FEASIBILITY AND ENVIRONMENTAL IMPACT STUDIES FOR TRANSPORT INFRASTRUCTURE PROJECTS IN MALTA
FINAL FEASIBILITY STUDY REPORT

CONTENTS OF FINAL FEASIBILITY STUDY REPORT **page**

[1] This is the main technical report.
[2] This volume (in several parts, due to size, if effectively the Annexes to Tech. Appendix Volume IV

0. OUTLINE

Over the last 15 years or so, parts of the network's infrastructure have been upgraded in order to increase capacity, however growth in transport demand has continue, in some cases, at a higher level than that originally forecast, and inevitably weak links and traffic bottlenecks in combined transport are already reappearing.

In April 2001, the European Commission contacted the Vienna-based TINA Office to carry out a Transportation Infrastructure Needs Assessment for road, sea and air transport in Malta. The TINA study has now been completed having taken full account of the provisions of Decision No. 1692/96/EC on the Community guidelines for the development of the Trans-European transport network.

Council Regulations (EC) No. 2236/95 on TENS financing sets out the rules for Community aid in this field. Among other criteria, it is stated that projects shall only be selected for financial support from the Community if they are economically viable and environmentally sustainable.

The wider objective of this study is to provide supporting information to the TINA final report in line with Council Regulation EC 2236/95 that lays down the general rules for the granting of Community financial aid in the field of Trans-European Network for possible co-financing through "Structural/Cohesion" funds. The study will take into account the Council and Parliament decisions on the development of TEN-T (1692/96 and 1346/2001).

Port Area (NA1)

View of Bridge R1-B1

This Final Feasibility Study Report has been prepared, as required under the Terms of Reference, at the end of the study period.

The project is economically beneficial.

As yet no known preconditions exist with relation to the implementation of the upgrading of the TEN-T network in Malta.

The programme (prior to construction) is governed by at least four main factors:

- Planning approval [including EIA approval of the preliminary design resulting from this study] of the works [on a link by link basis]
- Formal requirements [and procedures] for land acquisition [where needed] including compensation, on a link by link basis to match the works programme.
- Engineering and documentation requirements (including carrying out detailed design, preparation of tender documents, and the tendering and contract award procedures).
- Formal EC financing requirements [necessary paperwork relevant to the procedures to formally "acquire" the funds from EC], plus other external funding as necessary..

The environmental impact appraisal of the project is contained in the following two separate documents, which form part of the Final Feasibility Study Report:

Technical Appendix VIII. ENVIRONMENTAL IMPACT APPRAISAL
Technical Appendix IX. TECHNICAL ENVIRONMENTAL INFORMATION

Transport Infrastructure Projects, are designed to tackle the contextual issues of improving safety, alleviating traffic congestion, and achieving wider economic growth, in order to prevent the existing highways contributing to long-term social, economic and environmental decline. The projects have been guided by Sustainable Development principles from the outset, utilising a checklist of sustainability factors relevant to transport, including consideration of the emerging draft Sustainable Development Strategy for the Maltese Islands. Moreover, the iterative environmental impact appraisal process has promoted highway design in response to environmental considerations.

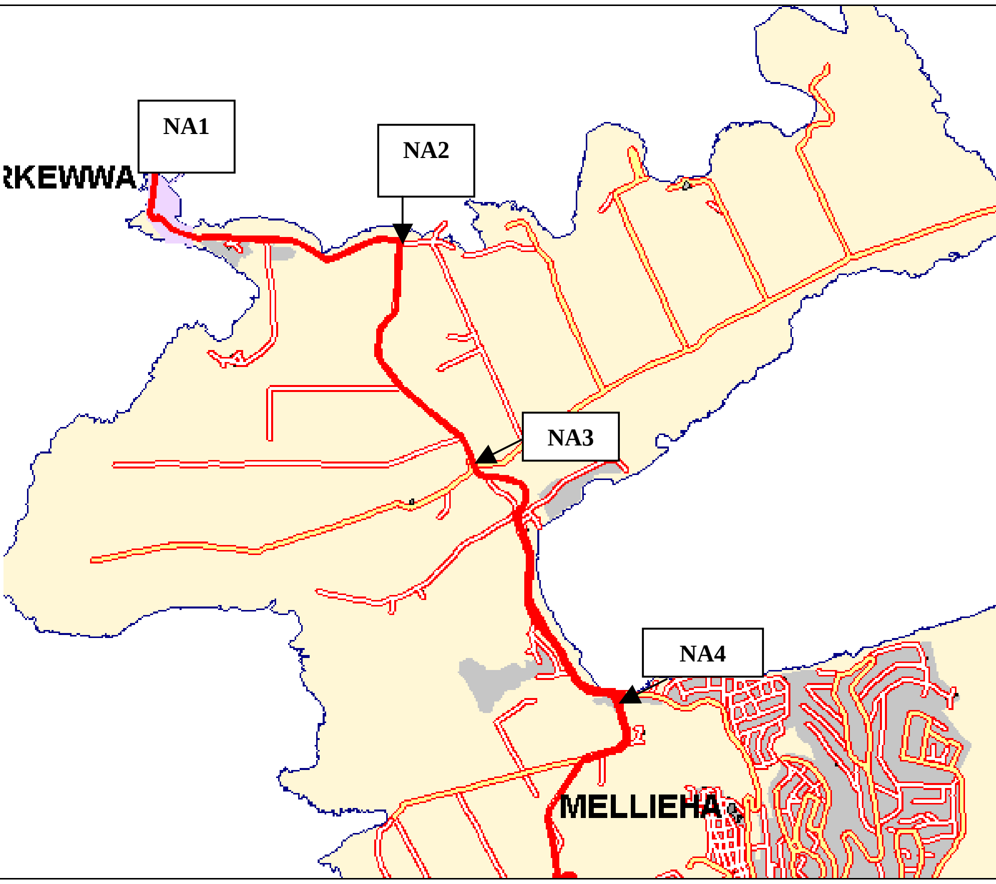
The Environmental Impact Appraisal report (Technical Appendix VIII) has identified the environmental issues associated with the proposed Transport Infrastructure Projects and provides information relating to potential environmental impacts and mitigation. The level of detail provided by the appraisal process corresponds with the outline proposals that have emerged from the Feasibility Study for Transport Infrastructure Projects in Malta and the appraisal report provides an initial foundation for future planning decisions regarding the projects.

The 'environment' is a complex multi-dimensional resource; environmental impacts therefore relate to a range of separate but interrelated considerations. In broad terms, impacts are a function of the magnitude of a proposed change and the sensitivity of the receiving environment and composite parameters, or receptors. Importantly, the value attributed to the environment by Maltese society, through the Government policy and planning framework, has been reflected in the appraisal process.

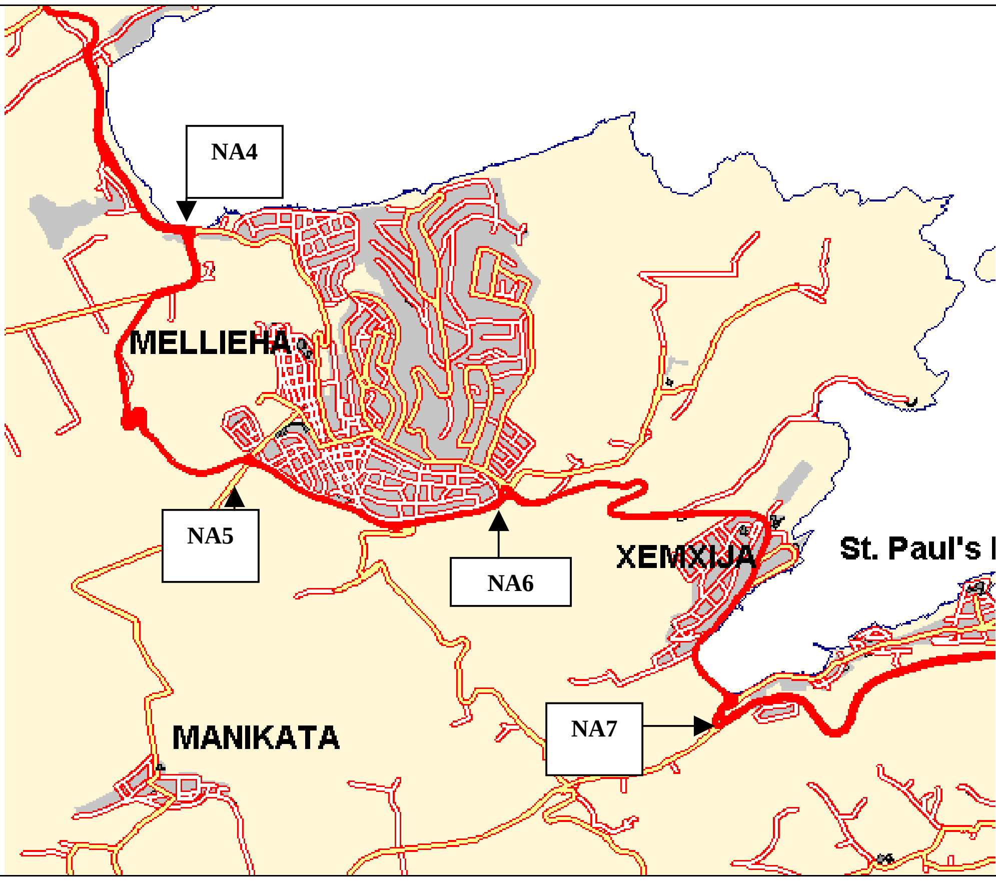
The value placed on the environment plays a significant part in the evaluation of environmental sensitivity. As for other environmental resources, this applies in the case of protected natural, semi-natural, historic and cultural features. It follows that those sections of the proposals that fall within areas that retain such characteristics, principally the rural areas between Cirkewwa Ferry Port (NA1) and the edge of Malta's largest urban conurbation (NA11), are potentially sensitive to highway development. Although the proposed change may not necessarily be great in these areas, and mitigation measures have the potential to minimise or overcome environmental impacts, inherent environmental sensitivity means that a proposal here is more likely to require rigorous evaluation in order to gain planning approval and comply with Legal Notice 204/2001 (Environmental Impact Assessment Regulations).

All of the proposed highway improvements are likely to result in environmental enhancements, such as improved water quality through the use of runoff treatment technology, greater public accessibility, and socio-economic benefits. In the urban and semi-urban areas, south of NA11, the existing environment has been heavily modified through modern development, with the exception of pockets of open land and historically or culturally important areas. Anticipated environmental benefits are therefore less likely to occur in tandem with issues surrounding the type of protected areas found in rural areas. However, a dense human population in close proximity to the highway proposals has implications for related environmental considerations, such as potential land use conflicts and varying forms of pollution (including noise and air quality issues). In many cases appropriate highway design and mitigation measures can limit or overcome such problems, however there are nonetheless potential environmental risks.

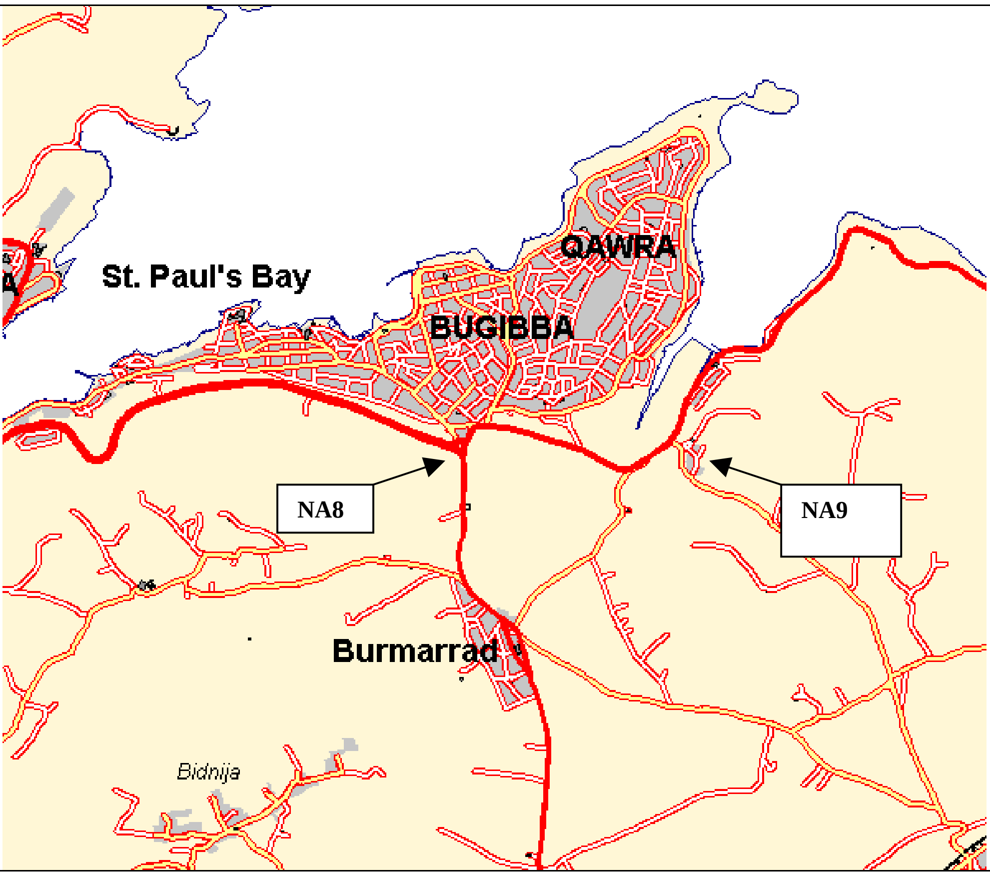
In general, proposals for improved highway infrastructure are more likely to meet with protracted planning procedures where the potential change is greatest – namely in the case of significant land take, vertical realignment of the highway, or large-scale demolition and reconstruction projects. Overall, the environmental implications of the proposals are complex, as described above, however transport is identified as one of the key sustainability issues in the draft Sustainable Development Strategy for the Maltese Islands and the proposed infrastructure improvements in Malta would make a contribution to progress associated objectives.



