５．テクニカルノート

Preparatory Survey on the Project for Improvement of Blantyre City Roads
in the Republic of Malawi

TECHNICAL NOTE

Blantyre City Assembly (BCA) and JICA preparatory Survey Team (JPST) discussed and confirmed the following. It is, however understood that the decision for the draft report will be made through the discussion with concerned parties during the analysis in Japan.

1. General

Basically Original Design of July 2007 will be referred except Item 3 to 10.
Design Standard/Criteria will be applied based on Local Standards, SATCC, AASHTO, Japanese Road Association (JRA) standards, etc.

2. Priority

1) Widening of existing road from 2-lane to 3-lane or 4-lane for the section-4.
2) Improvement of existing pavement structure
3) Installation of Pedestrian Walkway (With Inter Locking Block)
4) Installation of Bus Lay Bye (5 points for each lane)
5) Improvement of Drainage system along the roads
6) Improvement of 3 roundabouts intersections (Maselema, Yianakis, Illovo)
7) Installation/Improvement of Kerb Stones
8) Installation traffic Signs and Road markings
9) Installation of pedestrian crossings
10) Installation of Street Lights

3. Typical Cross Section

See attached figure.

1) Cross-section Slope will be improved from 2% to 3% for Section 4 & 5 based on Local standards.
2) Pavement type of Side walk will be revised to Inter Rocking Block.
3) Existing drainage will be utilized for section-3 basically.
4) Location of Drainage will be shifted from edge to shoulder for Section 5.

4. Bus Lay Bye

The Width has been revised from 2.925m to 3.67m~4.00m based on new Local Standards, but the length will be as in Phase I. Therefore this width will be applied to this project. But BCA accepted to reduce the width/length for both sides of Yianakis Bus Lay Bay with 1.0m width of pedestrian walkway because of limited space. The Bus lay Bye location at Right side of Chris and Company will be shifted from Chainage 53+20 to Chainage 57+80.

5. Street light

Street light will be installed to Roundabouts, Bus Lay Byes and Pedestrian Crossings. In terms of Road safety, JPST may propose to increase the number of street lights if approved.

6. Access Road

Approach length and Corner Radius for access Roads may be increased so far as side condition permit based on the Local Standards.

7. Signal/Hump

Existing Signals will be utilized. Therefore this project area has no installation of new signal.

Also No Hump will be applied for the project area.

8. Pavement Structure

Pavement structure will be analyzed and designed by JPST based on the results of Site Investigation, Data measured and collected, etc.

Design period will be 15 to 20 years.

9. Demolition/Relocation of Obstacles

BCA will relocate/demolish the obstacles (Fence, Utilities, Billboard, etc.) for widening at Section-4 by end of January, 2010.

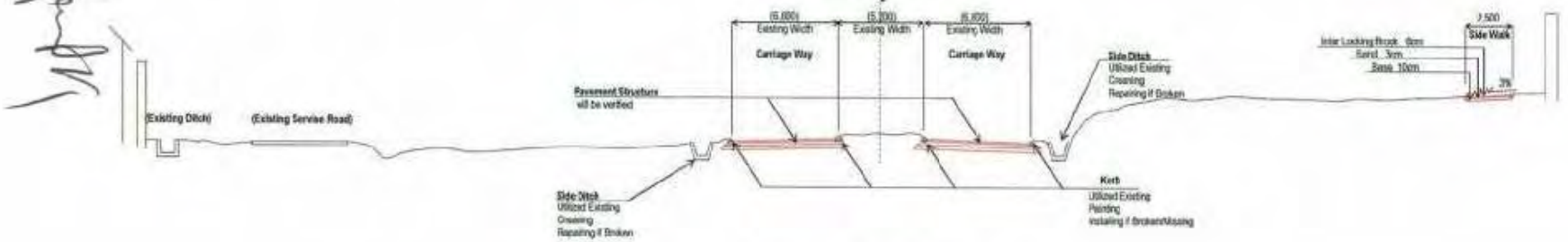
10. Roundabout

Maselema, Yianakis and Illovo will be improved based on original design of July 2007.

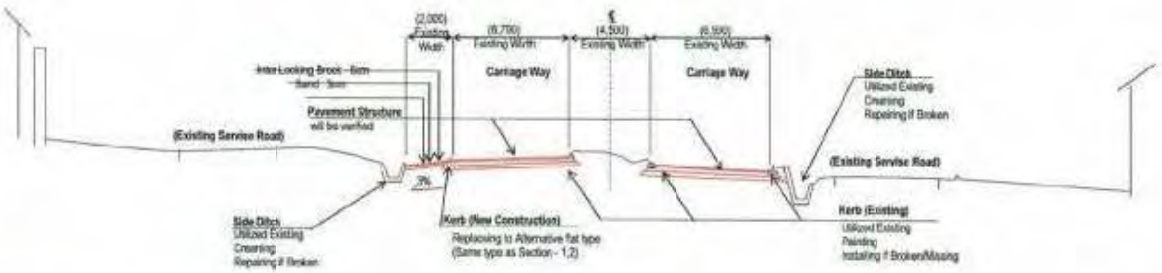
12 November 2009

Noted by	Noted by
Eng. Kenneth L. A. Kantwela	Mr. Tsuyoshi Yamazuku
Director of Engineering Services	Chief Consultant
Blantyre City Assembly	JICA Preparatory Survey Team

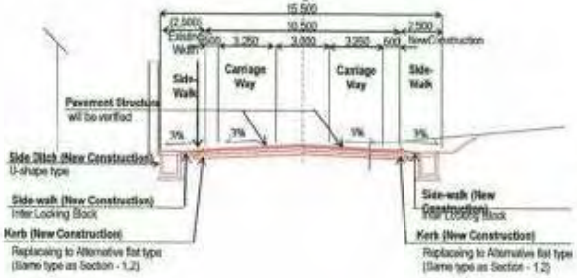
Chichiri RA to Maselema RA (Section - 3)
STA 35+00 ~ 51+00



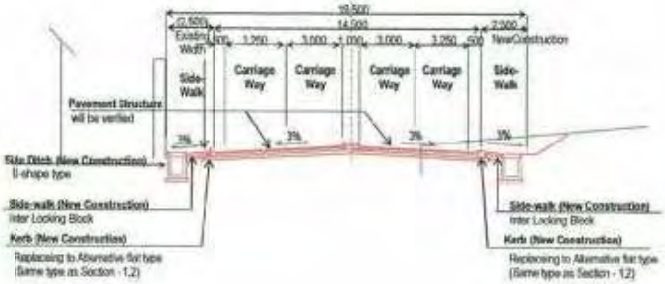
Maselema RA to Yianakis RA (Section - 3)
STA 51+00 ~ 61+00



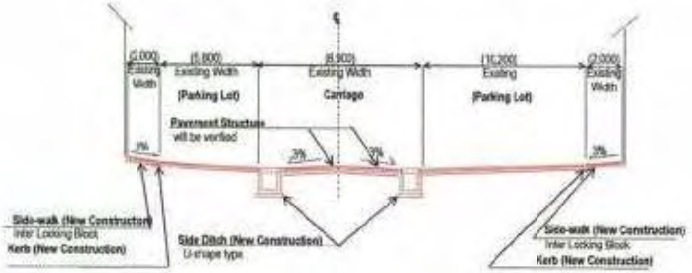
Yianakis RA to Standard Bank RA (Section - 4)
STA 61+00 ~ 69+00
(Widening to 3 lane)



Yianakis RA to Standard Bank RA (Section - 4)
STA 61+00 ~ 69+00
(Widening to 4 lane)



Standard Bank RA to Illovo RA (Section - 5)
STA 69+00 ~ 78+00



MALAWI GOVERNMENT

NCE No 28 EIA CERTIFICATE No. 28.5.1

ENVIRONMENT MANAGEMENT ACT
(No. 23 OF 1996)

CERTIFICATE OF APPROVAL OF A PROJECT

IN TERMS of section 26(3) of the Environment Management Act,

I, RAPHAEL PETER KABWAZA

Director of Environmental Affairs, hereby certify that

MASAUKO CHIPEMBERE HIGHWAY AND LIVINGSTONE ROAD PROJECT

Has been approved by the Minister under the Environment Management Act.

Dated this 9th day of May 2007

DIRECTOR OF ENVIRONMENTAL AFFAIRS

MALAWI GOVERNMENT

NCE No 28 EIA CERTIFICATE No. 28.5.1

ENVIRONMENT MANAGEMENT ACT
(No. 23 OF 1996)

NOTICE OF APPROVAL TO PROCEED WITH PROJECT

RE: BLANTYRE CITY ASSEMBLY,

PRIVATE BAG 67, BLANTYRE, MALAWI

WHEREAS the Minister has in terms of section 24 (1) of the Environment Management Act specified by notice published in the Gazette, that is, Government Notice No. 58 of 1997, types and sizes of projects which shall not be implemented unless an environmental impact assessment is carried out.

WHEREAS MASAUKO CHIPEMBERE HIGHWAY AND LIVINGSTONE ROAD PROJECT is, pursuant to said Government Notice, of a type and/or size requiring environmental impact assessment prior to implementation;

WHEREAS BLANTYRE CITY ASSEMBLY has conducted an environmental impact assessment of the project and has submitted to the Director of Environmental Affairs, in respect of such assessment, Environmental Impact Assessment Report; and

WHEREAS section 26 (1) (d) of the Environment Management Act provides that the Director of Environmental Affairs may recommend to the Minister approval of a project for which an environmental impact assessment has been carried out, subject to such conditions as of approval as he may deem appropriate.

NOW, THEREFORE TAKE NOTICE THAT MASAUKO CHIPEMBERE HIGHWAY AND LIVINGSTONE ROAD PROJECT

Has been approved to proceed subject to the terms and conditions overleaf.

Recommended: _____ 04-05-2007
Director of Environmental Affairs — Date

Concurred: _____ 11-05-2007
Chair, National Council for the Environment — Date

Approved: _____ 09-05-07
Minister Responsible for Environmental Affairs — Date

Attachments (where appropriate)

This certificate is issued on condition that **BLANTYRE CITY ASSEMBLY** shall:

a) Report regularly on the mitigation measures outlined in EIA report.

B) Fully implement the Environmental Management Plan (EMP) and recommendations in the approved EIA report.

Telephone: 01 771 111
Telefax No.: 01 773 379
Our Reference No.: EAD/99/07/05
Your Reference No.....

Communications should be addressed to:
The Director of Environmental Affairs

ENVIRONMENTAL AFFAIRS DEPARTMENT
LINGADZI HOUSE
CITY CENTRE
PRIVATE BAG 394
LILONGWE 3
MALAWI

7th May 2007

The Chief Executive
Blantyre City Assembly
P/Bag 67
Blantyre

Dear Sir,

REVIEW OF ENVIRONMENTAL IMPACT ASSESSMENT (EIA) REPORT FOR MASAUKO CHIPEMBERE HIGHWAY AND LIVINGSTONE ROAD IMPROVEMENT PROJECT

Following the meeting of the National Council for the Environment (NCE) held on 4th May 2007, we are pleased to inform you that your EIA Report for the above-captioned project was approved on condition that you will comply with mitigation measures outlined in the Environmental Management Plan (EMP).

An EIA Certificate is being prepared and you will be informed when it is ready. Meanwhile please find attached an invoice of MK3, 000,000 being payment for EIA fees.

The certificate can only be issued upon payment of the said fees. Please note that it is illegal to start implementing a prescribed project without an EIA certificate.

We look forward to your continued cooperation.

