ORIGINAL

FINAL REPORT

SFG1856 V2

THE IDENTIFICATION, SURVEYING AND MAPPING LAND, REQUIRED FOR STORM WATER DRAINAGE MANAGEMENT ON PALIYAGODA-PUTTALM ROAD (A 03)

Contract No. WB/RSAP II/CS/35

Project Director
Road Sector Assistance Project
3rd Floor "Sethsiripaya"
Battaramulla

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No 3, Swarna Place, Nawala Road, Rajagiriya 10107, Sri Lanka

ENGINEERING CONSULTANTS (Pvt.) LIMITED
Reg. No. PV 10690

30th June 2015

Project Director
Road Sector Assistance Project
3rd Floor, "Sethsiripaya"
Battaramulla
Sri Lanka

Consultancy Service for the Identification, Surveying and Mapping Lands Required for Storm Water Drainage Management on Paliyagoda - Puttalam Road (A 03)

Contract No. WB/RSAP II/CS/35

Dear Sir,

Enclosed herewith the Final Report covering the topics indicated in the TOR under clause 5 of Terms of Reference.
ECL submit herewith the (1 original and 1 copy, including 1 soft copy) for the Interim Report.

We trust that the report will meet your requirements and look forward to your early approval.

Yours faithfully,
ENGINEERING CONSULTANTS (Pvt.) LIMITED

Russel De Zilwa
General Manager

ENGINEERING CONSULTANTS PRIVATE LIMITED
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Excecutive Summery

One of the main reasons for deterioration of road is absence of proper Storm water management. During the study we were able to indetify many reasons to justify the above statement. Therefore in the data collection process our main attention was directed towards collecting as much as physical as well as technical data to raise awareness among the decision makers to find the most appropriate solution for this issue.

As quite correctly mentioned in the TOR there are crtain sections of the road where the shoulder areas or edge of the carriage ways are pooled even for a normal running showers. During rainy days some times these water pools are visible for longer periods making it a nuicence for the road user. The wet condition of the road sub surface will effect the wearing course to damage and weeken the strength of the road structure. This situation is prevailed in flat sections where proper lead aways are not available. As this is a very common issue other than the A(03) road which was selected by RDA for the model study.

In this study the section of the road passing through flat terrain near Wennapuwa and Marawila secion is having the problem of shoulder pooling. A detail study was done to collect information with regard to storm water drainage system in Wennapuwa urban area . Proposal prepared by SLLRDC to Disaster Mangement Authority to solve this problem contained more valuerble information with regard to the storm water issue in the said area. We have collected lots of valuerble information with regard to systems developed in other countries to solve similar problems. Adptation of such methods and systems were discussed in detail under the study reports. It was discussed with Executive Engineer Chillaw to do a trial test at site to find the response out of the road users and also residents along the flat terrain road stretch.

In most of other road sections where a rolling topography exists pooling of water at the edges or shoulders were not visible. However in such instances storm water collected at lower elevations of road sections frequently flodded due to unavailability of proper leadaway drain. The problem of not having proper leadaway drainage system was studied in detail one by one. The problems identified are different and based due to technical, social, enviorenment and political isuues. Lack of coordination between RDA maintenance management units and local authority engineering staff is one of the key factors identified by the study team. It appears in most of the Local Authorities less priority is given for the maintenance of leadaway drains below the ROW of the road. In some instances due to lack of technical expertise pradeshiya saba funds have disbursed to carry out drainage improvements in an unproductive manner. In such instances instead of mitigating the drainage issue, the construction done has aggrevated the situation. few such cases have quoated as examples in this report.

After doing a detail study on the culvert crossings and the function of these structures we came ascross unbelievable situations due to technical mistakes and also due to social and enviorenemnt reasons. Some of the problems created are new and some are older than ten or twenty years. The rappid development taking place on either side of the road is followed with changing of land use pattern which needs to be annalysed to find the new storm water discharge values. The same old opening sizes were used to discharge the runoff out of the road. Similar kind of changes taking place on physical infrastructure development along the road trace. Natural water paths were obstructed due to construction of parapet walls along the ribbon development belt. In this report important cases are highligted with more details showing photographs taken in such locations. Upgrading of drainage system of roads crossing urban areas is becoming a important issue which needs immediate attention.

1. Introduction

The Government of Sri Lanka has received financing from the International Development Association towards the cost of Road Sector Assistance Project II. A portion of these funds has been allocated to eligible payments under the contract for which this study is being carried out. Most of the required activities have been carried out under this project. Among them the activities pertaining to checking of the adequacy of existing drainage crossings, assessment of the condition of the inlet and lead away drains and their legal status, and solution to any adverse environmental impacts have been awarded to the Engineering Consultants (Pvt.) Limited on 1st of April 2015. The team proposed in the TOR by RDA includes ,

- Senior Draiange Engineer (TeamLeader)
- Expert on Local Legislations on Development Control
- Land Surveyer.

The following additional staff deployed on part time basis to support the specialists in carrying out their assignments efficiently. With very limited time period available to cover up the full length of the road and work with the agencies responsible in maintenance management of the road keeping to the given targets was not an easy task.

- Enviorenment specialist
- GPS Technitian
- Technical officer
- Survey assistant

Our efforts made to collect information on the present PP road maintenance management was to some extent successful. Specially the maintenance and records of lead away drains sections beyond the road ROw boundary is a responsibility of the respective local authority. Our findings with regard to the attiutdes and problems of most of these local authorities is explained under this report. Under the existing situation lead away paths have been utilized for varies other puposes by the local authorities themselves and also most of the service providing agencies such as Electricity Board , National Water Supply and Drainage Board, Telecommunication Authorities est. We have identified all such cases during our walk through field surveys and details were submitted in our interim reports. However we hope to give summery of such cases in this report.

By making all field investigations jointly with respective Excecutive Eengineers or with their subordinate technical officers we were able to understand very well the maintenance management systems implemented by them and also all drainage related problems faced by them. It was highlighted by them in most areas due to political, social and enviorenment situations they are unable to carry out their duties following the accepted technical procedures.

2. Initial Project Activities.

The dates of Inspections and Discussions carried out are as follows:

1st meeting: At ECL head Office on the 2nd of April 2015 on 07th April 2015

Participants:

1. Mr. Ghnanapala (Team leader, Senior drainage Engineer)
2. Mr. L.M. Samantha Kumara (Expert on local legislation on Development Control
3. Mr. P.A.K.G. Perera (Land Surveyor)
4. Mr. Bandaranayaka (Engineer)
5. L.nirodhawardane

1st Inspection: From Peliyagoda to Dandugama bridge:

Participants

1. Mr. Ghnanapala (Team leader, Senior drainage Engineer)
2. Mr. L.M. Samantha Kumara (Expert on local legislation on Development Control
3. Mr. P.A.K.G. Perera (Land Surveyor)
4. Mr. Bandaranayaka (Engineer)
5. Auto cad & GPS Specialist
6. Mr. L. Nirodhawardane (Coordinator , ECL)

2nd Inspection: From Puttlam to End of Chillaw Section on 24th April 2015

Participants

1. Mr. L.M. Samantha Kumara (Expert on local legislation on Development Control
2. Mr. Bandaranayaka (Site Engineer)
3. Auto cad & GPS Specialist
4. Mr. L. Nirodhawardane (Coordinator , ECL)

Same Participants, with RDA Technical Officer Mr.Thennakone

3rd Inspection: From Chillaw End to Thoppuwa on 25th April 2015
4th Inspection : GPS survey along the road from Peliyagoda to Puttlam.
5Th Inspection : 5th May : Collecting information on side drains.
6th Inspection : 7th May Visit to Survey Department Puttlam
7th Inspection : 25th May Survey Department Puttlam
8th Inspection : 1st June, Survey Department Puttlam
9th Inspection : 5th June, Ispection of Wennappuwa Marawila Stretch with the Enviorenment Specialist

Same Participants with RDA technical Officer, Mr. Asoka, Mr Ameen, Mr Charles ECL site Engineer , GPS specialist and Auto cad Draft person.

3. Description of the Proposed Project

Conferring to our understanding the OPRC contract format is to be applied to the design, rehabilitation/improvement & maintenance of the Peliyagada - Puttalam Road (A03) (Corridor 1- about 128.0 km) and the duration of this contract involving the mentioned civil works and ROW management, is estimated to about 10 years.

The OPRC project was designed under one integral civil works and management operation, providing at all the times the agreed "Level of Service" (LOS) conditions. The Contractor should include a “full cycle” of the road interventions to achieve these conditions.

It was known that one of the main reason for deterioration of road is absence of proper storm water management system. The OPRC contract format involves maintenance of road for ten year period. Therefore good understanding of the drainage problems along the road trace and finding solution for these drainage problems of the road will have substantial cost impact on the Contract Price of the OPRC contract.

Therefore in implementation of OPRC contracts controlling the high risk faced by the contractors is an essential need. To get the maximum cost effective benefits out of the OPRC contracts, identification of such high risk factors is a quite important exercise. Accordingly, under the consultancy service for the identification and mapping of the lands for storm water management we have prepared an in depth study report including the possible risk factors related to storm water management under different topographical and social enviorenemnt conditions and identifying such areas along the road trace. We presume by doing so in the selected model road trace for the pilot study we have fulfilled the RDA aspirations under the pilot study project.

Over our detail investigations it coud be confirmed that the smooth and undisturbed drainage system is the most critical factor that determines the performance of a road structure. Failure of roads structure is quite often attributed to poor drainage systems due to natural or man made obstructions. The best preventive maintenance for roads is to maintain road drainage. This makes the road last longer.

“The road with good drainage is a good road” is just as valid today as it ever was. Water, when allowed to enter the road structure has the effect of weakening the pavement layers and making them susceptible to the damaging effects of traffic. Water can enter the road structure in one of two ways; either by storm water directly penetrating the surface or indirectly, by ground water infiltration.

Storm water that falls on the road needs to be led away in a controlled manner. If allowed to flow too fast it will cause erosion of the edges, drains and the embankment slopes; and if allowed to float too slowly it will cause siltation in drains and culverts. If allowed to stagnate, the water will penetrate into the structure, through surface cracks etc., and also from the sides.

In flat terrain, special efforts have to be made to obtain sufficient gradients for the side drains and also to find suitable outlets for them, such as natural streams. In some cases, lead-away drains can be used to convey water away from the road. Also, the drains may have to be made as broad and as deep as possible so that they become temporary catchments, providing the necessary extra time for the storm water to get away from the roadway area.

As poor drainage facilities is identified as a major issue for the deterioration of the road, focus is made under the consultancy to address issues related to drainage systems and drainage structures. Distinction is made in the criteria between drainage systems and drainage structures. Drainage structures are the components of drains and channels leading water either to or from road. Drainage systems are evaluated according to presence of obstructions. Drainage structures are evaluated according to structural integrity as well as their ability to function correctly.

Implementation of the proposed project, the following works were carried out by the study team.

There was no need to carryout topographical surveys for the entire project as 1:10,000 topographical maps with contours were purchased from the survey department. In addition latest topographical digital maps collected was used to determination of catchment areas bordering the road and natural drain patterns of those catchments. Consequently catchment area demarcations and mapping of all the culverts and bridges along the road tace was prepared. Prior to do the GPS survey the *chainage* , type and other required parameters including the drainage flow condition and flow direction was recorded through a walk through survey along the road. (Attachment - 2). GPS survey was carried out to do the mapping of all l existing culverts, bridges, cross drainage structures, side drains along the road trace from Peliyagoda to Puttlam. (Attachment - 3) . GPS Mapping was prepared to sketch all existing lead away drains, the new lead away drains required to be provided to connect the culvert outlets to natural streams. (Attachment 3). Simultaneously ,discussions held with RDA staff involved in maintenance of Paliyagoda - Puttlam Road to identify drainage problems and the probable reasons for frequent inundation of road in some sections.

Defined the areas, where the development restriction (nfrastructure Development and filling of lands) required to be enforced to minimize / avoid construction to natural drainage pattern and to avoid inundation of road and lands in catchment areas to relevant Local authorities and RDA maiantenanace engineers. (Attachment 5).

Existing legislations for development restrictions to avoid obstructions to existing water ways and water bodies and drastic changes to land use pattern was collected from all the Institutions, agencies responsible for such actions. It includes presently available acts and legislations having provision for storm water management and new legislations required to avoid storm water drainage problems due to future developments. Specially the adaptation of environmental friendly drainage system in this project was considered as a important criteria in finding solutions to drainage problems.(Attachment –4.10-) According to our understanding it is very much healthier to avoid new accusitions to solve drainage management problems even though Pradeshiya sabas and Municipalities are fully authorized to do so. It could be a major setback for the success of the OPRC system promotion .However , we have identified and maps the natural drainage pattern and natural retention areas around the road which may have an direct or indirect impact on developing of lands on drainage discharge pattern. Such actions is proposed for restrictions under the project by enforcing regulatory 'Acts'.(Attachment 4). Regulatory Policies and storm water management policies and guide lines followed in other countries and propose such policies and guide lines appropriate for the corridor and country to achieve the objectives stipulated in the ToR was seriousely taken and our findings were recorded in this report. (Attachment -01) In very few instances it was possible to identify alternatives for lead-away which are obstructed by land owners.

Key activities implemented under the project

- Condition information on culverts ,bridges ,cross drainage structures
  The GPS survey of data was followed after completing a walk through survey along the road trace.
- Identification of Drainage lead-away facilities along the proposed study road trace.

This activity was carried out by visiting the project area and having discussions with RDA road maintenance field staff ad respective Pradeshiya saba Engineering staff. We were able to identify five types of lead away drains situations,

1. Clearly demarcated built up drains with a clear path to a natural drainage stream.
2. Built up drains blocked by various utility agencies mostly within the ROW.
3. Clearly demarcated but earth drain connects to natural stream without any obstructions.
4. Only a drainage path blocked with natural obstructions.
5. Only a drainage path unclear with man made obstructions.

Therefore identification and mapping of drainage paths is a quite complex and time consuming operation. Specially tracing of drainage paths with manmade obstructions have lead to unpleasant situations. Similarly “by passing” the utilities to clear the storm water drain path is a costly affair. With the experience gain over the study period it appears providing practical solutions is possible through indepth study on case by case basis.

- Preparation of catchment area maps along the road, indicating the discharge pattern and natural drainage path. dentification of obstructions to normal discharge pattern.Preparation of catchment area maps also involves several other related activities. Rainfall analysis and land use pattern.

- Identification of Natural Drainage patterns of the environs around the selected road.
  We were able to correctly map all the natural draianges and retention areas around the road trace using the 1:10000 topographic maps and also digital data maps.
- Establishing required legislations in Storm Water Management.
- Establishing law enforcement mechanism for enforcing development restrictions. In this regard primarily proper coordination with relevant local authorities and any other relevant government agencies was considered.

4. Policy Legal and Administrative –Frame Work.

There are many legislations pertaining to granting development approvals and it is a mandatory task to obtain a development permit to engage in any development activity. Concerning with granting approval for new development projects specially pertaining to obstruction of existing water Bodies and Drainage pattern, the following legislations are important.

1. Pradeshiya Sabha Act No. 15 of 1987
2. Municipal Council Ordinance No, 29 of 1947
3. Housing and Town improvement Ordinance No. 19 of 1915.
4. Town and country Planning Ordinance No.13 of 1946 amended by Act No.49 of 2000
5. Urban Councils Ordinance No. 61 of 1939
6. Code of Criminal Procedure Act No. 15 of 1979
7. Nuisances ordinance No. 61 of 1939 and No. 57 of 1946
8. National Environmental Act
9. Preventing Public Health Nuisances in the Western Province Statute No. 03 of 2012 (Gazette No. 1764/14)
10. Statute of preventing public Health Nuisance No. 03 of 2012 (Gazette No. 1771/23)
11. Colombo District (Low Lying Areas) Reclamation & Development Board Act No. 15 of 1968 as amended by Law No.27 of 1976, Act No. 52of 1982 and Act No. 35 of 2006.
12. Urban Development Authority Law No. No. 41 of 1978 and its Amendment Act No. 4 of 1982

Any developments including new development Projects, Policy ,Legal and Administrative Framework, especially preventing obstruction of existing water Bodies and drainage pattern come under following administrative limits.

I. Municipal Councils
II. Urban Councils
III. PradeshiyaSabhas

The Principal activities of the three types of above local authorities can be classified into three broad functional areas.

1. Public Health and environmental sanitation
2. Public thoroughfares
3. Public utility services including the provision of civic amenities.

These have the basic objectives of promoting the welfare and comfort of the citizens through services provided.

The above mentioned legislations except Urban Development Authority Law, describe more or less to control and administration of all matters relating to public health, public utility services, public thoroughfares and generally with the protection and promotion of the comfort, convenience and welfare of the people and all amenities within such areas.
Housing and Town Improvement Ordinance is the first legislation given to broad instructions for development activities and that can apply administrative limits of any Municipal Council, Urban Council and PradeshiyaSabhas and it says section 5 under part II “No building to be erected without approval of chairman of Local Authority”. There are ten types of improvement scheme in which,

- A Street scheme,
- A street intersection scheme

- A Street widening scheme coming under street development

. Moreover section 21 says the chairmen may give written directions to the person submitting plans for a new street with regard to various sectors such as,

- The levels of the new street
- The ground surface of the building sites
- Width of new street
- Mode of drainage management of the new street etc.