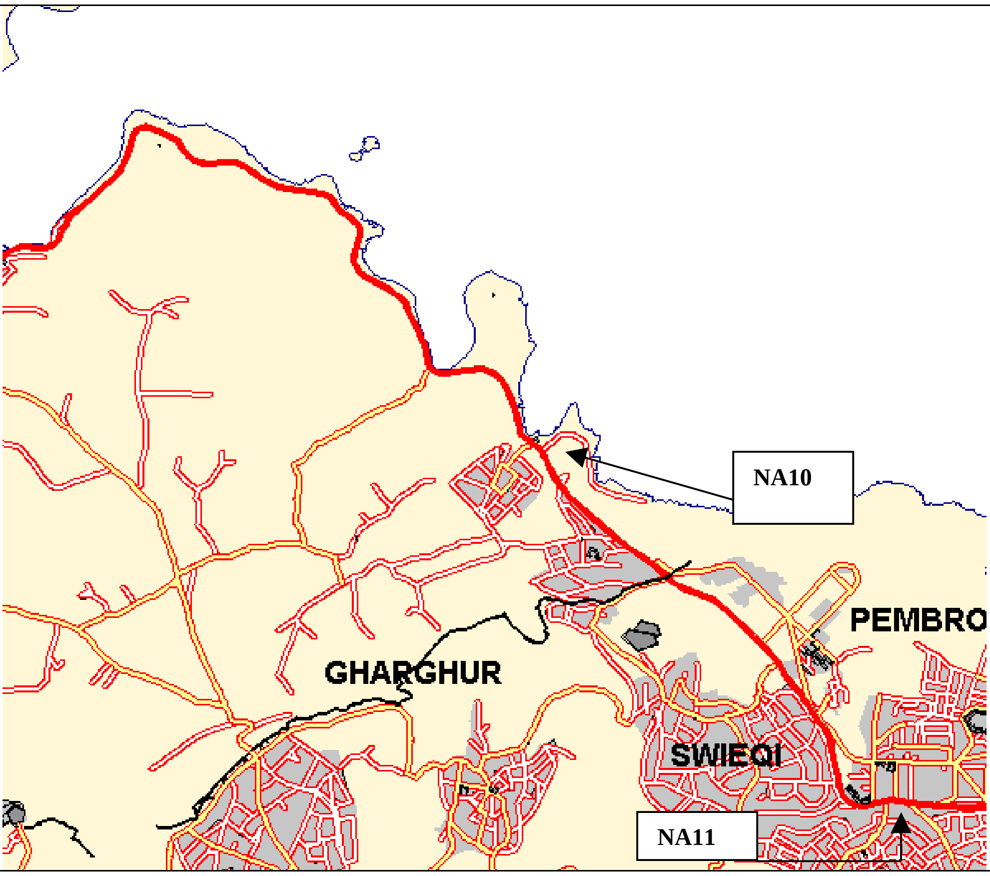
Plan 1: Route 1 Junctions NA1 to NA4



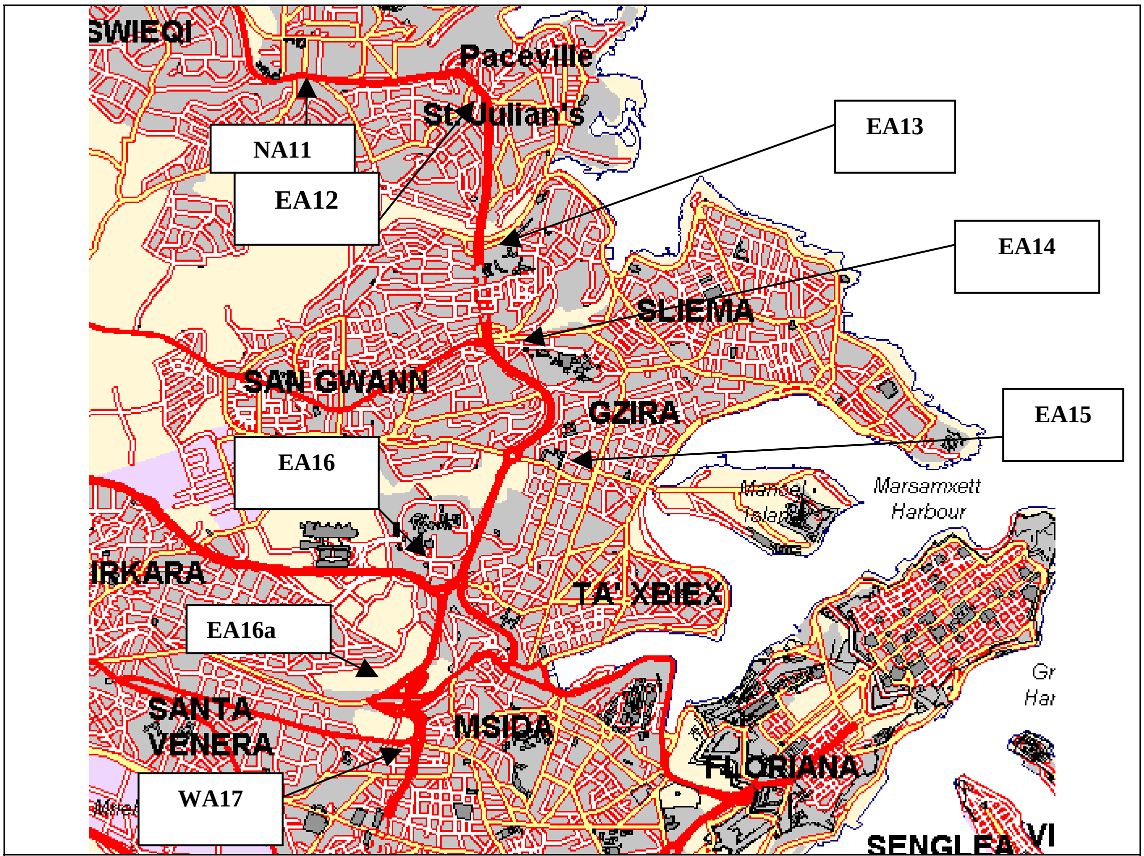
Plan 2: Route 1 Junctions NA4 to NA7 towards NA8



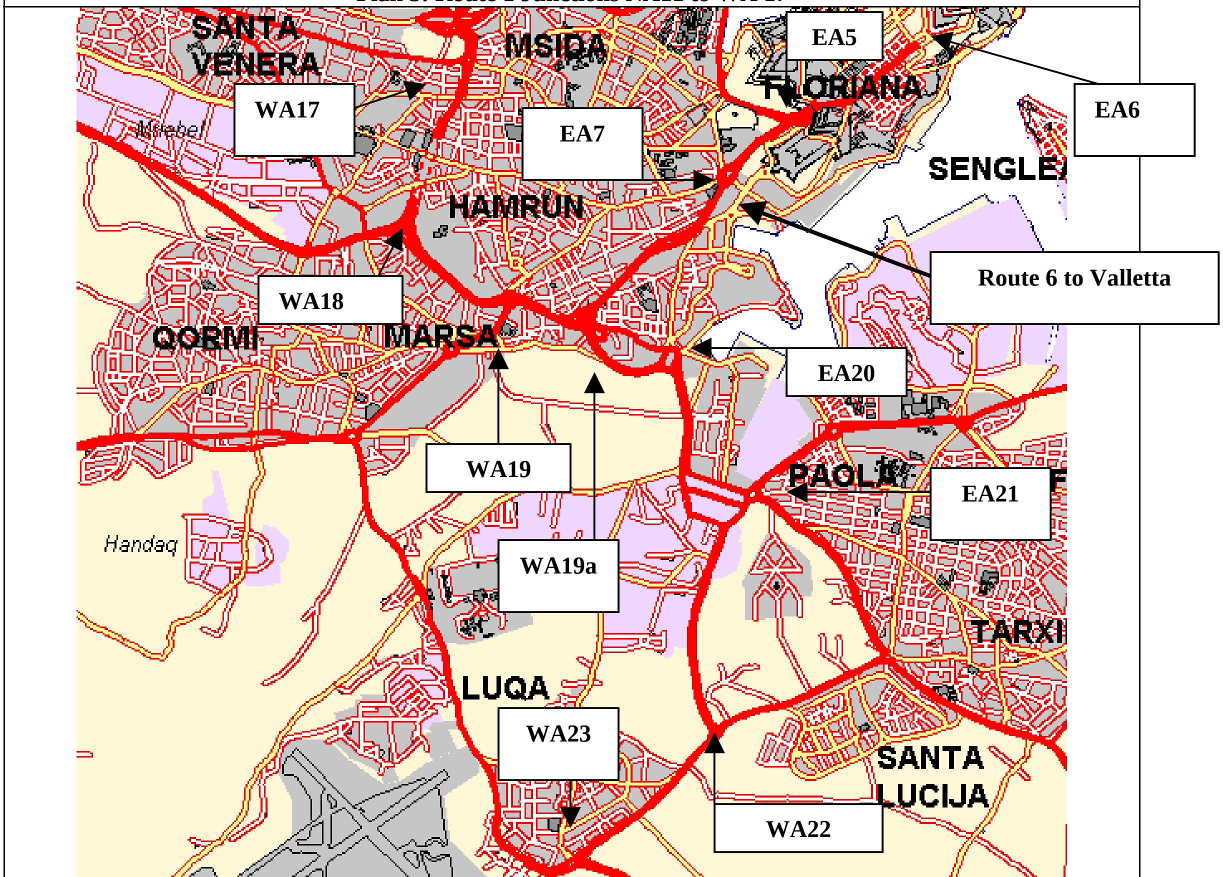
Plan 3: Route 1 Junctions NA8 to NA9 towards NA10



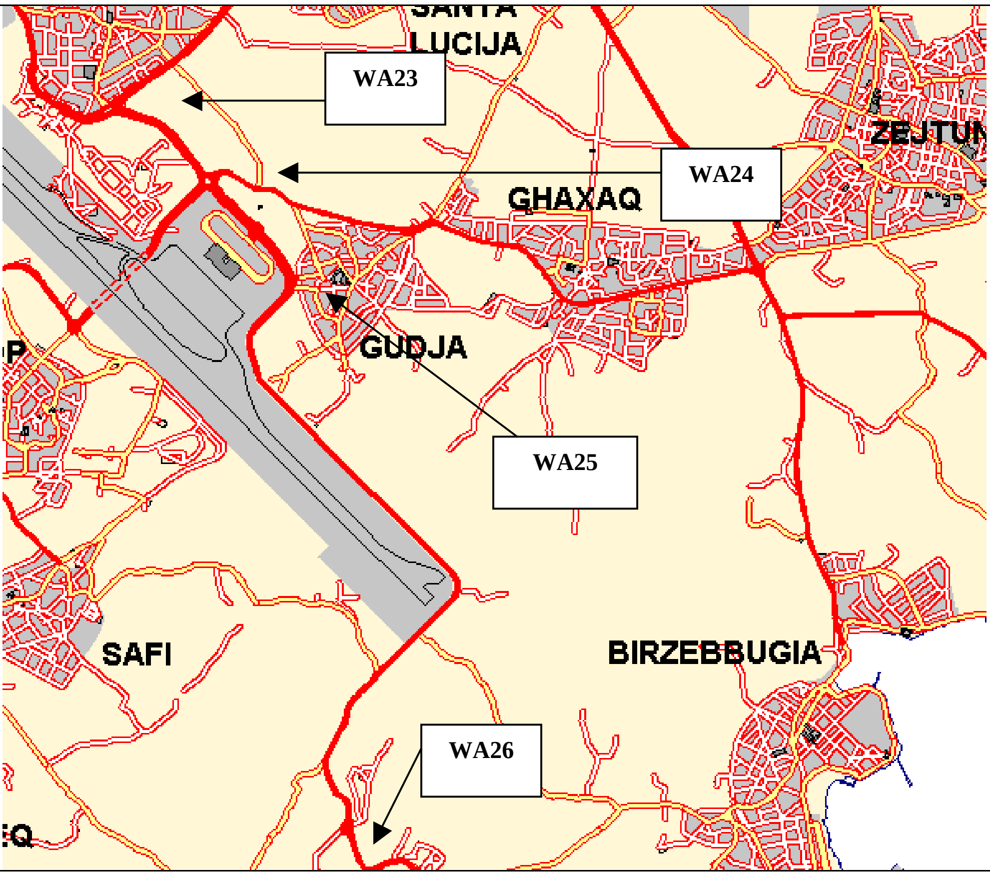
Plan 4: Route 1 Junctions NA10 to NA11



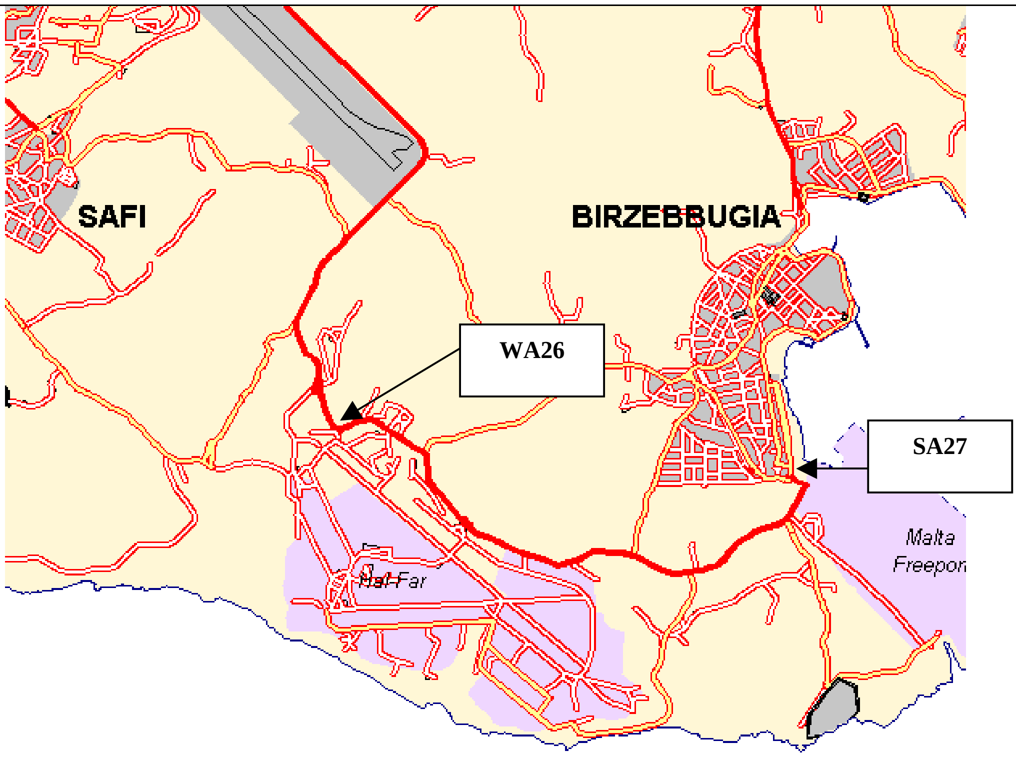
Plan 5: Route 1 Junctions NA11 to WA 17



Plan 6: Route 1 Junctions WA17 to WA23; and Route 1 Junctions WA19a to EA6



Plan 7: Route 1 Junctions WA23 to WA26



Plan 8: Route 1: Junctions WA26 to SA27

1. SUMMARY

1.1 INTRODUCTION

1.1.1 Country Background

Beneficiary Country	Contracting Authority
Malta	Government of Malta-Department of Contracts

Over the last 15 years or so, parts of the network's infrastructure have been upgraded in order to increase capacity, however growth in transport demand has continue, in some cases, at a higher level than that originally forecast, and inevitably weak links and traffic bottlenecks in combined transport are already reappearing.

In April 2001, the European Commission contacted the Vienna-based TINA Office to carry out a Transportation Infrastructure Needs Assessment for road, sea and air transport in Malta. The TINA study has now been completed having taken full account of the provisions of Decision No. 1692/96/EC on the Community guidelines for the development of the Trans-European transport network.

Council Regulations (EC) No. 2236/95 on TENS financing sets out the rules for Community aid in this field. Among other criteria, it is stated that projects shall only be selected for financial support from the Community if they are economically viable and environmentally sustainable.

Approaching NA3

Approaching NA3 [Red tower junction visible]

1.1.2 Current Administrative Situation

Road transport falls under the remit of ADT whose mission statement is given below.

To plan and provide for a high quality, safe, integrated, and efficient land transport system that will meet people's travelling needs in Malta within the national framework for economic development and protection of the environment.

1.1.3 Contract Objectives

Wider Objectives

To provide supporting information, to the Roads Master Plan and the TINA final report, in line with Council Regulation (EC) No.2236/95 that lays down the general rules for the granting of Community financial aid in the field of Trans-European network for possible co-financing through structural/cohesion funds. The results of the studies shall take into account the Council and Parliament decisions on the development of the TEN-T (Decision No. 1692/96/EC and its amendment Decision No. 1346/2001/EC).