Yours faithfully,

Dr. A.M. Kamperewera
For :DIRECTOR OF ENVIRONMENTAL AFFAIRS

cc : Secretary for Energy, Mines and Natural Resource, P/Bag 350, Lilongwe 3

: The Chairman, National Council for the Environment

The City Assembly of Blantyre

All correspondences to be addressed to:

THE CHIEF EXECUTIVE
TELEPHONE No. 670 211
TEL. ADDRESS "CITY"
TELEX No. 44536
FAX No. 265 670 417

EAA/36/1

THE SECRETARIAT
TOWN HALL
CIVIC CENTRE
PRIVATE BAG 67
BLANTYRE
MALAWI

29th January 2006

The Programme Officer
Japanese International Cooperation Agency (JICA)
PO BOX 30321
Capital City
Lilongwe 3

Fax: 01 771 125

Attention: Mr. G. Kapalamula

Dear Sir,

STAKEHOLDERS MEETINGS AND ACCEPTANCE FOR BLANTYRE CITY ROADS IMPROVEMENT PROJECT

Please refer to my letter dated 17th January 2007 of even reference. I wish to report that we had sensitization meetings with stakeholders for acceptance of the projects as follows:-

ITEM	DATE (S)	TIME	STAKEHOLDERS
1	22-01-2007	2:30 pm – 4:30 pm	**Media** • Radios • Television • Print Media
2	23-01-2007	10:00 am – 12 noon	**Public Institutions** • Hospital (s) • Churches • Education • Institutions

3	23-01-2007	2:30 pm – 4:30 pm	**People living along the Main Road** • Business • Residents
4	24-01-2007	10:00 am – 12:00 noon	**Opinion Leaders** • Members of Parliament • Chiefs • Community Development Committees
5	24-01-2007	10:00 am – 12:00 noon	**Public Utility Services** • Electricity • Water • Communication • Sewer
6.	25-01-2007	10:00 am – 12:00 noon	**Road Users** • Minibus Owners Association of Malawi • Truck Companies • Road Safety Council • Traffic Police • Ministry of Transport & Public Works • Consumer Association of Malawi

These meetings proved to be very useful and there were a lot of interest, comments and questions generated from the meetings. The meetings attracted a cross section of very important decision makers from each one of the stakeholders group (s). There was a good cover on Television and many radio stations who responded to our calls.

I have attached the copy of the paper that was presented, the lists of participants from each of the stakeholder groups. Most questions asked were similar, so please find appended below the questions or issues that need to be addressed by the Chief Consultant to this project when finalizing the project draft final report.

All stakeholders expressed happiness and willingness to support the project. Therefore we can say that it has been well received.

Questions and Comments

1.0 How will traffic flow during construction. What traffic control measures will be put in place. Will people living along the Highway be completely restricted during that time.

It was replied that traffic flow will be maintained through the highway during the construction period since there is enough space to work on.

2.0 There are many pedestrian crossings along the Highway which are dangerous especially at Ginnery Corner and the Polytechnic, what plans are there to safeguard pedestrians, including the disabled. Designers should put much thought into pedestrians crossing. The reply was given that the pedestrian crossings at schools, hospitals, colleges, institutions will be improved during the construction.

3.0 Is there enough room or space for the proposed roundabouts at the Traffic signed intersection at Mahatma Gandhi, and Johnstone Road Junctions?

4.0 There should not be space for bill boards and only Traffic Signs should be put up. It has been observed that a lot of traffic signs are missing from the road.

5.0 There is indeed need to consider drainage problems seriously. These should be well addressed so that there is no conflict between drainage outlets and proposed walkways and cycle track.

6.0 There is need to identify property, and infrastructure that needs to be removed, relocated and demolished. This is so to enable compensation procedures to be effected well before the start date of the project, the January 2008. Specific buildings that will be affected need to be identified now and owners notified in good time.

7.0 It was felt that one way systems should be implemented in Blantyre soon after the project to complement the same. It was noted that the Masauko Chipembere Highway will bring into Blantyre two carriageways flow of traffic which will cause a bottleneck at Larji Kurji Building roundabout. One way system would be good i.e. Haille Sellaisie Road, Victoria Avenue and Glyn Jones Roads as previously planned.

8.0 The stakeholders needed to be assured of the quality of work and duration of the construction period. Having experienced what

happened at Kenyatta Drive, where work took long and quality of work is very poor. We assured them that the project would be done to the highest quality and shortest possible shortest time.

9.0 The Federation of Disabled persons of Malawi (FEDOMA) requested that when designing technical elements, care should be taken to include the needs of the disabled. The walkway and cycle track should be mountable and accessible to wheelchairs and disabled alike. FEDOMA have given a copy of guidelines which is road note number 21. These are called enhancing the mobility of disabled people. A photocopy of the first page of Road Note No. 21 is attached and this may be looked up on the internet.

10.0 When installing street lights we should think how nature can assist like through the use of solar power to light or control street lights.

11.0 If services (underground) need to be removed or relocated there is a need to know the period of time this is expected to be done by. This is also so as not to delay the commencement of the project in January 2008.

In relation to the above it was observed that the road was narrow in certain places especially at or near the Shire Bus. The relocation of underground cables will be tricky especially the Malawi Telecommunication Limited (MTL) cables. Most cables also go in between the same narrow space.

12.0 Underground service providers say that they require enough time to relocate or reroute their plant especially that ordering the same take long time and that they are ordered from outside the country.

13.0 What assurance is there that Malawi Government will indeed pay compensation to all stakeholders who will be affected. The reply to this one is that the Malawi Government is a signatory to all the discussions held so far. And that the Japanese Government and Malawi Government are well aware of how these issues will be sorted out.

14.0 Another concern was if businesses along the Chipembere Highway will be affected by closure and if there will be detours as there is already too much traffic along the Highway.

15.0 It was stated that although we need to preserve the environment by keeping trees, some trees were said to be dangerously leaning into the road and a source of danger. The dangerous trees should be removed since they are eucalyptus and are harvestable.

16.0 The opinion leaders voiced their concerns in that the road appeared to be narrow between Yianikis and Stabic Bank in Limbe. They observed that there was congestion and a bottleneck for traffic moving into and from the Highway.

17.0 The treatment of Dalton Road/Livingstone Road junction is also a wonder. This is because it is almost impossible for traffic entering the Livingstone Road. There is a short distance which is two way from the junction to the Illovo roundabout. This need to be addressed by the consultants.

18.0 What type of bus shelters are being considered as the solid bus shelters were removed and replaced with fibre glass shelters which are not durable.

19.0 Are there any provisions for car parking on the street along the Livingstone Road and on the Chipembere Highway

20.0 The Project is welcome and should not fail at all.

21.0 What is the arrangement of the layout at end of the Highway at Stanbic Bank in Limbe.

22.0 What plans has the City got to improve the entry corridors between Blantyre and Limbe and even the implementation of the by passes project.

23.0 The City need to extend its limits so that services are available to the cities per urban areas. Road construction or improvement is one way of opening up the outlying areas.

24.0 The project should be completed by a good landscaping management.

25.0 The traffic growth should be taken into account when designing the Highway and carriageway.

26.0 Has the project taken into consideration the Independence Arch and height restrictions.

A. MEDIA

ITEM	NAME	CONTACT NO.	ORGANISATION
1	Maganizo Mazeze	01 830 278	Star Radio
2	Mike Kandulu	08 825 386	Nation Publication Ltd
3	Olunda Thomson	09 216 536	FM 101 Radio
4	Joyce Ng'oma	09 922 834	FM 101Radio
5	Daniel Kalaya	08 890 066	MBC – National Radio
6	Yohane Symon	09 274 550	Pride Magazine
7	Chikumbutso Njayo	09 946 128	The Weekly News
8	Orchestra Kamanga	09 724 250	Mana – News Agency
9	V. Mphande	08 920 920	TVM – Television
10	Steven Banda	09 382 634	Nation Newspaper
11	Enerstina Yobe	08 302 000	Blantyre City Assembly
12	Steven Kuyeri	08 856 592	Blantyre City Assembly
13	Kenneth L.A. Kantwela	08 843 735	Blantyre City Assembly

B. PUBLIC INSTITUTIONS

ITEM	NAME	CONTACT NO.	ORGANISATION
1	Enerstina Yobe	08 302 000	Blantyre City Assembly
2	Arthur Chokhotho	09 958 832	MBC – National Radio
3	E.B. Thombozi	08 825 629	Malawi College of Accountancy
4	W.F. Hill	09 429 645	University of Malawi Polytechnic
5	Dr. I. Ng'oma	08 841 947	University of Malawi Polytechnic
6	F.H. Nihaka	08 892 077	Worldwide Church of God
7	G. Wittika	08 833 591	Chichiri Integrated Pvt Schools
8	M. Chikalipo	08 362 505	FM 101 Radio
9	K. Kantwela	08 843 735	Blantyre City Assembly
11	R.T. Chigadula	09 950 360	District Education (Bt Urban)
12	V.J. Dacruz	09 912 509	Our Lady Wisdom of School
13	Kondwani Chalulu	98 502 604	Queen Elizabeth Central Hospital
14	S.M. Kuyeli	08 856 592	Blantyre City Assembly

C. ROAD USERS

ITEM	NAME	CONTACT NO.	ORGANISATION
1	Enerstina Yobe		Blantyre City Assembly
2	Kenneth Kantwela		Blantyre City Assembly
3	B.M. Ndhlovu		Limbe Police Station
4	Oliver Soko		Limbe Police Station
5	K.K. Phiri		Southern Region Police
6	L.C. Mwakapugha		Southern Region Police

7	C.K. Kumangirana		Roads Department (Lilongwe)
8	F.T. Msiska		National Roads Safety Council
9	L. J. Soko		Blantyre Police Station
10	W.H. Namasani		Blantyre Police Station
11	E.C. Zintambila		Road Traffic Department
12	Coxley Kamange		Minibus Owners Association of Malawi

D. OPINION LEADERS

ITEM	NAME	CONTACT NO.	ORGANISATION
1	Enerstina Yobe		Blantyre City Assembly
2	Kenneth Kantwela		Blantyre City Assembly
3	R.I. Kawiya		Blantyre City Assembly
4	Acting Chief Machinjiri		Traditional Chief
5	Halmes Chimombo Representative of Hon J. Banda		Blantyre City South Constituency
6	T/A Somba		Traditional Chief
7	J. Ndovi		Blantyre City Assembly
8	B.E.F. Nsitu		Blantyre City Assembly
9	Lester Makuluni		City South Constituency

E. PUBLIC UTILITY SERVICES

ITEM	NAME	CONTACT NO.	ORGANISATION
1	Kenneth Kantwela		Blantyre City Assembly
2	Enerstina Yobe		Blantyre City Assembly
3	R.I. Kawiya		Blantyre City Assembly
4	W. Senger		Malawi Telecommunication Ltd
5	J. Mtchuka		Malawi Telecommunication Ltd
6	W.B. Kawaga		Malawi Telecommunication Ltd
7	B.G.K Waya		Blantyre Water Board
8	L.T. Mwabutwa		Blantyre Water Board
9	James Kaphale		MACRA – Regulatory Authority

F. BUSINESS & RESIDENTS

ITEM	NAME	CONTACT NO.	ORGANISATION
1	E. Yobe	08 302 000	Blantyre City Assembly
2	K. Kantwela	08 843 743	Blantyre City Assembly
3	S.M. kuyeli	08 856 592	Blantyre City Assembly
4	C.M. Phiri		HTD Limited
5	H.A. Sidik		HTD Limited

6	I. Ibrahim	-	Petroda Limited
7	J.M Kayira	09 951 753	Automotive Products
8	S.C. Jalasi	08 854 734	World Vision
9	Lauro Phillips	08 714 433	Gesterner Ltd
10	D. Kausi	09 138 876	MCCCI – Chamber
11	W. Chawinga		Choice Bakery
12	J. Makina		Ingwe Linking Africa
13	R. Mussa		Gafferson LTD
14	M. Kotecha		HISCO LTD
15	M. Gondwe	08 590 015	Chichiri Lodge
16	F. Gondwe	08 866 893	Chichiri Lodge
17	R. Gondwe	09 134 848	Chichiri Lodge
18	Anton Beiber		Glave International LTD
19	W. Msiska		Chichiri Shopping Centre
20	A.R. Masangano		Chichiri
21	H.H. Amosi		H. Amosi House

We have attached other documents as stated above.

