the peak monsoon period when the drainage system stands critical and drainage problem develops due to blocking, inadequate section of the katcha khal (Garu Chira khal, Paital Beel and Raghunathpur Khal, highway and borrow pit) and obstruction in the drainage path. Therefore, adequate numbers of new secondary and tertiary drains have to be constructed, following a systemic drainage network.

#### 9.1.4.1 Regulations to implement the Drainage and Flood Plan

In preparing drainage management plan, the flowing design approach has been presented in this report. In the design approach, the Consultants have considered the practical aspects of desired results, cost efficiency, durability including ease of construction and maintenance. Visible social improvements for the urban population are considered to be the most important and mitigation of the annual flooding damage is considered to be the greatest tangible benefit. Reduction of diseases, infant mortality and increase of life span are considered to be the greatest intangible benefits.

In line with these considerations, the following broad approach has been adopted in preparing the drainage management plan for Narail Paurashava.


Map 9.2: Proposed Drainage Network of Narail Paurashava
2688000
2690000
2692000
2694000
2696000
606000
604000
602000
600000
598000
596000
To Magura
Chandibarpur
Ward No 01[ext]
Sahabad
Ward No 01
Proposed Waste Water Treatment Plant
Ward No 02
Ward No 04
Ward No 03
Ward No 05
Chitra River
To Jessore
To Kalna
Ward No 06
Ward No 06[ext]
Ward No 07[ext]
S M Sultan Bridge
Auria
Ward No 07
Mulia
Proposed Solid Waste Dumping Site & Recycling Area
Ward No 09
Ward No 08
To Gobra
N
0 0.250.5 1 1.5 2
Kilometers
Legend
Waste Water Treatment Plant
Boundary
Project Boundary
Ward Boundary
Proposed Road Type
Primary
Secondary
Tertiary
Proposed Drain Type
Secondary
Tertiary
Water bodies