Immediate Objectives

To prepare for ADT a pipeline complete of Economic Feasibility Studies and Environmental Impact Assessments for the upgrading of sections of Routes 1 and 6 as well as several potential extension project. These are identified in the TINA process, for upgrading and possible extension of the TEN-1 through eventual co-financing under structural / cohesion funding upon accession.

Expected Results

Feasibility Studies and Environmental Impact Assessment Studies are produced in accordance with the requirements described in this document. The Environmental Impact Assessment studies are accepted by the Malta Environment and Planning Authority and the European Commission Directorate-General for Environmental checks that the EIA has been carried out in linre with the requirements of Directive 85/337/EEC as amended by 97/11/EC.

1.1.4 Assumptions

TEN-T is to be expended to Malta and TENs financing regulations apply to Malta

TINA Study Final Report and Roads master Plan will serve as basis for these Feasibility and Environmental Impact Assessment Studies.

Southbound [approaching beachside section] – NA3 to NA4 section

Southbound [Beach side section] – NA3 to NA4 Section

1.1.5 Purpose of this Report

This Final Feasibility Report is submitted in response to the "Reports" section of the Terms of Reference (TOR) [Annex II of the Contract]. The requirement of the TOR in relation to the Final Feasibility (and the separate final Environmental Assessment) Reports is repeated below.

> *Latest (8) months from the beginning of the assignment. This report will include the results of the consultation process and present the final version of the feasibility studies.*

This part of the report includes the following sections[3]:

- Introduction [Section 1]
- Summary of TINA Document [Section 2]
- Existing Situation on Routes 1 and 6 (Base Case) [Section 3]
- Inception Report and Draft Feasibility Study Report [Section 4]
- Data Collection and Surveys for Feasibility Stage [Section 5]
- Traffic [Section 6]
- Accidents and Safety Audits [Section 7]
- Public Utilities [Section 8]
- Hydrology and Drainage [Section 9]
- Design Standards [Section 10]
- Pavement, Soils and Materials Investigations [Section 11]
- Survey of Affected Properties and Right of Way Requirements [Section 12]
- Survey of Existing Structures [Section 13]
- Identification of Alignment [Section 14]
- Preliminary Design [Section 15]
- Environmental Impact Appraisal [Section 16]
- Estimation of Quantities and Capital Cost [Section 17]

[3] These sections are essentially , other than Section 16, summaries of Technical Appendix IV

- Maintenance Plan, and Estimation of Maintenance Costs [Section 18]
- Economic Evaluation [Section 19]
- Selection of the preferred Option [Section 20]
- The Preferred Option [Section 21]
- Preconditions and Implementation [Section 22]
- Relevance and Sustainability [Section 23]
- Other Issues [Section 24]

The commencement of works on this contract is set as the 9th February 2004.

Southbound, close to junction NA5

Southbound, NA5 to NA6 section, leaving NA5, high walls to left

1.2 SUMMARY OF THE TINA DOCUMENT

The TINA [TINA a Common Transport Infrastructure Needs Assessment-Identification of the network components fora future Trans-European Transport Network] in MALTA] Final Report was produced in April 2002, and was drafted by Drafted by TINA VIENNA – Transport Strategies, Auerspergstrasse 15, 1082 - Vienna, Austria.

The TINA Main Network has been defined as follows (from West to East):

> **Victoria (capital of Gozo) – Mgarr (ferry station on Gozo) – Cirkewwa (ferry station on Malta) – Bugibba – St. Julian's – Marsa – Valletta (including the links to Grand Harbour; Passenger Sea Terminal) – Luqa (airport) – Birzebbugia (Freeport)[4]**

The overall network comprises: 1 airport, 5 ports (Valletta, Marsaxlokk, Cirkewwa, Mgarr, Marsamxett); 51 km of TINA Main Roads and 45 km of Access Roads

An extract from Chapter 10 from the TINA report (Conclusions, Recommendations) is given below.

The final TINA Network in Malta comprises 96 km of roads, 5 seaports and one airport. The outline of the Network has been finally defined; however, minor changes in its shape might occur, if future studies prove this necessity.

The Network seems to serve well the Maltese islands, from any viewpoint (economic, touristic, social).

The ratio of network length to surface area is significantly higher in Malta than inside the EU and the other candidate countries. However, the ratio of network length to population is far below than in European regions, if we take into consideration that there is no rail network in Malta, so all the transport needs are covered by roads.

The cost to construct the Network has been estimated by the Maltese authorities at € 490.28 million (€ 233.60 million for the total road network, € 40.00 million for the one airport and € 216.68 million for the five identified seaports).

[4] This Feasibility Study only considers the network on the Island of Malta, not Gozo

From the Report it appears that, the complete realisation of the network in Malta is absolutely realistic in the time horizon of 2015.

1.3 EXISTING SITUATION ON ROUTES 1 AND 6 [BASE CASE]

In a simplistic way one can define Route 1 as comprising 4 main sections [and lots of subsections]:

- The rural (or more precisely part rural) section from Cirkewwa (NA1) to say Pembroke (NA11)
- The urban section from Pembroke to the north side of the airport (WA23)
- The recently improved section next to the airport
- The "rural or part rural" section from Hal Far to the Container Freeport. (3 km length WA26 to WA27)

Southbound, NA5 to NA6 section, near NA5a, note sign gantry (obstacle) in picture

Southbound, NA5 to NA6 section, near Il-Mithna Street Junction a

In the rural areas the road ranges from 2 lanes (sometimes wider) without any kerbs, footpaths or cycle-lanes in sight, to a more ordered two-lane section with kerbs and at least some footpath (often on one side only, and often over narrow). Generally any provision of footpath on the older sections looks as though it were an afterthought [or was only put into the space left after the road pavement was constructed and the boundary lines]. One can see Maltese and tourists walking down some of the road sections trying avoid the vehicles, but except in a relatively few areas (such as the new section next to the airport) pedestrians are not at present well catered for.

The urban section is a complete mixture of single carriageway, dual carriageway with "grade separated" interchanges, tunnels [generally dual 2 lane], and some dual 2 lane bridges, plus some junctions comprising at grade roundabouts (signalised), plus junctions served by traffic signals. In parts of the network pedestrians are totally excluded [i.e. there is absolutely no provision for them and the road looks nearly like a motorway, though a few pedestrians can be seen trying to get to the nearby used bus-stops], in other parts footpaths are in part provided.

From a mainland western european perspective through the main urban section many of the junctions and on and off ramps (including on and off sections to local areas via stop signs) are "horribly" tight, and in fact the whole horizontal and vertical alignment of the urban section of route 1 can best be described as being tight.

The project is defined as route n°1 (from Gozo ferry port at Cirkewwa, to the Free Port zone at Bir Zebbuga), and route n°6 (from WA19a-EA20 nodes in Marsa to EA6 node in Valletta). This effectively is the TINA main network for the island of Malta (i.e. excluding the island of Gozo).

The TINA document essentially says for all existing links the current road pavement gets the following treatment "*Removal of existing asphalt, recompacting of base, recycling of removed asphalt for base course, asphalt wearing course*". We consider this a potentially expensive oversimplification, as some parts of the pavement are in reasonable condition.

There are 3 existing road tunnels on Route 1, and none on Route 6.

Other than the standard of driving road safety in general is compromised by the following physical attributes of the road [the list is not exhaustive]:

- The generally " slippery road pavement. Most road pavement built to date on the island used local (hard) limestone which wears relatively quickly and becomes slippery. Light rain at times can make the pavement very more treacherous.
- Unusual road widths (its difficult in places to decide if the Route 1 is 2, 3 or even a narrow 4 lanes wide)
- Very little in the way of existing visible road markings and reflectors. The existing road-paint seems to quickly either merge into the black pavement or wear out.
- Poor sightlines in many places
- Very "tight" existing junction layouts [on the urban section of route 1] with "merges" and "diverges" which are extremely short.
- Lack of footpaths at times forcing pedestrians (often tourists) into the road [see photo before]
- Lack of consistent street lighting [its sometimes good, sometimes not]

Elderly pedestrians with one child (all probably tourists) forced to walk in road [Route 1, towards north end of island] as no footpath available

Currently in some of the central [urban] portions of Route 1 one actually has bus stops but with no apparent safe method (i.e. no footpaths) of getting pedestrians from these bus stops into the adjacent urban areas. This problem has already been noticed in MEPA's Local Plans [North Harbour Local Plan]

Cyclist facilities, other than on the road pavement, are non-existent on Routes 1 and 6 except on the relatively new section of Route 1 adjacent to the airport, [which does not form part of this project].

There does not appear to be any regulations banning pedestrians from any part of Routes 1 and 6. The central (urban) section of route 1 in fact has such significant vehicle traffic that definitely pedestrian usage of at least parts of this road needs to be discouraged if not actively banned as a safety hazard [both to the pedestrian and the vehicles], but this of course conflicts with the use of buses and bus stops on Route 1 through the urban area..

There are many Planning (landuse) documents in existence that in part or full cover Transport related topics. The following are the major documents in existence and in various stages of approval, but others of a more specific nature exist as well [such as the Crown Works/Horn Works Action Plan on Route 6].

- 1990 Structure Plan
- Local Plans (Grand Harbour Local Plan, Marsaxlokk Bay Local Plan, North West Local Plan, Cental Malta Local Plan, North Harbours Local Plan, Malta South Local Plan,
- Structure Plan Review Topic Paper on Transport.

Ghost island too narrow [Junct EA11]

Pedestrians crossing Route 1 [Junct EA11]

1.4 INCEPTION REPORT AND DRAFT FEASIBILITY STUDY REPORT

The Inception Report was the first significant report to be submitted under this Study, and was submitted in early March 2004.

As stated in Chapter 12 of the Inception Report, and still relevant to the study:

"The main issue (in the short term) is to prioritise on the projects to be funded in the next few years, under Cohesion funds 2004-2006, plus Structural funds 2004-2006.

One fundamental point that needs to be made is that through the urban section of Route 1 [essentially the section from Pembroke to the airport] one suspects Route 1 itself [if upgraded as a generally maximum 2x2 carriageway with various interchange improvements] will never handle – in capacity terms - the traffic resulting from a design life of 20 years [Note the TOR – page 6- states that the design life to be taken into consideration shall be 20 years following the completion of the works] assuming traffic just keeps growing with GDP and the (significant) growth of new development in the urban coastal sections. In theory the "improved" network might just cope provided absolutely no accidents or breakdowns occur – which is obviously unrealistic.

The requirement of the TOR in relation to the Draft Feasibility Study Report is repeated below.

Four (4) months from the beginning of the assignment. This report shall present the results of the feasibility study and recommend the selection of all alternatives.

This report was submitted in June 2004.

Essentially this current Final Feasibility Report is a major update of the earlier draft report, taking into account comments and consultations, plus technical work carried out in and post June 2004.

1.5 DATA COLLECTION AND SURVEYS FOR FEASIBILITY STAGE

Significant data has been collected from both ADT and MEPA.

Surveys of existing tunnels, existing bridges, existing drainage, materials and pavement, safety aspects, environmental aspects and geometry, to name but some, have been carried out.

1.6. TRAFFIC

Existing traffic count data [generally hourly over 24hr periods] was purchased from MEPA early on in the project.

Three types of surveys were carried out during the Study period, comprising of:

- Turning movement counts at all the major junctions on Routes 1 and 6 during the three-hour peak periods, obtained manually
- Classified 24-hour volume counts on the main carriageways of Routes 1 and 6 between major junction over a three to seven-day period, from automatic traffic counters (ATC)
- Journey Time surveys on selected network links

Manual traffic counts

Automatic traffic counts

Large groups needed at Marsa junction

Team of enumerators for data recording

Two-wheeled vehicles

Private cars

4WD, pick-ups, vans, minibuses

Buses, coaches

Light commercial vehicles

2-axle trucks

3-axle trucks

3-axle+, articulated trucks

During the course of the traffic surveys and Safety Audits, a number of general traffic observations were made. A number of issues were identified as contributing to high accident potential on Malta’s roads, which are not always evident in either the Audits or the traffic flows. These factors include the following:

- Relatively low standard of driving
- Lack of driver anticipation
- Poor mechanical condition of many vehicles
- High average age of many vehicles
- High level of vehicle usage
- Poor road surface condition, poor wearing course, worn road markings
- Sub-standard and non-uniform highway layouts
- Lack of pedestrian facilities
- Reduction of geometric standards because of topography
- Social habits – communal activities
- Impatience, and high priority for personal mobility and accessibility

All the items above can have an impact on road safety. However, some improvements in isolation can actually increase accidents, as geometric and design improvements can result in an increase in traffic speed, with a consequent increase in accidents.

First previsions of the Maltese population for the future, prepared by NSO up to 2050, were recently revised. Accordingly, this revised version were used as a basis for the population forecasts in Malta. The revision is as follows:

Maltese Population Forecasts

Year	Maltese
2002	387,000
2005	389,300
2010	392,800
2020	393,700
2025	389,000

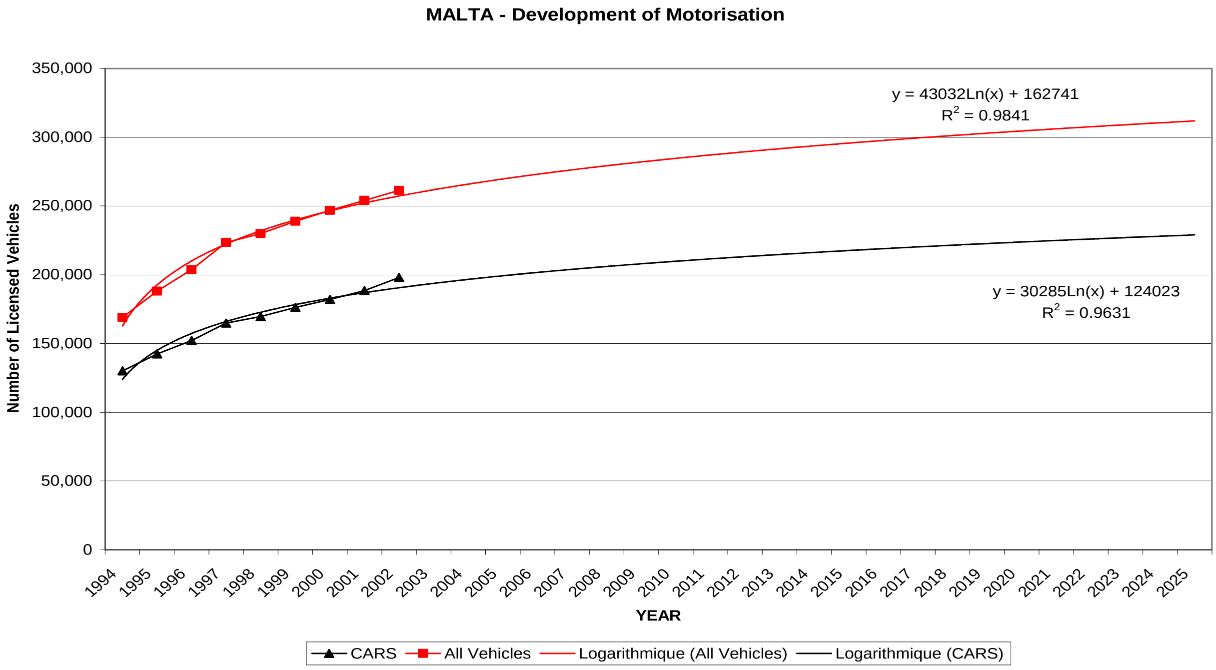
The Gross Domestic Product (GDP) and Gross National Product (GNP) over the 10 past years provides (at current price) an annual average growth of about 6.8 per cent for the GDP and 6.4 per cent for the GNP. Based on the TINA Report, this growth at constant price should be around 4.4 per cent per year, which is quite consistent. However, the exchange rate MLT/Euro of 2.93 in 2000 is now reduced at about 2.50 in 2004.