Yours faithfully

K L A KANTWELA
DIRECTOR OF ENGINEERING SERVICES
FOR: CHIEF EXECUTIVE

Attach:

KLAK/glc

BLANTYRE CITY ASSEMBLY

IMPROVEMENT OF BLANTYRE CITY ROADS

STAKEHOLDERS SENSITISATION MEETING

1.0 Introduction

In August 2001, the Government of the Republic of Malawi made a request for a Grant Aid for the project for Improvement of Blantyre City Roads. The Japanese Government having gone through the process necessary for the granting of aid for the project sent two study teams to Blantyre. These study teams were sent through Japan International Cooperation Agency (JICA), the official agency for the implementation Japanese government technical assistance. The Japanese Study Teams were as follows:-

1.1 Preliminary study on the Project to improvement of Blantyre City Roads.

The main objectives for the preliminary study team were:-

- To confirm the contents of the requested project.
- To make site surveys and collect necessary data and information to acquaint themselves with the present situation of the road network.
- To examine environmental and social consideration.

1.2 Basic Design Study on the Project for Improvement of the Blantyre City Roads.

The main objectives of this study are:-

- To identify and confirm the components of the Project which are:-
  - Widening of the existing roads from 2 lane to 4 lane from Lurji Kurji Building to Chichiri Roundabout and 2 lane to 3 lane from Yianikis Roundabout to Stabic Bank in Limbe.
  - Rehabilitation of existing roads and services roads.

- Replacement of traffic signal Intersections with roundabouts. Intersections (Mahatma Gandhi and Johnstone Intersections).

- Improvement of existing 6 roundabouts (Larji Kurji, Clock Tower, Chichiri, Maselema, Yianikis and Illovo).

- Improvement of drainage system along the roads. Masauko Chipembere Highway and Livingstone Road.

- Improvement of existing bus stops and installation of new bus stops. (about 15 no.)

- Installation of pedestrian walkway and cycle track.

- Installation of side kerb stones.

- Installation of Traffic Signs and road markings.

- Installation of street lights.

- Installation of pedestrian crossings (at schools, colleges, hospitals, and shopping centres)

- Improvement and installation of pedestrian crossing signals.

- To appraise and evaluate the Technical and economical viability of the project.

- To estimate the cost of the Project and prepare a schedule of Implementation.

- To identify necessary works to be done by the Malawi (Blantyre City Assembly) prior to the commencement of the project, during and after the project.

These are as follows:-

- Land acquisition necessary for the improvement of the project.

- Ensure the safety of the consultants and contractors with the assistance of the Malawi Police Service if necessary (Equipment and Staff).

- Secure land for construction yard and to establish offices and Asphalt Plant.

- Relocation of existing utilities such telephone cables, water mains, electricity, sewers when and if necessary.

- Budget allocations for tax exemption of imported contraction materials.

- Assessment for and budget allocations for compensation of affected property.

- Take necessary activities to get environmental Impact Assessment Certificate done.

- Hold Stakeholders meetings to sensitise media, public institutions, people living along the main road, opinion leaders, public utilities, and road users.

2.0 Implementation Flow Chart

- The likely flow of works is as follows:-

2.1 Applications done through request written in 2001

2.2 Preliminary study done in June and July 2006.

2.3 Basic Designs Study done in November and December 2006.

2.4 Draft Final Report to be done in April 2007.

2.5 Appraisal and Approval by the Japanese Government, may be done by end of May 2007

2.6 Detailed Designs to be done by October 2007.

2.7 Tender/contract signing by December 2007.

2.8 Construction to be started by January 2008.

2.9 Construction period of between one (1) year and two (2) years.

END OF MEETING

Blantyre City Assembly

Inter Departmental Memorandum

From: Director of Town Planning and Estates

To: Director of Engineering Services

Ref: TP/PM/22

Date: 09 December 2009

Subject: **MARKET VALUE OF COMMERCIAL AND INDUSTRIAL PLOTS ALONG MASAUKO CHIPEMBERE HIGHWAY**

Please be advised that the following are current commercial values of vacant plots along the Masauko Chipembere Highway as per Government rates:

a) Commercial and industrial plots – **MK6,000,000** per Hectare
b) Residential plots – **MK3,000,000** per Hectare.

Value of developed plots may vary depending on particular development on the plot.

C. Chanza
Director of Town Planning and Estates Services

CC : DAS

７．事業事前計画表（概略設計時）

１．案件名

マラウイ国ブランタイヤ市道路網整備計画（第２期）

２．要請の背景（協力の必要性・位置付け）

マラウイ共和国（以下「マ」国という）は周囲を３ヵ国に囲まれた内陸国であり、道路交通は国際物流を含む物資、旅客輸送の中心的な役割を担っており、経済発展における重要な基盤である。「マ」国の道路総延長は16,500kmであり、主要幹線道路、その他の経済・輸送道路が6,500kmを占め、そのうち43%が舗装道路である。しかしながら、既存道路の多くは財政上の制約から路面の劣化や損傷が進行しており、道路インフラ整備は同国の国家開発計画における最重要課題の一つとされている。これを受け 2002 年には「道路セクター投資プログラム（2003-2012）ROADSIP」が策定され、南部アフリカ近隣国への輸送回廊や国内幹線道路を中心とした整備が進められてきた。

本計画対象地域であるブランタイヤ（ブランタイヤ市および隣接するリンベ市の組織体）は、「マ」国首都リロングウェから南に約300kmに位置し、最も工業化の進んだ「マ」国最大の都市である。市内道路のほとんどは 1950 年代前半に建設されたが、経年による路面の劣化進行だけでなく、人口集中や産業発展に伴い、交通量が設計時の交通容量を大幅に上回ったため、慢性的な交通渋滞や事故を引き起こしており、市民の日常生活、経済活動に支障を来す深刻な状況となっている。

ブランタイヤ市に関して、ROADSIPに舗装道路の改修案件が24件示されているが、財政難より実施された案件は無い状況である。

このような問題に対し「マ」国政府は改修が必要とされる 42 区間の改善について、我が国に対し無償資金協力を要請した。

この要請に対し、2006年6月、要請内容および対象地域の確認、協力対象道路の優先順位付け等を目的とした予備調査を実施した。その結果、チペンベレハイウェイ（Chipembere Highway）とリビングストンアベニュー（Livingstone Avenue）の２路線、7.47kmを優先的に改修することについて、本案件の無償資金協力としての実施妥当性が確認された。

これに基づき、我が国は基本設計調査の実施を決定し、2006年11月から2007年6月にかけて「ブランタイヤ市道路網整備計画」基本設計調査を実施した。同結果を踏まえ、第1期分（3.54km、チペンベレハイウェイ（ラルジクルジランドアバウト（RA）－チチリRA間））の無償資金協力に係るE/Nが2007年7月に締結され、詳細設計、入札を経て2008年3月に工事が開始された。他方、第２期分（4.36km、チペンベレハイウェイ（チチリRA－スタンダードバンクIC間、リビングストンアベニュー）は2008年7月にE/Nが締結されたが、諸般の事情により事業実施が中断された。これを受け、日本国政府は、新たなE/Nを締結した上で第２期を実施することとし、第２期分を対象に改めて協力準備調査を実施することとなった。

３．プロジェクト全体計画概要

（１）プロジェクト全体計画の目標

・既存幹線道路を整備することにより、ブランタイヤ地域のアクセス改善と道路利用者の移動時間短縮および交通事故の減少を目標とする。

・裨益対象の範囲及び規模：ブランタイヤ市民約66万人

（２）プロジェクト全体計画の成果

・ブランタイヤ市内の道路が整備される

（３）プロジェクト全体計画の主要活動

・チペンベレハイウェイ（区間-3：2.75km 及び区間-4：0.72km）およびリビングストン・アベニュー（区間-5：0.89km）を整備する

・道路整備後の維持管理を行う

（４）投入

ア　日本側：無償資金協力 9.30 億円

イ　「マ」国側：

（ア）必要な人員：維持管理要員：約 20 名

（イ）施設の運営維持管理に係る経費：6.63 百万マラウイクワチャ

（５）実施体制

・主管官庁：地方自治・開発省（Ministry of Local Government and Rural Development）

・実施機関：ブランタイヤ市役所（Blantyre City Assembly）

４．無償資金協力案件の内容

（１）サイト

「マ」国　ブランタイヤ市　ブランタイヤ地区～リンベ地区

（２）概要

・以下の道路の整備（ヤナキス RA～スタンダードバンク IC の既存２車線から４車線への拡幅、舗装〔車道・歩道〕、排水設備、照明設備、バス停の整備を含む）

1）チペンベレハイウェイ（チチリ RA～ヤナキス RA 間：2.75km）

2）チペンベレハイウェイ（ヤナキス RA～スタンダードバンク IC：0.72km）（４車線拡幅区間）

3）リビングストンアベニュー（スタンダードバンク IC～イロボ RA：0.89km）

（３）相手国負担事項

①　プロジェクト用地確保、支障物（フェンス、看板）移転

②　ユーティリティーの移設

（４）概略事業費

・概略事業費 9.33 億円（日本側負担 9.30 億円、「マ」国側負担 0.03 億円）

（５）工期

・詳細設計・入札期間を含め約 17.5 ヶ月(予定)

（６）貧困、ジェンダー、環境および社会面の配慮

・EIA レポートに準拠し、区間-4 で樹木３本を撤去するため植樹を行う。

５．外部要因リスク（プロジェクト全体計画の目標達成に関して）

・当初想定よりも交通量が大幅に増加しない。

・異常気象により予想を超える降雨が発生しない。

６．過去の類似案件からの教訓の活用

・なし

７．プロジェクト全体計画の事後評価に係る提案

（１）プロジェクト全体計画の目標達成を示す成果指標

項目	2009 年	2012 年
区間-3～区間-5（計 4.36km）の平均所要時間	オフピーク時： 7 分 ピーク時：17 分	オフピーク時： 5 分 ピーク時：12 分
朝夕（朝 7:00～8:00、夕 17:00～18:00）の平均走行速度の向上	平均走行速度 36km/hr	平均 55km/hr 程度

（２）その他の成果指標

項目	2009 年	2012 年
対象路線における年間維持管理費用の軽減	1,400 万 MK	663 万 MK

収 集 資 料 リ ス ト

調　査　名:　マラウイ国　ブランタイヤ市道路網整備計画（第２期）準備調査

番号	資 料 の 名 称	形 態 図書・ビデオ 地図・写真等	オリジナル・コピー	発 行 機 関	発行年
1	EIA Report	電子データ	コピー	ブランタイヤ市役所	2007
2	標準図一式	図面	コピー	ブランタイヤ市役所	-
3	ブランタイヤ市都市計画書	電子データ	コピー	ブランタイヤ市役所	2006
4	2008 POPULATION AND HOUSING CENSUS	電子データ	コピー	国家統計局	2008
5	ATLAS for Malawi (Third Edition)	図書	オリジナル	Macmillan Publish Limited	2009
6	Spectrum guide to Malawi	図書	オリジナル	Camerapix Publishers International	-
7	STRIDES in Geography (Form2)	図書	オリジナル	-	-
8	Statistical Year Book 2007, 2008	図書	オリジナル	National Statistical office	2007,2008
9	Welfare Monitoring Survey 2008	図書	オリジナル	National Statistical office	2008
10	Quarterly Statistical Bulletin 2009	図書	オリジナル	National Statistical office	2008
9	気象データ、降雨量データ	ﾌﾟﾘﾝﾄﾃﾞｰﾀ	コピー		2009
10	URBAN ROADS Maintenance and Rehabilitation Study Final Report Vol.3 Traffic Study	図書	コピー	地方自治省、労働省	1994
11	URBAN ROADS Maintenance and Rehabilitation Study Final Report Vol.6 Projection of Urban Extension and Urban Road Developments	図書	コピー	地方自治省、労働省	1994
12	URBAN ROADS Maintenance and Rehabilitation Study Final Report Vol.9 Urban Roads Standards	図書	コピー	地方自治省、労働省	1994

(1) 交通量調査結果

Table 3-1(1) Traffic Volume Result

		I: Light Vehicles		II: Medium Vehicles		III: Heavy Vehicles				IV: 2-Wheel Vehicles		V: Others		Remarks
		Sedan / Wagon	Pick-up / 4WD	Van / Mini Bus	Mini Truck	Standard & Large Bus	2-Axle Truck	3-Axle Truck	Articulated Truck	Motorbike, BikeTrailer	Bicycle, Tricycle	Animal Cart	Walker	
Section-3 (18 hrs)	Chichiri RA to Yianakis RA	4,102	3,674	2,509	425	22	659	85	208	202	814	0	1,595	4:00 - 22:00
	Yianakis RA to Chichiri RA	3,518	4,016	3,005	510	106	226	300	377	322	805	0	2,176	4:00 - 22:00
	Sub-Total	7,620	7,690	5,514	935	128	885	385	585	524	1,619	0	3,771	
Section-4 (12 hrs)	Yianakis RA to Standard Bank IC	2,403	1,796	1,962	450	15	184	32	28	123	465	0	1,808	6:00 - 18:00
	Standard bank IC to Yianakis Ra	2,428	2,055	1,587	328	4	147	48	41	108	425	0	1,641	6:00 - 18:00
	Sub-Total	4,831	3,851	3,549	778	19	331	80	69	231	890	0	3,449	
Section-5 (12 hrs)	Standard bank IC to Illovo RA	736	582	1,124	97	180	79	36	22	125	297	0	3,192	6:00 - 18:00
	Illovo RA to Standard bank IC	3,198	2,333	3,009	155	79	400	18	41	151	933	0	3,130	6:00 - 18:00
	Sub-Total	3,934	2,915	4,133	252	259	479	54	63	276	1,230	0	6,322	
Total		16,385	14,456	13,196	1,965	406	1,695	519	717	1,031	3,739	0	13,542	

*Note : Average data of 2 days, Nov. 10 and 12, 2009.