Referring with this ordinance it is understood, there are many rules and regulations pertaining to granting approval for new development projects.

Town and country Planning ordinance mainly focuses to controlling the development of the land securing such as,

- Proper sanitary conditions,
- Amenity and convenience of preserving existing buildings and places of architectural, historic or artistic interest and places of natural beauty.

Its 49 of 2000 amendment says " An ordinance to authorize the formulation and implementation of national physical planning policy; the making and implementation of a national physical plan with the object of promoting and regulating integrated planning of economic, social, physical and environmental aspects of land in Sri Lanka, to provide for the protection of natural amenities, the conservation of natural environment, building of architectural and historic interest and places of natural beauty ;

to facilitate the acquisition of land for the purpose of giving effect to such plan and to provide for matters incidental to or connected with the matters aforesaid. This enactment has empowered Municipalities and Urban councils to be urban development areas of preparation of an outline physical plan or detailed plan for its area or any land therein, and for its execution. It has also empowered for PradeshiyaSabahas for above after Minister assigned. In concerning with this legislation, there is a wide range of opportunities to engage with developments activities in a planned manner.

Municipal Council Ordinance (Attachment 4.1) is applied within the administrative limit of Municipal Council area. This legislation directly describes lot of facts regard to the subject matter than above legislations. Section 97 of this ordinance under the topic of drainage says;

" The Government or any Municipal council may, from time to time, caused to be made altered or extended such public main or other drains, sewers and watercourses as may appear to be necessary for the effectual draining of the Municipality, and, if necessary, the Government or the council may carry them through, across, or under any street or any place laid out as or intended for a street, or any cellar or vault which is under any of the streets, and into, through or under any enclosed or other lands whatsoever, doing as little damage as may be and making full compensation for any damage done.''

Accordingly the rapier, alter and discontinue drains, power to affix to buildings pipes or ventilation of drains, clearing and emptying of drains, obstruction of drainage of rain water and drainage, obstruction of drains and water courses, construction of drain with any public drain without

authority, erection of building over public drains, construction of private drains, drains in new buildings, drains of premises within 100 feet of public drains, drainage of premises in other cases, drainage in combination, right to carry drains through land belonging to other persons, right of owners to joint use of drains, maintenance and repair of drains, reconstruction of defective drains and appliances, drains or appliances laid on streets, entry of premises , new drains not be used without permission and offences are mentioned section 97 to 117 in detail. As such it is cleared the Municipal ordinance has more provisions for the subject matter.

Urban Council Ordinance (Attachment 4.2) is applied within the administrative limit of Urban Council area. It is mentioned the facts of subject matter under the powers for public health. Section 103 to 109 of the ordinance says regarding to construction, maintain, change and close of public drains etc. As Municipal council ordinance there are more or less rules and regulations of the urban council ordinance for the drainage works of urban council areas.

Pradeshiya Sabha Act (Attachment 4.3)is applied within the administrative limit of Pradeshiya Sabha areas. Section 79 to 84 of this act describes regarding to drainage under the sub topic of Storm water drainage.

Code of Criminal Procedure Act No. 15 of 1979 section 98 says regarding to removal of nuisance. It is mentioned 98 (1) (a) that any unlawful obstruction or nuisance should be removed from any way, harbor, lake, river, or channel which is or may be lawfully used by the public or from any public place; (Attachment 4.4)

Nuisances ordinance No. 61 of 1939 and No. 57 of 1946, mainly focuses to protect the public health and its section 9 and 12 relates to the subject matter. (Attachment 4.5)

Preventing Public Health Nuisances in the Western Province Statute No. 03 of 2012 (Gazette No. 1764/14) and Statute of preventing public Health Nuisance No. 03 of 2012 (Gazette No. 1771/23) relate to planning the rules and regulations to uplift and conserve the public health, prevent the nuisances and diseases spreading through mosquitoes, control other public health nuisances and matter related or consequential them. It is included the fines for offences to disturb the drains and other public nuisance acts. (Attachment 4.6)

Colombo District (Low Lying Areas) Reclamation & Development Board Act No. 15 of 1968 as amended by Law No.27 of 1976, Act No. 52of 1982 and Act No. 35 of 2006 is here related to getting approval for any development activity. (Attachment 4.7)

Urban Development Authority Law No. No. 41 of 1978 and its Amendment Act No. 4 of 1982 relates to preparation of development plans for urban development areas , carrying out integrated planning and physical development of lands and buildings in a development area and formulation and implementation of an urban land use policy in urban development areas. (Attachment 4.8)

There lots of rules and regulation pertaining to obstruction of existing water Bodies and Drainage pattern and it is here above mentioned only selected legislations in brief. Copies of selected legislations are attached herewith.

Methodology to adopt the acquisition procedure

Acquisition Application Form 01, Form 02,	Applicant Institution - Forward the application through the respective Ministry

Form 03, Form 04	
Section 2 Direction	Ministry of Land and Land Development – Grant authority to enter the land and the decision of Hon. Minister that the particular land is needed for a public purpose.
Section 2 Notice Sinhala, English, Tamil	Divisional Secretary - Publish the notice in the surrounding area.
Advance Tracing	Superintendent of Surveys
Section 4 Direction	Ministry of Land and Land Development- Inviting objections from the land owners and decision of the Hon. Minister for investigation
Section 4 Notice Sinhala, English, Tamil	Divisional Secretary - Publish the notice inviting objections
Objection Inquiry	Applicant Ministry - Forward recommendations after conducting investigations on objections
Section 5 Declaration	Ministry of Land and Land Development - Decision of the Hon. Minister of Lands that the land is to be acquired
Section 5 Notice Sinhala, English	Divisional Secretary/Government Printer - Publish a gazette notice that Hon. Minister of Land and Land Development decided that the land is to be acquired
Final plan	Superintendent of Survey
Section 7 Gazette Notice Sinhala, English	Divisional Secretary/Government Printer - Invitation notice to investigate the title of the land.
Section 9- Inquiry into Title	Divisional Secretary – Investigating title
Section 10- Decision on Title Notice, Forward to Court (Form 02, Form 04)	Divisional Secretary – Determine the title
Valuation	Valuation Department
Section 17 – Awarding Compensation (Form)	Divisional Secretary
Payment of Compensation	Divisional Secretary - Allocate financial provisions from the Ministry of Lands or the relevant Institution and make payments to the land owner
Gazette 38 Order	Ministry of Land and Land Development - Take over the land's possession to the Government
Taking undisturbed possession	Divisional Secretary – Take over the procession and hand it over to the applicant institution

Section 44 Vesting Certificate/ Registration of State Ownership Form 01,Form 02, Form 03,Form 04, Form 05, Form 06,Form 07, Form 08	Divisional Secretary/Registrar General - Issue vesting certificate to the Institution concerned, after payment of compensations to the land owners

LA 7

D - 8

Land Acquisition Act (Chapter 460)

Declaration under Section 5

I, ..., Minister of Land and Land Development, here by declare under Sub-section (1) of Section 5 of the Land Acquisition Act, that the land described below is needed for a public purpose and will be acquired under the provisiona of that Act.

.....( ) allotments of land in total extent of about ..... Hectares, depicted in Advance Tracing No. ..... of ..... prepared by the Surveyor-General situated in the Village/s of ..... in the Divisional Secretary's Division of ..... in ..... District and bounded as follows:

.....
Minister of Land and Land Development

My Reference No. .....

Divisional Secretary's Ref. No. .....
"Govijana Mandiraya"
No. 80/5, Rajamalwatta Road,
Battaramulla.
Date:

State Printing Corporation (97/134)

LAND ACQUISITION ACT (CHAPTER 460)

NOTICE UNDER SECTION 4

My No:

Land Min's Ref No:

Having been duly directed by the Hon. Minister of Land and Land Development under the provisions of Section (IV) of the Land Acquisition Act (Chapter 460), as amended by the Land Acquisition (amendment) Act No. 28 of 1964, I hereby give notice, as required by that Section that the following land/servitude over the following land is required for a public purpose, and that the Government intends to acquire the said land/servitude, namely:-

Any objection to the proposed acquisition by interested persons should be made in writing to the Secretary, Ministry of , before the

..... day of quoting reference to the Case No of the

Ministry of ..

Divisional Secretariat Office

Date: · .

Divisional Secretary

Division: .

District : .

LA 7

D - 8

Land Acquisition Act (Chapter 460)

Declaration under Section 5

I, ..., Minister of Land and Land Development, here by declare under Sub-section (1) of Section 5 of the Land Acquisition Act, that the land described below is needed for a public purpose and will be acquired under the provisiona of that Act.

.....( ) allotments of land in total extent of about ..... Hectares, depicted in Advance Tracing No. ..... of ..... prepared by the Surveyor-General situated in the Village/s of ..... in the Divisional Secretary's Division of ..... in ..... District and bounded as follows:

.....
Minister of Land and Land Development

My Reference No. .....

Divisional Secretary's Ref. No. .....
"Govijana Mandiraya"
No. 80/5, Rajamalwatta Road,
Battaramulla.
Date:

State Printing Corporation (97/134)

5. Description of the catchment areas and stormwater discharge pattern

The following catchments are crossing the A3 road from Peliyagoda to Puttalam (See Figure 01)

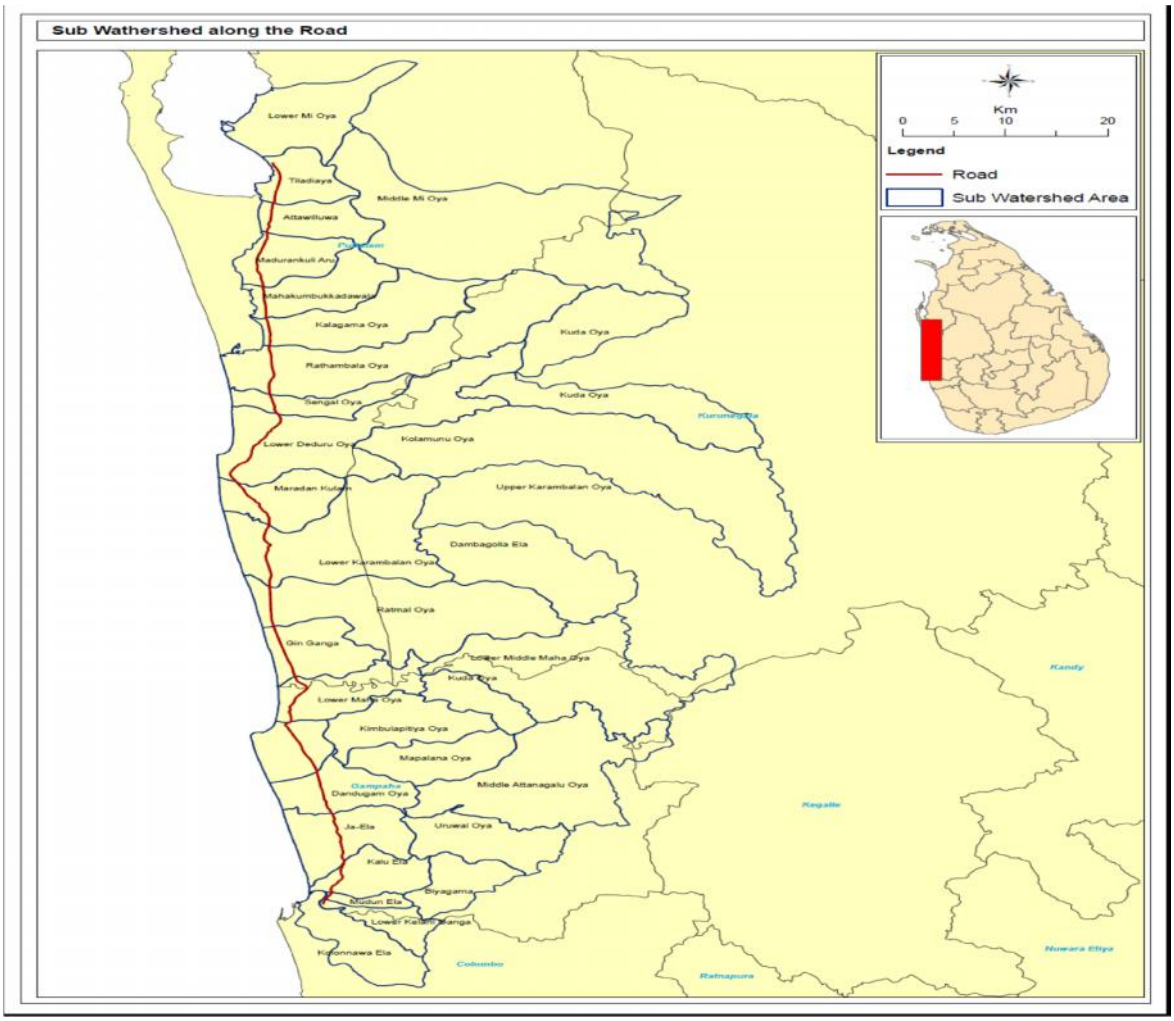


Figure 1 :General Layout of the Sub watershed along the road

1. Mudu Ela

   The Catchment area of Mudun Ela is bounded by Wattala in the north, Kelaniya in the east, Kelani River flood bund in the south, and Colombo - Negambo Road in the west. This can be identified under 3 catchment sub sectors as followers:

   - Peliyagoda
   - Dalugama - Telangapatha
   - Naraminiya Oya - East of Kelaniya Road

Flooding is the main constraint which occurs twice a year in the Kelani River. Drainage into the Kelani River is through three culverts with flood gates, one at Peliyagoda, and the other two at Oilyamulla close to Wattala. This area is protected from Kelani river floods by the flood protection bunds on the northern bank of the river. There is a Master plan prepared by Sri Lanka Land Reclamation and Development Corporation for the Mudun Ela Project.

2. Kalu Oya

Topography of the basin is flat as a whole with maximum elevation of 40.0 m above m MSL at the north-eastern boundary. The drainage stream originates in the north-eastern part of the basin and 15 Km away from Kelani river outfall. Rainfall runoff is from urban residential areas such as Mahara, Kadawatha, Mabole, Sapugaskanda, Kiribathgoda , Ragama ,Horape and flowing in to Kalu oya.

Gradient of lower reaches of Kalu oya is as low as one in ten thousand. Based on flood plain survey data, carried out by this consultant, existing Mahara Mudun ela and Kalu oya bed levels vary between 0.20 to -1.50 m MSL, and major portion of the flood plain is below sea level. There is a steep rise in the upper reaches from 1 to 10 MSL within a short distance 6 Km . Hence the downstream of the Kalu oya basin experiences tidal effects and cause backwater on the drainage network. This tidal effects retard the conveyance of the flood flow.

3. Atthanagalu oya

The Dandugan Oya and Ja Ela basin with a drainage area of 860km2 is located between the Maha Oya basin to the north and the kelani Ganga Basin to the south. The basin has a complicated waterway system with interconnections and branches in the downstream reaches.

The Attanagalu Oya originates from the hills with the highest elevation of 300m above MSL at the eastern boundary of the basin, located some 40km away from the sea. From Gampaha to Ekala, the Attanagalu oya runs through flat land along the A33 Road in parallel with the Uruwal Oya, which drains the southern part of the basin. These two streams interconnect at some locations in this area.

Around Ekala, the two main streams branch in different directions. One stream goes to the north as the Dandugam Oya. The other is a man-made canal called the Ja- Ela following to the east.

The Dandugam Oya turns to the south near the International Airport after joining the two tributaries, the Mapalam Oya and Kimbulpitiya Oya draining the northern part of the basin. The river crosses the Negambo Road and runs through the northern part of the Muthurajawela Marsh, then pours into the Negambo lagoon.

The Ja Ela flows down a deep-cut section before crossing the Negambo Road and goes through the Muthurajawela Marsh, then pours into the Negambo lagoon.

These two streams are also interconnected through the old Negambo Canal, which branches from the dadugam oya in the North and runs along the seaward, side of the Negambo Road down to the Kelani Ganga to the south.

4. Maha Oya

The Maha Oya commences in the hilly regions around Aranayake, Bible Rock, and Kadugannawa. These regions experience the highest rainfall over the catchment, somtimes exceeding 3800mm per annum. The mountain streams which originate in the Kegalle District, cascade down from all directions and from the Maha Oya near Rambukkana. The river than flows in a winding westerly direction and acts as the boundary between Kurunagala and Kegalle Districts. Near Warakapola, the river becomes the boundary between Kurunagala and Gampaha districts. The right bank of the final reach of the river forms the Southern boundary of Puttlam District. The Maha Oya then flows into the Indian Ocean at Waikkal(Kochchikade). Hence the entire river basin lies in five major administrative

areas of the island.The Catchment area is 1,528 km^2 and largest stream length from source to sea is about 130km.