The economic situation of Malta, summarised by the GDP/GNP, makes the country among the wealthier countries to have recently joined the EU, even though it remains about half of the former 15 Member States, as it is demonstrated in the table below. This means that there exists room for economic growth.

In 2002 the fleet of vehicles, licensed in Malta, was about 260,000 motor vehicles (including motorbikes) of which 76 per cent was made up of private cars only. This ratio is a little higher that 81 per cent if “other and motorbike” vehicle category is excluded. The average annual growth of licensed vehicles, over the last ten years, is 5.4% for the private cars and 5.6% for all the vehicles.

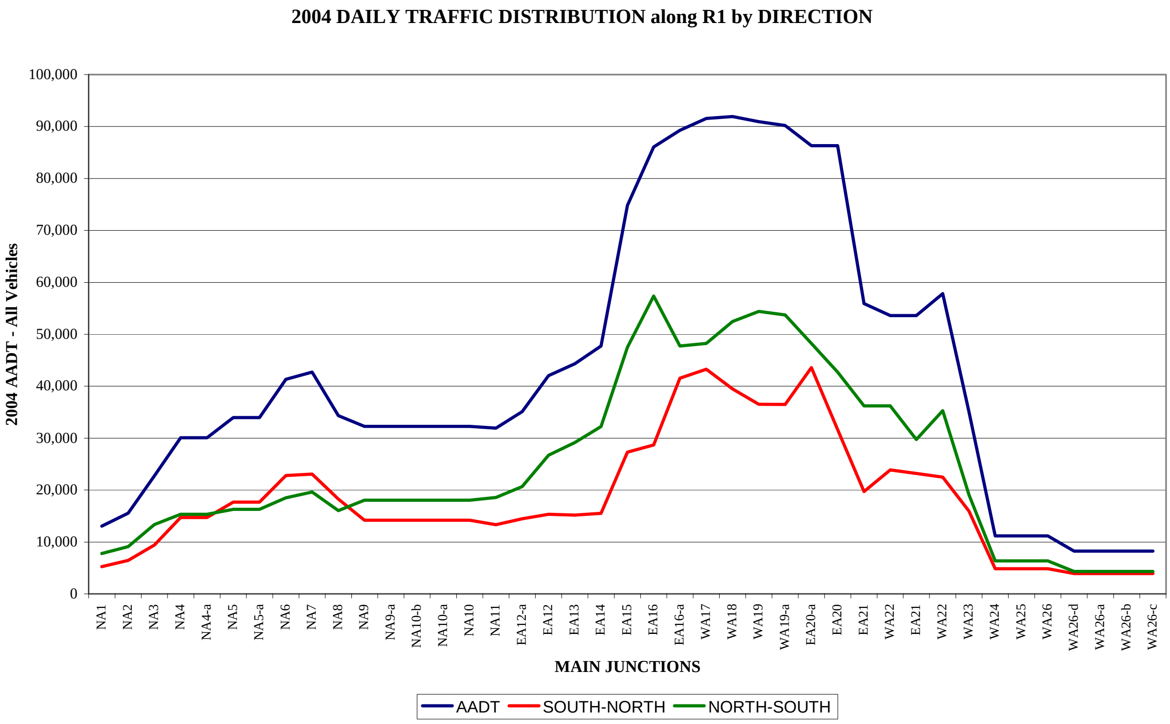
These figures provide motorisation rates quite high for the country in general and for Malta Island in particular, as it is shown in the table below. They reach levels almost similar than highly developed countries (e.g. USA and Europe) that have GDP per capita much higher than in Malta.

It is clear that population and motorisation will reach some limits within the next two decades, in the limited area of the Maltese Islands. A realistic approach is to use the past trend of vehicle development, but calibrated of a logarithmic curve, in order to get a preliminary approach of the future motorisation.



Based on the current vehicle fleet available in Malta, it can be said that every day, every vehicle (except other vehicle and motorbike categories) uses a part or a section of R1 at least 1.45 times.

In terms of running traffic along R1, the following table summarises the 2004-AADT on every road-link. This is illustrated through two graphs: the first one gives the traffic pattern (total and by direction) according to the precise mileage, and the second one by road-link (junction to junction), therefore distorted.



From the traffic analysis made, it is not easy to extract -from the permanent ATCs- a consistent traffic growth rate in between the years: 2000-2001-2003. The total traffic over the 365 days of the year remains in volume very similar. This assessment is confirmed by the analysis of the annual average hourly traffic in 2001 and 2003 given by the two graphs below from Msida ATC.

By applying the methodology developed for the year 2004 (to build up the Origin/Destination matrix), it comes out the traffic forecasts on the R1 road-links which are summarised in the table here-after. Consequently the O/D matrices for both years respectively are also produced for further modelling.

R1 – Traffic Forecasts 2010 and 2025 in terms of AADT

		A A D T					
R1 - Road Link		2004		2010		2025	
NODE North	NODE South	**S-N**	**N-S**	**S-N**	**N-S**	**S-N**	**N-S**
NA1	NA2	5,259	7,792	6,052	8,964	6,296	9,318
NA2	NA3	6,440	9,118	7,401	10,480	7,748	10,946
NA3	NA4	9,395	13,356	10,772	15,321	11,408	16,164
NA4	NA4-a	14,723	15,328	16,855	17,551	17,969	18,617
NA4-a	NA5	14,723	15,328	16,855	17,551	17,969	18,617
NA5	NA5-a	17,655	16,288	20,230	18,630	21,585	19,800
NA5-a	NA6	17,655	16,288	20,230	18,630	21,585	19,800
NA6	NA7	22,795	18,526	26,067	21,133	27,904	22,561
NA7	NA8	23,085	19,608	26,212	22,091	28,183	23,696
NA8	NA9	18,280	16,038	20,602	17,843	22,332	19,278
NA9	NA9-a	14,196	18,051	15,970	19,974	17,393	21,606
NA9-a	NA10-b	14,196	18,051	15,970	19,974	17,393	21,606
NA10-b	NA10-a	14,196	18,051	15,970	19,974	17,393	21,606
NA10-a	NA10	14,196	18,051	15,970	19,974	17,393	21,606
NA10	NA11	14,196	18,051	15,970	19,974	17,393	21,606
NA11	EA12-a	13,320	18,589	14,948	20,536	16,306	22,239
EA12-a	EA12	14,463	20,643	16,268	22,912	17,814	24,912
EA12	EA13	15,317	26,726	17,141	29,578	18,807	32,222
EA13	EA14	15,167	29,131	16,926	32,153	18,588	35,044
EA14	EA15	15,528	32,223	17,271	35,492	18,962	38,654
EA15	EA16	27,322	47,496	30,019	52,041	32,696	56,469
EA16	EA16-a	28,675	57,390	31,418	62,792	34,147	68,030
EA16-a	WA17	41,551	47,732	45,391	52,262	49,333	56,540
WA17	WA18	43,294	48,252	47,275	52,802	51,354	57,089
WA18	WA19	39,471	52,470	43,132	57,425	46,807	62,065
WA19	WA19-a	36,539	54,399	39,961	59,566	43,366	64,366
WA19-a	EA20	36,490	53,730	39,929	58,852	43,349	63,612
EA20-a	EA20	43,601		47,751		51,770	
EA20	EA21		42,717		46,840		50,818
EA21	EA20-a	19,709		21,589		23,391	
WA22	EA20-a	23,892		26,162		28,379	
EA21	WA22		29,715		32,579	0	35,388
WA22	WA23	22,523	35,310	24,731	38,751	26,843	42,136
WA23	WA24	15,952	19,104	17,640	21,151	19,132	22,965
WA24	WA25	4,826	6,363	5,368	7,083	5,838	7,711
WA25	WA26	4,826	6,363	5,368	7,083	5,838	7,711
WA26	WA26-d	4,826	6,363	5,368	7,083	5,838	7,711
WA26-d	WA26-a	3,900	4,344	4,339	4,835	4,719	5,264
WA26-a	WA26-b	3,900	4,344	4,339	4,835	4,719	5,264
WA26-b	WA26-c	3,900	4,344	4,339	4,835	4,719	5,264
WA26-c	WA27	3,900	4,344	4,339	4,835	4,719	5,264

According to the table of the recently recorded accidents in Malta, it can be deducted that, every year, one vehicle over 18 has an accident: one over 17.5 in Malta Island and one over 30 in Gozo. Taking into account the motorisation rate, one can then say that one Maltese resident over 29 has a road accident during the year, and worst one over 320 has an accident with casualties.

Fortunately, among the annual 910 accidents, 86.5 per cent are only damages, and among the 178 injuries only 2.32 are fatal. These figures, compared to Malta island only, represent for R1: 6.9 per cent of all recorded accidents and 17.5 per cent of all casualties (14.5 per cent for the fatal injuries). Whatever these numbers of accidents on R1 are considered low or high, it is clear, that the economic costs of accidents will not make the difference regarding the economic upgrading of this arterial road.

1.7. ACCIDENTS AND SAFETY AUDITS

A number of safety audits have been carried out along Routes 1 and 6 at the same time as junction traffic counts were made. At this stage some audits still have to be made (for those junctions where counts will be carried out in the June/July period).

Whilst these audits are not formal Safety Audits, they follow the guidelines and format issued in HD 19/03, issued by the UK Highways Agency in November 2003. These guidelines cover all aspects affecting the safety of all road users, including drivers, pedestrians and cyclists.

Accident data is not available to be used as input in the Safety Audits, and all observations and recommendations relate to accident potential. At some junctions there was evidence of accident damage in the form of damaged signs, kerbs, landscaping, tyre marks, etc, and these observations have been incorporated into the Safety Audit comments.

Traffic queuing back southbound [Junct EA12]

No road delineation at bridge below Route 1

During the course of the traffic surveys preparation and implementation, a higher number of accidents were observed than would have been expected, particularly bumper-to-bumper accidents which are not normally reported to the police. This situation reflects a need for a range of general safety measures, such as driver education, stricter driving tests, extended traffic law enforcement, speed cameras, etc, to make drivers and pedestrians more safety conscious.

Throughout the road network, improvements to speed and capacity of the traffic flows have been given priority over safety, and the needs of pedestrians. This has resulted in a number of design conflicts, such as at the junction of on-ramps and the main carriageway of Route 1.

It is normal design practice to have a perpendicular alignment for a priority junction with a stop line, to allow maximum visibility for both approaching and exiting traffic; for merging traffic with an acceleration lane, it is normal practice for the lanes to be angled and converging, to minimise the relative velocities of the two traffic flows. However, the junctions on Route 1 combine angled 'give-way' approaches with stop lines, thus losing the benefit of any minimising of speed differentials. This both reduces the capacity of the merge, and substantially increases the accident potential, as high flows on Route 1, combined with the impatience of Maltese drivers, reduces the gap in traffic flows that drivers consider to be acceptable. Use of too small a gap results in sudden braking by traffic on the main route, and a high number of bumper-to-bumper accidents.

As part of a policy shift, accidents could be reduced if there was a change in philosophy from speed and access priority to safety and sustainability. This would involve reduction in speed limits, increased chanellisation and road markings, ramp metering, increased traffic signal usage, and general traffic capacity reduction or restraint.

At most locations visited, road marking have been worn away, resulting in confused or obscure messages to drivers. A policy of using thermo-plastic permanent markings needs to be considered.

Short deceleration lane after tunnel [Junct EA13]

Ghost splitter island, poor visibility left turn [Junct EA13]

Evidence of pedestrian activity is not easily quantifiable at most locations. This is felt to be the result of the lack of formal pedestrian facilities. Individuals forced to walk in high-trafficked carriageways, and openings in boundary walls leading directly onto carriageways, tend to discourage pedestrians from following these routes. At a number of locations there is evidence of regular, small-scale pedestrian activity, which needs to occupy the carriageway because of the lack of footways. In these situations, it is necessary to either provide some form of infrastructure to accommodate the movements, or to take steps to prohibit the pedestrian movements.

Geometric layouts, combined with the Design Standards, set the theoretical design speeds for the road network. The changing character and purpose of Route 1 means that there are difficulties in fixing a consistent limit along the whole length. There is also visual evidence that drivers do not adhere to the existing speed limits. Speed enforcement procedures need to be implemented, either with cameras and number-plate recognition software, or more Police or Warden intervention.

Use of deceleration lane [Junct EA14]

Poor visibility for on and off-ramps [Junct EA14]

1.8. PUBLIC UTILITIES

The public utilities in Malta consist of the following services;
Telephones – Matacom and mobile phone operators
Electricity – Enemalta Corporation
Water – Water Services Corporation
Sewage – Water Services Corporation
Cable TV – Melita Cable

Considerable thought will be required during the detail design stage to ensure that service diversions [or protection works] are included in the detailed designs, and that materials needed for service works are procured on time.

1.9. HYDROLOGY AND DRAINAGE

Malta has a low annual rainfall which occurs over the winter months and none of the natural water courses are perennial. The ground is generally porous and has high natural rainfall retention providing very little river flow for most of the time. These factors have resulted in a historical approach to road drainage that has tolerated local flooding of the roads. Very little attention has been paid to designing for the winter floods, maintaining existing drainage facilities or for preservation of natural water courses. That is until recently. Following the severe flooding that was experienced in September 2003, a series of projects have been mobilised for improving or re-establishing old water channels, and in some cases providing additional water retention infrastructure. However none of these projects are yet complete and it is therefore difficult to see to what extent the proposed measures will solve the flooding problems, and they may in the short term even exacerbate the situation (as discussed later).

There is an obvious need to ensure that the maximum possible water infiltration is achieved to recharge the scarce groundwater resources that provide approximately half the present population’s water consumption. The balance comes from the reverse osmosis sea water treatment which is expensive and requires power generated using imported fuel. The maximum recharge objective is fully supported by this project, however it is not seen as part of the road improvements to provide additional retention basins within the large catchment areas (for which additional land acquisition may be required). This problem needs to be addressed within the National Water Resources Strategy. At the road itself embankments may be used for short term flood retention only where this does not jeopardise the integrity of the road embankment and pavement strength.