(2) 交通速度調査結果

Table-3-1(2) TRAVEL SPEED SURVEY RESULT

	Cumulative Distance	Time (min)								
		Morning			Noon			Evening		
Inbound	(km)	6:00~	7:00~	8:00~	11:00~	12:00~	13:00~	16:00~	17:00~	18:00~
Chichiri RA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maselema RA	1.71	2.03	2.02	2.07	1.92	1.98	1.83	1.97	2.50	2.15
Yianakis RA	2.75	3.28	3.57	3.62	3.20	3.48	3.20	3.38	4.43	3.72
Standard Bank IC	3.47	4.27	5.17	5.38	5.62	5.83	4.47	4.83	7.50	5.92
Illovo RA	4.36	5.50	6.85	6.85	7.47	8.03	6.28	6.97	9.80	7.80
Outbound	(km)	6:30~	7:30~	8:30~	11:30~	12:30~	13:30~	16:30~	17:30~	18:30~
Illovo RA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Standard Bank IC	0.89	1.58	3.33	3.15	2.55	2.12	2.38	2.93	3.33	2.42
Yianakis RA	1.61	2.75	5.78	4.82	5.35	4.62	3.93	5.68	5.35	3.67
Maselema RA	2.65	3.83	7.02	6.02	6.53	5.92	5.23	7.03	6.73	4.88
Chichiri RA	4.36	5.75	9.33	8.20	8.90	8.05	7.42	9.15	17.42	6.77

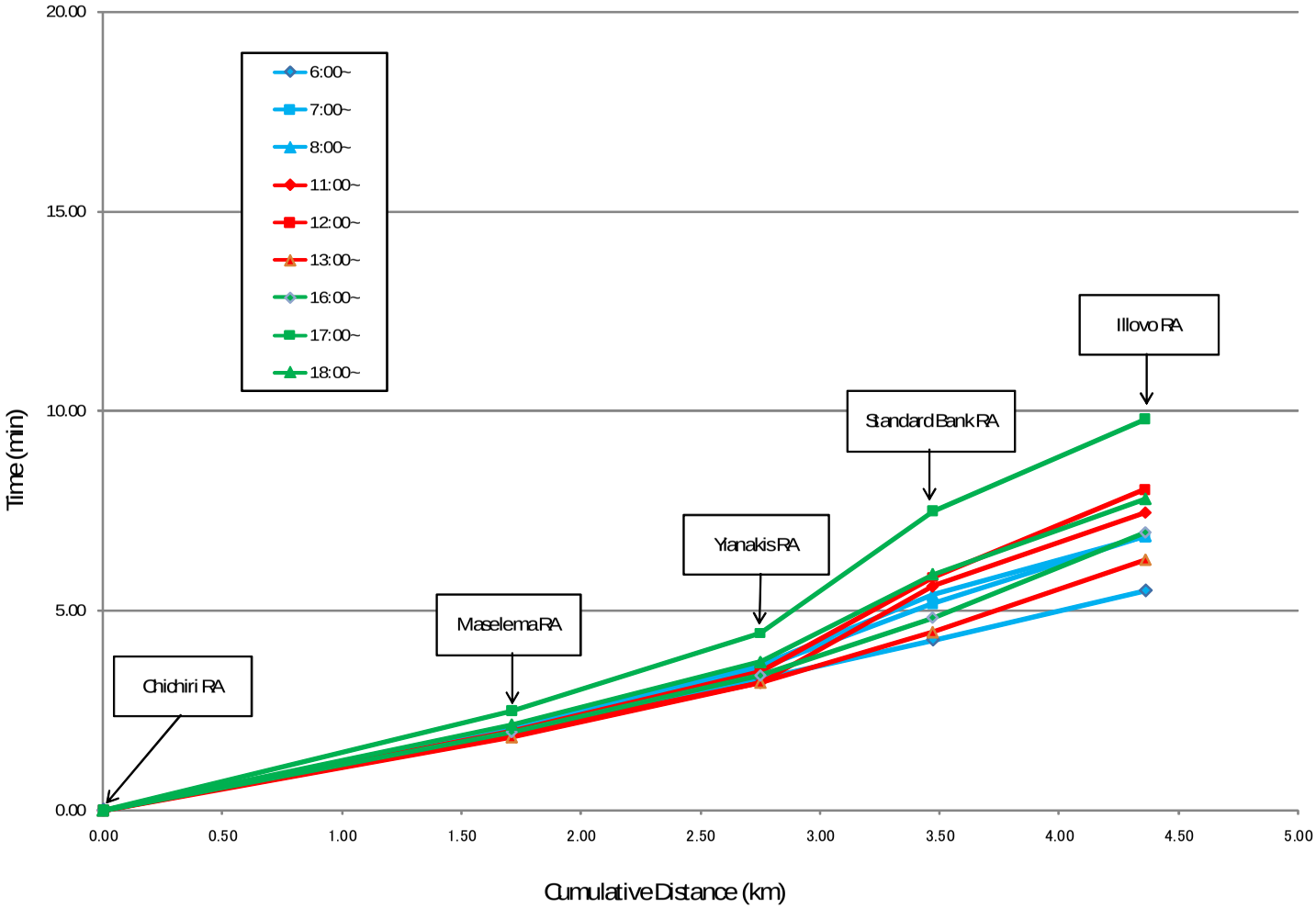


Table-3-1 (3) TRAVEL SPEED SURVEY RESULT OF INBOUND (From Chichiri RA to Illovo RA)

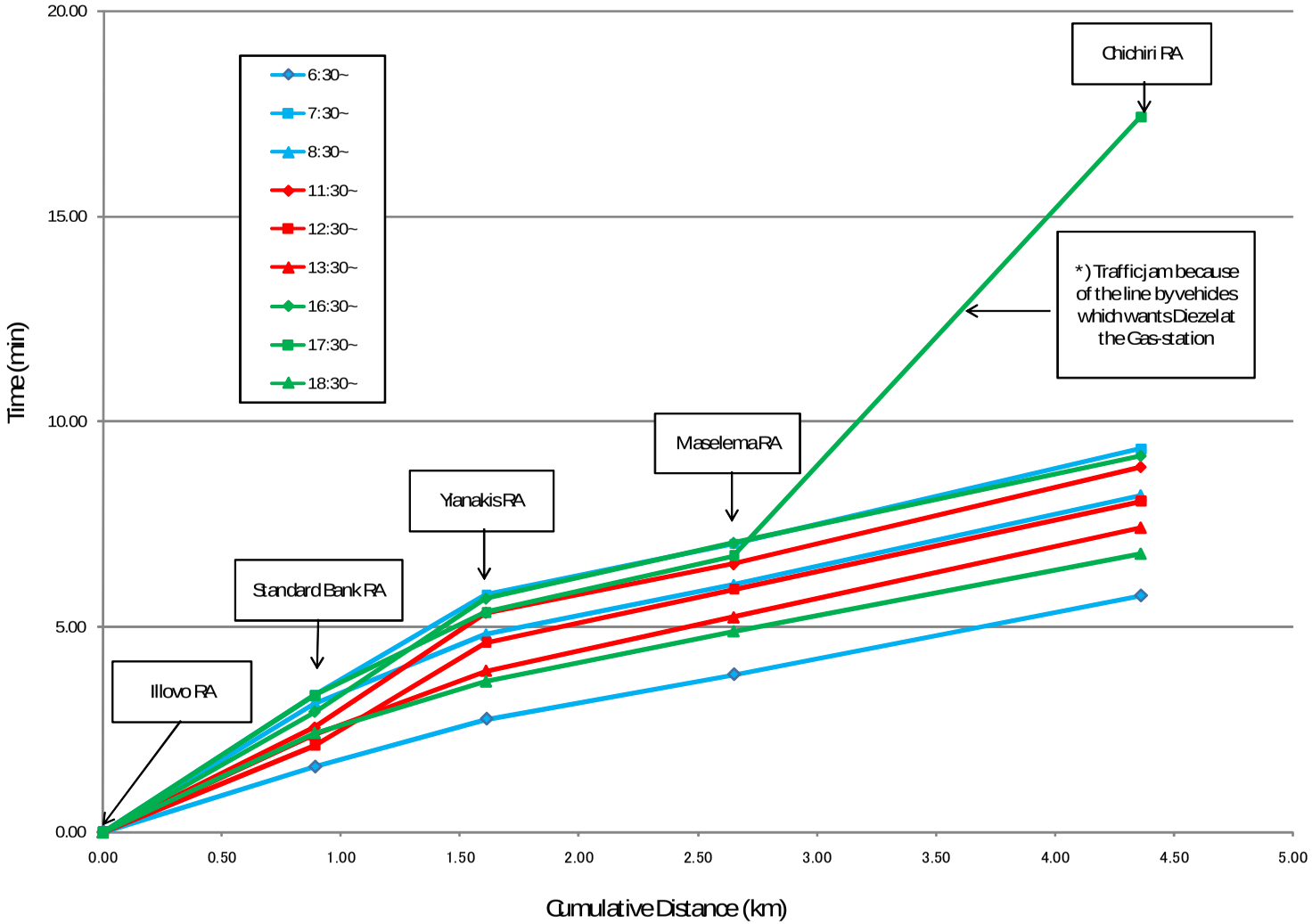


Table-3-1 (4) TRAVEL SPEED SURVEY RESULT OF OUTBOUND (From Illovo RA to Chichiri RA)

技術資料-2　ひび割れ調査

調査方法

全区間において、ひび割れ率を目視により調査した。ひび割れ率は、路面上に縦横 0.5m の枡目を想定し、各枡目のひび割れ状況を記入し、ひび割れのある枡目の割合をひび割れ率とした。なお、オーバーレイやパッチングによる補修済み箇所もひび割れ有りと評価した。