5 Drainage paten of the water ways from Deduru oya up to Puttalam Lagoon.

Downstream part of the drainage partten of the water ways from Deduru Oya to Puttalam Lagoon connected to the Dutch canal. The Dutch Canal in the project area consists of the following large water bodies, namely, the Chilaw lagoon (1400acs), the Mundel Lake (7700acrs), and the puttalam lagoon (57600acrs). The Dutch Canal connects these, three water bodies with natural and artificially cut segments. The system also consists of various outfalls leading water to the sea.

In the project area, three categories of waterways, based on their sea outfall conditions, could be distinguished. First are the major rivers and lagoon which have an outlet directly to the sea.
These are;

a) Deduru Oya
b) Mi-Oya
c) Kala Oya
d) Chilaw Oya
e) Puttalam Oya

6. Significant Enviorenment and Social Impacts

Public involvement: Public involvement consists of three related, and often overlapping, processes: information dissemination, consultation, and stakeholder participation. Stakeholders are the individuals, groups, or institutions which have an interest or "stake" in the outcome of a project or are potentially affected by it. Stakeholders include project executing agencies; groups contracted to carry out project activities and/or consulted at various stages of the project; project beneficiaries; groups of people who may be affected by project activities; and other groups in the civil society which may have an interest in the project.

Stakeholder participation: Where stakeholders collaboratively engage in the identification of project concepts and objectives, selection of sites, design and implementation of activities, and monitoring and evaluation of project outcomes. Developing strategies for incorporating stakeholder participation throughout the project cycle is particularly necessary in projects which have impacts on the incomes and livelihoods of local groups, especially disadvantaged populations in and around project sites (e.g., indigenous peoples, women, poor households).

National Environmental Act No. 47 of 1980(NEA) is an overarching legislation enacted for the protection of environment and natural resources. Establishment of the Central Environmental Authority under the provision of this act has provided capacity to enforce environmental laws. Environment protection is a cross cutting responsibility of central, provincial and local administration. Maintaining quality of environment at grass root level is shared across many agencies and the key responsibility is with local government. NEA provides for enforcement of regulations to protect and improve quality of environment.

Effective life of major infrastructure development depends on the subsequent management of the associated environment that would affect the performance quality of services expected from the infrastructure development. Maintaining quality of environment at local level depends on Pradesiya Sabas commitment to enforce laws and regulations related to drainage and un authorized structures obstructing lead away drains and access to maintenance of such facilities Sustainable environment management is essential to protect life cycle effectiveness of infrastructure and benefits to be delivered by developed infrastructure.

Since ancient times, it is understood that storm water from constructed areas should be managed somehow. Waste and pollution transported by stormwater poses quantity and quality problems, affecting public health and the quality of the environment. Sanitation infrastructures in urbanized regions have different development levels and the perception of stormwater changed considerably during the centuries and especially in recent years. Still, there is an evident worldwide heterogeneity when analyzing the lack of studies on urban stormwater conducted in some Asian or African countries.

Strategies for sustainable stormwater management are needed at different decision levels (political, regional or local scale, for instance) but all of them need information and a clear understanding of the possibilities that are at stake as well as the main consequences of each decision. A sound approach to stormwater management should be flexible, based on local characteristics, and should take into consideration temporal, spatial and administrative factors and law, among other issues. Economic or technical constraints define different decision scenarios.

Best Management Practices should be seen as an opportunity for development and improvement of social, educational and environmental conditions in urbanized and surrounding areas. Therefore

they require an ample perspective and the participation of different stakeholders. High-quality decision needs time and a fair overview of the problem. For sustainable stormwater management, informing on With the launching of the industrial revolution, our civilization entered an era of accelerated industrial development. This has led to the unimpeded exploitation of nature and ever increasing degradation of the environment. It is now obvious that if this state of affairs continue human civilization itself will head for a catastrophe of unforeseen dimensions. The world community headed by scientists is now seeking ways and means of guiding industrial development on a sustainable basis. The UNO and other global agencies are initiating various treaties for this purpose and invariably new laws and legislation to control and regulate the social development would be necessary to implement such a programme of sustainable development. It is our responsibility to create awareness of these treaties, laws and regulations among the people as much as the deepening environmental problems itself. This will to some extent infuse confidence in people that with their co-operation some ill-effects of environmental pollution could be alleviated. This Index to Environmental Legislations in Sri Lanka lists a collection of laws regulations and guidelines for the preservation of living environment in our country. It is hoped that this information would be of some use to decision-makers and other environmental activists to initiate necessary action to prevent further environmental damage.

One of the main causes for social effects is the imperfect upgradings and rehabilitations done to the existing road limiting to the ROW , without proper attention to social and enviorenmental isues propped up in areas away from the ROW line. Comman problem created due to above situation is related to drainage management issues outside the ROW line. Such improvements carriedout under Donar funded projects are mostly govern by the scope of work in the loan agreement which is normally specified up to ROW .

The authority issues concerning the management of such problems directly effect the mitigation of social and enviorenment problems congregated in effected areas. Leadaway drain paths drops to respective Local Authority Govern areas. Therefore the responsibility of maintaining drainage management system beyond ROW has to be taken up by the local authorities. The problems identified within the Local Authorities in managing the system are multipart,

- Local Authorities are not equipped with required resources for proper maintainance of the drainage system.
- In adequate technical and engineering knowledge within the local authority to find most suitable solutions for difficult drainage problems.
- Absence of established system for regular training and awareness raising programs to educate the Local Government staff invoved in development works.
- Want of coordination between Local Government Engineering staff and RDA Excecutive Engineering Staff.
- Less priority positioned for continuous maintenance of the drainage system by the Local Authorities to mitigate flooding.
- Budgetery restrictions within the Local Authorities.
- Some instaces the incorrect technical decisions taken by the local authorities due to undue preasure from the affected communities.

Closed leadaways due to Enviorenmental and Social effects

No	Chainage/Location	Flow Direction	Lead Away /Culvert No	Remarks
1	15+833	LHS to RHS	16/3	Closed by the land owner after introducing side drains under the rehabilitation program
2	16+584	RHS to LHS	17/1	Previousely closed by the land owner over a social dispute.
3	20+980	RHS to LHS	21/3	Leadaway is partially blocked due to construction of a crossdrain by the Seeduwa TC.
4	22+200	RHS to LHS	23/1	Originql leadaway path diverted with reduction of width of thwe canal
5	25+010	RHS to LHS	26/1	Land owner has constructed a building on the drain . Local Authority has provided all the service connections.
6	25+500	RHS to LHS	26/2	Clear case of bad maintenance. A B0-tree has grown on the side covering the drainage path.
7	17+330	RHS to LHS	18/1	Residents have divert the water path at number of locations after partitioning the land. The width of the canal reduced. Ail right angle bends. Blocked by debris and domestic waste. Situation is acute after connecting the new side drains.
8	29+010	RHS to LHS	30/1	Lead Away is not visible. Poor maintenance leads to this situation.
9	32+140	RHS to LHS	33/2	Covered with ciover slabs on the lead away drain obstructing for clearing process.
10	33+500	RHS to LHS	34/2	House constructed on the leadaway drain.
11	33+900	RHS to LHS	34/3	Leadaway completely blocked. And constructed an house on the leadaway.
12	35+100	RHS to LHS	36/1	Timber shop constructed completely blocking the leadaway path
13	42+700	RHS to LHS	43/3	Leadaway is 50% blocked by the land owner reqest given to EE chilaw to divert the flow to 43/2 culvert. EE has accepted the reqest made and wanted to opent the connecting path.
14	42+400	RHS to LHS	43/2	Land owner has blocked the path .
15	48+300	RHS to LHS	49/1	Approch canal is blocked by constructing a gas station across the path.
16	49+300	RHS to LHS	50/1	House constructed on the leadaway.
17	62+200	RHS to LHS	63/3	Box culvert section compleately clogged.
18	66+650	RHS to LHS	67/3	Land owner has closed the leadaway.
19	72+900	RHS to LHS	73/3	A grocery shop constructed on the leadaway drain by closing the drain.
20	85+500	RHS to LHS	86/3	Water way of the leadaway is blocked due to utility lines passing through the drain.
21	85+700	RHS to LHS	86/4	Completely blocked.
22	83+980	RHS to LHS	84/1	Completely blocked.
23	102+500	RHS to LHS	103/2	Leadaway sealed by land owner
24	40+700	RHS to LHS	41/2	Head walls are not visible and blocked .
25	53+998	RHS to LHS	54/1	Opening not visible
26	56+400	RHS to LHS	57/1	Lead away not visible completely closed
27	80+200	RHS to LHS	81/1	Leadaway blocked by land owner.

In addition almost all the leadaway traces are silted or blocked in different percentages due to placing of service lines across the water path.

Flat Terrain Draiange isuue leading to enviorenment and social problems due to rapid ribban development.

Unsettled flat terrain drainage management has caused many social and enviorenment issues specially during the stormy weather periods. Challenges of stormwater management for urban developments on flat terrain are unresolved and keepon increasing with the development of

infrastructure along the roads. This situation is quite clear along the PP road trace specially around Wnnappuwa and marawilla areas and many other small stretches along the trace. It employs the philosophy and principles of Water Sensitive Urban Design (WSUD) to develop a case for the use of distributed “at-source” bioretention systems as a cost effective and more sustainable alternative to traditional approaches to stormwater management on flat terrain.

Flat terrain has long represented a challenge for urban stormwater practitioners. The challenge involves achieving minimum grades for road pavements and pipe drainage systems and to maintain self cleansing velocities in pipes. This often results in large diameter pipe networks with pipe invert levels at the drainage outfall often several metres below natural surface levels. Achieving free draining outfalls to natural watercourses can therefore be very difficult, as can be the effective treatment of stormwater runoff to attenuate flows and remove pollutants.

Careful consideration of the urban design and supporting infrastructure is therefore paramount to ensure the pattern of development supports an appropriate stormwater management network able to meet both drainage requirements and the management of waterway health. The philosophy and principles of water sensitive urban design (WSUD) provide a framework for this to occur and describes the pertinent process and outcomes from applying WSUD to flat terrain developments.

Water sensitive urban design (WSUD) is now widely adopted in Australia as an approach to mitigate the impacts of urban development on the natural water cycle and re-engage communities in environmental management. In general terms the objectives of WSUD are to reduce potable water demand, minimise wastewater discharges, improve the quality of urban stormwater runoff and preserve the natural hydrologic regimes of catchments. WSUD seeks to achieve these objectives by integrating strategies or measures with the built environment.

Constructed stormwater wetland and bioretention systems are considered to be the most effective measures for removing sediments and nutrients from stormwater runoff which are often limiting nutrients in aquatic ecosystems. The design approaches for these systems are now well documented through the national, state and regional design guidelines tailored to local climatic and regulatory environments. Bioretention systems are often used in preference to wetland systems as they are able to deliver a similar level of stormwater treatment with a much smaller footprint, and are more versatile in shape and form allowing tighter integration with built environments.

Flat terrain presents a significant challenge for water sensitive urban designers, since constructed wetlands and bioretention systems both require a free draining outlet which compounds the drainage issues raised above. Many urban designers and engineers seek to apply wetlands and bioretention systems at the end of stormwater drainage systems, since this approach allows conventional sub-divisional design techniques to be applied, and stormwater quality management can then be dealt with as a secondary design issue. On many flat sites, once water enters the piped drainage system there is often insufficient grade available to daylight that water onto a treatment system and then to discharge flows to a receiving waterway. Bioretention systems, the preferred measure for reasons discussed above, is more challenged than wetlands in flat terrain since they work by percolating stormwater vertically through a biological soil media.

The alternative to implementing bioretention systems at the end of pipes is to apply bioretention treatment before water enters the underground drainage system. Treating stormwater at surface in this way keeps water as high as possible in the landscape and makes efficient use of limited vertical fall on a flat site. It also allows treated water collected from the base of the systems to be discharged

to shallow open waterways throughout the urban environment which can double as open space corridors and can further connect the community to water.

In order to implement stormwater treatment at surface requires a distributed network of small streetscape bioretention systems, which we have termed 'biopods'. A biopod is required at every location where a conventional side entry pit would otherwise be required, which is at every low point (sag point) and before every road crossing to ensure road drainage criteria are satisfied.

The process of placing bioretention systems within conventional streetscapes, which

already need to accommodate myriad other services, requires consideration of many facets of urban design which are discussed below:

Urban densities

Higher urban densities are being sought for most new urban development in order to limit the overall footprint of urban development and improve the efficiency of service provision. Often associated with higher urban densities are narrow road reserve widths (14 m) and shorter allotment frontages. The pressure for higher urban densities constrains the ability to provide additional space for bioretention systems and creates a driver to integrate them into available public realm space such as road reserves.

Landscape design

Landscape design influences the behaviour of residents and the overall livability of an area. To most people bioretention systems appear as essentially depressed garden beds, and in this regard their integration into the urban design is as much a landscape design issue as an engineering issue. Co-locating biopods with sites of landscape embellishment results in cost synergies and also leads to passive irrigation benefits.

Drainage

In South East Queensland (SEQ), conventional stormwater drainage often requires that road crests must not be inundated under minor (2 yr ARI) storm events. For a typical 14 m wide road reserve with a 5.5 m wide carriageway this objective is satisfied by providing a point of drainage relief - such as a side entry gully pit – at least every 100 m. This sets a notional maximum distance between streetscape biopods.

Pedestrian Movement

Footpaths occupy a significant amount of space in the road verge and limit the area available for biopods. If local streets are designed in away to deliver average speeds below 30 km/h, then pedestrians and cyclists can safely travel along the road carriageway, and only informal pedestrian passage needs to be provided behind biopods. For local streets in Queensland, the 30 km/h target speed is achieved by keeping street leg lengths under 75 m, either through intersections or traffic calming devices. The maximum street leg length of 75 m dovetails nicely with the 100 m distance typically required between drainage relief points.

Stormwater Treatment

For bioretention systems to achieve best practice water quality objectives in SEQ they need to be sized at approximately 1.6% of the contributing catchment area. The average catchment area for 75 m length of road is about 2800 m2 which requires about 45 m2 of bioretention. This area can be accommodated within the verge and between driveways provided no footpaths or services need to also be accommodated. Where footpaths and services are needed, a solution may still be achieved by using localised widenings of the road reserve (by indenting property boundaries) and/or offsetting the carriageway within the road reserve to achieve a wider verge on one side of the road.

The design considerations mentioned above have been integrated into an overall urban design solution for stormwater treatment in flat terrain which is presented schematically in Figure 2 below. This solution, using small streetscape biopods, has been successfully implemented on a large residential development located on the flat coastal plain of Queensland's Sunshine Coast. Delivering this solution required a significant change to the urban design process. Stormwater treatment considerations came to the foreground and influenced the urban design. This compares to the conventional design approach whereby a pre-agreed urban design is handed to a drainage engineer who then seeks to document a drainage solution irrespective of how conducive the urban design is to stormwater treatment requirements.

Local Government Perspective

Engineering assessment within local government is based on relatively rigid design guidelines and standard drawings, which have evolved over time to balance the various conflicts and objectives between the different aspects of development assessment (i.e. water, sewer, stormwater, landscaping, roads and other services) and to minimize the risk to the local authority in terms of maintenance costs, community acceptance and public liability. Significant challenges exist in attempting to merge completely new technologies with current development guidelines and standards, with the key challenges being:

- Organisational resistance to change and dealing with uncertainty;
- Providing integrated assessment when multiple disciplines are involved;
- Community acceptance; and
- Developing standard solutions

A willingness within the local authority to consider alterative stormwater treatment techniques on flat sites was initially borne from the perceived failures of 'conventional' end-of-line bioretention systems, which have been discussed earlier. Even with strong drivers for change, assessment of innovative solutions requires a significant shift in the traditional mind-set of assessment staff in order to confidently deal with the uncertainty inherent in new approaches. A key issue was the resolution of the perceived conflicts between the biopods and the current engineering guidelines and standard drawings. This issue was resolved by assessing the proposal against the outcomes sought by the guidelines rather than looking for the conventional solutions which are typically provided to achieve those outcomes. For example, the hydraulic performance of the bioretention pods can be assessed against the same criteria for roadway flow width and depth limits as conventional drainage design, even though some conventional drainage design components have

been replaced with alternative features. When assessed in this way, it became apparent that there was no real conflict between the proposal and current engineering guidelines.

Another key issue in the assessment of new technologies is how to resolve the overlap and conflicting requirements which can occur between assessment officers of different disciplines. Effective communication between officers is essential in situations where the delineation between responsibilities is not yet well defined, and can only occur when officers are part of the same multi-disciplinary team. In Caloundra City Council, this was already achieved through the current structure of the assessment unit which is based on multi-disciplinary assessment teams, where engineers, environment officers and planners work in the same area and for the same manager. Integrated assessment can be further enhanced by encouraging applicants to submitted combined applications for both civil works and landscaping approval jointly.

Perhaps the greatest unknown in the adoption of new technology is the future acceptance by residents. Biopods result in much greater interaction with residents than for traditional end-of-line basins and there is potential for resentment by residents where biopods occupy a significant portion of the frontage of the allotment. Property Notes and Conditions have been put on all approvals to notify purchasers of the presence and function of the biopods and their responsibility not to interfere with them. Conditions were also implemented requiring the developer to include information to purchasers about the biopods in all marketing material and to take steps to foster community acceptance of the devices. Experience so far in Queensland has shown good acceptance by residents, with some residents supplementing the existing plantings in the batter areas of the devices with their own plants. While this may not be in strict adherence with the landscape intent for the devices, such actions by residents show an 'adoption' of the device and so long as the filter media plantings are not interfered with, can only be a positive for the long-term success of the devices.