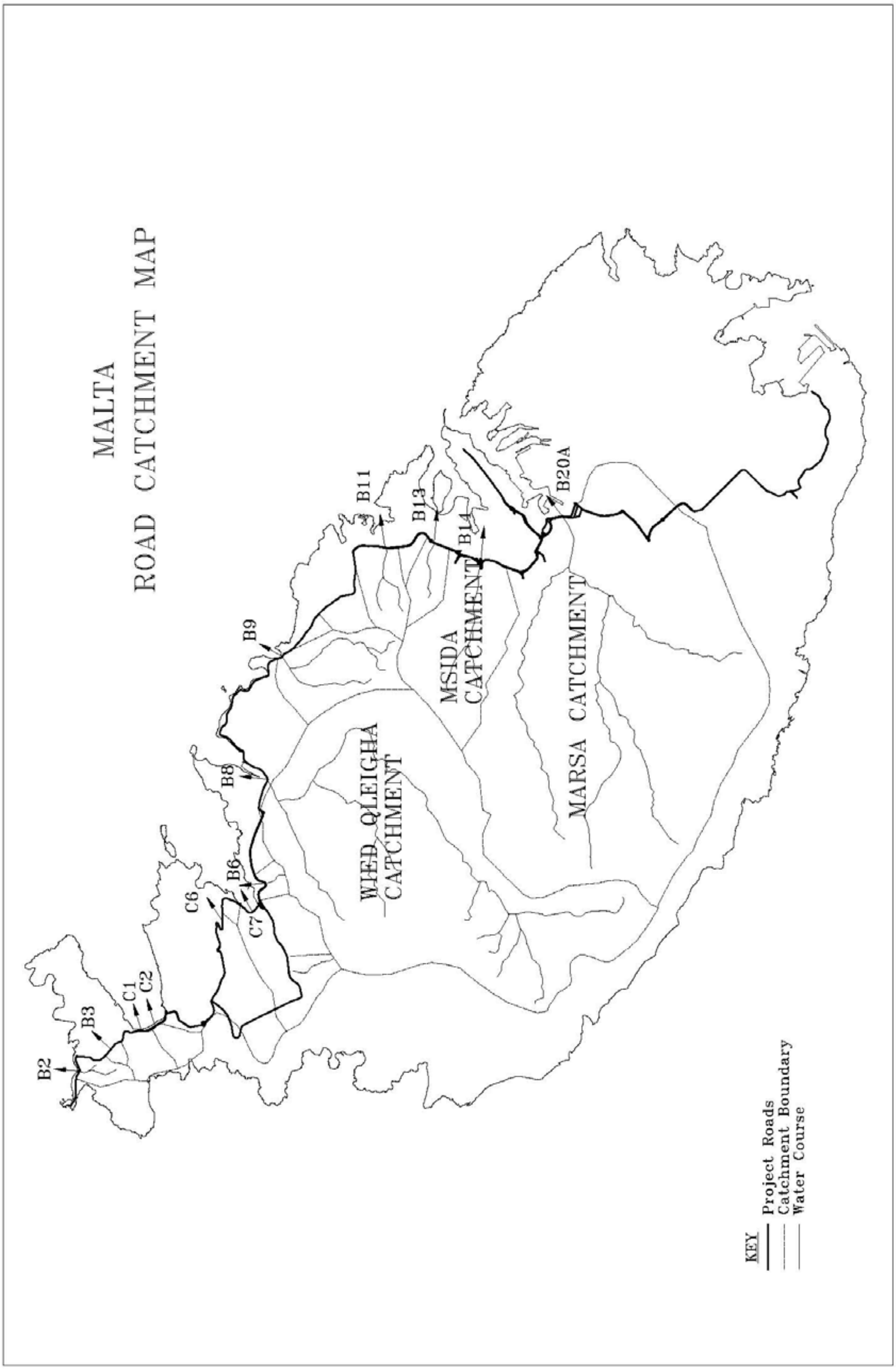
Excessive water on the road will close the road to traffic in the extreme case, under normal storm conditions this water increases the dangers of loss of vehicle control through aquaplaning, and water retained in the pavement layers will reduce the pavement strength. Road drainage design has three main elements that need to be considered. The most obvious is the cross drainage; that is where the road crosses a natural water course and a bridge or culvert is required to pass the flood flows. The second element is the road surface drainage, and this comprises the collection and disposal of rain water falling on the impermeable road pavement. This has environmental considerations as the water may contain significant levels of fuel oils or chemicals which could contaminate groundwater and agricultural soils. The third element is the groundwater drainage under the pavement layers. All of these aspects have been considered in the following sections and design recommendations proposed.

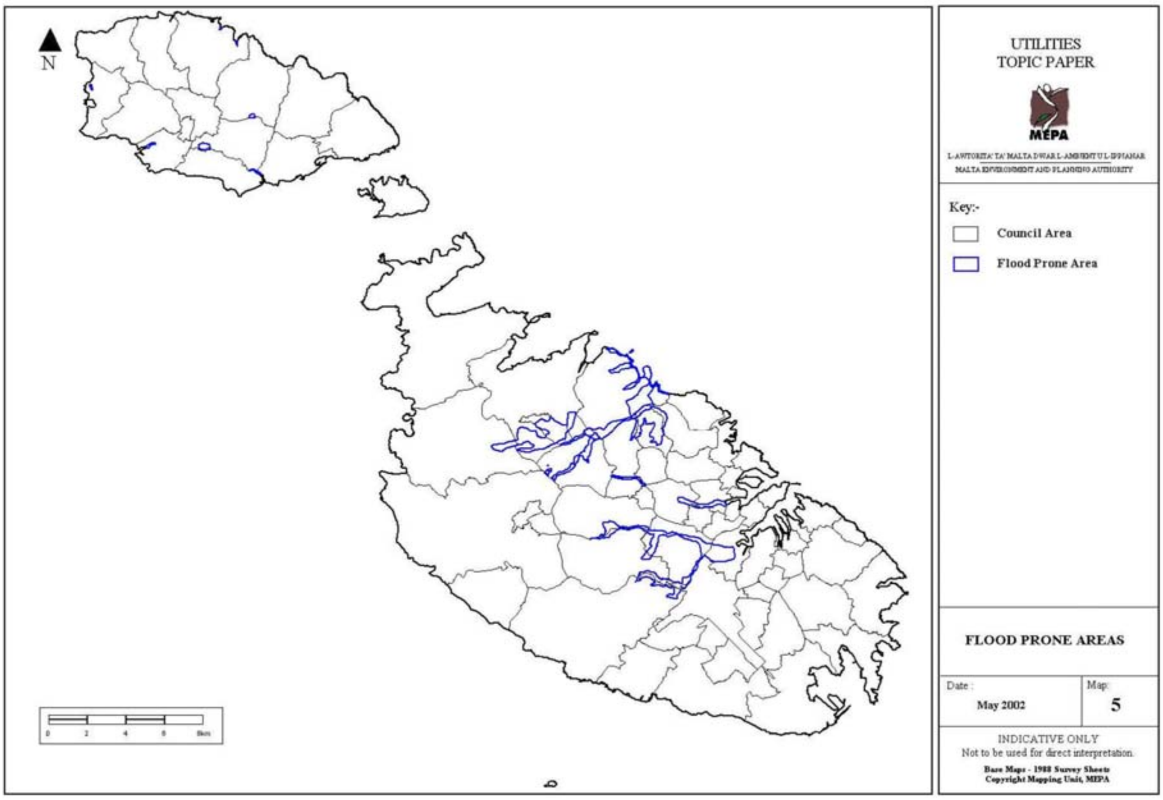
For this feasibility study a preliminary design has been carried out to define the drainage structure locations and approximate sizes to estimate the costs of construction of the various sections. It is envisaged that a full detailed design will be required for the preparation of contract documents for the construction of these sections.

For the drainage and hydrology the principal data sources have been from ADT, Works Division, MEPA, Malta Resources Authority (MRA), Meteorological Office Archives, Cleansing Services Department and the field inspection of catchments, existing cross drainage and road drainage provisions. This has been supplemented by talking to local residents and senior officials with knowledge of historical flooding of the road and adjacent areas and comparing this with identified flood prone areas.

Malta's longest axis lies in a northwest to southeast direction with highest ground to the south and south west. There is a general watershed in the high ground running close to the coast along the south west side of the island and most of the island catchments drain towards the east or north east crossing the road as it discharges to the sea. No permanent streams run the full length to the sea and very little river flow is regularly generated. In general this is due to the porous nature of the underlying limestone, the long dry summer period and the natural retention of the irregular ground surface with 'ponding' areas. In some catchments man-made retaining features have been constructed within the catchments and where cultivation is present terracing may be part of the agricultural development, all of which will attenuate flood peaks or even provide total retention and subsequent infiltration and evaporation.

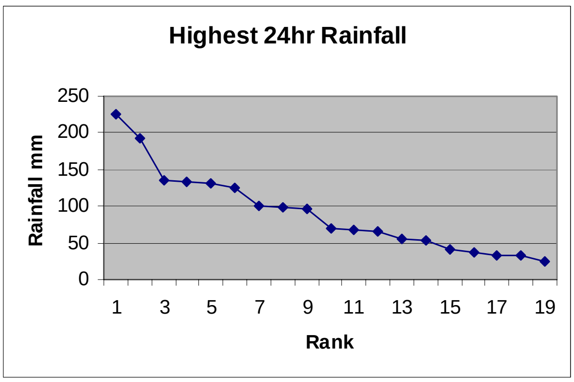
However during longer high rainfall intensity storms the rivers will flow and flooding can occur as has been computed in the following sections. MEPA have produced a map identifying flood prone areas which are discussed where relevant in the details of existing drainage features later in this section of the report. The MEPA map is included hereafter for reference and general information.


MALTA
ROAD CATCHMENT MAP
B2
B3
C1
C2
C6
B6
C7
B8
B9
B11
B13
B14
B20A
WIED QLEIGHA CATCHMENT
MSIDA CATCHMENT
MARSA CATCHMENT
KEY
Project Roads
Catchment Boundary
Water Course



The rainfall for Malta is quite low, annual average of approximately 550mm with 60 rain days, mostly in the winter months. Water resource considerations are therefore important as the population density is high. Most of the winter rainfall infiltrates the limestone to recharge the aquifers, although evaporation can be significant in autumn and spring storms. The ground water can only provide about half of the water required for the population and the balance of the water requirements are met from reverse osmosis (seawater desalination) treatment plants of which there are two on the island. This is a costly resource so any reduction in fresh water discharge to the sea will produce benefits.

The Consultant has obtained rainfall data from the Meteorological department for which detailed records exist for the period from 1985 to present. The following graph shows the ranked 24 hour rainfall totals for the 19 years of records plotted with no scale adjustments. As can be seen 100mm in 24 hours is a relatively frequent event. The data shows that the maximum recorded 24 hour total is 226.3mm, the average is 91mm and the median is 126mm.



The largest catchment of all the catchments in Malta (53km^2) and the drainage outlet crosses the project road near the Marsa sports stadium and the Millenia building. At this point there is flooding of the road every other year. In September 2003 the road was submerged under approximately 1 metre of water which closed the road for several hours and serious flooding appears to occur every ten years.

Marsa Inlet. Improved piers, channel not widened.   Marsa Culvert. Subsequently improved

In response to this flooding the Department of Works has recently carried out improvements to the upstream channels and the bridge piers. On our first inspection of the existing bridge it was found that there are a series of elongated pillars supporting the bridge soffit slab. Subsequent work has been done to connect the piers with metal plates and provide a pointed metal edge at the inlet end effectively making a multiple box culvert and minimising the risk of blockages at the inlet and through the culvert. The sharp edge is designed to break up any debris that is washed against the inlet dividing walls. The upstream approach channel has been widened from 11m to 14m to improve the efficiency of discharge and to provide greater retention to attenuate the flood peak.

Inlet streamlined to reduce blockages   Marsa; recently widened upstream channel

Marsa Outlet. Flow direction change Marsa Outlet. Channel is 'listed' structure.

Marsa Sea Outlet, Outlet channel and arch (from sea end)

Further upstream the channel has been improved, and as there are significant urban areas that appear to be expanding within the upper catchment it is likely that the flood peaks will be greater despite the additional capacity for retention. The main problem has always been the outlet channel and with the upstream improvements this has become critical. There remains at present a narrow channel section and a drain protruding into the channel immediately upstream of the culvert/bridge crossing and there is a sharp bend (75°) at the outlet and drains protruding into the channel at the outlet. The outlet channel itself is too narrow to cope with the flood flows, the bridge at the sea outlet is too small and the sea outlet itself is frequently blocked by derelict vessels. There are however significant problems in implementing improvements as the channel and bridge are protected structures (grade 1 listed), and the adjacent road is so full of buried high tension power cables that a second parallel channel under the road may not be feasible on this side. The only option appears to be to construct a second relief channel through the school premises east of the existing channel. This could be a covered channel so as to permit the school to make full use of its present property, although it may include rebuilding any building that is affected by the construction. In any case the sharp bend and present restricted outlet needs to be significantly improved to avoid future serious flooding. It is planned to realign the road which will be raised and a better bridge arrangement included in the new design.

Wied Qliegha and Salinas (B8) is the second largest catchment (41km^2) and includes some very impressive deep gorges in the middle and upper catchment.

Upper Wied Qlieha catchment, Ta'l Isperanza Valley

As in the Marsa catchment, works are being carried out to improve the flood drainage by improving the drainage channels. In this catchment retention structures exist and additional retention is being incorporated in the present works as seen below:

Improved channel below Targa Gap

Retention structure

Unlike the Marsa catchment the outlet channel, at Salinas, is only poorly defined as the lower catchment is relatively flat and has been intensively cultivated. The original channel has totally disappeared in these lower flat areas and the intention of the present works is to restore a 12m wide by 2m deep channel to the sea outlet.

The outlet at the end of Kennedy Grove discharges into the sea at Salinas and incorporates a concrete sill, adjacent to the road, to prevent the salt water channel progressing upstream into the agricultural land. The existing road culverts, whilst they are adequate in total waterway area, are inefficient with a direction change on most of the culverts and they not tied into any specific inlet channel. The main outlet channel was silted up and overgrown but has recently been cleared out, but the second relief channel, running south of the salt pans, is totally overgrown and silted up. With no defined inlet channel, the existence of overflow culverts and no clear overflow outlet, the whole of the road section from the main channel crossing to the junction NA 9A (to Naxxar) is liable to flooding when this large catchment receives prolongued heavy rainfall.

It is intended in the present drainage improvement works to carry out some maintenance on the relief channel to reduce the smells and restore the drainage capability. However this has been identified as a site of environmental significance with unique characteristics of a fresh water/ salt water margin. Any maintenance will therefore have to be undertaken sensitively.

Salinas main inlet

Overflow inlet to secondary channel

Salinas main outlet and sill

Salinas dredging outlet

Salinas; blocked secondary outlet channel

Restricted overflow to secondary channel

The structural aspects and design criteria of the drainage structures are discussed in the Structural section of this report. River training works are envisaged at Salinas and the Marsa Catchment main crossing. The latter includes the final inlet widening, the outlet additional channel and realignment and may be completed under the present improvements.

There is a need to develop a funding and implementation mechanism for road maintenance and this is discussed elsewhere. For the drainage it is clear that a more systematic and regular repair and clearing of gulleys, drain inlets and outlets is needed to maintain the capacity of the system.

As was noted earlier very little provison for either road surface drainage or subsoil drainage exists in the resent project road. For environmental reasons it is thought advisable to be able to collect the first flush of storm drainage and for this reason we have included storage and filtration for this. As land acquisition is generally difficult the preliminary design has included a buried pipe system within the road boundaries. For longitudinal surface drainage we have included a 400mm diameter concrete collector pipe as shown in the road cross sections. For subsoil drainage we have included 200mm subsoil drains on the cut slope side. Details are shown on the drawings along with location and sizes of buried retention and filtration tank systems.

This preliminary design process has identified all the locations where road drainage needs to be improved. This includes the cross drainage provisions and inlet and outlet arrangements at the two largest catchments (Salinas and Marsa). Other locations may need improvements for structural reasons or local road drainage. All details of the proposed works have been included on the road plan and section drawings. This also includes provision for longitudinal surface and subsoil drainage which does not generally exist along the road at present.

Retention provisions for water resource conservation within the catchments needs to be considered along with the protection of existing watercourses. However this is a wider aspect than can be fully addressed in a road project. In the detailed design further consultations will need to be included to establish what measures are planned or have been included in the present improvements.