調査結果

ひび割れ率をグラフ化した結果を以下に示す。

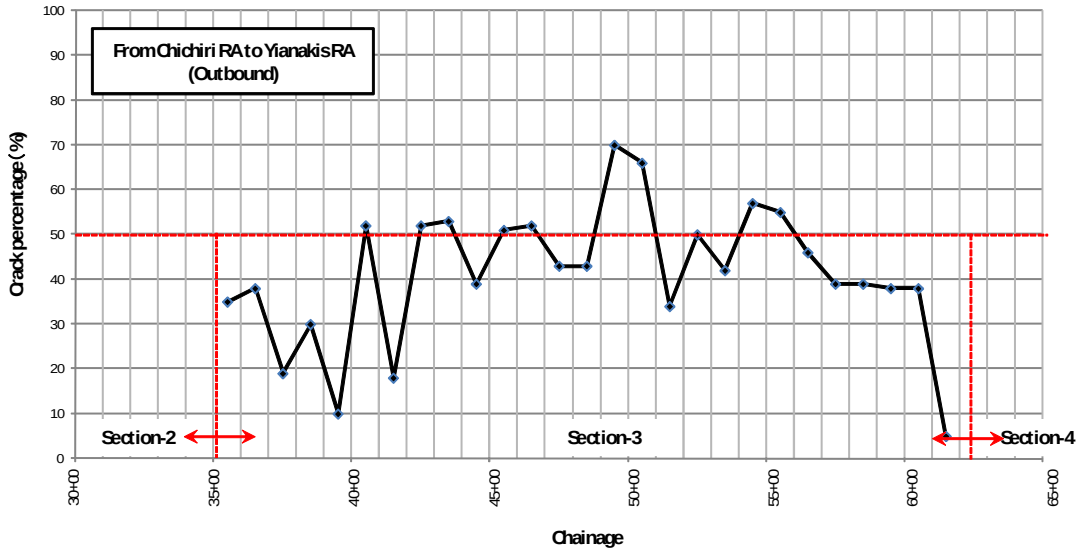


図 3-2(1)　区間－３ ひび割れ調査結果（下り線側/チチリ⇒ヤナキス）

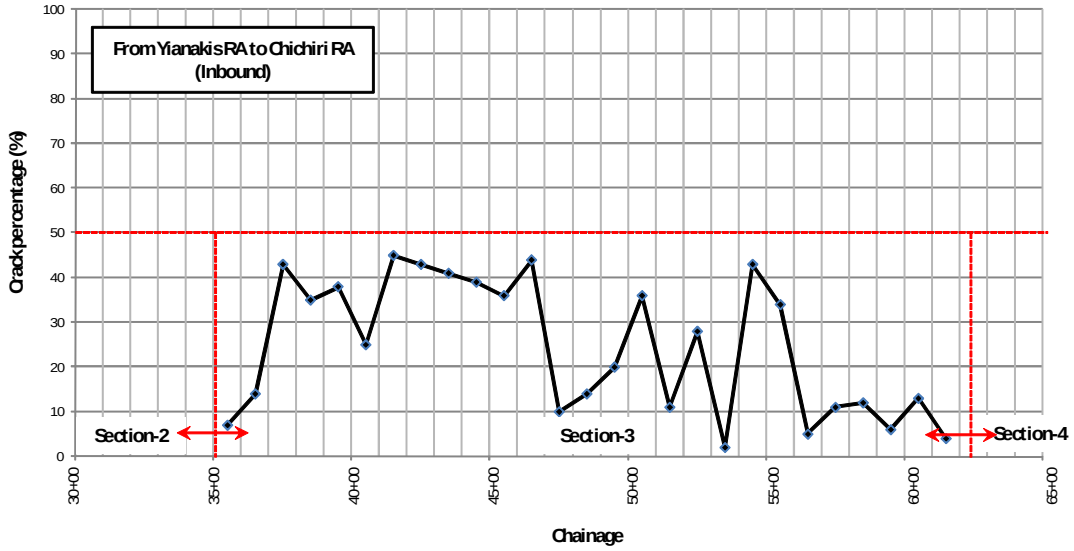


図 3-2(2)　区間－３ ひび割れ調査結果（上り線側/ヤナキス⇒チチリ）

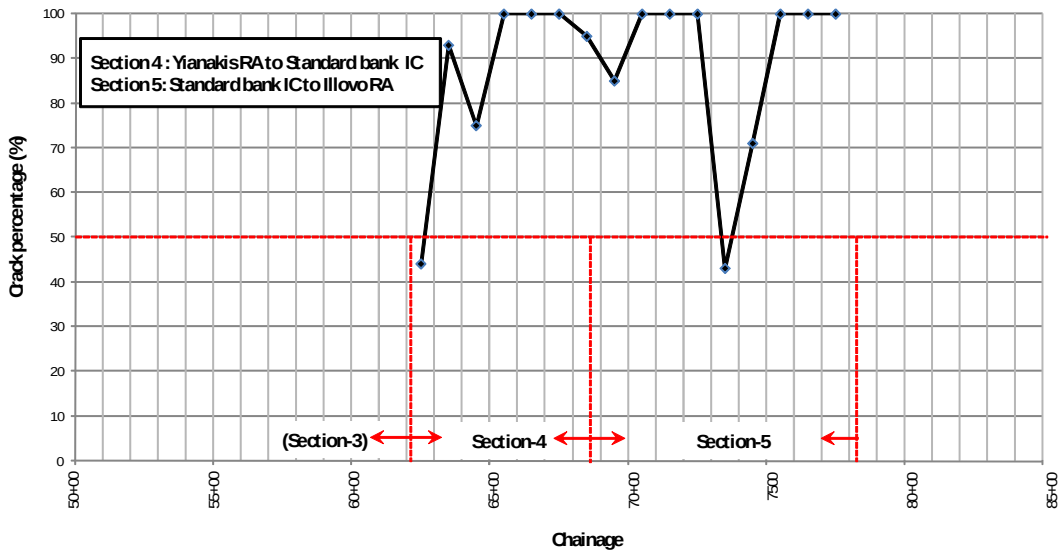


図 3-2(3)　区間－４、５ ひび割れ調査結果

考察

ひび割れ率調査結果、ひび割れ状況の観察結果から以下の点が考察された。

【区間－３】

・図３－２(1)より、区間－３の下り線側でひび割れ率 50%を超える区間がある。これは図３－２(4)（出典：日本道路協会 道路維持修繕要綱 1978 年 7 月）によると、50%以上の補修方法は打ち替えとなる。

・区間－３は、ひび割れは多いものの比較的に平坦性は保たれている。したがって、ひび割れの原因は、下層から来るものではなく、「表層の劣化」によるものと推定される。

・図３－２(1),(2)より、ほとんど全区間でひび割れ率は 30%を超えている。これは図３－２(4)によると、30%以上の補修方法はオーバーレイ、一部打ち替えとなる。したがって全区間に渡り補修は必要と判断される。また、50%を超えた個所は、下層から打ち替えるべきと判断される。

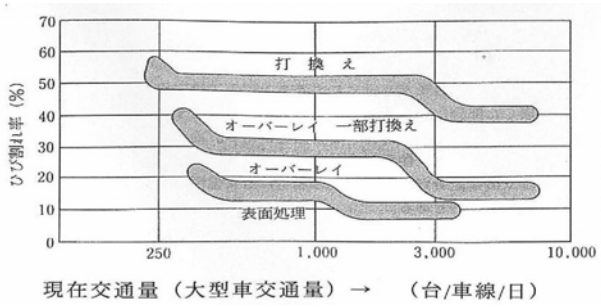
・以上より、区間－３の補修方法は「表層打ち替え区間」と「下層から打ち替えが必要な区間」に大別される。その区間分け判断は、別途行ったベンケルマンビーム試験結果から決定するものとする。

【区間－４，５】

・この区間の平坦性は補修に次ぐ補修により、保たれているとは言い難い。

・図３－２(3)より、ほぼ全域でひび割れ率 50%を超えている。

・比較的新しいオーバーレイやポットホール補修箇所にもひび割れが発生している。



・図３－２(4)によると、30%以上がオーバーレイ工法・一部打ち替えによる補修、50%以上が（下層路盤から）打ち替えとされている。

・以上より、区間－４，５の補修方法は、「下層路盤から打ち替え」を全区間に適用するものとする。

技術資料-3　ベンゲルマンビーム調査

調査方法

ベンケルマンビーム試験は、載荷した大型ダンプトラックが通過した時の舗装面の沈下量を計測する試験である。区間－３において、道路の現状を確認し、適切な補修工法およびその適用範囲を確認するため、上下線で約 200m に 1 箇所、全 28 個所で実施した。

調査結果

ベンケルマンビーム試験結果を以下に示す。

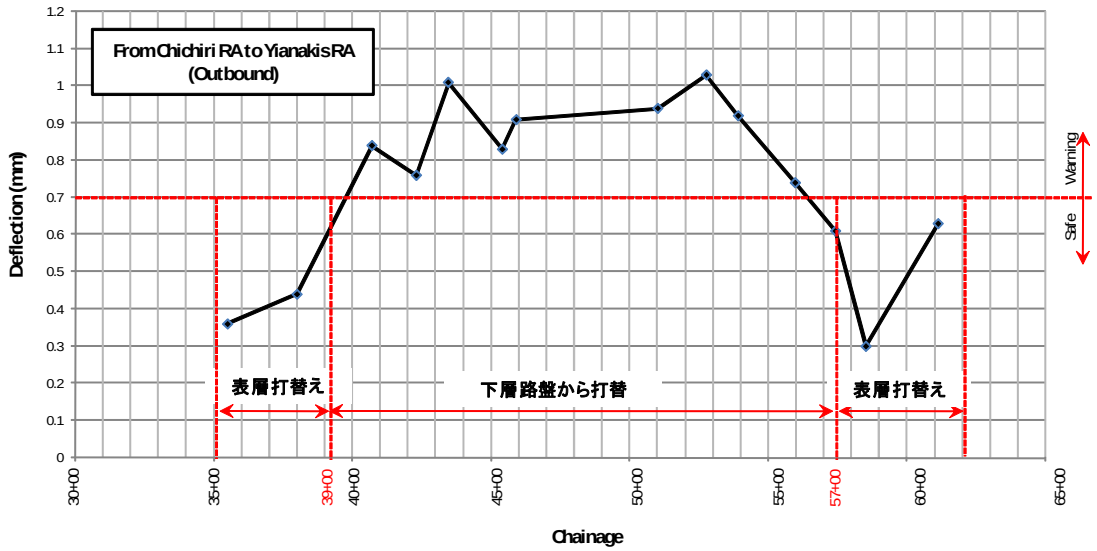


表 3-3(1)　ベンケルマンビーム試験結果および舗装補修方法と適用範囲
（下り線側/チチリ⇒ヤナキス）

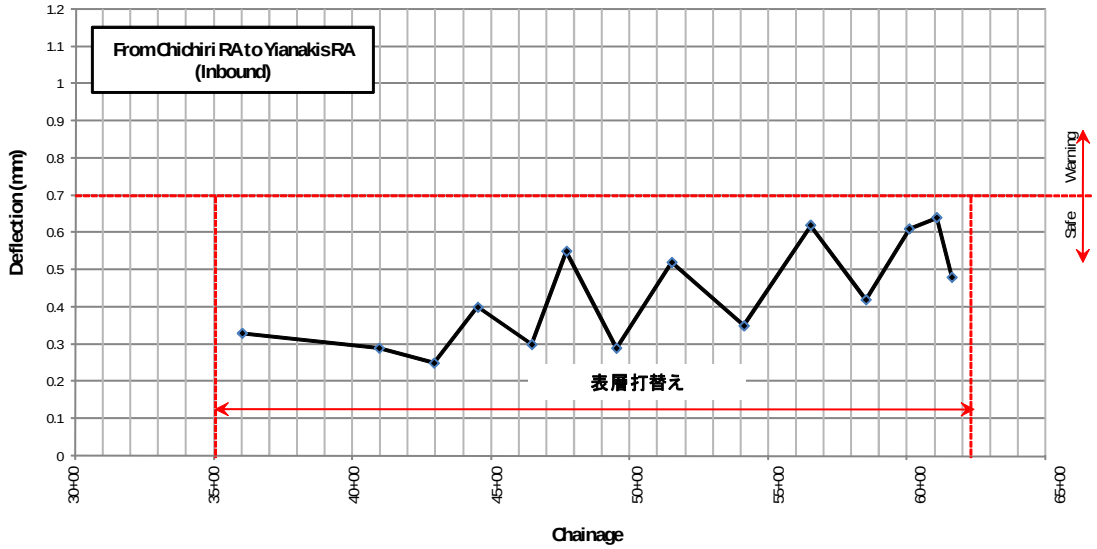


表 3-3(2)　ベンケルマンビーム試験結果および舗装補修方法と適用範囲
（上り線側/ヤナキス⇒チチリ）

考察

Draft, Technical Recommendation for Highways 12, Flexible pavement Rehabilitation Investigation and Design 1997(南アフリカ)によると、ベンケルマンビーム試験結果の沈下量は以下の判断基準が示されている。