For large multi-stage developments, it is possible to develop standard solutions in conjunction with the applicant and their consultants where all the key design parameters are addressed. This approach has been used successfully in the past where, following essentially only one design-iteration, a 'standard' biopod configuration was agreed and has now resulted in much faster development approvals for the remainder of the estate and much more certainty of the outcome for the local authority. It would also be possible and desirable to have key components such as subsoil drain details and cleanout points, kerb turn-outs, bollard design and off-sets, plant species lists, and filter media specifications included in new standard drawings within the local authorities engineering guidelines so these components can be easily conditioned and consistently applied across all developments. However to some degree these types of devices will always have aspects which will be site-specific and standard drawings cannot be a complete replacement for integrated multi-disciplinary assessment based on sound judgment.

Appraisal of this urban design solution

Positives

- Lower construction costs relative to end-of-pipe solution and hence lower replacement costs for local authority;
- Retains good conventional drainage components (kerb and channels, underground pipe system for minor event);
- Provides passive irrigation of streetscape landscaping;

- Possible reduction in total maintenance costs by combining landscape and stormwater treatment features into one asset;
- Education – greater awareness of fate of runoff – though this doesn't seem to apply to builders!
- Increased urban densities.

Issues/Challenges

- Conflicts with services, driveways and pedestrian movement – have been addressed;
- Construction risks;
- Acceptance by residents – still unknown;
- Long-term maintenance – still unknown.

Traditional approaches to urban design have created a disconnection between human behaviour and the impacts of our actions and activities on the natural environment. Basic and easily comprehended concepts which we use in our daily life to mediate our behaviour and decision making such as supply and demand and cause and affect have been conveniently designed out of our consciousness. The result of this is now clear, degraded urban environments and blissfully ignorant perpetrators. The biopod solution is highly legible; connecting road ways with receiving environments. Rather than telling residents to not pollute runoff because it flows to creeks or bays, they are able to see clearly that any pollution they generate accumulates in the raingarden in the front of their homes. This immediate cause and effect loop creates a powerful driver for behavioural change.

Conclusion

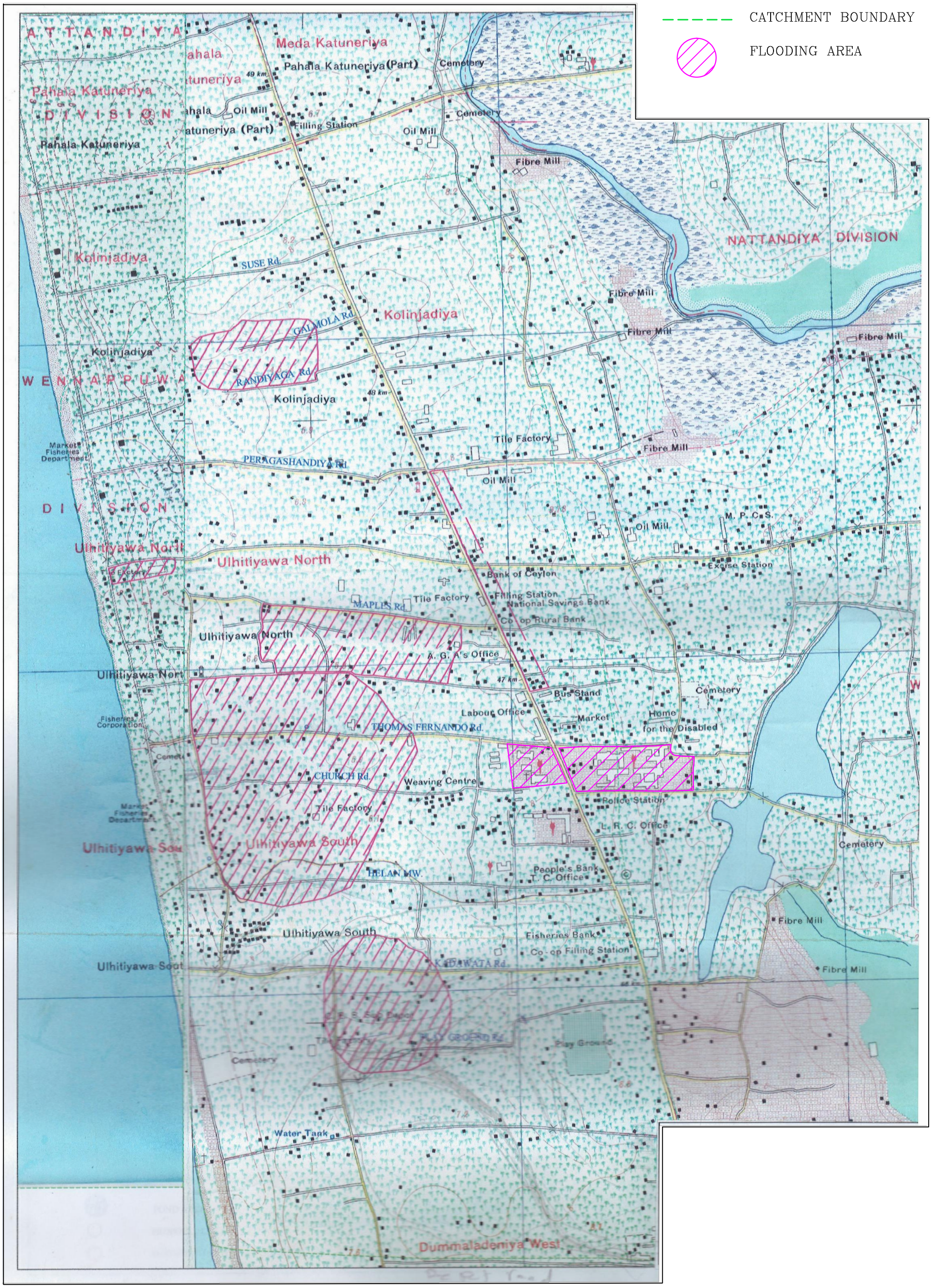
Conventional approaches to stormwater management on flat terrain are problematic due to the depth of drainage systems. Including stormwater treatment at the end of deep drainage systems confounds this problem as further depth is required. Treating stormwater at-surface, i.e. before it enters the underground drainage system, is an approach that has been successfully implemented in a large residential development on Queensland's Sunshine Coast. Implementing this solution required an integrated approach to urban design, and from local government perspective, required and an integrated approach to development assessment.

To incorporate stormwater treatment into flat terrain there needs to be an integrated approach to urban design and there also needs to be an integrated approach to development assessment.

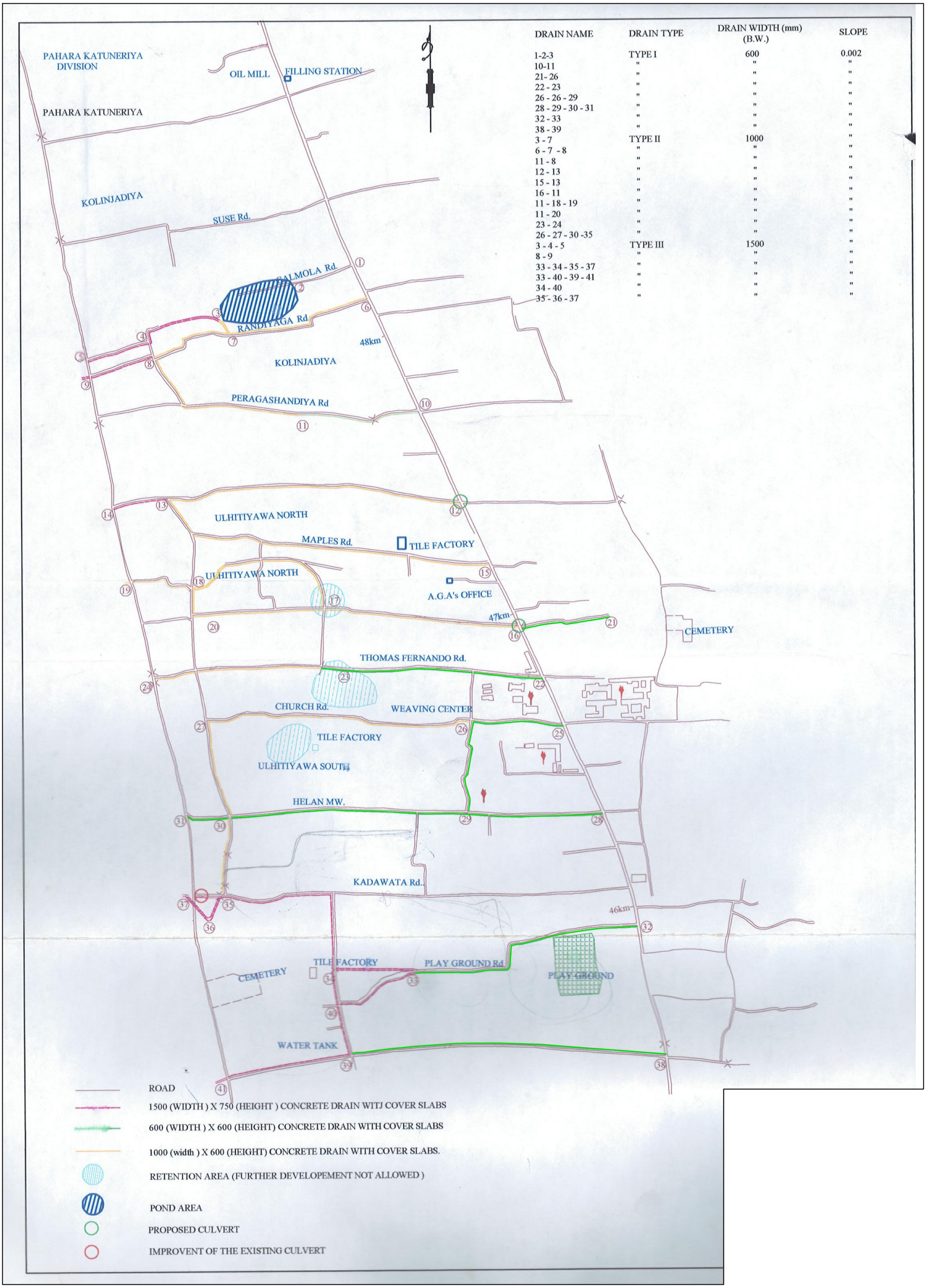
Alternative proposal (1) for Identified Flat terrain :

CATCHMENT BOUNDARY

FLOODING AREA



DRAIN NAME	DRAIN TYPE	DRAIN WIDTH (mm) (B.W.)	SLOPE
1-2-3	TYPE I	600	0.002
10-11	"	"	"
21- 26	"	"	"
22 - 23	"	"	"
26 - 26 - 29	"	"	"
28 - 29 - 30 - 31	"	"	"
32 - 33	"	"	"
38 - 39	"	"	"
3 - 7	TYPE II	1000	"
6 - 7 - 8	"	"	"
11 - 8	"	"	"
12 - 13	"	"	"
15 - 13	"	"	"
16 - 11	"	"	"
11 - 18 - 19	"	"	"
11 - 20	"	"	"
23 - 24	"	"	"
26 - 27 - 30 -35	"	"	"
3 - 4 - 5	TYPE III	1500	"
8 - 9	"	"	"
33 - 34 - 35 - 37	"	"	"
33 - 40 - 39 - 41	"	"	"
34 - 40	"	"	"
35 - 36 - 37	"	"	"



Localized : Drainage Problem on either side of the road and Part of the road Stretch In Wennappuwa

Local Authority : Area The main cause of flooding has resulted from the urbanization that has been taken place during last two decades due to increase of population without due consideration to storm water drainage aspects.

Thus areas has become a storm water detention areas where there is no sufficient drains or define lead

away drains from main road. It is necessary to identify improvements required for the existing drainage

system, the extent of retention areas required for temporary storage of storm water as shown in the attached plans.

Alternative proposal (2) for Identified Flat terrain

Urban Design Solutions for Stormwater Treatment On Flat Sites

Alternative solution for Wennappuwa & Marawilla road drainage Issues.

Challenges of stormwater management for urban developments on flat terrain.

It employs the philosophy and principles of Water Sensitive Urban Design (WSUD) to develop a case for the use of distributed “at-source” bioretention systems as a cost effective and more sustainable alternative to traditional approaches to stormwater management on flat terrain.

To support its position, the proposal presents the pros and cons of “at-source” and “end-of-pipe” technologies for stormwater treatment and flow attenuation on flat terrain. Potential synergies between road design, traffic management, landscape design and stormwater management are examined in the study, as well as 'tricks' and techniques that can be employed in the urban design to deliver best practice stormwater management whilst maintaining high urban densities and associated ribbon developments along the A3 and conventional road reserve widths.

The challenges and perspectives of local government officers involved in the assessment of innovative stormwater management techniques are presented in this proposal. Discussion is provided on organizational resistance to change, integrated assessment, dealing with uncertainty, and developing ‘standard’ solutions. Ways to address these challenges - either through design or processes - are also discussed.

Introduction

Flat terrain has long represented a challenge for urban storm water practitioners. The challenge involves achieving minimum grades for road pavements and pipe drainage systems and to maintain self-cleansing velocities in side drains and pipes. This often results in stagnation of water along side drains or large diameter pipe networks with pipe invert levels at the drainage outfall often below natural surface levels. Achieving free draining outfalls to natural watercourses can therefore be very difficult, as can be the effective treatment of storm water runoff to attenuate flows and remove pollutants.

Careful consideration of the urban design and supporting infrastructure is therefore paramount to ensure the pattern of development supports an appropriate stormwater management network able to meet both drainage requirements and the management of waterway health. The philosophy and principles of water sensitive urban design (WSUD) needs to be study and introduce to flat terrain urban developments.

The conventional approach to managing storm water on flat terrains is to construct a deep open water body within the development area, into which the road side drains or pipe drainage lines can discharge, often with high tail water conditions creating permanently backwatered drains or pipes. Overflows from the open water bodies are then discharged, typically by overflow weir, to natural surface allowing free passage of storm water runoff to receiving watercourses. Many urban developments on flat terrain will also use the material excavated in the construction of these deep open water bodies as a source of low cost fill material to turn flood prone land into developable land. In many cases, these deep open water bodies are also put forward as the principal measure for provision of storm water quality improvement and attenuation of stormwater flows from the urban development. Examples of this approach to urban stormwater management on flat terrain can be found throughout Australia. A schematic of this approach is presented in Figure 1 (Attached). There are however several short comings to this approach, as outlined below:

- Drainage system costs are often prohibitively high due to pipe diameter and depth;
- The permanently backwatered pipe systems are hydraulically inefficient and can often become deposition zones for sediments and organic litter which can lead to nuisance conditions.
- High tail water conditions preclude or limit the effectiveness of litter traps. This often results in the unmitigated delivery of organic litter and suspended sediments to the water body - creating a long term source of carbon and nutrients.
- The large permanent water storage volumes often associated with the deep stratified open water bodies results in long hydraulic residence times (often several months). This creates a propensity nuisance aquatic plant and algae growth.
- Whilst generally pretty effective in the short to medium term for capturing, retaining and/or transforming urban stormwater pollutants for the protection of receiving waterways, the deep open water bodies often experience considerable difficulty themselves in maintaining a healthy trophic status over the medium to long term and can therefore become a liability as a recreational and landscape asset. They can also become a source of nutrients and aquatic weeds to receiving environments.

The WSUD approach to managing stormwater on flat sites Water sensitive urban design (WSUD) is now widely adopted in Australia as an approach to mitigate the impacts of urban development on the natural water cycle and re-engage communities in environmental management. In general terms the objectives of WSUD are to reduce potable water demand, minimize wastewater discharges, improve the quality of urban stormwater runoff and preserve the natural hydrologic regimes of catchments. WSUD seeks to achieve these objectives by integrating strategies or measures with the built environment.

Through our field investigations and discussions had with relevant stake holders the above mentioned approach is one of the most suitable sustainable solutions to address the existing drainage issues in flat terrain between Wennappuwa and Marawilla section of the PP (A3) road.

Bio Retention Systems, Bio retention swales and Bio Pods

Bioretention

Bioretention systems are shallow depressions in the urban landscape designed to collect and treat storm water. Storm water conveyed to a bioretention system is treated by filtering the stormwater through a densely vegetated, biologically active sand and loam filter media. As the water pe4colate through the filter media, pollutants are captured by fine filtration. Adsorption and biological processing by both soil microbes and plants. Treated water could be discharged to groundwater or could be conveyed via slotted or perforated pipes to downstream drainage systems such as water ways, channels or pipes.

Constructed stormwater wetland and Bioretention systems are considered to be the most effective measures for removing sediments and nutrients from stormwater runoff limiting nutrients in aquatic ecosystems. The design approaches for these systems are now well documented through the

national, state and regional design guidelines tailored to local climatic and regulatory environments. Bioretention systems are often used in preference to wetland systems as they are able to deliver a similar level of stormwater treatment with a much smaller footprint, and are more versatile in shape and form allowing tighter integration with built environments.