Bumper-to-bumper accident [Junct EA15]

Accident damage at boundary fence

High-speed traffic from arm C through tunnel

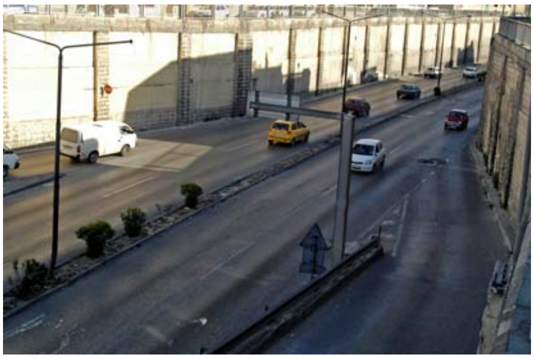
Short merging space, [Junct EA16]

1.10 DESIGN STANDARDS

The design standards to be used on the project will essentially be those of ADT as included in the CD handed over to BCEOM on 13th February 2004.

Other standards [i.e. those not covered in the ADT CD] are either European “norm” standards, or where these do not exist standards from major European countries (such as the UK, France, Germany etc.).

Accident black spot sign [Junct EA17]



On and off-ramps at arm A [Junct EA17]

1.11. PAVEMENT, SOILS AND MATERIALS INVESTIGATIONS

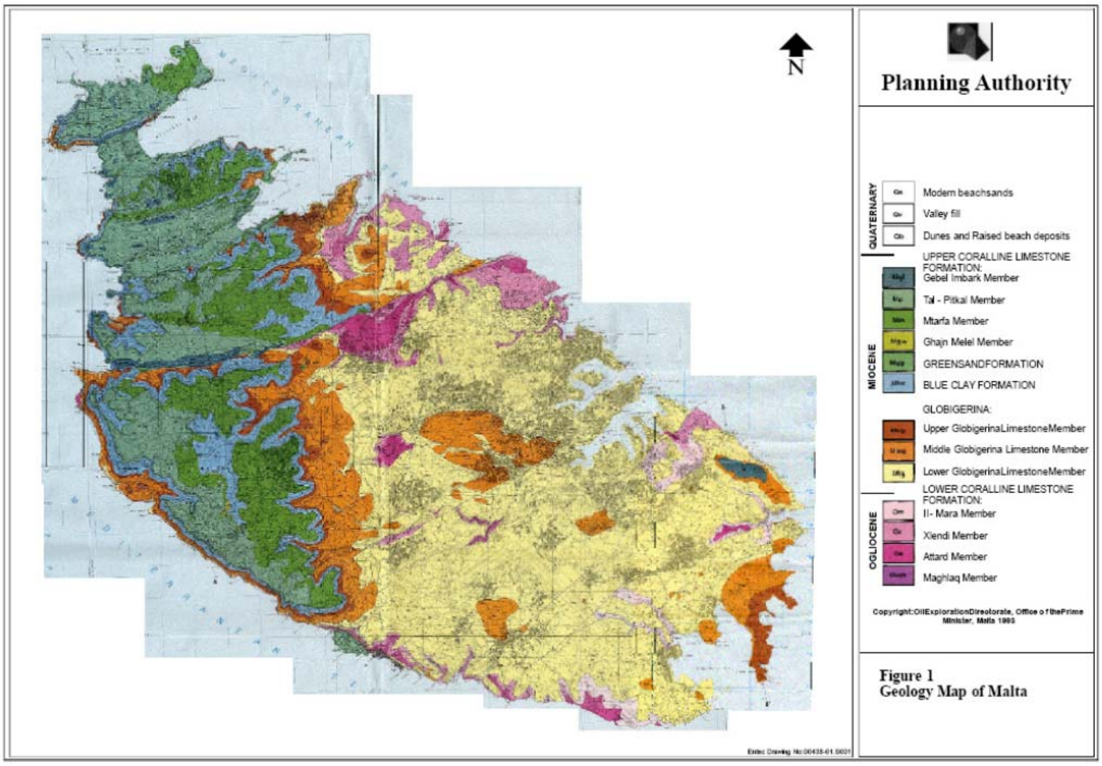


Figure 1
Geology Map of Malta

An investigation was carried out of pavement, soils and materials, involving pavement coring, trial pitting, skid resistance testing, Benkelman beam deflection tests, and laboratory testing.

1.12 SURVEY OF AFFECTED PROPERTIES AND RIGHT OF WAY REQUIREMENTS

It is clear that one of the reasons why the existing Route 1 has such tight geometry in places (and by this we include areas with short sightlines, areas lacking footpaths etc.) is that as the road has expanded [and been rebuilt and upgraded] over time, there appears to have been a reluctance [or an inability, land and property take is extremely expensive] by Government to "acquire" sufficient land upon which to comfortably "build" or "expand" the existing road. The end result is a road which is currently very tight, especially in the urban sections.

In fact when traffic levels were considerably lower the tightness of the network was not so much of a problem as it was still relatively easy to enter and exit the main road, but as traffic levels have built this has become more difficult [less gaps to move into].

The preferred options generally require at least some permanent landtake [and/or building-take] to give space for a "safe" and "effective" upgrading of the existing road, including necessary sightlines etc..

In at least one location [in the Pembroke area] land will need to needed on a temporary basis [for several years most likely] for a temporary traffic detour.

Upgrading Route 1 to a safe and reasonable standard will require landtake[5] especially for junction improvements.

Land Acquisition is normally [at least on small road-schemes] done where at all possible by agreement in Malta, but Government do have [and at times use] statutory powers to acquire land. This is done via the Land Acquisition (Public Purposes) Ordinance [Cap. 88], which is quite a long document [and can be found on the Malta Government website] but essentially "The President of Malta may by declaration signed by him declare any land to be required for a public purpose."

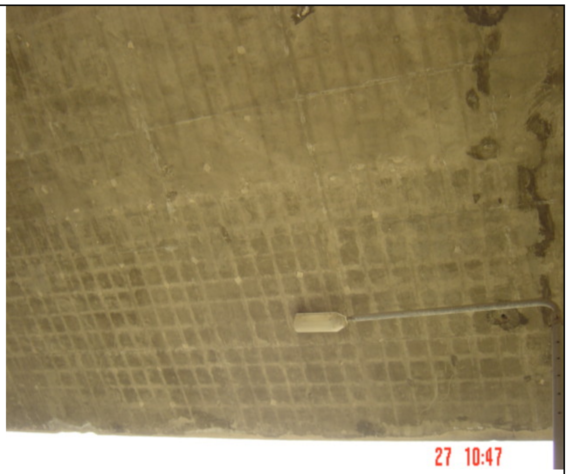
It is likely that the statutory powers will be needed in at least some cases to enable the land necessary for the works to be acquired.

Obviously necessary land acquisition cannot occur immediately and in full for the whole length of Routes 1 and 6 where such acquisition is necessary.

It is understood that MEPA [the Planning Authority], can freeze any potential [or future proposals] for development in land which needs to be temporarily or permanently required. ADT need to agree with MEPA the procedures to carry out and implement this freezing process. Obviously it is necessary to keep other significant developments from occurring on land needed in the short, medium and long term for the highway improvements.

[5] Clearly in some (possibly many) cases there will be a potential conflict between the land designations [including environmental] and usage and the aspirations of the highway scheme to improve on road capacity and safety. The EIA process and discussions held with MEPA as this study progressed, and later as detail design takes place, should minimize conflicts, but it must be recognized that since so much of Route 1 is "substandard" in terms of current highway standards [i.e. in parts it is unsafe] landtake is an essential part of the technical highway capacity and safety improvement process, and where for other governing factors [cost, environmental, inability to acquire land etc.] it is not allowed then the end result will be a less [or in places much less] improved road. Therefore, throughout the route option selection and assessment process to the preferred option the compromises between highway improvements and other impacts have be suitably considered.

Break Line formed at the cantilever joint - Creep Effect



Insufficiency of concrete cover - traces of the steel mesh at the lower slab of caisson

Failure of concrete and corrosion of reinforcement bars at the edge of pier

Heavy damage of concrete at the junction of pier with the foundation

Tension bars are highly corroded at the base of pier – Loss of section

Spalling of Concrete at the base of pier – Gozo side

Route N°1 - <u>Bridge BR232</u>- *Pre-stressed Concrete Cantilever Bridge*

1.13 SURVEY OF EXISTING STRUCTURES

SURVEY OF EXISTING BRIDGES

The overall objective is to identify and describe the repair and strengthening works needed for 24 selected existing bridges on Route 1, (Cirkewwa - Free Port) and 7 existing bridges on Route 6 :(Marsa Junction – Valetta), in order to meet the required level of safety and service for international heavy road traffic in accordance with the Eurocodes.

SUMMARY OF EXISTING BRIDGES

Route N°1:

- RC Arch Bridge	: 2
- Masonry Arch Bridge	: 1
- RC Box Culvert	: 4
- Pedestrian Underpass	: 1
- Irish Crossing	: 2
- RC Deck Slab	: 6
- Prestressed Cantilever Bridge	: 1
- Prestressed Caisson Deck bridge	: 1
- Composite Steel - Concrete Deck Bridge	: 1
- RC Tee Girders and Slab Deck Bridge	: 4
- Prestressed I-Beams Footbridge	: 1
Total of structures on Route N°1:	**24**

Route N°6:

- RC Underpass	: 3
- RC Tee Girders and Slab Deck Bridge	: 1
- RC Deck Slab	: 2
- Prestressed I-Beams Footbridge	: 1
Total of Structures on Route N°6:	**7**
Grand Total of Bridges on Route N°1 & N°6:	**31**

The Routes N°1 & N°6, consisting primarily of 2x2 lanes, two in each direction [urban section], is heavily congested in the urban zone. All existing bridges, located on the said routes, have been inspected and measured up by tape in the period from 22 to 31 March. The present technical report is prepared on the basis of the visual survey of bridges.

A limited in-situ inspection is used for checking correspondences between the actual details of the structure with the available original executive construction drawings for the two bridges BR 232 and BR 237 that were retrieved at the Malta Transport Authority (ADT). The Consultant has checked the said drawings before issuing the present report.

A comprehensive in-situ inspection is used when the original executive construction drawings are not available and when a higher knowledge level is sought. This involves performing inspections as indicated in item "Site Visit Report" below.

No direct information on the mechanical properties of the construction materials is available, neither from design specifications nor from original test reports. In this case, default values were assumed according to standards of the time of construction.

The dates of construction of different bridges which give a very good indications on the quality of materials (steel and concrete) used at that time, correlated to the detailed visual inspection has permitted the assessment of the actual conditions of these bridges.

Repair and strengthening works have been defined from comparison of the actual condition of the bridges with the requirements as laid down in Eurocodes. Proposals for optimal repair and strengthening methods are sought considering the entire assemblage of bridges. Alternative methods are proposed by the Consultant for some individual bridges if relevant.

A brief tabular summary of the main findings is given below:

ROUTE N°1

Route N°1	Kilometric Point KP(KM)	Type of Bridge	Rehabilitation, Repair/Strengthening
BRU 001	0+128	RC Arch Bridge	-Minor repair of RC structure, -Replacement of Fittings.
HBR 009	0+925	RC Arch Bridge	-Minor repair of RC structure, -Replacement of Fittings.
BC 024	2+421	RC Box Culvert	-Widening of road by a additional Retaining Wall, -An opening with dimension of 1.5m x 1.5m will be provided in this wall for drainage continuity.
BRU 038	3+819	RC Underpass	- Minor repair of structure, - Providing of Waterproofing behind walls,
BRU 088	8+800	Masonry Arch Bridge	-Rehabilitation with a new RC deck Slab.
HBR 111	11+172	RC Deck slab (alignment on a stiff Curve) Inlet: Water catchment area.	-Minor repair of RC structure, -Replacement of Fittings.
BC 120	12+000	Box culvert with 3 cells. Inlet & Outlet: water catchment area.	-Replacement by a new bridge to be decided at further detailed design stage.
BC 123	12+350	Box culvert with 3 cells. Inlet & Outlet: water catchment area.	-Replacement by a new bridge to be decided at further detailed design stage.
HB 141	14+100	RC Irish Crossing with 14 cells + 2cells + 2cells	-Replacement by a new structure.
HB 186	18+670	RC Irish Crossing with 4 cells.	-Replacement by a new structure.
BR 225	22+526	Paceville Bridge - RC Deck Slab	-Replacement of the bridge by a composite structure with lateral steel girders. -Diversion of existing services/drainage prior to the commencement of works.
BR 232	23+200	Pre-stressed concrete cantilever bridge	**Deck Bridge**: Replacement the existing deck by a three girder composite deck bridge. **Supports** : Neoprene bearings + Concrete pads + Heavy repair of piers and abutments
BR 237	23+775	Pre-stressed concrete caisson bridge	- Replacement the existing deck by a three girder composite deck bridge. - Minor repair of piers and abutments, -Drainage of water behind walls + placing of Wheepholes, -Treatment of vegetation, -Providing of Neoprene bearings + Concrete pads on piers and abutments after Jacking of deck bridge, -Replacement of fittings + expansion joints.
BC 247	24+750	RC Deck slab	Replacement of existing structure by a RC Box Culvert: 4.5mx4.5m Surrounded by Gravity wall of Limestone.
BRU 250	25+050	RC Deck Slab Bridge	-Replacement by a new bridge to be decided at further detailed design stage.
-	26+00	Composite Steel-Concrete deck bridge	To be Demolished.
BRO 261	26+191	RC I-beam deck bridge	-Minor repair of the existing piers and abutments by sand

			blasting, cleaning and joining of stonework, -Providing of Neoprene bearings + Concrete pads on abutments after Jacking of deck bridge, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Treatment of vegetation, -Rehabilitation of existing fittings,
BRO 262	26+222	RC I-beam deck bridge	-Minor repair of the existing piers and abutments by sand blasting, cleaning and joining of stonework, -Providing of Neoprene bearings + Concrete pads on abutments after Jacking of deck bridge, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Treatment of vegetation, -Rehabilitation of existing fittings,
BRO 264	26+390	RC I-beam deck bridge	-Minor repair of the existing piers and abutments by sand blasting, cleaning and joining of stonework, -Providing of Neoprene bearings + Concrete pads on abutments after Jacking of deck bridge, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Treatment of vegetation, -Rehabilitation of existing fittings,
BRU 271	-	RC Deck Bridge	-Lengthening of Existing Underpass by abut 4m, -Minor repair of the existing abutments by sand blasting, cleaning and joining of stonework, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Treatment of vegetation, -Rehabilitation of existing fittings,
BR 277	27+781	RC Deck slab + I-beams deck bridge	-Replacement of the bridge by a new one, -Diversion of existing services/drainage prior to the commencement of works.
BR 282	28+200 R1-R6 Interchange	RC I-beam deck bridge	-Drainage of water behind walls, placing of Wheepholes, -Minor repair of the existing piers and abutments by sand blasting, cleaning and joining of stonework, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks. -Providing of Neoprene bearings + Concrete pads on abutments after Jacking of deck bridge, -Treatment of vegetation, -Rehabilitation of existing fittings,
-	-	Pre-stressed I-beam footbridge	To be Demolished.
BH 289	28+925	Marsa Hydraulic Bridge	Replacement of existing structure by a RC Box Culverts 2 Cells: 2 x (4.5m x 4.5m),

ROUTE N°6:

PBU 024	2+475	RC. Underpass	- Diversion of existing services (electricity, water pipes, phone cables, etc.) -Lack of waterproofing behind RC walls, -Rehabilitation of the underpass + access ramp by sand

			blasting and cleaning of surfaces, -Concrete patch repair with epoxy resin and injection of possible cracks, -Painting of structures, -Evacuation of rainy water, - Placing of expansion joint.
PBU 022	2+266	RC. Underpass	- Diversion of existing services (electricity, water pipes, phone cables, etc.) -Lack of waterproofing behind RC walls, -Rehabilitation of the underpass + access ramp by sand blasting and cleaning of surfaces, -Concrete patch repair with epoxy resin and injection of possible cracks, -Painting of structures, -Evacuation of rainy water, - Placing of expansion joint
PBU 018	1+855	RC. Underpass	- Diversion of existing services (electricity, water pipes, phone cables, etc.) -Lack of waterproofing behind RC walls, -Rehabilitation of the underpass + access ramp by sand blasting and cleaning of surfaces, -Concrete patch repair with epoxy resin and injection of possible cracks, -Painting of structures, -Evacuation of rainy water, - Placing of expansion joint
BRU 018	1+825	RC I-beam deck bridge	-Drainage of water behind walls abutments, placing of Wheepholes, -Rehabilitation of the existing abutments by sand blasting, cleaning and painting of walls, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Providing of Neoprene bearings + Concrete pads on abutments after Jacking of deck bridge, -Rehabilitation of existing fittings, -Treatment of vegetation.
BR 013	1+341	RC Deck slab	-Drainage of water behind walls abutments, placing of Wheepholes, -Rehabilitation of the existing abutments by sand blasting, cleaning and painting of walls, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Providing of Neoprene bearings + Concrete pads on abutments after Jacking of deck bridge, -Rehabilitation of existing fittings, -Treatment of vegetation.
PB 008	0+865	Pre-stressed I-beam footbridge	-Rehabilitation of piers and abutments by sand blasting, cleaning and joining of stonework, -Demolishing of RC deck slab and building of new one, -Providing of Neoprene bearings + Concrete pads on piers & abutments after Jacking of the pre-stressed beams, -replacement of existing fittings, -Painting of footbridge, -Treatment of vegetation.