Deflection	Condition
>0.7	Satisfactory
0.7 to 1.2	Warning
1.2>	Severe

図３－３(1)（下り線側）の 39+00～57+00 の区間で、0.7mm から 1.2mm の警告（Warning）沈下量を示しているが、その他の区間は 0.7mm 以下の安全（Satisfactory）沈下量であった。この結果からも区間－３の路盤は比較的しっかりしていることが分かり、表層のひびわれは「劣化」によるものと判断される。

ひび割れ範囲は日々広がっており、現地政府の負担する舗装補修費用は年々増加しており、現地政府から補修を最小限に抑えられるよう適切な舗装工事を期待されている。したがって、補修方法は以下のとおりとする。

・下層路盤から打ち替え：下り線側 39+00～57+00

・表層打ち替え：上り線側全区間、下り線側 35+00～39+00 および 57+00～61+80

なお、始点側 34+35～35+00 については、第 1 期工事にて舗装打ち替えが実施済みであるため、今回は補修しない。

技術資料-4　コーン貫入試験

調査方法

コーン貫入試験（DCP 試験）は、簡易的に路床の CBR を算定するものである。各区間で 5 箇所ずつ、計 15 箇所で実施した。

調査結果

今回調査結果と前回基本設計時の結果を以下に示す。

表 3-4(1)　コーン貫入試験（ＤＣＰ試験）結果による推定ＣＢＲ値と室内試験ＣＢＲ値との比較

区間	前回基本設計調査結果（DCPおよび室内CBR結果）						今回調査結果（DCPのみ）		
	番号	測点	DCP値より推定される現場CBR値(%)	近傍の試掘ピット番号	室内試験CBR値(%)	設計CBR	番号	測点	DCP値より推定される現場CBR値(%)
区間－3	18	35+00	27.5	3-1	5	4.3	D-1	35+50	10
	19	37+00	針入不可						
	20	39+00	針入不可						
	21	41+00	針入不可	3-2	7				
	22	43+00	33.5						
	23	45+00	32.1	3-3	4				
	24	47+00	27.3				D-2	48+00	8
	25	49+00	針入不可						
	26	51+00	17.4	3-4	5				
	27	53+00	針入不可				D-3	53+00	14
	28	55+00	73.7	3-5	20		D-4	55+00	50
	29	57+00	81.4				D-5	57+00	11
	30	59+00	針入不可						
	31	61+00	68.4	3-6	6				
区間－4	32	63+50	針入不可	4-1	21	17.3	D-6	62+00	20
	33	65+50	50.2				D-7	63+50	12
	34	67+50	67.3	4-2	18		D-8	65+00	11
							D-9	66+00	14
							D-10	67+50	12
区間－5	35	70+50	針入不可			17.3	D-11	69+00	14
	36	73+50	73.6	5-1	21		D-12	70+50	21
	37	75+00	針入不可				D-13	73+00	15
	38	77+00	68.3	5-2	18		D-14	75+00	14
							D-15	76+50	33

考察

今回のコーン貫入試験結果から推定される CBR 値は、前回基本設計調査時の結果に比較的近いものとなった。したがって、舗装設計に用いる設計 CBR 値は前回採用した値（区間－３で 4.3%、区間－４，５で 17.3%）を用いる。

技術資料-5　舗装計算

(1) 日本道路協会（TA 法）による舗装計算結果

1. 交通クラス
1)区間-3,4
(大型車交通量)=(1,270+585)=1,855　（台・日・2方向:交通調査時）
1,855÷2(方向)×1.85(15年後)=1,373　（台・日・1方向:15年後）　（C交通; 1,000以上3,000未満）

2)区間-5
(大型車交通量)=(62+72)　=134　（台・日・1方向:交通調査時）
134×1.85(15年後)　=250　（台・日・1方向:15年後）　（B交通; 250以上1,000未満）

2. 舗装設計
1)区間－3

N=　7,000,000（C交通:15年、1日1,000～3,000台／日・方向）
CBR=　4（CBR4以上6未満）

$$TA=\frac{3.84*N^{0.16}}{CBR^{0.3}}=32$$

	a	h(cm)
アスファルト	1.00	10
上層路盤(CBR>80)	0.35	35
下層路盤(CBR>30)	0.25	40
全層厚		85

T= a1h1*a2h2+a3*h3　=　32.25　>TA

2)区間－4

N=　7,000,000（C交通:15年、1日1,000～3,000台／日・方向）
CBR=　12（CBR12以上20未満）

$$TA=\frac{3.84*N^{0.16}}{CBR^{0.3}}=23$$

	a	h(cm)
アスファルト	1.00	10
上層路盤(CBR>80)	0.35	20
下層路盤(CBR>30)	0.25	25
全層厚		55

T= a1h1*a2h2+a3*h3　=　23.25　>TA

3)区間－5

N=　1,000,000（B交通:15年、1日250～1,000台／日・方向）
CBR=　12

$$TA=\frac{3.84*N^{0.16}}{CBR^{0.3}}=17$$

	a	h(cm)
アスファルト	1.00	5
上層路盤(CBR>80)	0.35	20
下層路盤(CBR>30)	0.25	20
全層厚		45

T= a1h1*a2h2+a3*h3　=　17.00　=TA

(2) 舗装計算結果一覧表

表-舗装構成一覧

Section -3 (Re-construction) Outbound (39+00 ~ 57+00)			Section -3 (Replace) Inbound (All), Outbound(35+00 ~ 39+00, 57+00 ~ 61+80)			
Traffic Class = C			Traffic Class = C			
Surface	Asphalt Concrete Surface Course=5cm Binder Course=5cm	10.0cm	Surface	Asphalt Concrete	5.0cm	Replace
Base	Granular (Soaked CBR>80%)	35.0cm	Base	(Existing Granular) (Re-Compaction)	(10.0cm)	Utilize Existing material
				(Existing Cemented)	(15.0cm)	Keep Existing
Subbase	Granular (Soaked CBR>30%)	40.0cm		(Existing Subgrade)		
	CBR=4			CBR=4		
	Total	85.0cm		Total	5.0cm	
Section -4 (Re-construction) All (61+80 ~ 69+00)			Section -5 (Re-construction) All (69+00 ~ 77+90)			
Traffic Class = C			Traffic Class = B			
Surface	Asphalt Concrete	10.0cm	Surface	Asphalt Concrete	5.0cm	
Base	Granular (Soaked CBR>80%)	20.0cm	Base	Granular (Soaked CBR>80%)	20.0cm	
Subbase	Granular (Soaked CBR>30%)	25.0cm	Subbase	Granular (Soaked CBR>30%)	20.0cm	
	CBR=12			CBR=12		
	Total	55.0cm		Total	45.0cm	

(1) 降雨データ

Place: Chichiri
Term: 1999 - 2008

Chichiri Daily Rainfall Data for 1999

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	14.3	0.0	9.5	1.4	0.0	0.0	0.0	0.0	0.0	12.8	0.0
2	0.0	19.2	0.0	18.5	2.4	0.0	0.0	0.0	0.4	0.0	0.0	10.4
3	101.1	0.2	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0
4	16.7	0.0	3.4	5.5	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
5	7.4	0.0	3.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0	16.0	0.0
6	24.2	0.0	126.0	1.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	4.0	8.0	0.0	4.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	28.1	0.0	5.1	11.3	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
9	18.3	30.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	0.2	0.0
10	28.6	3.0	2.1	3.4	0.0	0.0	0.0	0.0	0.0	0.0	21.9	14.0
11	0.0	0.0	0.0	20.6	0.0	0.0	0.0	0.0	0.0	0.0	2.1	7.6
12	1.0	0.0	2.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.8
13	57.0	32.6	41.1	4.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0	6.8
14	36.5	1.1	10.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5
15	5.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.3
17	40.0	0.0	16.8	0.0	0.0	0.0	3.8	0.0	0.0	0.0	0.0	0.0
18	29.3	0.0	0.0	0.0	0.1	0.0	1.7	0.0	0.0	0.0	4.9	0.0
19	32.0	73.8	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	16.0	0.0
20	3.4	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	18.2
21	0.0	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0
22	5.0	35.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	3.0	4.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	15.5
24	17.7	62.0	11.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	8.1	3.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
26	7.9	1.8	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	4.0	11.1	18.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	8.4	0.7	2.5	2.2	0.0	0.0	0.0	0.0	0.0	79.2	0.0	0.0
29	24.0		3.8	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7
30	10.2		1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	31.9		9.5		0.0		0.0	0.0		0.0		0.0
Total	569.6	305.7	266.7	93.5	4.8	0.0	7.2	0.0	0.4	81.3	92.1	92.8

Total 1,514.1

Chichiri Daily Rainfall Data for 2000

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	7.3	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
2	0.0	86.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.5
5	5.5	0.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.4	23.9
6	0.0	0.8	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	21.9
7	0.0	0.0	0.8	0.0	14.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	7.2	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.2	0.0	3.5	0.0
9	23.0	3.0	1.7	12.2	2.9	0.0	0.0	0.0	0.0	0.0	0.2	0.0
10	32.9	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0
11	10.9	10.4	1.2	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	42.5	7.9	15.3	7.1	0.1	0.0	0.0	0.0	0.0	0.0	3.0	0.0
13	0.0	0.0	3.2	2.1	0.0	0.0	0.0	0.0	0.0	0.0	25.4	26.9
14	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.6
15	3.3	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	1.0
16	0.0	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0
17	23.0	27.0	0.0	4.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	27.3	0.0	6.9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	38.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5	0.0
20	0.0	0.0	15.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	20.8
23	0.0	0.0	6.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.2
24	0.0	67.7	29.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
25	22.0	6.2	32.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
26	36.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5	0.0
27	0.2	63.5	0.0	0.0	0.0	7.5	0.0	0.0	0.0	0.2	25.9	5.9
28	8.4	0.0	2.1	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.3	0.0
29	5.7	0.0	0.0	2.5	0.0	0.5	0.0	0.0	0.0	2.1	0.0	5.0
30	0.0		0.0	0.7	0.0	0.0	0.0	0.0	0.0	30.9	8.4	2.0
31	16.0		8.7		0.0		0.0	0.0		2.1		9.6
Total	312.2	283.8	127.7	32.1	22.4	9.9	0.0	0.0	0.2	35.3	153.1	173.3

Total 1,150.0

Chichiri Daily Rainfall Data for 2001

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	1.2	8.0	7.4	4.0	0.0	0.0	0.0	0.7	0.0	0.0	9.5	0.0
2	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.7	0.0	1.5	23.9	0.0	0.0	0.0	0.0	0.0	0.0	5.8	1.0
4	0.1	13.5	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
5	0.0	6.9	42.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	4.9
6	0.0	10.3	0.3	4.0	0.0	1.2	0.0	1.7	0.0	0.0	0.0	0.0
7	0.0	18.7	0.0	0.0	9.2	0.0	0.0	0.4	0.0	0.0	0.0	16.8
8	0.0	49.7	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0
9	0.0	2.3	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
10	0.0	4.5	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	48.5
11	1.7	3.6	8.0	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	1.8	11.2	4.8	1.6	5.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0
13	27.8	1.5	1.7	1.8	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	16.0	0.0	13.1	4.4	0.6	0.0	0.1	0.0	0.0	0.0	6.8	2.2
15	11.3	13.1	0.0	0.0	0.0	0.0	0.4	0.0	15.9	0.0	0.0	0.0
16	1.7	6.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	19.3	95.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.1	21.0
18	7.2	45.1	13.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.5	0.1
19	0.0	9.2	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
20	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.6	55.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	44.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.6	32.1
23	0.0	33.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	21.0
24	0.0	24.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	4.8	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.9
27	13.1	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7
28	7.0	1.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	26.8
29	1.4		0.0	0.0	1.5	0.0	2.2	0.0	0.0	0.0	0.0	20.2
30	12.6		4.4	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	2.3
31	41.3		4.0		0.0		0.0	0.0	0.0	0.0		0.6
Total	175.6	390.1	261.6	48.0	17.5	2.2	3.9	4.0	15.9	23.0	90.6	247.4