Flat terrain presents a significant challenge for water sensitive urban designers, since constructed wetlands and bioretention systems both require a free draining outlet which compounds the drainage issues raised above. Many urban designers and engineers seek to apply wetlands and bioretention systems at the end of stormwater drainage systems, since this approach allows conventional sub-divisional design techniques to be applied, and stormwater quality management can then be dealt with as a secondary design issue. On many flat sites, once water enters the piped drainage system there is often insufficient grade available to daylight that water onto a treatment system and then to discharge flows to a receiving waterway. Bioretention systems, the preferred measure for reasons discussed above, is more challenged than wetlands in flat terrain since they work by percolating stormwater vertically through a biological soil media.

Even in situations where sufficient grade exists to achieve a free-draining outfall, flat terrain can result in end-of-line treatment measures which have a treatment surface which is significantly lower than the surrounding ground levels, resulting in a device which is isolated from the urban landscape and is expensive to construct. Such sunken 'end of pipe' systems are difficult to integrate into the surrounding landscapes and, to ensure public safety, they often require either: • large batter slopes into the bioretention system (which have the consequence of increasing the overall footprint of the system); or • retaining walls and safety fences around the bioretention system, which increase construction and replacement costs, hinder maintenance and are often unsightly and disengage the local community from any sense of stewardship of the system.

The alternative to implementing bioretention systems at the end of pipes is to apply bioretention treatment before water enters the underground drainage system. Treating stormwater at surface in this way keeps water as high as possible in the landscape and makes efficient use of limited vertical fall on a flat site. It also allows treated water collected from the base of the systems to be discharged to shallow open waterways throughout the urban environment which can double as open space corridors and can further connect the community to water.

Bio Pods

In order to implement stormwater treatment at surface requires a distributed network of small streetscape bioretention systems, which we have termed 'biopods'. A biopod is required at every location where a conventional side entry pit would otherwise be required, which is at every low point (sag point) and before every road crossing to ensure road drainage criteria are satisfied.

Integrated design considerations for at surface treatment the process of placing bioretention systems within conventional streetscapes, which already need to accommodate myriad other services, requires consideration of many facets of urban design which are discussed below:

Urban densities higher urban densities are being sought for most new urban development in order to limit the overall footprint of urban development and improve the efficiency of service provision. Often associated with higher urban densities are narrow road reserve widths (14 m) and shorter

allotment frontages. Which is the case for road stretch along Wennapuwa and Marawila town areas. The pressure for higher urban densities constrains the ability to provide additional space for bioretention systems and creates a driver to integrate them into available public realm space such as road reserves.

Bioretention Swales

Bioretention swales are a type of bioretention system that both treats and conveys stormwater. A bioretention swale is comprised of all the main components of a bioretention system co-located within the base of a swale. For bioretention swales the surface of the filter media follows the grade of the swale surface >(0.5% and <2% slope) and is generally 600-2000 mm wide. The swale component of a bioretention swale conveys and pre-treats storm water to remove coarse to medium sized sediment. The bioretention filter media removes finer particulates and contaminants.

The bioretention swales are typically located within road reserves ,parklanads, and draianage easements with small catchments less than 2ha. The can receive lateral flows across road adjacent allotments. The bioretention swales are densly planted with sedges and bushes and may include trees to form a canopy.

Landscape design

Landscape design influences the behavior of residents and the overall livability of an area. To most people bioretention systems appear as essentially depressed garden beds, and in this regard their integration into the urban design is as much a landscape design issue as an engineering issue. Co-locating biopods with sites of landscape embellishment results in cost synergies and also leads to passive irrigation benefits.

Drainage in Wennappuwa and Marawilla flat terrain area conventional stormwater drainage often requires that road crests must not be inundated under minor 2yr storm events. For a typical 14 m wide road reserve with a 5.5 m wide carriageway this objective is satisfied by providing a point of drainage relief - such as a side entry gully pit – at least every 100 m. This sets a notional maximum distance between streetscape biopods.

Pedestrian Movement Footpaths by the side of the road occupy a significant amount of space in the road shoulder, and limit the area available for biopods. If local streets are designed in a way to deliver average speeds below 40 km/h (Normal speed limit enforced by the Traffic Police in town limits) , then pedestrians and cyclists can safely travel along the road carriageway, and only informal pedestrian passage needs to be provided behind biopods. For local streets in Queensland, the 30 km/h target speed is achieved by keeping street leg lengths under 75 m, either through intersections or traffic calming devices. The maximum street leg length of 75 m dovetails nicely with the 100 m distance typically required between drainage relief points.

Stormwater Treatment For bioretention systems to achieve best practice water quality objectives in SEQ they need to be sized at approximately 1.6% of the contributing catchment area. The average

catchment area for 75 m length of road is about 2800 m2 which requires about 45 m2 of bioretention. This area can be accommodated within the Shoulder edge and the carriageway provided no footpaths or services need to also be accommodated. Where footpaths and services are needed, a solution may still be achieved by using localized widening of the road reserve (by indenting property boundaries) and/or offsetting the carriageway within the road reserve to achieve a wider shoulder width on one side of the road.

The design considerations mentioned above have been integrated into an overall urban design solution for stormwater treatment in flat terrain which is presented schematically in Attachment 2. This solution, using small streetscape biopods, has been successfully implemented on a large residential development located on the flat coastal plain of Queensland's Sunshine Coast. Delivering this solution required a significant change to the urban design process. Stormwater treatment considerations came to the foreground and influenced the urban design. This compares to the conventional design approach whereby a pre-agreed urban design is handed to a drainage engineer who then seeks to document a drainage solution irrespective of how conducive the urban design is to stormwater treatment requirements.

Figure 1 Schematic of the conventional approach to stormwater management on flat terrain.

Figure 2 Schematic of the WSUD approach to stormwater management on flat terrain.

Figure 3 Sketch and photo of biopods in a residential street

Local Government Perspective Engineering assessment within local government is based on relatively rigid design guidelines and standard drawings, which have evolved over time to balance the various conflicts and objectives between the different aspects of development assessment (i.e. water, sewer, stormwater, landscaping, roads and other services) and to minimize the risk to the local authority in terms of maintenance costs, community acceptance and public liability. Significant challenges exist in attempting to merge completely new technologies with current development guidelines and standards, with the key challenges being:

- Organizational resistance to change and dealing with uncertainty;
- Providing integrated assessment when multiple disciplines are involved;
- Community acceptance; and
- Developing standard solutions

A willingness within the local authority to consider alterative stormwater treatment techniques on flat sites was initially borne from the perceived failures of 'conventional' end-of-line bioretention systems, which have been discussed earlier. Even with strong drivers for change, assessment of innovative solutions requires a significant shift in the traditional mind-set of assessment staff in order to confidently deal with the uncertainty inherent in new approaches. A key issue was the resolution of the perceived conflicts between the biopods and the current engineering guidelines and standard drawings. This issue could be resolved by assessing the proposal against the outcomes sought by the guidelines rather than looking for the conventional solutions which are typically provided to achieve those outcomes. For example, the hydraulic performance of the bioretention pods can be assessed against the same criteria for roadway flow width and depth limits as conventional drainage design, even though some conventional drainage design components have been replaced with alternative features. When assessed in this way, it became apparent that there was no real conflict between the proposal and current engineering guidelines.

Another key issue in the assessment of new technologies is how to resolve the overlap and conflicting requirements which can occur between assessment officers of different disciplines. Effective communication between officers is essential in situations where the delineation between responsibilities is not yet well defined, and can only occur when officers are part of the same multi-disciplinary team. In other countries this was already achieved through the assessment unit which is based on multi-disciplinary assessment teams, where engineers, environment officers and planners work in the same area and for the same target. Integrated assessment can be further enhanced by encouraging applicants to submitted combined applications for both civil works and landscaping approval jointly.

Perhaps the greatest unknown in the adoption of new technology is the future acceptance by residents. Biopods result in much greater interaction with residents than for traditional end-of-line basins and there is potential for resentment by residents where biopods occupy a significant portion of the frontage of the allotment. Property Notes and Conditions have been put on all approvals to notify purchasers of the presence and function of the biopods and their responsibility not to interfere with them. Conditions were also implemented requiring the developer to include information to purchasers about the biopods in all marketing material and to take steps to foster community acceptance of the devices. If properly introduced could expect acceptance by residents, some of them even supplementing the proposed plantings in the batter areas of the devices with their own plants. While this may not be in strict adherence with the landscape intent for the devices, such actions by residents show an 'adoption' of the device and so long as the filter media plantings are not interfered with, can only be a positive for the long-term success of the devices.

For large multi-stage developments, it is possible to develop standard solutions in conjunction with the applicant and their consultants where all the key design parameters are addressed. This approach has been used successfully in the past where, following essentially only one design-iteration, a 'standard' biopod configuration was agreed and has now resulted in much faster development approvals for the remainder of the estate and much more certainty of the outcome for the local authority. It would also be possible and desirable to have key components such as subsoil drain details and cleanout points, kerb turn-outs, bollard design and off-sets, plant species lists, and filter media specifications included in new standard drawings within the local authorities engineering guidelines so these components can be easily conditioned and consistently applied across all developments. However to some degree these types of devices will always have aspects which will be site-specific and standard drawings cannot be a complete replacement for integrated multi-disciplinary assessment based on sound judgment.

Appraisal of this urban design solution Positives;

Lower construction costs relative to end-of-pipe solution and hence lower replacement costs for local authority;

- Retains good conventional drainage components (kerb and channels, underground pipe system for minor event);
- Provides passive irrigation of streetscape landscaping; • Possible reduction in total maintenance costs by combining landscape and stormwater treatment features into one asset;
- Education – greater awareness of fate of runoff – though this doesn't seem to apply to builders! • Increased urban densities.
- Issues/Challenges
- Conflicts with services, driveways and pedestrian movement – have been addressed;

- Construction risks;
- Acceptance by residents – still unknown;
- Long-term maintenance – still unknown.

Traditional approaches to urban design have created a disconnection between human behaviour and the impacts of our actions and activities on the natural environment. Basic and easily comprehended concepts which we use in our daily life to mediate our behaviour and decision making such as supply and demand and cause and affect have been conveniently designed out of our consciousness. The result of this is now clear, degraded urban environments and blissfully ignorant perpetrators. The biopod solution is highly legible; connecting road ways with receiving environments. Rather than telling residents to not pollute runoff because it flows to creeks or bays, they are able to see clearly that any pollution they generate accumulates in the raingarden in the front of their homes. This immediate cause and effect loop creates a powerful driver for behavioural change.

Conclusion Conventional approaches to stormwater management on flat terrain are problematic due to the depth of drainage systems pollution issues. Including stormwater treatment at the end of deep drainage systems confounds this problem as further depth is required. Treating stormwater at-surface, i.e. before it enters the underground drainage system, is an approach that has been successfully implemented in a large residential development on Queensland's Sunshine Coast. Implementing this solution required an integrated approach to urban design, and from local government perspective, required and an integrated approach to development assessment. To incorporate stormwater treatment into flat terrain there needs to be an integrated approach to urban design and there also needs to be an integrated approach to development assessment.

7. Inter Agency and Stake holder Consultation

There are number of agencies having powers to take action on drainage management related activities.Legislative powers of these organisations are some times overlapping due to the Acts and amendments to these acts done time to time to cover up important responsibilities of these organizations.

Executing Agencies

SriLanaka Land Reclamation and Development Cooperation (SLLRDC) – Attachment 6

SLLRDC was established in 1968 by Act No.15 of 1968. The objective of the board were, 1)to reclaim and develop every reclamation and development area declared by the Minister which included lowland, marshy, Waste or swampy areas, and 2) to have the custody , management and control of lands comprising such areas indicated in Board Act No.15 of 1968.

General powers of the board include 1) to acquire, hold or take on lease any property, or to mortgage, pledge, sell or otherwise dispose of any property, 2)to undertake the preparation and execution of development schemes in the areas, 3) to cause the construction of roads in the areas, and 4) to cause the construction of works for the provision of public services in the areas including surface water drainage ,sewerage and disposal of sewage , lighting and water supply.

The Act was subsequently amended in 1976, which allows the Board to sell reclaim lands. Furter amendments were done in 1982 allowing acquisitions and vesting of lowlands in any part of the country. The name of the Board changed to the present one at that time.

The canals and waterways in and around Colombo were handed over from the Irrigation Department to SLLRDC for maintenance. Canal Development maintenance division has responsibility for maintenance of canals.

Irrigation Department Attachment – 8

Irrigation Department is an old organization and no Acts exist for its establishment. The relevant statutes describing responsibilities and powers of Irrigation Department (IRD) are the Irrigation Ordinance No.48 of 1968 and the Flood Protection Ordinance No.4 of 1924. IRD is responsible to undertake irrigation and drainage works, conservation of catchment of rivers and major reservoirs and the flood protection areas declared by the IRD. IRD is, in principal responsible for inter provincial irrigation schemes, whilst the Provincial irrigation Departments are directly responsible for Provincial Irrigation Schemes.
Waterways can be grouped in to three categories by objectives, 1) Irrigation Schemes, 2) Flood Protection and Drainage management schemes, Drainage and salt water exclusion schemes. IRD is responsible for major irrigation schemes and medium irrigation schemes while the Provincial Irrigation Department or the Agrarian Development Department is responsible for minor schemes. Flood protection and drainage schemes and drainage and salt water exclusion schemes can be handled by either IRD or Provincial Irrigation Department based on the principal above.

Agencies responsible for Land use Planning and Regulations.

Urban Development Authority (UDA) Attachment 5

Urban Development Authority Law No.41 of 1978provides for the establishment UDA to permit for integrated planning and implementation of economic, social and physical development of urban development areas in the country , which are specific areas declared by the ministry. UDA is vested with strong powers to execute, regulate and control development plans in urban development areas, which includes 1)to formulate and implement an urban land use policy , 2) to develop environmental standards and prepare schemes for environmental improvements, 3) to acquire and hold any movable or immoveable property or dispose of same, 4) to formulate and execute housing schemes , 5)to cause the clearance of slum and shanty areas and to undertake their redevelopment, 6) to approve , coordinate , regulate, control or prohibit any development scheme or project , or any development activity , of any Government Agency and 7) to regulate any planning projects or schemes prepared by any Government Agency. (*Extracted from section 8 in Urban Development Authority Law No. 41 of 1978, its amendment No. 4 of 1982, and No. 44 of 1984)*

Agrarian Development Department (ADD) Aatachment 9

ADD was renamed from Agrarian Services Department by the Agrarian Development Act No. 46 of 2000. Objectives of the Act are to ensure maximum utilization of agricultural land for agricultural production by introducing clear restrictions to be imposed on persons using agricultural land for non-agricultural purposes.

IN the definition by the ADD, any land can be divided in to two types' Low land and highland. The lowland is divided in to two categories, paddy fields (including abanded paddy fields) and marshes. The highland has several categories including agriculture, urban, forestry, park and so on. The categories covered by the department are paddy fields in the low land and agricultural land in the highland. Marsh is an area of SLLRDC coverage. There exists a strong demand to develop paddy land

particularly in urban and urbanizing areas. Development of paddy land by land filling requires the permission of the commissioner –General of ADD, for which several steps are needed.

In case of illegal land filling in paddy or abandoned paddy lands, the Act empowers ADD to take legal actions such as the removal of filled earth and imposing of fines. In case of illegal land filling in other lands within UDA declared areas, UDA is empowered to take necessary legal actions. Although local authorities are also empowered to take legal actions for illegal land filling within their respective administrative boundaries, they usually consult UDA or ADD to take legal actions in order to avoid interventions by local politicians.

Agencies related to Land Acquisition and Resettlement

Ministry Of Lands Attachment - 7

By the Land Acquisition Act, the Ministry Of Land has a sole responsibility to acquire land, which is owned by state, Local Authority or Private companies / Individuals, for public projects approved by the central Government. The land Registration Department is responsible for registration of lands titles. These records are maintained and updated by district officers under the supervision of LRD.The responsibility of the land valuation department is the estimation of land prices, based on market values, for compensation , which is paid to land owners in the case of local authorities or private company individuals. The land commissioner's department is in charge of alienation of state land.

National Housing Development Authority (NHDA) – Attachment -4

NHDA was established by the National Housing Development Authority Act No.17 1979. This Act empowers the authority to promote housing development and to directly engaged in the construction of flats, houses and other living accommodation in urban and rural areas. However these activities in the urban areas were handed over to UDA and since then NHDA had been focusing on housing development for lower income groups in rural areas. The current major responsibilities are 1) relocation of legal and illegal dwellers for public projects, 2) renewal and development of urban housing, 3)Sale of land after relocation, 4) land acquisition

Regulatory Agency

Central Environment Authority (CEA) –Attachment -10

CEA was established by the National Environmental Act No. 47 of 1980. The powers, functions and duties of the Authority include to require the submission of proposals for new projects and changes in exiting projects and to require any local authorities to comply with any recommendations relating to environmental protection.