BR 005	0+565	RC Deck slab	-Rehabilitation of piers and abutments by sand blasting, cleaning and joining of stonework, -Rehabilitation of the deck bridge by sand blasting, cleaning and concrete patch repair with epoxy resin and injection of possible cracks, -Drainage of water behind walls, cleaning of existing Wheepholes, -Providing of Neoprene bearings + Concrete pads on piers & abutments after Jacking of deck bridge, -Replacement of existing fittings, -Treatment of vegetation

Route N°1:

Total of bridges on Route N°1: **24**

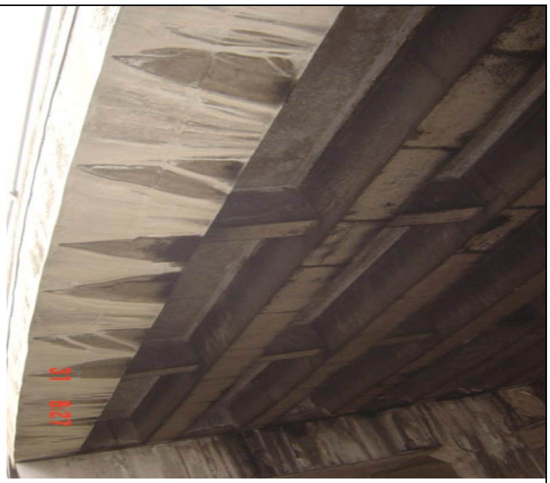
Number of bridges to be rehabilitated: **11**
Number of existing bridges to be replaced: **11**
Number of existing bridges to be demolished **13**

Route N°6:

Total of bridges on Route N°6: **7**

Number of bridge to be replaced: **-**

Elevation – RCI-Beams a Deck Slab Bridge – Absence of Neoprene bearings



Lower part of the deck slab – Water infiltration problem

Deep Water infiltration on pier – Absence

Important damage of concrete pier-

of water evacuation system	**Severe corrosion of reinforcement bars- Concrete affected by carbonation**
	
Collapse of concrete pier- severe corrosion of reinforcement – Loss of section	**Absence of expansion joint**

Route N°1- Bridge BR277- RC I-Beams and Deck Slab Bridge

Survey of Existing Tunnels

Immediate and urgent renovations that are required for the existing tunnels include:

- Reconstructing the roadway surface to assure that it provides the necessary adhesion and stopping distances as well as to provide a crossfall of approximately 2.5%.
- Upgrading the tunnel lighting so that it conforms to the current design standards.
- Upgrading the power supply system so as to provide an uninterruptible power supply to critical tunnel installations (emergency lighting, illuminated signs and lights indicating the emergency exits etc).
- The construction of technical buildings near the tunnel portals to house the power supply equipment.

Renovations that are slightly less urgent, but still need to be carried out as soon as possible include:

- Providing fire protection to the cut and cover tunnel structure.
- Installing signs indicating the location of the safety emergency escape passages. the fire hydrants and the direction to the nearest exit.
- Installing fire resistant doors to the escape passages and cross passages in the tunnel
- Installing ventilation systems to prevent smoke from entering the escape passages and cross-passages.
- Closing the cross passages in the cut and cover tunnel.
- Closing opening to the evacuation stairs at the balcony level so that smoke can not enter into the escape passage.
- Construction of a central dividing wall at each of the tunnel portals to prevent smoke from recycling from one tube to the other.

Renovations that can be delayed for a certain period of time include:

- Renovation of the drainage system and tunnel footpaths:
- Upgrading of the fire fighting network
- Establishment of a traffic management centre
- Installation of emergency call network
- Installation of a CCTV network
- Installation of an automatic incident detection system
- Installation of a traffic management system.
- Installation of a SCADA system.

Cost Estimations

Immediate and urgent renovations that are required for the existing tunnels include:

	Unit Price France	Unit Price Italy	Quantity	Total Price
Reconstructing the roadway surface to assure that it provides the necessary adhesion and stopping distances as well as to provide a crossfall of approximately 2.5%.	This work should be included as part of the "upgrading pavement works" on the roads adjoining the tunnels. Hence these costs are not included in the estimation for the cost for the tunnel works.			
Upgrading the tunnel lighting so that it conforms to the current design standards.	750 Eur/m		1 800	1 350 000
Upgrading the power supply system so as to provide an uninterruptible power supply to critical tunnel installations (emergency lighting, illuminated signs and lights indicating the emergency exits etc).	100 000 Eur/u		3	300 000
Construction of technical buildings near the tunnel portals. (35 m2)	30 000 Eur / u	25 000 Eur / u	3	75 000
TOTAL Before VAT				**1 725 000**

Cross Passage in the Santa Venera Tunnel. Note that there are no signs indicating the presence of a cross passage, there are no doors preventing smoke from passing from one tube to another and that the electrical distribution cabinet and cables are unprotected from the effects of a fire.

Renovations that are slightly less urgent, but still need to be carried out as soon as possible include:

	Unit Price France	Unit Price Italy	Quantity	Total Price (EUROS)
Providing fire protection to the cut and cover tunnel structure.	150 Eur / m2	110 Eur / m2	13 500	1 500 000
Installing signs indicating the location of the safety emergency escape passages. the fire hydrants and the direction to the nearest exit.	4 000 Eur / u		12	48 000
Installing fire resistant doors to the escape passages and cross passages in the tunnel	40 000 Eur / u		12	480 000
Installing ventilation systems to prevent smoke from entering the escape passages and cross-passages.	5 000 Eur / u		12	60 000
Closing the cross passages in the cut and cover tunnel.	10 000 Eur / u	5 000 Eur / u	1	5 000
Closing opening to the evacuation stairs at the balcony level so that smoke can not enter into the escape passage.	10 000 Eur / u	5 000 Eur / u	4	20 000
Construction of a central dividing wall at each of the tunnel portals to prevent smoke from recycling from one tube to the other.	65 000 Eur / u	50 000 Eur / u	6	300 000
TOTAL Before VAT				**2 413 000**

Renovations that can be delayed for a certain period of time include:

	Unit Price France	Unit Price Italy	Quantity	Total Price
Renovation of the drainage system and tunnel footpaths:	1 300 Eur / m		2 000 m	2 600 000
Upgrading of the fire fighting network (No pumping station)	230 Eur / m	190 Eur / m	1 800 m	340 000
Establishment of a traffic management centre				
Installation of emergency call network				
Installation of a CCTV network				
Installation of an automatic incident detection system				
Installation of a traffic management system.				
Installation of a SCADA system.				
TOTAL Before VAT (Rough estimation between 5 000 000 Euro and 6 000 000 Euro)				

1.14. IDENTIFICATION OF ALIGNMENTS

Alignments as provided by ADT in February have been looked at and analysed, and then evolved to a preferred option.

1.15. PRELIMINARY DESIGN

Ground models, and orthophotos have been received and set up in Piste (the highway design software) and AutoCAD. A running centreline along the whole of route 1 and route 6 has been established using Piste.

Highway Working papers have been prepared for all the link sections. Following comments on these preferred options were evolved.

1.16 ENVIRONMENTAL IMPACT APPRAISAL

The environmental impact appraisal of the project is contained in the following two separate documents, which form part of the Final Feasibility Study Report:

Technical Appendix VIII. ENVIRONMENTAL IMPACT APPRAISAL
Technical Appendix IX. TECHNICAL ENVIRONMENTAL INFORMATION

Transport Infrastructure Projects, are designed to tackle the contextual issues of improving safety, alleviating traffic congestion, and achieving wider economic growth, in order to prevent the existing highways contributing to long-term social, economic and environmental decline. The projects have been guided by Sustainable Development principles from the outset, utilising a checklist of sustainability factors relevant to transport, including consideration of the emerging draft Sustainable Development Strategy for the Maltese Islands. Moreover, the iterative environmental impact appraisal process has promoted highway design in response to environmental considerations.

The Environmental Impact Appraisal report (Technical Appendix VIII) has identified the environmental issues associated with the proposed Transport Infrastructure Projects and provides information relating to potential environmental impacts and mitigation. The level of detail provided by the appraisal process corresponds with the outline proposals that have emerged from the Feasibility Study for Transport Infrastructure Projects in Malta and the appraisal report provides an initial foundation for future planning decisions regarding the projects.

The ‘environment’ is a complex multi-dimensional resource; environmental impacts therefore relate to a range of separate but interrelated considerations. In broad terms, impacts are a function of the magnitude of a proposed change and the sensitivity of the receiving environment and composite parameters, or receptors. Importantly, the value attributed to the environment by Maltese society, through the Government policy and planning framework, has been reflected in the appraisal process.

The value placed on the environment plays a significant part in the evaluation of environmental sensitivity. As for other environmental resources, this applies in the case of protected natural, semi-natural, historic and cultural features. It follows that those sections of the proposals that fall within areas that retain such characteristics, principally the rural areas between Cirkewwa Ferry Port (NA1) and the edge of Malta’s largest urban conurbation (NA11), are potentially sensitive to highway development. Although the proposed change may not necessarily be great in these areas, and mitigation measures have the potential to minimise or overcome environmental impacts, inherent environmental sensitivity means that a proposal here is more likely to require rigorous evaluation in order to gain planning approval and comply with Legal Notice 204/2001 (Environmental Impact Assessment Regulations).

All of the proposed highway improvements are likely to result in environmental enhancements, such as improved water quality through the use of runoff treatment technology, greater public accessibility, and socio-economic benefits. In the urban and semi-urban areas, south of NA11, the existing environment has been heavily modified through modern development, with the exception of pockets of open land and historically or culturally important areas. Anticipated environmental benefits are therefore less likely to occur in tandem with issues surrounding the type of protected areas found in rural areas. However, a dense human population in close proximity to the highway proposals has implications for related environmental considerations, such as potential land use conflicts and varying forms of pollution (including noise and air quality issues). In many cases appropriate highway design and mitigation measures can limit or overcome such problems, however there are nonetheless potential environmental risks.

In general, proposals for improved highway infrastructure are more likely to meet with protracted planning procedures where the potential change is greatest – namely in the case of significant land take, vertical realignment of the highway, or large-scale demolition and reconstruction projects.

Overall, the environmental implications of the proposals are complex, as described above, however transport is identified as one of the key sustainability issues in the draft Sustainable Development Strategy for the Maltese Islands and the proposed infrastructure improvements in Malta would make a contribution to progress associated objectives.

Lack of crossing facilities

Judging gaps in the traffic

1.17. ESTIMATION OF QUANTITIES AND CAPITAL COST

The table below shows a comparison of the original TINA estimate and the current estimate of the work.

Road / Link	Length	Description	TINA Cost estimate (M. Euro)	Current Estimate (M Euro)
NA1-NA4	4.2	Cirkewwa Ferry – Jct. At Seabank Hotel	6.887	13.251
NA4-NA5	1.8	Jct. At Seabank Hotel – Jct. To Manikata	4.337	3.177
NA5-NA6	1.4	Jct. To Maanikata – Roundabout at Bellview	3.362	0.747
NA6-NA7	2.9	Roundabout at Bellview-Xemxija Bay	4.598	1.475
NA4-NA7	3.5	Bypass-Mellieha/Xemxija, now remaned Manikata Road and Tunnel [from NA5 to NA7]	11.475	24.870
NA7-NA8	2.7	Xemxija Bay – Bugibba Roundabout	6.181	6.000
NA8-NA9	1.2	Bugibba Roundabout – Jct. To Naxxar/Iklin	2.745	3.616
NA9-NA10	4.4	Jct. To Naxxar/Iklin – Jct to Splash and Fun	7.025	11.339
NA9-NA10a	3.2	Bypass-Coast Road	13.098	0
NA9-NA10a, and NA11a-EA12	1.2	Bypass-Coast Road	0	0
NA10-NA11	2.6	Jct. To Splash and Fun – St. Andrews	4.087	25.906
NA11-EA12	1.3	St. Andrews - Paceville	2.968	20.206
EA12-EA14	1.2	Paceville-Jct. To San Gwann/St. Julians	2.486	18.515
EA14-EA15	0.8	Jct. To San Gwann/St. Julians –Kappara Roundabout	1.83	17.596
EA15-EA16	0.8	Kappara Roundabout – Tal- Qroqq Jct.	1.83	6.114
EA16-EA16A	0.5	Tal – Qroqq Jct. – Jct to Msida Valley (incl. bridge construction)	1.148	53.321
EA16A-WA18	1.2	Jct. To Msida Valley-Harum	2.825	6.312
WA18-WA19A	1	Harum – Jct. to Valletta	2.287	8.679
EA15-Gzira Sea front	1.2	Link from Route 1 to Manoel Island	10.898	16.761
WA19A-EA20	0.5	Jct. To Valletta - Roundabout Match Factory	1.148	24.212

Road / Link	Length	Description	TINA Cost estimate (M. Euro)	Current Estimate (M Euro)
EA20-EA21	1	Roundabout match Factory – Marsa Traffic Light Junction	3.887	17.237
EA20-EA21	2.1	Grade Separated Junction – Marsa	9.325	Incl above
EA21-WA23	2.3	Marsa Traffic Light Jct. – Roundabout Freight Terminal Luqa	5.266	7.399
WA23-WA24	0.6	Roundabout Freight Terminal Luqa – Roundabout Gudja Airport	1.372	1.283
WA26-WA27[6]	3	Jct. At Peace Lab. Jct. At Freeport	4.732	4.732
WA19A-EA7A	0.7	Jct. To Valletta – Jct at Triq Dicembru Tiettax	1.523	Inc below
EA7A-EA5	0.8	Jct. At Triq Dicembru Tiettax – Jct. At Bieb il-Bombi	1.762	Inc below
Road / Link	**Length**	**Description**	**TINA Cost estimate (M. Euro)**	**Current Estimate (M Euro)**
EA5-EA6	0.9	Jct. At Bieb il-Bombi – Roundabout War Memorial	1.973	Inc below
A6-Sea Pass. Term	0.9	Roundabout Mar Memorial – Sea Passenger Terminal	1.531	Inc below
EA7A-Sea Pass Terminal	1.8	New Link to Sea Passenger Terminal	3.811	Inc below
Route 6 works	1.8	All the route 6 works above	0	11.417
Short Term Works	-	Short Term Improvement Measures[7]	0	10.000
		Total	126.397	314.165

Cost Estimate by Link [in euro]

So the current estimate is close to 315 million euro [at current November 2004 values]. This includes approximately 50 million euro [estimated] of land and property acquisition/compensation, and 110 million euros of bridge and tunnel works.