Total	1,279.8

Chichiri Daily Rainfall Data for 2002

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	1.8	107.0	0.0	1.2	0.0	3.0	0.0	0.0	0.0	0.0	0.0
2	3.6	30.6	0.0	0.0	0.0	0.0	8.0	0.5	0.0	0.0	0.0	0.0
3	0.0	52.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0	0.0
4	0.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7
5	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.2
6	0.0	0.0	78.0	9.7	0.0	0.0	0.0	0.0	12.2	1.6	1.6	0.0
7	0.0	0.0	10.0	31.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	10.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0
9	4.9	0.0	31.0	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	13.3
10	0.0	0.0	31.0	0.0	0.4	0.0	0.0	0.0	2.2	0.0	0.0	67.0
11	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.1	0.1	7.7
12	17.4	0.0	0.0	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0	62.5
13	24.0	0.0	2.0	4.9	0.0	0.0	0.0	0.0	0.7	0.0	0.0	4.1
14	39.7	0.0	112.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0
15	7.1	0.0	14.0	45.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0
16	0.0	0.0	0.0	39.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	28.8	3.2	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	3.5	46.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
19	0.0	0.0	27.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.1
20	82.0	1.5	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.1	0.1	8.8
21	0.9	0.0	32.7	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	7.5
22	1.6	0.0	14.2	0.0	0.0	9.0	0.0	0.0	0.0	0.5	0.5	1.1
23	0.0	12.8	13.0	1.2	0.0	0.0	0.0	0.7	0.0	0.0	0.0	15.9
24	0.0	0.0	43.0	0.0	0.0	0.0	0.0	10.3	0.0	25.0	25.0	46.2
25	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.9
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	19.5	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	14.1		94.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	25.5		0.0		0.0		0.0	0.0	0.0	0.0		0.0
Total	274.8	199.4	646.9	137.1	8.0	15.5	11.0	15.3	16.4	28.0	28.0	297.1

Total	1,677.5

Chichiri Daily Rainfall Data for 2003

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	23.3	32.9	15.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	35.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	19.5	30.0	0.9	0.0	0.0	0.0	0.7	0.0	3.6	0.0	0.0	0.0
4	7.2	56.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0
5	9.8	1.3	1.7	2.9	0.0	0.0	3.2	0.0	0.0	0.0	0.0	0.0
6	0.0	18.7	0.0	1.0	0.0	0.0	4.7	0.0	0.0	0.0	14.0	0.0
7	0.0	1.5	22.4	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0
8	5.2	32.7	23.1	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	1.0
9	21.0	15.7	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	9.4	6.2	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	0.0	0.0
11	49.3	1.3	0.8	0.5	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
12	0.1	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.1
13	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.2	0.0	0.0	0.0
15	0.0	0.0	0.0	0.5	7.4	0.0	0.0	0.0	0.0	0.0	0.0	1.7
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.1	0.0
17	0.0	32.3	36.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	3.9	0.0	0.0	1.3	0.6	0.5	0.0	0.0	0.0	0.0	0.8	0.0
19	12.7	0.0	0.0	0.0	2.7	1.4	0.0	0.0	0.0	0.0	0.0	2.3
20	2.2	0.0	27.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.8
21	3.3	14.2	13.0	0.0	0.0	0.0	0.0	1.0	0.0	0.2	0.0	0.0
22	0.5	37.5	3.7	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0
23	14.5	1.5	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
24	2.8	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	10.3	2.1	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	16.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.4
27	0.0	0.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.3
28	0.0	0.0	8.1	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	18.1
29	6.3		1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	2.7		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
31	8.9		11.9		0.0		0.0	0.0	0.0	0.0		0.0
Total	247.9	301.5	207.8	6.9	11.2	7.2	15.1	4.0	3.8	0.2	23.5	82.1

Total	911.2

Chichiri Daily Rainfall Data for 2004

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	0.0	0.0	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
3	0.0	14.6	12.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0
4	0.0	0.0	47.4	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	15.5	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	1.3
6	0.0	0.0	34.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	6.1
7	2.8	0.0	0.0	39.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	1.4	0.0	0.0	31.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	10.9	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	4.0
10	1.4	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	8.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	18.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	36.9	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	19.4	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
15	7.6	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
16	0.0	24.5	0.0	2.9	0.0	0.0	0.0	0.0	0.0	0.0	8.1	1.5
17	0.0	0.0	0.0	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	21.6	0.0	12.6	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.8	0.0
19	3.9	38.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	22.1	2.1	0.0	27.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	38.5	3.3	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.2	0.0	0.0
22	16.4	21.4	0.0	0.0	0.2	0.0	0.0	3.0	0.0	0.0	0.0	7.4
23	0.4	13.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	5.2
24	0.0	0.0	0.0	1.1	1.3	0.0	0.0	0.0	0.0	0.0	0.0	83.0
25	5.9	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1
26	15.5	0.0	0.0	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.1
27	0.9	0.0	0.0	0.0	5.3	0.0	0.0	0.0	0.1	0.0	0.0	23.0
28	19.8	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.5
29	9.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0
30	22.0		5.1	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.6	0.0
31	19.3		21.0		3.5		0.0	0.0	0.0	0.0		26.0
Total	246.7	184.7	171.5	120.3	20.5	0.0	0.0	4.0	0.4	0.2	23.5	274.4

Total	1,046.2

Chichiri Daily Rainfall Data for 2005

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
2	0.0	0.0	0.0	7.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
3	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0	0.0	0.0	0.0	2.0
6	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.5
7	4.4	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	0.0
8	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	31.0
9	39.2	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.0
10	13.0	10.3	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0
12	1.5	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
13	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
14	0.7	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.5
15	0.5	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.9
16	0.0	24.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.4
17	4.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0
18	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	47.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	0.0
21	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5
22	12.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.5
24	22.5	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5
25	15.0	5.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	0.0	0.0	11.5
26	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
27	10.5	46.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.5	30.0
28	1.4	3.5	0.0	1.0	0.0	0.0	0.0	0.0	28.0	0.0	6.0	0.0
29	4.3		0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	9.0	28.5
30	0.0		0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	9.5	8.5
31	0.0		0.0		0.0	0.0	0.0	0.0		0.0		14.5
Total	215.6	103.8	6.2	15.5	0.0	3.4	11.8	0.0	29.7	0.0	81.9	261.6

Total	729.5

Chichiri Daily Rainfall Data for 2006

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	26.0	5.3	22.3	7.5	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0
2	12.5	4.8	7.0	0.5	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	1.5	0.0	11.0	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	5.5	23.0	11.5	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0
5	0.0	3.9	25.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.6
6	78.5	17.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.2	2.1	14.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8
8	0.0	0.0	1.2	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	20.0
9	0.0	0.0	22.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5
10	13.9	0.0	0.0	1.5	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0
11	9.0	7.1	4.5	1.5	0.0	0.0	0.0	0.0	0.0	0.0	7.1	2.6
12	2.0	0.0	28.5	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	13.4
13	9.5	19.6	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	18.0	14.0
14	21.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.6	12.0
15	15.0	14.9	3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.5	22.0
16	28.0	16.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0
17	0.0	0.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0
18	1.8	46.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	15.9
19	0.0	4.1	7.3	1.5	0.0	0.0	0.0	0.0	0.0	0.4	0.0	1.9
20	2.2	1.5	0.0	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
21	7.0	10.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	1.3	0.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	0.0
23	0.0	7.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0
24	3.0	0.9	5.5	0.0	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	36.5	51.5	6.2	1.5	0.0	0.0	0.0	0.0	0.0	0.0	37.5	0.5
26	21.8	48.5	11.5	0.8	0.0	4.5	0.0	0.0	0.0	0.0	6.2	13.6
27	3.7	1.2	0.5	1.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.7
28	0.5	0.0	28.0	1.2	0.0	0.0	0.0	0.0	0.0	1.5	0.0	16.4
29	0.0		14.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
30	0.0		0.0	0.0	0.0	0.0	0.0	0.0	28.5	0.0	0.0	0.0
31	0.0		0.0		0.0	0.0	0.0	0.0		0.0		25.0
Total	300.4	289.4	249.3	83.7	2.8	5.7	3.4	0.0	30.0	1.9	186.0	216.3

Total	1,368.9

Chichiri Daily Rainfall Data for 2007

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	30.1	5.0	0.0	11.3	0.0	1.0	0.0	0.0	0.0	0.0	1.0	4.5
2	16.4	30.5	0.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	4.5	52.0
3	24.9	0.0	2.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	1.5
4	1.9	0.5	0.5	0.0	0.9	0.0	1.0	0.0	0.0	0.0	0.0	0.0
5	31.2	0.0	0.0	0.0	2.5	0.0	0.0	2.0	0.0	0.0	0.0	9.0
6	23.2	0.0	9.8	0.0	5.7	0.0	0.0	0.5	0.0	0.0	0.0	0.0
7	1.8	0.0	15.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	21.9	0.0	7.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	4.5	2.0
9	2.2	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	7.5
10	0.0	9.6	1.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	6.5	25.5
11	0.9	18.5	22.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
12	0.0	58.4	32.8	2.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	8.0
13	0.0	16.5	0.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.0
14	0.7	0.0	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	2.5
16	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	6.5	0.0	1.5	0.0	0.0	3.5	0.0	9.0	0.0
18	12.6	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	16.8
19	102.1	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	19.0
20	4.9	0.0	0.0	10.5	0.0	2.0	0.0	0.0	0.0	0.0	0.0	2.5
21	4.8	39.5	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.0
22	0.0	12.6	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	17.3
23	0.0	14.0	4.5	0.0	0.0	0.5	0.0	0.0	0.0	13.5	0.0	34.0
24	0.0	30.6	5.0	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	73.0
25	0.5	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
26	13.6	28.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
27	0.7	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	25.8
28	16.4	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	4.0
29	3.8		1.5	0.0	0.0	0.0	0.0	0.0	0.0	4.0	6.0	18.6
30	0.0		36.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5
31	25.0		1.5		0.0	0.0	0.0	0.0	0.0	0.0		0.0
Total	339.6	269.9	160.9	32.5	9.5	10.0	16.1	2.5	3.5	20.0	50.8	374.2

Total	1,289.5

Chichiri Daily Rainfall Data for 2008

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.5	3.0
2	0.0	0.0	14.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	3.7	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	10.0
4	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
5	0.0	1.5	47.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0
6	1.5	0.0	12.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.5	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0
8	0.0	6.7	17.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	10.0	2.0	0.0	0.0	0.0	6.5	0.0	0.0	0.0	0.0	0.0	12.0
10	26.5	9.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	15.5
11	26.0	0.0	17.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0
12	33.5	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	1.0
13	19.3	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0
14	19.8	0.0	4.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0	5.0	16.5
15	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	2.6
16	14.0	0.0	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5
17	16.7	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.0
18	3.0	0.0	0.0	0.0	1.3	0.0	0.0	4.6	0.0	0.0	0.0	21.2
19	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	5.5
20	37.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5
21	3.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	0.0	0.0
22	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.0	0.0
23	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	46.5
24	36.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0
25	0.0	0.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0
26	30.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.5
27	3.2	7.7	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0
28	8.0	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.2
29	2.4	35.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	24.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	3.4		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3
Total	396.5	68.4	127.1	0.0	1.3	8.8	4.1	15.6	0.0	13.5	36.0	333.8

Total	1,005.1

(2) 雨量統計データから確率雨量の算出（正規分布法）

① 順位	② Xi 降雨量	③ logXi	④ Xi+b	⑤ log(Xi+b)	⑥ {log(Xi+b)}^2
1	126.0	2.1004	176.9783	2.2479	5.0531
2	112.0	2.0492	162.9783	2.2121	4.8935
3	102.1	2.0090	153.0783	2.1849	4.7738
4	95.0	1.9777	145.9783	2.1643	4.6841
5	86.0	1.9345	136.9783	2.1367	4.5653
6	83.0	1.9191	133.9783	2.1270	4.5243
7	78.5	1.8949	129.4783	2.1122	4.4614
8	60.0	1.7782	110.9783	2.0452	4.1830
9	56.0	1.7482	106.9783	2.0293	4.1180
10	47.5	1.6767	98.4783	1.9933	3.9734
11					
12					
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39					
40					
41					
42					
43					
計	846.1	19.0878		21.2530	45.2300
計/n	84.61	1.9088		2.12530	4.52300
				(Xo)	(X^2)