As for land use management, CEA is responsible to formulate and recommend a land use scheme, which includes 1) scientifically adequate land inventory classification system, 2) determination of present land use, 3)Comprehensive and accurate determination of the adoptability of land for various economic activities, 4)a method for exercising government control over the use of land , 5) a policy for influencing the location of new areas for resettlement of persons and the methods for assuring appropriate controls over land use. Land use plans for areas declared by UDA are finalized by UDA in consultation with CEA for environment aspects. National Environmental Act No. 47 of 1980(NEA) is an overarching legislation enacted for the protection of environment and natural resources. Establishment of the Central Environmental Authority under the provision of this act has provided capacity to enforce environmental laws. Environment protection is a cross cutting responsibility of central, provincial and local administration. Maintaining quality of environment at

grass root level is shared across many agencies and the key responsibility is with local government. NEA provides for enforcement of regulations to protect and improve quality of environment.

Effective life of major infrastructure development depends on the subsequent management of the associated environment that would affect the performance quality of services expected from the infrastructure development. Maintaining quality of environment at local level depends on Pradesiya Sabas commitment to enforce laws and regulations related to drainage and un authorized structures obstructing lead away drains and access to maintenance of such facilities Sustainable environment management is essential to protect life cycle effectiveness of infrastructure and benefits to be delivered by developed infrastructure.

CEA organized an inter-ministerial committee called the committee on environmental Policy and Policy management. An agency to provide, guide lines, approvals and monitoring related to environmental preservation and protection. Currently working on , 1)Urban and industries, 2) land 3) fishery , 4) energy, 5)biodiversity

Other Related Agencies:

- Survey Department

Survey Department has a responsibility to maintain cadastral maps .

- Land use policy Planning Division (LUPPD)

LUPPD is one of the divisions in the Ministry of Lands . The major responsibility of LUPPD is to maintain and update maps for state land , based on the basic maps developed by survey department, and to deverlop land use policy plans. These maps are used for land use planning in various planning agencies. In order to update these maps , LUPPD provides staff to the divisional secretary with training to survey the current land use conditions. This information is fed back to revise the maps.

Local Authorities

Municipal Councils –Attachment (1)

There are 23 Municipal councils in Sri Lanka, which are the legislative bodies that preside over the largest cities in the country. Introduced in 1987 through the 13th Amendment to the Constitution of Sri Lanka, municipal councils became a devolved subject under the Provincial Councils in the Local Government system of Sri Lanka. The municipal councils collectively govern 2,765,533 people within a 698 square kilometer area. There are 445 Councillors in total, ranging from 53 to 9 per council.

The Municipal Council Ordinance No. 17 of 1865 transferred responsibility for some local administration to local residents. The Municipal Councils consisted of elected and appointed members. Under the ordinance Municipal Councils were created for Colombo and Kandy. Reforms enacted in 1931 resulted in all members of Municipal Councils being elected.

The Village Communities Ordinance No. 26 of 1871 introduced Village Committees for local administration and Rural Courts for judicial administration. The ordinance allowed the Governor and the Legislative Council to create a Village Committee at the request of local residents. The Government Agent chaired the Village Committee and other members were appointed. The Village Committees were similar to the Village Councils. Village Committees worked well and in 1938 reforms were carried allowing for members to be elected, the chairman being elected by other

members, the creation of wards and the exclusion of local chiefs from being members. Village Committees could now collect land tax and provide local services such as roads, water supply, common amenities and public health.

The Sanitary Boards Ordinance No. 18 of 1892 created bodies to provide a number of public health services such as electricity, drainage, public conveniences, markets, dairies, laundries and water supply in small towns. The Sanitary Boards consisted of officials appointed by the Governor. The Local Boards Ordinance No. 13 of 1898 created Local Health and Sanitation Boards for larger towns. Their composition and powers were similar to the Sanitary Boards. The Local Health and Sanitation Boards started functioning on 1 September 1899.

The Local Government Ordinance No. 11 of 1920 created three types of local authorities: Urban District Councils (UDC), Rural District Councils and General Councils. Previous local authorities had been mostly appointed but these new authorities were elected. Two UDCs were created in 1922 and a further six in 1923.

The Donoughmore Commission made a number of recommendations in relation to local government including that all members of local authorities be elected, establishment of new authorities, reorganisation of existing authorities and the creation of the Department of Local Government. The Urban Councils Ordinance No. 61 of 1939 created Urban Councils in the largest towns in the country. 27 Urban Councils created. The Town Councils Ordinance No. 3 of 1946 created Town Councils for small towns. 24 Town Councils were created by abolishing all the Sanitary Boards and Local Health and Sanitation Boards that existed at that time. The Town Councils were divided into wards and provided local services such as thoroughfares, public health, common amenities, physical planning and the collection of revenue.

Post independence

When Ceylon achieved independence in 1948 local authorities consisted of Municipal Councils , Urban Councils, Town Councils and Village Committees. The Local Authorities Enlargement of Powers Act No. 8 of 1952 transferred some powers from Central Government to local authorities and granted new powers to Urban Councils. In the thirty years after independence local authorities received more and more powers. There were 40 amendments to the Municipal Councils Ordinance, 44 amendments to the Urban Councils Ordinance, 23 Amendments to the Town Councils Ordinance and 49 amendments to the Village Committees Ordinance.

The 1979 Tennakoon Commission recommended that District Development Councils (DDC) be established to carry out development functions currently carried out by the Central Government. The District Councils Act No. 35 of 1980 was passed by Parliament and 24 DDCs created. The DDCs consisted of elected members and local Members of Parliament. District Ministers were also created. In addition, legislation was passed to abolish the Town Councils and Village Committees and to transfer their functions to the new DDCs. This last move was opposed by the Tennakoon Commission. The 24 DDCs started functioning on 1 July 1981. At the same time 83 Town Councils and 549 Village Committees were abolished.

The DDCs didn't live up to expectations and a new form of local government was sought. The Wanasinghe Committee recommended that the DDC's be abolished and replaced by Divisional Councils (Pradeshiya Sabha or Pradesha Sabhai), sometimes called Rural Councils or Regional Councils. Parliament passed the Pradeshiya Sabha Act No. 15 of 1987 on 15 April 1987. The Divisional Councils were generally commensurate with their namesake Divisional Secretariats (Assistant Government Agent). The Local Authorities (Amendment) Act Nos. 20 and 24 of 1987 also changed the method of electing all local authority members from the first past the post using wards to

proportional representation using open lists. 257 Divisional Councils started functioning on 1 January 1988.

The 13th Amendment to the Constitution transferred the control and supervision of local government from Central Government to the newly created Provincial Councils. However, powers relating to the form, structure and national policy on local government remained with the Central Government. This meant that only the Central Government could create new local authorities, promote them, dissolve them and call an election.

In 1995 a Divisional Council was created for Biyagama which had previously been governed by the Board of Investment of Sri Lanka. In 1997 Moratuwa and Sri Jayawardenapura Kotte Urban Councils were promoted to Municipal Councils.[2] As of 199 there were 309 local authorities (14 MC, 37 UC, 258 DC). All parts of Sri Lanka are governed by local authorities except the Free Trade Zones in Katunayake and Koggala which are governed by the Board of Investment of Sri Lanka.

Powers

Local authorities don't derive their powers from an individual source but from numerous Acts and Ordinances. The main Acts relating to local government are the Municipal Council Ordinance No. 29 of 1947, the Urban Councils Ordinance No. 61 of 1939 and the Pradeshiya Sabha Act No. 15 of 1987. As a consequence the three different types of local authorities have slightly different powers. Municipal Councils have more powers than Urban Councils and Divisional Councils.

Local authorities have the power to instigate legal action, enter into contracts, acquire land and employ staff. However, these powers are somewhat curtailed by the fact that they are subordinate to the Central Government and Provincial Councils and by the fact that other state institutions such as the District Secretary enjoy similar powers as the local authority.

Services

There is only one Municpal council in the study area. MCs are expected to develop their physical plans. Since Negambo Municpality do not have sufficient capacity of planning staff, their physical plans are developed together with UDA.

Local authorities are required to "provide for the comfort, convenience and well being of the community". Laws require local authorities to carry out regulatory and administrative functions, promote public health and provide physical structures. Local authorities can only provide services which the law specifically allows them to do. Services provided by local authorities include roads, drains, parks, libraries, housing, waste collection, public conveniences, markets and recreational facilities.

Unlike local authorities in other countries, those in Sri Lanka do not run schools, hospitals or the police. State schools and hospitals are run by the Central Government or Provincial Councils. There is a single police service in Sri Lanka which is run by the Central Government.

Water, electricity, street lighting and rest houses used to be provided by local authorities but these services were taken over by various companies and departments under the control of the Central Government. This takeover affected the finances of local authorities because these services are had provided local authorities with useful sources of revenue.

Pradeshiya Sabas- (Attachment 2)

Peliyagoda - Putlam (A3 road) passes through the following pradeshiya sabas areas.

Peliyagoda, Wattala, Ja-ela, Seeduwa, Katana, Archchikattuwa, Wennappuwa, Naththandiya, Kalpitiya, Chillaw, Puttlam. This Act may be cited as the Pradeshiya Sabhas Act, No. 15 of 1987, and shall come into operation in respect of all or any of its provisions on such date or dates as the Minister may appoint by Order published in the Gazette.

Constitution of Pradeshiya Sabhas

- The Minister may, with a view to The Pradeshiya Sabha constituted for each Pradeshiya Sabha area shall be the local authority within such area and be charged with the regulation, control and administration of all matters relating to public health, public utility services and public thoroughfares and generally with the protection and promotion of the comfort, convenience and welfare of the people and all amenities within such area facilitating the effective participation of the people in local government and development functions, by Order published in the Gazette declare any area to be a Pradeshiya Sabha area for the purposes of this Act and shall define the administrative limits of the area so declared. The administrative limits of every Pradeshiya Sabha area so declared shall, as far as possible, correspond to limits of an Assistant Government Agent's division excluding any areas comprised in a Municipality or a town (within the meaning of the Urban Councils Ordinance) which falls within the limits of such Assistant Government Agent's division. The Minister may by the same Order or by a subsequent Order, constitute a Pradeshiya Sabha for such Pradeshiya Sabha area and assign a name to such Sabha.
- Every Pradeshiya Sabha constituted by an Order under subsection (1) shall be a body corporate with perpetual succession and a common seal and shall have power, subject to the provisions of this Act, to acquire, hold and sell property and may sue and be sued in such name.
- The common seal of the Pradeshiya Sabha shall remain in the custody of the Secretary of such Sabha, and shall not be affixed to any contract or other instrument on behalf of the Pradeshiya Sabha, except in the presence of the Chairman and the, Secretary of such Sabha, who shall sign their names to such contract or other instrument in token of their presence.
- No act or proceeding of a Pradeshiya Sabha constituted by an Order under subsection (1) shall be deemed to be invalid by reason only of the existence of a vacancy among its members or any defect in the election of a member thereof.

The Pradeshiya Sabha constituted for each Pradeshiya Sabha area shall be the local authority within such area and be charged with the regulation, control and administration of all matters relating to public health, public utility services and public thoroughfares and generally with the protection and promotion of the comfort, convenience and welfare of the people and all amenities within such area.

Powers of Pradeshiya Sabhas to be vested in the majority

All matters or questions authorized by this Act or by any other written law to be decided by a Pradeshiya Sabha shall be decided upon by the majority of members present at any meeting of the Pradeshiya Sabha held in accordance with the provisions of this Act,

Where the votes of the members present at any meeting are equally divided in regard to any question, the Chairman, Vice-Chairman or other member presiding at the meeting shall, in addition to his vote as a member, have a casting vote.

Powers of the Pradeshiya Sabha

Local authorities don't derive their powers from an individual source but from numerous Acts and Ordinances. The main Acts relating to local government are the Municipal Council Ordinance No. 29 of 1947, the Urban Councils Ordinance No. 61 of 1939 and the Pradeshiya Sabha Act No. 15 of 1987. As a consequence the three different types of local authorities have slightly different powers. Municipal Councils have more powers than Urban Councils and Divisional Councils.

Local authorities have the power to instigate legal action, enter into contracts, acquire land and employ staff. However, these powers are somewhat curtailed by the fact that they are subordinate to the Central Government and Provincial Councils and by the fact that other state institutions (such as the District Secretary) enjoy similar powers as the local authority.

For the purpose of the performance of its duties under this Act, a Pradeshiya Sabha (without prejudice to any other powers specially conferred upon it) shall, subject to the other provisions of this Act and to any rules made thereunder and the Local Government Service Law, No. 16 of 1974, have the following powers:

To create all such posts or offices as it may deem necessary and to assign to any such post or office, such salary, allowance or remuneration as the Pradeshiya Sabha may deem fit, subject however, to the prior approval in writing of the Commissioner regarding such creation and assignment of salary; to make appointments to any post or office in the service of the Pradeshiya Sabhas; to remove any officer or servant of the Pradeshiya Sabha ; to enter into any agreement with any other Pradeshiya Sabha or other local authority for the joint execution of any work or for the employment and remuneration of any officer or servant, of such Pradeshiya Sabha ; to purchase or take on lease any land or building; to sell or exchange with the prior approval in writing of the Minister, any land or building belonging to the Pradeshiya Sabha or vested in it otherwise than by virtue of section 16 and subject to the terms and conditions of the instrument by which such land or building was transferred to the Pradeshiya Sabha ;) to let or lease with the prior approval in writing of the Minister, any land or building vested in the Pradeshiya Sabha by virtue of section 16 or section 18 and not required for a public purpose and subject to the terms and conditions of the instrument by which such land or building was transferred to or vested in the Pradeshiya Sabha.

Obstruction of discharge of rain water and drainage

Whenever a Pradeshiya Sabha has by a resolution determined that any natural watercourse, channel, late, swamp or any part thereof into which rain water or drainage has thereto discharged, shall remain open for the reception of such rain water or discharged, any person who, after receiving a written notice of the resolution from the Pradeshiya Sabha. Fills up or permits to remain filled up any such water course, channel. lake or swamp in such a manner as to obstruct or interfere with the free flow of such rainwater or drainage, shall be guilty of an offence and shall be liable on conviction to a fine not exceeding five hundred rupees; Provided that

(a) such natural watercourse, channel, lake or swamp may be need up if the owner thereof first provides such other channel or drain, as may be in the opinion of the Chairman, be sufficient and suitable for the reception and conveyance of such water or drainage; and

(b) The Pradeshiya Sabha may contribute in part or in whole to the cost of providing such other channel or drain.

General control of the drains

(1) Every private drain within the limits of any Pradeshiya Sabha shall be under the survey and control of the Pradeshiya Sabha of that area, and shall be constructed, altered, repaired, or kept in proper order as the Pradeshiya Sabha may require, at the cost and charges of the owners of the land or building to which such drain belongs or for the use of which it is constructed.

(2) If the owner of any land or building to which any such drain belongs neglects during eight days after the service of a written notice in that behalf by the Pradeshiya Sabha, to alter, repair, or put the drain in good order in such manner as may be specified in the notice, the Pradeshiya Sabha may cause such drain to be altered. Repaired or put in good order in the manner required and the

expenses incurred therein by the Pradeshiya Sabha shall he paid by the owner and shall be recoverable as hereinafter provided.

Regular interagency coordination meetings and regular consultation of stake holders through implementation commetees is a very important to the success of the new system. At field level the officials representing the stakeholder agencies could meet and discuss the issues faced by each party. In this regard the local authorities could play a major role. The council could facilitate the coordination role among the different stake holders to influence them for positive participation for the meetings at council auditoriums. Unlike the present system, under the new road maintenance system RDA could involve most of the stakeholder organizations in deeper sense so that each of these agencies will feel the ownership for the drainage systems within their areas. Also they could share the knowledge and experience having by each of the stakeholder organizations to find more sustainable and economical solutions for the issues faced by the residents.

URBAN COUNCILS ORDINANCE (Attachment -3)

Areas for which urban councils are constituted :

2. Power to declare towns and to define their administrative limits.
3. Urban council to be constituted for each town.
4. Functions of urban councils.
5. Composition of urban councils.

Alteration of limits of towns and number of members

Part ii

Status, powers and duties of urban councils

31. Urban council to be corporation.

General powers and duties

32. Lands vested in urban council.
33. Method of vesting, administration of such lands.
34. Other property vested in the Council.
34A. Control and erection of monuments.
34B. Naming of Public Parks.
35. General duties.
36. General Powers.
36A. Powers of the Minister in respect of commercial and industrial enterprises.
37. Power to authorize surveys.
38. Contracts.
39. Consent of Council.
41. Acquisition of lands or buildings for general public purposes.
42. Compulsory acquisition of lands and buildings.
43. Power of Urban Council to act as trustee for any public purpose.

PART III

POWERS AND DUTIES AS TO THOROUGHFARES

44. Urban Council to be the general authority for thoroughfares and communications.
45. General powers of Council with regard to thoroughfares and open spaces.
46. Thoroughfares vested in Urban Council.
47. Prescription.
48. Language of notices and how served.