摘　要

$$logXo=\frac{\Sigma logXi}{n}=1.90878$$

∴ Xo= 81.0554

	Xs	Xt	$b=\frac{Xs\cdot Xt-Xo^2}{2Xo-(Xs+Xt)}$
1	126.0	47.5	51.361
2	112.0	56.0	50.595
3			
4			
計			101.957

平均 b＝ 101.9566/2= 50.97832

ﾃﾞｰﾀ数10個の10%は、1であるので、
2対のXs,Xtを用いる

$\sqrt{2}\sigma$ ＝ 0.11642

確率年	確率雨量X	
2	82.466 mm/day	
3	93.819	（側溝用）
4	100.666	
5	105.547	（横断管用）
10	119.160	（渡河部用）
20	131.289	
30	137.940	
40	142.511	
50	145.990	
100	156.758	

流達時間t＝10minとして上記日降雨量を
下式により時間降雨量に変換する。

$X' = (24 * 60 / t)^{(2/3)} * X/24$

超過確率定数値計算表

確率年	再現確率	基準確率変量	備考
2	1/2	0.00000	
3	1/3	0.30457	
4	1/4	0.47694	
5	1/5	0.59512	
10	1/10	0.906194	
20	1/20	1.163088	
30	1/30	1.296788	
40	1/40	1.385977	
50	1/50	1.452452	
100	1/100	1.651006	

確率年	時間降雨量X'	
2	94.400 mm/hour	
3	107.396	（側溝用）
4	115.234	
5	120.822	（横断管用）
10	136.404	（渡河部用）
20	150.289	
30	157.902	
40	163.135	
50	167.117	
100	179.443	

(3) 排水路設計条件

	No.	Chainage	Gradient	Distance (m)	Catchment Width (m)	Catchment Area(ha)	Remarks
Side Ditch	S-1	34+35 – 36+90	6.70%	255	10	1.13	
	S-2	36+90 – 41+30	4.70% ↙	440	10	0.70	
	S-3	41+30 – 45+60	0.86%	430	10	0.43	
	S-4	45+60 – 48+70	2.10% ↘	310	10	0.31	
	S-5	48+70 – 52+30	1.82% ↙	360	10	0.36	
	S-6	52+30 – 55+50	1.86% ↘	320	10	0.32	
	S-7	55+50 – 60+80	5.30% ↙	530	10	0.53	
	S-8	60+80 – 63+20	4.56% ↘	240	10	0.24	
	S-9	63+20 – 64+80	7.80%	160	10	0.40	
	S-10	64+80 – 66+00	5.00% ↙	120	10	0.12	
	S-11	66+00 – 67+50	3.80% ↘	150	10	0.15	
	S-12	67+50 – 68+40	7.40% ↙	90	10	0.09	
	S-13	68+40 – 70+30	0.40% ↘	190	10	0.19	
	S-14	70+30 – 71+20	7.50% ↙	90	10	0.09	
	S-15	71+20 – 72+90	0.20% ↘	170	10	0.17	
	S-16	72+90 – 73+70	4.20%	80	10	0.25	
	S-17	73+70 – 74+90	2.44%	120	10	0.42	
	S-18	74+90 – 75+40	6.70% ↙	50	10	0.30	
	S-19	75+40 – 76+90	4.50%	150	10	0.25	
	S-20	76+90 – 77+90	0.50%	100	10	0.10	
Cross Drainage	C-1	48+70	0.50%			0.67	(S-4)+(S-5)
	C-2	55+50	0.50%			0.85	(S-6)+(S-7)
	P-1	64+80	0.50%			10.00	*River Sec.
	P-2	67+50	0.50%			10.00	*Ricer Sec.
	C-3	70+30	0.50%			0.28	(S-13)+(S-14)
	C-4	73+70	0.50%			1.49	SUM(S-15~S-20)

(4) 雨水流出量の計算

表－雨水流出量の計算 （側溝）

No.	Catchments Area A	Return Period	Reinfall R	Discharge Coefficient	Discharge Q
	ha		mm/hr	C	cu.m/sec
路面、商業地域	0.5	3	107.4	0.80	0.119
	1.0	3	107.4	0.80	0.239
	1.5	3	107.4	0.80	0.358
	2.0	3	107.4	0.80	0.477
C=0.8	2.5	3	107.4	0.80	0.597
	3.0	3	107.4	0.80	0.716
	3.5	3	107.4	0.80	0.835
	4.0	3	107.4	0.80	0.955
	4.5	3	107.4	0.80	1.074
	5.0	3	107.4	0.80	1.193
	0.5	3	107.4	0.60	0.090
	1.0	3	107.4	0.60	0.179
住宅地域	1.5	3	107.4	0.60	0.269
	2.0	5	107.4	0.60	0.358
	2.5	3	107.4	0.60	0.448
C=0.6	3.0	3	107.4	0.60	0.537
	3.5	3	107.4	0.60	0.627
	4.0	3	107.4	0.60	0.716
	4.5	5	107.4	0.60	0.806
	5.0	3	107.4	0.60	0.895
	0.5	3	107.4	0.40	0.060
	1.0	3	107.4	0.40	0.119
間地庭園の多い	1.5	3	107.4	0.40	0.179
住宅地域	2.0	5	107.4	0.40	0.239
	2.5	3	107.4	0.40	0.298
	3.0	3	107.4	0.40	0.358
C=0.4	3.5	3	107.4	0.40	0.418
	4.0	3	107.4	0.40	0.477
	4.5	5	107.4	0.40	0.537
	5.0	3	107.4	0.40	0.597

表－雨水流出量の計算 （横断管）

No.	Catchments Area A	Return Period	Reinfall	Discharge Coefficient	Discharge Q
	ha		mm/hr	C	cu.m/sec
路面、商業地域	0.5	5	120.8	0.80	0.134
	1.0	5	120.8	0.80	0.268
	1.5	5	120.8	0.80	0.403
	2.0	5	120.8	0.80	0.537
C=0.8	2.5	5	120.8	0.80	0.671
	3.0	5	120.8	0.80	0.805
	3.5	5	120.8	0.80	0.940
	4.0	5	120.8	0.80	1.074
	4.5	5	120.8	0.80	1.208
	5.0	5	120.8	0.80	1.342
	0.5	5	120.8	0.60	0.101
	1.0	5	120.8	0.60	0.201
住宅地域	1.5	5	120.8	0.60	0.302
	2.0	5	120.8	0.60	0.403
	2.5	5	120.8	0.60	0.503
C=0.6	3.0	5	120.8	0.60	0.604
	3.5	5	120.8	0.60	0.705
	4.0	5	120.8	0.60	0.805
	4.5	5	120.8	0.60	0.906
	5.0	5	120.8	0.60	1.007
	0.5	5	120.8	0.40	0.067
	1.0	5	120.8	0.40	0.134
間地庭園の多い	1.5	5	120.8	0.40	0.201
住宅地域	2.0	5	120.8	0.40	0.268
	2.5	5	120.8	0.40	0.336
	3.0	5	120.8	0.40	0.403
C=0.4	3.5	5	120.8	0.40	0.470
	4.0	5	120.8	0.40	0.537
	4.5	5	120.8	0.40	0.604
	5.0	5	120.8	0.40	0.671

※）Q=A*R*C／360

(5) 排水量の計算

表- 排水計算(管路)

No.	Pipe Dia. φ(m)	Roughness n	Catchments Area (ha)	Return Period	Rainfall (mm/hr)	Discharge Coefficient	Discharge Q(m3/sec)	Gradient i(%/100)	Velocity V(m/sec)	W. Depth (m)	Sec. Area (m^2)	R (m)	Spec.	Remarks
S-1	0.594	0.013	1.5	3	107.4	0.8	0.358	0.067	4.542	0.194	0.079	0.109	DP-600	Side Ditch, (34+35~36+90)
S-2	0.594	0.013	1.0	3	107.4	0.8	0.239	0.047	3.567	0.173	0.067	0.099	DP-600	Side Ditch, (36+90~41+30)
S-3	0.594	0.013	0.5	3	107.4	0.8	0.119	0.009	1.593	0.187	0.075	0.106	DP-600	Side Ditch, (41+30~45+60)
S-4	0.594	0.013	0.5	3	107.4	0.8	0.119	0.021	2.192	0.149	0.054	0.087	DP-600	Side Ditch, (45+60~48+70)
S-5	0.594	0.013	0.5	3	107.4	0.8	0.119	0.018	2.083	0.154	0.057	0.090	DP-600	Side Ditch, (48+70~52+30)
S-6	0.594	0.013	0.5	3	107.4	0.8	0.119	0.019	2.099	0.153	0.057	0.090	DP-600	Side Ditch, (52+30~55+50)
S-7	0.594	0.013	1.0	3	107.4	0.8	0.239	0.053	3.725	0.168	0.064	0.096	DP-600	Side Ditch, (55+50~60+80)
S-8	0.594	0.013	0.5	3	107.4	0.8	0.119	0.046	2.886	0.123	0.041	0.074	DP-600	Side Ditch, (60+80~63+20)
S-9	0.594	0.013	0.5	3	107.4	0.8	0.119	0.078	3.488	0.107	0.034	0.065	DP-600	Side Ditch, (63+20~64+80)
S-10	0.594	0.013	0.5	3	107.4	0.8	0.119	0.050	2.981	0.120	0.040	0.072	DP-600	Side Ditch, (64+80~66+60)
S-11	0.594	0.013	0.5	3	107.4	0.8	0.119	0.038	2.705	0.128	0.044	0.077	DP-600	Side Ditch, (66+60~67+50)
S-12	0.594	0.013	0.5	3	107.4	0.8	0.119	0.074	3.423	0.109	0.035	0.066	DP-600	Side Ditch, (67+50~68+40)
S-13	0.594	0.013	0.5	3	107.4	0.8	0.119	0.004	1.208	0.229	0.098	0.124	DP-600	Side Ditch, (68+40~70+30)
S-14	0.594	0.013	0.5	3	107.4	0.8	0.119	0.075	3.440	0.108	0.035	0.066	DP-600	Side Ditch, (70+30~71+20)
S-15	0.594	0.013	0.5	3	107.4	0.8	0.119	0.002	0.937	0.278	0.127	0.142	DP-600	Side Ditch, (71+20~72+90)
S-16	0.594	0.013	0.5	3	107.4	0.8	0.119	0.042	2.803	0.125	0.042	0.075	DP-600	Side Ditch, (72+90~73+70)
S-17	0.594	0.013	0.5	3	107.4	0.8	0.119	0.024	2.299	0.144	0.052	0.085	DP-600	Side Ditch, (73+70~74+90)
S-18	0.594	0.013	0.5	3	107.4	0.8	0.119	0.067	3.306	0.111	0.036	0.068	DP-600	Side Ditch, (74+90~75+40)
S-19	0.594	0.013	0.5	3	107.4	0.8	0.119	0.045	2.872	0.123	0.041	0.074	DP-600	Side Ditch, (75+40~76+90)
S-20	0.594	0.013	0.5	3	107.4	0.8	0.119	0.005	1.310	0.216	0.091	0.118	DP-600	Side Ditch, (76+90~77+90)
C-1	0.594	0.013	1.0	5	120.8	0.8	0.268	0.005	1.615	0.344	0.166	0.162	DP-600	Cross Drainage, (48+70)
C-2	0.594	0.013	1.0	5	120.8	0.8	0.268	0.005	1.615	0.344	0.166	0.162	DP-600	Cross Drainage, (55+50)
C-3	0.594	0.013	0.5	5	120.8	0.8	0.134	0.005	1.354	0.230	0.099	0.124	DP-600	Cross Drainage, (70+30)
C-4	0.594	0.013	1.5	5	120.8	0.8	0.403	0.005	1.736	0.463	0.232	0.180	DP-600	Cross Drainage, (73+70)
P-1	1.460	0.013	10.0	50	136.4	0.8	3.031	0.005	2.959	0.859	1.024	0.401	DP-1500	River Crossing, (64+80)
P-2	1.460	0.013	10.0	50	136.4	0.8	3.031	0.005	2.959	0.859	1.024	0.401	DP-1500	River Crossing, (67+50)

※)開水路区間は断面積が管路より大きく、安全側となるため計算は省略する。