49. Control of roads and paths in charge of minor local authority.
50. Power of Urban Council to construct new, and improve existing thoroughfares.
51. Acquisition of lands required for diversions or enlargements.
52. Gifts of land required for diversion or enlargement of thoroughfares.
53. Power to dispose off discontinued street.
54. Power to take land adjoining new street for building diverting, widening, opening or enlarging purposes.
55. Other powers of an Urban Council.
55A. Naming of streets.
56. Roads for benefit of individual property owners.
57. Power to construct and maintain tramways.
58. Agreement with promoters for construction of tram ways.
59. Public vehicular communications.
60. Houses in a ruinous and dangerous state.
61. Failure to comply with notice.
62. Sale of materials of ruinous houses.

MAINTENANCE AND REPAIR OF THOROUGHFARES

63. Proper officers empowered to enter upon land for repair of thoroughfare.
64. Power to take materials.
65. Power to erect buildings and keep cattle.
66. Power to throw rubbish upon adjacent lands.
67. Power to make temporary road.
68. Power to cut trees.
69. Power to put up fences.
70. Power to make and keep open ditches and to lay trunks.
71. Power to lay stones.

BUILDING ALONG THOROUGHFARES

72. Notice of intended building along a thoroughfare.
73. Erection of temporary fences and enclosures.
74. Building limits along roads.
75. Power of Minister to modify building limit.
76. Condition to be attached to all licences under section 74.
77. Power of Urban Council to deal with building, boundary wall or gateway erected or re-erected in contravention of Ordinance.
78. Principles of assessing compensation in respect of land developed by building.
79. Power of Urban Council to acquire adjacent land for owner of land within building limit.

OBSTRUCTIONS TO THOROUGHFARES

80. Power to demand production of title deeds.
81. Demand of production of deed to include power of examination.
82. Power to make survey of premises.
83. Proof of right to apparent encroachment to rest upon the owner.
84. Removal of obstructions or encroachments.

INJURIES TO THOROUGHFARES

85. Destroying milestone, bridge.
86. Using new road for certain time after making.
87. Owner or occupier bound to have bridge over drain leading to his house.
88. Allowing trees to grow in such a way as to injure thoroughfares.

220. No action to be instituted against Council until after one month's notice, nor after six months cause of action.
221. Protection of Council and its officers.
222. Relief against formalities.
POWERS AND RESPONSIBILITIES OF OFFICERS
223. Delegation of powers of Chairman to officers of Council.
224. Power of Council to grant general authorities to its officers.
225. Punishment for obstructing officers of Council.
226. Penalty for misuse of power by officers of Council.
227. Officers and servants of Council not to be interested in contracts.
228. Officers and servants of Urban Council to be public servants.
229. Repealed.
PART X
REPEAL, APPLICATION OF EXISTING LAWS, TRANSITIONAL ARRANGEMENTS AND MISCELLANEOUS PROVISIONS
230. Repeal.
231. Construction and application of existing laws.
232. No further roads to be constructed under Branch Roads Ordinance or Estate Roads Ordinance.
233. Adaptation of Branch Roads Ordinance and Estate Roads Ordinance.
234. On imposition of new taxation, contributions under Estate and Branch Roads Ordinances to cease.
235. Consequences of imposition of new tax in areas under operation of Village Councils Ordinance.
236. Urban Councils to be local authorities.
237. Saving for existing securities and discharge of debts.
238. Proclamations, orders, rules, notifications continued in force.
239. Saving for pending actions, contracts.
240. Officers and servants.
241. Adjustment of salaries.
242. Power of authorized Urban Council to apply retrospectively by-laws for the grant of pensions to dependents of deceased officers or servants.
243. Abolition of offices.
244. Rates and assessments.
245. Equitable adjustment of property, debts on transfer.
246. Omitted.
247. Adjustment of questions not provided for.
248. Power to exclude application of specified provisions of Ordinance within specified limits.
249. Interpretation.

Code of Criminal Procedure Act No. 15 of 1979 (Attachment 14)

Nuisances ordinance No. 61 of 1939 and No. 57 of 1946 (Attachment 15)

Annex 1

Storm water anagement Policies and Guide lines followed in Other Countries

Sustainable Urban Draiange systems 'SUDS for Roads' is now intended to further advance our knowledge of the interaction between roads and drainage within an urban context where roads are now multifunctional and must provide much more than sealed surfaces for wheeled vehicles.

SUDS (Sustainable Urban Drainage Systems) were introduced to the UK more than 10 years ago and much of the early work developed here in Scotland concentrated on the hydrology and water quality aspects of SUDS. Roads designers have been required to adapt to this new strategy without apparently having input to the processes. Equally, legislation has advanced significantly in the area of water management and, arguably, roads legislation has not kept up.

The design of roads now incorporates SUDS and together provides long term environmental and social factors. This recent growth and accrued benefits from the use of SUDS has been supported by the work of a range of public and private sector organisations, and facilitated by a series of documents. While many of these documents describe the suitable design of SUDS, few have provided appropriate advice and direction for practitioners involved in the design approval and adoption of SUDS within the road network boundary.

Early in 2008 the SUDS Scottish Working Party, guided by practitioners, took ownership of this connect and, from then on, a committed group of professionals, from a variety of industry stakeholders have worked collaboratively to resolve this issue.

This document, commissioned and guided by SCOTS and SUDS Working Party, and authored by WSP, is the result of careful partnership working between a range of public and private sector organisations including the Scottish Government, Scottish Water, Scottish Enterprise, Homes for Scotland, University of Abertay Dundee and Transport Scotland.

The document is supported by robust research, and evidence gathering, and provides a guide for all professionals involved in the road design process. It is anticipated the primary readership of SUDS for Roads will be Local Authorities and Private Developers however the principles contained herein apply equally to designers in other disciplines such as Architecture and Landscaping.

The purpose of the document is to guide the reader through the design of roads incorporating SUDS that are suitable as best practice at reasonable cost. The Sustainable Urban Drainage Scottish Working Party believe, "SUDS can be incorporated into every new development in Scotland if all those involved in the decisions about drainage work together

Structure of the Guidance Manual

The following descriptions identify where key information is located within the guidance document:

Chapter 1 Introduction describes the traditional and historical context of road drainage design. It describes the responsibilities of the roads drainage adopting authorities and provides an over view of concepts of SUDS and its relationship with road pavement construction. It also looks at surface water management plans and their importance in providing an integrated regional drainage strategy.

Chapter 2 SUDS Applications for Roads deals with details of road hierarchy and site classification and will set out the hydrological criteria requiring consideration in the design process, the principles of water quality enhancement by utilising SUDS for roads drainage, and the environmental risk addressed by applying these principles. It will

introduce the types and applicability of SUDS features for roads at pre-treatment, source control and site control and will outline the framework enabling design and detailing of these features taking into account of structural integrity of the road, hydraulic considerations, water quality, amenity and ecological performance objectives associated with various road types. A selection matrix and flow chart for the selection of SUDS for various roads applications is described within this chapter.

Chapter 3 Practical Guidance for Construction, Operation and Maintenance of Road SUDS will outline practical guidance for particular SUDS features for use in roads taking cognisance of particular issues associated with construction detailing and installation/ construction guidelines. It will also provide an overview on the maintenance of completed SUDS, why and when they need to be maintained and by who.

Chapter 4 Procedure for Adoption sets out the current position, relevant at the time of writing, with respect to legislation and statutory obligations, ownership and maintenance responsibilities. It will outline the adoption process from the land use planning system to Road Construction Consent, adoption agreements and maintenance responsibilities.

The importance of Building Control related issues will also be considered:

Chapter 5 Un-adopted SUDS and Retrofitting summarises the retrofitting options available for existing un-adopted SUDS, their applicability and technical feasibility to a required standard where they can be adopted. It will also consider the introduction of SUDS to roads where they have been previously drained solely by conventional piped drainage techniques.

Chapter 6 Factors affecting Cost presents the initial and long-term costs that are likely to be required to support the SUDS from 'cradle to grave'. It will present a framework for whole life costing of the SUDS features including an assessment of the environmental costs and benefits.

Legislation and statutory Obligations

Review of existing and potential future Legislation

Roads

Roads (Scotland) Act 1984

4.1.1 Road construction is controlled by a process of construction consent as described in Section 21 of the Roads (Scotland) Act 1984. Procedures for application for Road Construction Consent (RCC) are generally described in guidance prepared by each local authority. The RCC application is made by persons other than the roads authority who wish to construct a road that will become adopted by the roads authority

4.1.2 The purpose of RCC is to ensure the road is constructed in accordance with the roads authority development guidelines and to protect the future maintenance liabilities of roads authorities. For residential development, a roads authority is protected against non-completion by the requirement for the developer to post a Road Bond, either in a cash sum or a security by an

acceptable institution, for an amount sufficient to meet the construction cost of the road(s) outlined in the consent. The value of the Bond is determined by the roads authority, and must be deposited with the roads authority prior to commencement of house building.

4.1.3 All roads that are constructed to an RCC are private roads with public right of passage. Adoption can only take place when the developer offers the road for adoption and when the roads authority agree that all necessary remedial works have been carried out to the roads authority satisfaction.

4.1.4 Road Construction Consent is separate from Planning Permission and most developments, where a road is to be constructed, will require both.

4.1.5 The local authority may require confirmation for ongoing maintenance of SUDS features associated with new roads. It may be possible to combine roads SUDS with general SUDS for the development (roof water, hard standings, etc) where these are provided*. All SUDS that drain potentially publicly adopted roads should be maintained by the Roads Authority or Scottish Water, once adopted or vested by that body.

Planning

4.1.6 The application of SUDS techniques is a condition of planning.

Town & Country Planning (Scotland) Act 1997

4.1.7 The Town and Country Planning Act 1997 sets the planning context for new development and redevelopment of existing properties/ facilities.

4.1.8 This Act is the basis for the planning system and sets out the roles of the Scottish Ministers and local authorities with regard to development plans, development control and enforcement. The Planning etc. (Scotland) Act 2006 was an amending act and the 1997 act, although substantially amended, remains the principal piece of

planning legislation.'[1]

Planning etc (Scotland) Act 2006

4.1.9 The Planning etc (Scotland) Act 2006 seeks to modernise the planning process in Scotland. This Act replaces and amends sections of the 1997 Act.

4.1.10 The 2006 Act emphasises the responsibility of ministers and local authorities to contribute to sustainable development.

4.1.11 A 'Brief Guide' to the 2006 Act is available from the Scottish Government website www.scotland.gov.uk/Publications/2007/03/07131521/0

PAN 61: Planning and Sustainable Urban Drainage Systems

4.1.12 PAN 61: Planning and Sustainable Urban Drainage Systems was published in

July 2001.

4.1.13 'Sustainable development implies taking a multidisciplinary approach to address the many diverse and complex issues in the development process. One of these issues is surface water

drainage. To provide Sustainable Urban Drainage Systems (SUDS) requires a number of disciplines and agencies (developers, planners, drainage engineers, architects, landscape architects, ecologists and hydrologists) to work in partnership. Planners have a central co-ordinating role in getting SUDS accepted as an integral part of the development process. Planning policy should set the framework in structure and local plans and in masterplanning exercises. In implementing SUDS on the ground, planners have a key role through the development control process, from pre-application discussions through to decisions, in bringing together the parties and guiding them to solutions which can make a significant contribution to sustainable development.' (Para 1 from Introduction)

PAN 79: Water and Drainage

4.1.14 PAN 79: Water and Drainage was published in September 2006.

4.1.15 'The purpose of this Planning Advice Note (PAN) is to provide advice on good practice in relation to the provision of water and drainage in a planning context. It encourages joint working in order to ensure a common understanding of any capacity constraints and agreement on the means of their removal. The PAN

explains the framework within which Scottish Water provides and contributes to new water infrastructure and contains advice on the appropriateness of private schemes. It clarifies the role of the planning authority in setting the direction of development to inform the planning and delivery of new infrastructure in a coordinated way. It also highlights the respective roles of Scottish Water and the Scottish Environment Protection Agency (SEPA), indicating when and how they should interact with the planning system.' (Para 3 from Introduction)

4.1.16 Paragraphs 47-49 deal specifically with SUDS.

Building (Scotland) Regulations 2004

4.1.17 Where SUDS features lie within private land and serve only one property (or a number of buildings under single ownership) then they will generally remain in private ownership. In this case responsibility for maintenance, etc. lies with the owner. In these circumstances they will generally have to comply with the requirements of the Building (Scotland) Regulations 2004.

4.1.18 The 'Environment' sections of both the 2007 Domestic and Non-domestic Handbooks (section 3) give requirements for building drainage. Section 3.6 deals with surface water drainage and paragraph 3.6.4 deals specifically with SUDS.

4.1.19 Note: Paragraph 3.6.5a states: '… trial holes and finished soakaways should be a minimum of 5m from the dwelling and the boundary.' Some slight relaxation of this figure may be possible on small sites with appropriate ground conditions. This 5m rule does not necessarily preclude the use of permeable paving within 5m as long as the

sub-base is isolated from the foundations of a building – see worked examples 1 and 2.

Flood Risk Management (Scotland) Act 2009

4.1.20 The Flood Risk Management (Scotland) Act 2009 makes provision in relation to the following areas: coordination and cooperation within the domain of flood risk management; assessment of flood risk and preparation of flood risk maps and flood risk management plans; amendments to local authority and SEPA functions for flood risk management; a revised statutory process for flood

protection schemes, and amendments to the enforcement regime for the safe operation of reservoirs.

Water

Sewerage Scotland Act 1968

4.1.21 This Act established the duties on local authorities for the provision, construction, adoption and maintenance of sewers and sewerage systems. It defined the rights of owners to connect and the methods of control of discharges to the sewer system. In 1975 the new Regional and Islands Council's took over this responsibility from the local authorities. Following the disbandment of the Regional Councils in 1995, three larger Water Authorities (East, West and North) were established. At each of these changes, the new authority undertook the duties defined in the 1968 Act.

Water Environment and Water Services (Scotland) (WEWS) Act 2003

4.1.22 The WEWS Act transposes the Water framework Directive (Directive

2000/60/EC) into Scots Law.

4.1.23 This Act requires the control of:

Point source discharges and diffuse sources liable to cause pollution
The abstraction of water from the water environment
The impoundment of surface water
Alterations to the structure and condition of surface water habitats
Artificial recharge or augmentation of groundwater

4.1.24 Sections 29, 30 and 33 of the WEWS Act amend the Sewerage Scotland Act

1968 and the Water Industry (Scotland) Act 2002 to include for the connection and adoption of SUDS by Scottish Water.

Sewers for Scotland 2nd Edition

4.1.25 Sewers for Scotland 2nd Edition specifies Scottish Water's requirements for adoptable sewerage systems. Section 2B of this document describes SW's requirements for SUDS systems.

Environment

Environment Act 1995

4.1.26 Schedule 6 of the Environment Act 1995 establishes the status and constitution of SEPA. Further sections of the Act establish SEPA's role and responsibilities.

4.1.27 Since its creation SEPA has also been granted powers under other legislation, e.g. WEWS Act 2003.

4.1.28 Best Practice Management for Surface Water was first introduced in Scotland in the mid 1990's by the then Forth River Purification Board. Since this time the emphasis of SUDS in Scotland has been on improving water quality, unlike England & Wales where the emphasis has been on attenuation.

4.1.29 Since its inception in 1995 SEPA has worked to promote these measures, further developing SUDS ethos and practice.

Water Environment (Controlled Activities)(Scotland) Regulations 2005

4.1.30 The Controlled Activities Regulations (CAR) (made under powers granted by Section 20 of the WEWS Act) supersede SEPA's policy 15 which previously stated the requirement for SUDS and those circumstances where discharge consent was required.

4.1.31 The CAR identifies those situations where SUDS are necessary and where specific licensing is required to permit work close to or within the water environment. Guidance on the application of CAR can be found in SEPA's document 'A Practical Guide' (at version 5 dated June 2008 at time of writing). This document may be downloaded from the SEPA website using the following link: http://www.sepa.org.uk/water/water_regulation/car_application_forms.aspx

ENGLAND AND WALES

Roads

4.1.32 In England and Wales adoptable road construction is controlled by agreement in accordance with Section 278 of the Highways Act 1980.

4.1.33 Private roads are much more common in England and Wales than in Scotland. Usually these are the responsibility of the adjacent land owner. Often they are managed by a co-operative of owners/ residents.

4.1.34 The design, adoption and maintenance of SUDS for trunk roads fall under the responsibility of the appropriate trunk road authority.

Highways Agency

4.1.35 The Highways Agency is the Trunk Road Authority for England.

Wales

4.1.36 There are three Trunk Road Authorities covering North, Mid and South Wales respectively.

Planning

Town and Country Planning Act 1990

PPS25: Development and Flooding

Water

Water Bill 1973

4.1.37 Created 10 Regional Water Authorities

Water Act 1989

4.1.38 Allowed English and Welsh local authorities to sell off their water companies.

Water Industry Act 1991

4.1.39 Deals with the appointment and regulation of water undertakers, the duties of water companies with regard to water supply and sewerage services, financial provisions, powers and provision of information.

Water Companies

4.1.40 There are currently 10 water and sewerage companies operating in England and Wales. There are a further 14 companies who deliver water services only.

4.1.41 Information on these companies can be obtained from www.water.org.uk.

Flood and Water Management Act 2010

4.1.42 There will be national strategies and guidance on managing flood risk in England and Wales. Unitary and county councils will bring together the relevant bodies, who will have a duty to cooperate, to develop local strategies for managing local flood risk.

4.1.43 The Environment Agency, local authorities and internal drainage boards will be able to ensure that private assets which help manage the risks of floods cannot be altered without consent. For example, putting a gate in a wall that is helping protect an area could increase the risk of flooding.

4.1.44 Drainage systems for all new developments will need to be in line with new National Standards to help manage and reduce the flow of surface water into the sewerage system.

Environment

4.1.45 Environment Agency is an Executive Non Departmental Public Body responsible to the Secretary of State for Environment, Food and Rural Affairs and an Assembly Sponsored Public Body responsible to the National Assembly for Wales.

4.1.46 EA policy is to 'promote SUDS as a technique to manage surface and groundwater regimes sustainably.'

4.1.47 Discharges to rivers, watercourses, other surfacewaters, groundwater, tidal waters or the sea may require discharge consent in accordance with Water Resources Act 1991 and Groundwater Regulations 1998.

NORTHERN IRELAND

Roads

4.1.48 Roads Service is responsible for almost all roads in Northern Ireland.

4.1.49 Roads Service is an executive agency within the Department for Regional Development (DRD). Its responsibilities include: taking measures to implement the Regional Transportation Strategy for Northern Ireland 2002-2012; and managing, maintaining and developing the public road network (including its drainage systems).

4.1.50 Roads Service has experience of the design and operation of SUDS on a number of major new schemes that have had a measure of success in dealing with drainage issues.

4.1.51 The proposed strategy confirms that Roads Service will continue to implement

SUDS to control runoff from new and significant highways.

4.1.52 Roads (Northern Ireland) Order 1993 (NI 15)

Planning

4.1.53 Planning Service is an agency of the Department of Environment (DOE). It is responsible for regulation of development and land-use. It also sets and monitors planning policy.

PPS 15 Planning and Flood Risk

4.1.54 Appendix C of PPS 15 Planning and Flood Risk describes SUDS measures, recognises their potential benefits, discusses constraints and refers to the SUDS Working Party (see below), but makes few definitive recommendations.

Water

4.1.55 Northern Ireland Water was formed on 1 April 2007 to manage the water resource and provide sewerage for Northern Ireland.

Water and Sewerage Services (Northern Ireland) Order 2006 (N.I.21)

4.1.56 This Order establishes the structure and responsibility for the provision of water and sewerage services within Northern Ireland.

Environment

4.1.57 Northern Ireland Environment Agency (NIEA) is an agency of the Department

of Environment. It advises on and implements environmental policy and strategy. It also regulates discharges to watercourses.

4.1.58 Rivers Agency is an agency of the Department of Agriculture and Rural Development. It is the statutory drainage and flood defence authority for Northern Ireland. It too regulates discharges to watercourses. It designs, constructs and maintains flood defences. It provides drainage infrastructure.

Northern Ireland Sustainable Drainage Systems Working Party

4.1.59 The Northern Ireland Sustainable Drainage Systems Working Party has been developing a strategy for promoting the wider use of SUDS techniques in Northern Ireland.

4.1.60 This working party is chaired by Northern Ireland Environment Agency and including representatives of Northern Ireland Water Ltd (NIW), DRD Roads Service, DOE Planning Service, Department of Agriculture and Rural Development (DARD) Rivers Agency, Northern Ireland Housing Executive (NIHE), DOE Planning and Environmental Policy Group (PEPG), Department of Finance and Personnel DFP Central Procurement Directorate, the Agri-Food & Biosciences Institute (AFBI) and Belfast City Council.

Abstracted from: "The Sustainable Urban Drainage Scottish Working Party"

Australian Guildellnes for Urban Stormwater Management

INTRODUCTION

1.1 Urban storrnwater

Urban stormwater is runoff from urban areas, including the major flows during and following rain as well as dry weather flows. Dry weather drainage flows generally originate from groundwater, garden watering, washdown, leaking water pipes, and illegal discharges. In most systems, overflows from sewerage systems or septic tanks may also become part of stormwater flows during wet and dry weather. Management of sullage in small towns can also present a problem, as some properties have inadequate provision for on-site treatment and discharge directly to stormwater In many Australian cities stormwater runoff is seen as a nuisance to be disposed of as quickly as possible. Urban drainage systems have often been developed to minimise the risk of flooding, without due consideration of other important values such as resource conservation, environmental quality, public safety, and amenity.

It is now clear that a new approach to stormwater management is needed - an approach that addresses issues of stormwater quality and aquatic ecosystem health, as well as stormwater quantity. We need an approach that recognises the environmental impacts of urbanisation, the linkages between land and water management, and the importance of community values and involvement.

Urban stormwater presents a management challenge in terms of quantity (flood and drainage management, stormwater reuse), quality (litter, nutrients, chemicals, sediments) and aquatic ecosystem health (aquatic habitats, riparian vegetation, stream stability and environmental flows).

1.2 Purpose of these guidelines

These guidelines aim to provide a nationally consistent approach for managing urban stormwater in an ecologically sustainable manner. The approaches outlined in this document represent current best practice in stormwater planning and management in Australia. In particular, these guidelines will help managers to identify objectives for stormwater management (including protecting social, environmental and economic values) and to integrate management activities at the catchment, waterway, and local development level.

The tools and approaches in these Guidelines will assist managers to undertake integrated storm water management planning in accordance with the values and conditions of the local environment, while integrating these activities into the catchment context.

The Guidelines also outline:

- why we need to manage our stormwater;
- what are the challenges;
- how to involve the community;
- The management tools available; and preparing, implementing and monitoring Stormwater Management Plans.

It is important to recognise that different jurisdictions may have different legislative and resource management requirements relating to storm water management. Many State, local and regional governments have developed comprehensive technical guidelines on specific stormwater management techniques and practices, many of which are referred to in these guidelines.

Managers should approach their relevant state, territory or regional agency for information on any specific requirements than need to be met, or technical information that may assist in their stormwater planning and management activities.

1.3 Impacts of urbanisation

With progressive changes in the Australian landscape from forest or other indigenous vegetation to rural or urban environments, the natural movement of water has changed dramatically. The growth of urbanisation has led to a substitution of vegetated ground with land covered by large impervious surfaces such as roofing and paving. Topography has also radically changed through land levelling and grading, and natural watercourses have been replaced with gutters, pipes and channels.

It is difficult to make generalisations about what impacts urbanisation will have on aquatic ecosystem health. Generally, reduced water quality and a lower diversity of aquatic flora and fauna can be expected. The composition of ecological communities may also be altered, or the relative abundance of species tolerant to the altered conditions may increase. Left unmanaged, these impacts may not only be detrimental to the environmental values of urban waterways, but may also pose a risk to public health and restrict potential opportunities for the community to benefit from the waterway.

A detailed discussion of the impacts of urbanisation on the stormwater environment is provided in below, These include changes in:

- catchment hydrology - increased frequency and intensity of runoff and flooding events, higher runoff volumes and peak flows, more rapid peaking of storm flows, and reduced base flows in watercourses.
- water quality - elevated levels of suspended solids, nutrients, micro-organisms, heavy metals and organic materials.
- waterway channels - channel form may be changed by increased erosive force of flows, removal of riparian vegetation, and sedimentation.
- riparian vegetation - removal of riparian vegetation and replacement with exotic species can lead to, for example, higher water temperatures, loss of aquatic and terrestrial habitats, and decreased bank stability.
- aquatic habitats - aquatic habitats may be lost through changes in the bed material and bed shape of waterways, removal of in-stream objects such as snags and aquatic plants, and drainage of wetlands and floodplains.
- watercourse barriers and constrictions - structures such as bridges and culverts may alter flow patterns, fauna movement, and sediment transport patterns.

The magnitude and nature of these impacts will be specific to individual catchments. They may also be influenced by other factors such as pre-development land uses.

From a management perspective, there are two key points that should be noted:

actions should be tailored to the catchment - generic solutions are not appropriate; and

Changes to runoff patterns should be minimised. This reduces a range of other environmental impacts.

2 STORMWATER MANAGEMENT FRAMEWORK

What do we want to achieve in Stormwater Management?

There is no single objective that is appropriate for the management of all urban stormwater systems. A multiple objective approach should be adopted, considering objectives such as:

- ecosystem health, both aquatic and terrestrial;
- flooding and drainage control;
- public health and safety;
- economic considerations;
- recreational opportunities; social considerations; and aesthetic values.
- These objectives often need to be addressed in two contexts:
- restoring existing stormwater systems; and
- minimising the impacts of stormwater from new developments.

In established urban areas, the first context will be the most common. There will, however, be the need to appropriately manage the impacts of redevelopment projects and seek opportunities for restoration and upgrading. In urban growth areas, the second context will be dominant. This is an important responsibility for stormwater managers in these areas. It is generally more economical and effective to minimise the impacts of new developments than it is to mitigate these impacts from completed developments.

The applicability of many storm water management techniques will depend on whether restoration, rehabilitation and/or prevention are the goals. In many existing areas, constraints such as existing properties, heritage classified waterways and bridges may prevent management objectives from being fully realised.

2.2 Integrated Catchment Management

Integrated Catchment Management (ICM) or Total Catchment Management (TCM) recognises the catchment-wide relationships between resource use and management. It also addresses the need for community involvement in identifying issues and management solutions. It has been adopted in a number of States and Territories and embraces:
holistic approach to natural resource management within catchments, marine environments and aquifers, with linkages between water resources, vegetation, land use, and other natural resources recognized integration of social, economic and environmental issues;

co-ordination of all the agencies, levels of government and interest groups within the catchment; and community consultation and participation.

Integrated Catchment Management is increasingly becoming the 'umbrella' for sustainable resource management.

2.3 Ecologically Sustainable Development

Ecologically Sustainable Development (ESD) represents one of the greatest challenges facing Australia's governments, industry, business and community in the coming years. While there is no universally accepted definition of ESD, in 1990 the Commonwealth Government suggested the following definition for ESD in Australia:

using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased. '

Put more simply, ESD is development which aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations. To do this, we need to develop ways of using those environmental resources, which form the basis of our economy in a way which

maintains and, where possible, improves their range, variety and quality. At the same time we need
to utilise those resources to develop industry and generate employment.

The 1992 National Strategy for ESD identifies core objectives and guiding principles designed to achieve development that improves the total quality of life in a way that maintains the ecological processes on which life depends.

The principles of ESD are:

(a) The precautionary principle. Namely, that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

(b) Inter-generational equity. The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

(c) Conservation of biological diversity and ecological integrity. Conservation of biological diversity and ecological integrity should be a fundamental consideration,

(d) Improved valuation, pricing and incentive mechanisms. Environmental factors should be included in the valuation of assets and services.

The challenge in ESD is to develop and manage in an integrated way, the quality and quantity of surface and groundwater resources and to develop mechanisms for water resource management which maintain ecological systems while meeting economic, social and community needs.

2.4 Ecosystem Health Management

Stormwater management is currently undergoing a paradigm shift. The traditional focus on flood management is being broadened to address stormwater quality considerations. A further shift is emerging, where stormwater managers are addressing aquatic ecosystem or river health. This involves the management of all aspects of the water environment to achieve the best outcome for
the health of watercourses, lakes, estuaries and the marine environment. Streamflow, water quality, aquatic habitats and riparian vegetation are all considered when management decisions are made.

2.5 Water quality objectives

Ambient water quality objectives have been, or are in the process of being, established for waterways in many States, Territories and regions. These objectives can provide a goal for urban stormwater management. This is, however, complicated by:

water quality being affected by other pollution sources, such as point sources, agricultural runoff and sewer overflows; and

difficulties in establishing relationships between ambient water quality concentrations and wet weather stormwater discharges.

Guidelines for fresh and marine water quality have been prepared by ANZECC and ARMCANZ (ANZECC & ARMCANZ, 2000a) to provide governments and the community, particularly

catchment/water managers, regulators, industry and community groups. a sound set of tools for assessing and managing ambient water quality. Also several NWQMS Guidelines relating to sewerage systems and effluent management have been, or are in the process of being, developed .

2.6 River flow objectives (water for the environment)

Objectives for river or environmental flows are being developed in some States, Territories and regions. These objectives recognise that waterway health is influenced by the flow regime, which may be affected by landuse change and water extraction. River flow objectives can also provide a framework for urban stormwater management, although in many large catchments, urban areas may be only a small component of the catchment. The National Principles for the Provision of Water for Ecosystems (Sustainable Land and Water Resources Management Committee Subcommittee on Water Resources 1996) provides some guidance for river flow objectives.

2.7 Public health and safety

- Management objectives to minimise public health and safety risks can include:
- designing structural controls and waterways to minimise the risk of trapping people caught in waterways during floods;
- minimise the risk of injury to the public and maintenance staff from structural controls; and
- minimising public risks associated with vectors such as mosquitos from constructed wetlands.

2.8 Integrated Water Cycle Management

Traditionally, stormwater, water supply and sewage have been managed separately. There are, however, opportunities available to integrate these aspects of the water cycle in a way that improves environmental and community outcomes, sometimes at reduced cost. From a stormwater
perspective, the most common approach is stormwater reuse, generally for non-potable purposes. This reduces the demand on the potable water supply and reduces runoff volumes and flow rates. Schemes have also been developed that reuse both stormwater and treated effluent.

Contemporary approaches to stormwater management also include ensuring that water supply systems allow for environmental flows in streams below extraction points, the sustainable management of extractions for irrigation, and mimicking natural flow regimes in managed streams. These approaches recognise that stormwater management needs to identify both the environmental values of streams as well as the opportunities to utilise stormwater as it passes its way through the urban water cycle.

2.9 Urban stormwater as a resource

In the past, the main aim of urban stormwater management was collecting and removing excess runoff as quickly and cheaply as possible. This was to avoid flooding during major rains and to provide general amenity drainage. As growing urban communities approach or exceed the economically viable limits of water supplies, opportunities associated with use of local water sources such as urban stormwater and groundwater are being recognised. Better management of the water cycle at the residential block needs to be achieved to reduce demand for domestic irrigation. Where urban areas are located over or adjacent to groundwater aquifers, there is potential for stormwater to be used to recharge aquifers provided the water quality is protected. This requires very careful management as potential issues include rising water tables, salt problems and groundwater extraction rights.

The quality of urban open space has often been compromised by the loss of natural urban streams to restricted hard engineering drainage structures. This can be due to poor planning of the urban form as part of the original urban development and the requirement to ensure a certain flood immunity
and drainage standard. The loss of natural urban streams can adversely affect the amenity of surrounding areas, ecological health and water quality. In new developments it is essential that stormwater is recognised as a resource prior to allotment layouts being finalised.

Long term social, environmental and economic benefits can be achieved for open space drainage corridors through planning and design approaches which recognise urban stormwater and streams as valuable resources. Opportunities to retrofit pollution control devices and re-establish an
aesthetically appealing environment to degraded drainage corridors by habitat restoration should
also be investigated.

2.10 Community values and participation

Managing stormwater only for flood protection is no longer an adequate response to changing community values which now reflect concern for protecting the environment, ecologically sustainable development, and improved access to open space and recreational facilities.

Most urban dwellers enjoy a very high level of flood protection due to the works done in the past. These need maintenance and, at times, upgrading. Demand should now focus equally on improved environmental quality and recreational opportunities.

The NWQMS paper, Policies and Principles - A Reference Document (1994), seeks to respond to these community values by adopting the objective of 'achieving sustainable use of the nation's water resources by protecting and enhancing their quality while maintaining economic and social development'.

10 Community participation helps to:

- identify strategies which are responsive to community concerns;
- explore problems, issues, community values and alternative strategies openly;
- increase public ownership and acceptance of proposed solutions;

generate broader decision making perspectives not limited to past practices or interests; and reflect the community's life style values and priorities.

2.11 Economic Sustainability

A wide range of stormwater management practices is available. The capital and ongoing operations and maintenance costs of these practices are highly variable. It is important for stormwater managers to adopt solutions that are economically sustainable. This is particularly relevant when choosing structural water quality controls. The annual operating and maintenance costs of these devices may represent a large percentage of, or exceed, their initial capital cost. Management authorities may find this cost difficult to afford on an ongoing basis. This may then compromise the effecti veness of the device in meeting its treatment objectives.

Figure 2: Lead away close by shop owners

Figure 1: Lead away blocked downstream, heavy growth of weeds and siltation

Figure 4: completely blocked lead away due to very poor maintenance

Figure 3: Completly blocked due to utilities and siltation

Figure 6 : Many utility lines blocking the water way path (Culvert 33/2)

Figure 5:Main water line taken through the lead Away path (27/1)

Figure 8: Grocery shop built on the Lead away drain

Figure 7: Totally blocked lead away with weeds and silt

Figure 10: Neglected lead away drain

Figure 9 : Leadaway path is partially blocked

Figure 12: Completely blocked lead away

Figure 11: leadaway blocked by residents down stream

Figure 13: House constructed over the leadaway drain by completely closing the drain

Figure 14: Timber craft shop on top of the lead away drain

Figure 15 :Lead Away completely closed clay pot shop constructed on the waterway path

Figure 16 : Grocery shop on top of the leadaway path