This cost does not include VAT.

1.18. MAINTENANCE PLAN AND ESTIMATION OF MAINTENANCE COSTS

We understand that ADT are moving towards a pattern of utilising “contractors” [controlled by ADT] to maintain the roads, though specialist items (such as street lighting) are or will be maintained (we think) eventually via the local councils or currently via ememalta. We are not sure if the maintenance is based on instructed work done, or as seems to be getting popular world wide the contractor maintaining defined lengths of road based on a performance requirement.

Our current observations are that

- Virtually no maintenance is done on any bridge (or major drainage) structure;
- Road markings are not replaced when worn out or obscured [at least not in a systematic form]
- Only in exceptional circumstances is the road pavement replaced / significantly repaired or made less slippery by mechanical means.

[6] Original TINA estimate left, its value is near correct, and the works have already been designed in detail by ADT

[7] These are described in Technical Appendix I, with the cost summary being given on page 22 of Technical Appendix I

The Consultant has seen workmen cutting vegetation, and cleaning ditches and installing new signs on gantries, and some asphalting works (but not asphalting on route 1).

Current practice [from an outsiders viewpoint] seems to more of letting the road wear out over a significant length of time and then carry out a major reconstruction than keeping the existing road upgraded at very regular intervals.

It is also noted that we have not seen a systematic numbering of the road features (signs, street lights etc.) that might be used if a detailed maintenance plan is in operation.

Our belief is that maintenance costs vary between about 2 to 7% of asset value, all depending on condition, climate, usage and many other factors. Given that Route 1 and Route 6 combined probably are worth some 200 to 300 million euro [as an approximate figure, the total replacement figure would probably be higher] then a budget for a reasonable level of maintenance on these two roads might be about 5 to 7.5 million euro per year [or about 2 to 3 million Maltese Pounds].

What we suspect is currently lacking is a coherent and detailed maintenance plan within ADT [which must have as its goal the requirement to keep Routes 1 and 6 in a safe and usable condition An outline suggested maintenance plan[8], for ADT to modify and adopt as needed for local conditions is given in Section 18.2 of Technical Appendix IV, and the introduction to this plan follows.

This plan is based on the principle that highway maintenance, and indeed the wider agenda of network management, should be managed as an integrated asset management regime, with the objectives of delivering safety, serviceability and sustainability. These three objectives, set within the context of a sound financial management, define the framework both the service, including arrangements for inspection, standard setting and performance.

Bearing in mind the legal obligations, ADT should adopt reasonably consistent and well defined approaches in addressing the safety objective.

Purpose of Highway Maintenance

The main purpose of highway maintenance is to maintain the highway network [in this case particularly Routes 1 and 6] for the safe and convenient movement of people and goods. This purpose however needs to be set within the wider contexts of integrated transport, Best Value and the corporate vision of ADT.

Bus stop Junct EA19a

Queue back from Floriana, Junct EA10a

The objectives of highway maintenance can be defined as:

a) Network Safety

i) Complying with statutory obligations

ii) Meeting users' needs

b) Network Serviceability

i) Ensuring availability

ii) Achieving integrity

[8] The majority of this plan is heavily based on the publication "Delivering Best Value in Highway Maintenance" Code of Practice for Maintenance Management, published by the Institution of Highways and Transportation UK, 2001

iii) Maintaining reliability
iv) Enhancing quality
c) Network Sustainability
i) Minimising cost over time
ii) Maximising value to the community
iii) Maximising environmental contribution

Each of these objectives is equally relevant to the network management function, which brings together highway maintenance, improvement and management.

Scope of Highway Maintenance
Highway maintenance is a wide-ranging function and the following types of activity are defined:

a) Reactive – Responding to inspections, complaints or emergencies
b) Routine – Regular consistent schedule for patching, cleaning, landscape maintenance and other activities
c) Programmed – Planned schemes, primarily of resurfacing, reconditioning or reconstruction
d) Regulatory – Inspecting and regulating the activities of others
e) "Winter" service
f) Weather and other emergencies

Within each of these types of maintenance there are various maintenance activities applying to highway elements usually grouped as follows:

Reactive
- All elements – sign and make safe
- All elements – provide initial temporary repair
- All elements – provide permanent repair

Routine
- Carriageways, footways and cycleways – minor works and patching
- Drainage Systems – cleansing and repair
- Embankments and cuttings – stability
- Landscaped areas and trees – management
- Fences and barriers – repair
- Traffic signs and bollards – cleansing and repair
- Road markings and studs – replacement
- Lighting Installations – cleansing and repair
- Bridges and Structures – cleansing and minor works

Programmed
- Carriageways – minor works, resurfacing or reconstruction
- Footways – minor works, resurfacing or reconstruction
- Cycleways – minor works, resurfacing or reconstruction

Regulatory
- Highway register
- Management of utilities
- Licenses for highway occupation
- Other regulatory functions – encroachment, illegal signs etc

Winter Service
- Pre–treatment
- Post–Treatment
- Clearance of sand [such as on the NA3 to NA4 section]

Weather and other Emergencies
- Flooding
- High winds
- High temperatures
- Other emergencies

Dangerous merging movements, WA19

Two lanes on single lane ramp, WA19

1.19. Economic Evaluation

From the traffic results and after calculating transport [vehicle operating costs], time [vehicle operating time] and accident costs an economic analysis has been made. The results of the analysis are summarised below. Essentially the project as a whole is economically viable.

In fact the analysis is probably an underestimate as accident records are not that coherent [so accident savings are most likely an underestimate] and junction time savings estimated are probably on the low side.

Route 1 and Manikata Bypass[9]				**SAVINGS (Eco. Costs)**		**SAVINGS (Eco. Costs)**		**SAVINGS (Eco. Costs)**	
Ref	From	To	Construction cost [MTL]	Acc. TREND	Acc. POLICY	Acc. TREND	Acc. POLICY	Acc. TREND	Acc. POLICY
				NPV(10%)	NPV(10%)	EIRR =	EIRR =	NPV(6%)	NPV(6%)
1	NA1	NA2	1,171,459	-1,222,586	866,708		21.9%	-1,464,738	1,563,056
2	NA2	NA3	1,055,421	421,312	421,312	16.3%	16.3%	930,719	930,719
3	NA3	NA4	3,491,952	-1,236,398	-1,236,398	3.2%	3.2%	-673,169	-673,169
4	NA4	NA4-a	407,887	217,333	217,333	17.5%	17.5%	454,697	454,697
5	NA4-a	NA5	951,737	1,111,246	1,551,348	26.1%	31.3%	1,906,150	2,543,944
6	NA5	NA7[10]	11,378,294	34,295,710	34,295,710	44.7%	44.7%	53,383,289	53,383,289
9	NA7	NA8	2,567,394	13,889,504	13,889,504	55.6%	55.6%	21,945,456	21,945,456
10	NA8	NA9	1,547,408	6,132,210	6,136,825	54.1%	54.1%	9,474,017	9,480,705
11	NA9	NA9-a	289,512	6,605,849	6,613,253	226.8%	227.0%	9,743,147	9,753,878
12	NA9-a	NA10-b	1,507,457	7,232,799	7,420,849	62.4%	63.5%	11,104,528	11,377,050
13	NA10-b	NA10-a	2,166,346	8,241,084	8,241,084	52.2%	52.2%	12,778,930	12,778,930
14	NA10-a	NA10	988,333	6,046,866	8,513,375	76.5%	97.8%	9,147,223	12,721,677
15	NA10	NA11	11,085,245	-19,755	4,309,201	10.0%	16.0%	3,471,178	9,744,682
16	NA11	EA12-a	4,801,851	6,411,947	6,427,557	29.3%	29.4%	10,732,171	10,754,793
17	EA12-a	EA12	3,844,198	5,403,590	5,408,250	29.6%	29.6%	9,080,236	9,086,677
18	EA12	EA13	5,789,809	6,704,630	6,880,357	23.9%	24.3%	12,068,098	12,322,760
19	EA13	EA14	2,132,529	93,713	665,369	10.7%	14.9%	796,353	1,624,795
20	EA14	EA15	7,777,402	9,403,579	9,626,572	28.1%	28.5%	15,827,639	16,150,798
21	EA15	EA16	2,615,840	11,221,703	11,221,703	49.8%	49.8%	17,346,554	17,346,554
22	EA16	EA16-a	6,716,475	4,846,124	4,846,124	19.8%	19.8%	9,279,126	9,279,126
23	EA16-a	WA17	15,671,775	9,049,684	9,049,684	18.0%	18.0%	18,481,125	18,481,125
24	WA17	WA18	2,701,103	6,122,346	8,127,870	35.1%	41.8%	9,826,748	12,732,808
25	WA18	WA19	3,713,795	8,003,295	8,216,791	33.9%	34.4%	12,981,124	13,286,568
26	WA19	WA19-a	3,644,495	4,888,573	4,888,573	26.6%	26.6%	8,342,297	8,342,297

[9] No economic analysis of the Link to Manuel Island from Kappara Roundabout has been carried out.
[10] Manikata Bypass

27	WA19-a	EA21	13,763,869	41,609,114	42,311,487	44.1%	44.6%	66,519,804	67,566,438
31	EA20-a	WA22	1,462,333	-382,463	-382,463	4.8%	4.8%	-112,890	-112,890
32	WA22	WA23	1,676,037	9,648,041	9,648,041	67.3%	67.3%	14,545,392	14,545,392
32	WA23	WA24	538,885	1,113,918	1,113,918	34.9%	34.9%	1,808,365	1,808,365
Total R1 excl short term			**115,458,841**	205,852,968	219,289,937			339,723,569	359,220,520
Route 6				**SAVINGS (Eco. Costs)**		**SAVINGS (Eco. Costs)**		**SAVINGS (Eco. Costs)**	
32	WA23	WA24	4,795,189	60,316,066	60,316,066	97.5%	97.5%	91,937,860	91,937,860

As can be seen there is little point doing a cost sensitivity analysis, essentially if the cost rises from that projected (on Route 1) by some 80 or more % the NPV is still about 10%, and even if the cost (of works on Route 1) goes up by close to a factor of 3 the NPV of the project is still 6%.

The results on Route 6 are even better, though it may be that the benefits are overestimated here.

The economic results show that emphasis [at least from an economic viewpoint] should be given to the following sections

- WA24 to WA23 to WA22 to EA20a-EA21 to WA19a [the WA23 to WA24 section is scheduled to commence work in 2005, thee economic results of continuing this work through to the junction of Route 1 and 6 are high.
- Works in the vicinity of junction EA15 [Grade separation], and associated pavement improvements from junctions EA14 to EA16.
- Works on the coast road from NA8 to NA10
- Section NA7 to NA8 [scheduled to commence works in 2005]
- Manikata Bypass [NA5 to NA7]
- The NA11 to EA13 section

1.20. SELECTION OF THE PREFERRED OPTION

The method of selection of the preferred option, over the period February 2004 to September 2004, required the following:

a. Identification of proposals given in the TINA [2002] report [refer Technical Appendix VI, Appendix 2.1 for copy of Chapter 9 of the TINA Report];
b. Identification of earlier "designs" and the "programme" as envisaged by ADT;
c. Identification of existing road useage [traffic flows, by collection of existing data and survey];
d. Identification of safety and accident related issues [collection of accident data, Junction Safety Audits [refer Technical Appendix VI, Annex 7 for Junction Safety Audits]];
e. Identification of existing road condition [pavement and materials surveys, walkovers by specialists etc., technical analysis];
f. Identification of constraints [public utilities, properties, environmental, planning, drainage, etc.];
g. Identification of any problems with the existing structures [refer Technical Appendix VI, Annex 13.1 for the full report titled "Survey of Existing Bridge Structures"];
h. Identification of any problems with the existing Tunnels [refer Technical Appendix VI, Annex 13.2 for the full report titled "Survey of Existing Tunnels"];
i. Identification of any problems in the existing street lighting [refer Technical Appendix VI, Annex 15.2, for the full report on "Public Highway Lighting"];
j. Identification of potential highway improvements [refer Technical Appendix VI, Annex 15.1 for all the individual reports relating to potential highway improvements], and the environmental constraints associated with these [refer Technical Appendix VI, Annex 16.1, "Environmental Constraints Summary Tables"];
k. Technical Analysis of selected potential highway improvements [as written up in this report];

l. Collecting the initial views of ADT and MEPA[11] on the individual potential highway alternatives [refer Technical Appendix VI, Annex 20 for letters from MEPA on the subject];
m. Presenting the alternatives [to ADT, with MEPA representatives present – in August and September 2004] to enable ADT in discussion with the Consultant to "chose" a preferred option based on a number of parameters [traffic capacity link and junction, land availability, physical constraints, environmental constraints, budget, perceived need, economic benefits, other local factors etc.];

1.21. THE PREFERRED OPTION

The preferred option consists of the following:

- Highway Improvements (Long Term or Permanent - involving pavement reconstruction and geometric upgrade], described by link in Technical Appendix I, and in the drawings in Technical Appendix V.
- An initial "low cost improvement, or short to medium term" on all links that will not be fully upgraded within the next five years [2005 to 2009], also described in Technical Appendix I. This would include junction items, an ATC network, accident analysis capability, speed cameras, reflective studs and road markings, bus stops, and location specific works.

1.22. PRECONDITIONS AND IMPLEMENTATION

As yet no known preconditions exist with relation to the implementation of the upgrading of the TEN-T network in Malta.

The current study, as well as identifying "nodal" based projects has also identified:

- A "start up" major maintenance / local rehabilitation type project for the whole of routes 1 and 6, essentially full road markings – thermoplastic- (plus some reflectors), pothole repairs (and repairs of areas where pavement is getting close to potholing), local repairs of signs, barriers, addition of safety signs, addition of any safety features, local drainage repairs etc.
- Urgent Bridge repair/replacement.

To arrive at a sensible programme for the nodal based projects and the others given immediately above one has to consider the following points[12]:

- Planning approval process;
- Complexity of detail design and tendering stages [these need to be carried out before works can start];
- Complexity of the Land Acquisition process;
- Other facilities in the corridor [a lot less pre-planning and pre-ordering of cables, pipes etc. is needed where there are no or few services to relocate compared to sections where there are a lot of services to relocate)
- Potential public perception of the works [it is likely the public will want works to be more concentrated where there are significant traffic problems]
- Other projects being implemented [offline from Routes 1 and 6, such as the Park and Ride implementation, the Italian Protocol Projects, major property developments such as at Manoel Island and Tigne Point]
- Funding [getting the money – almost on a link by link basis- in place to pay for both the pre-tender works such as detail design and obtaining the final planning approvals, and to pay for both the land acquisition, the works plus associated service relocations, and any required supervision]. The assumption is that most funding will come from the European

[11] The objective was to eliminate potential alternatives that would not meet Planning/Environmental requirements, such that remaining options could be studied/optimized [in light of comments], and a preferred one then be selected.
[12] This in a non exhaustive list.

Union as funding for the TEN-T network, but there are obviously limits to this funding, and these limits may well be less than the total cost estimates derived.

- Safety [i.e. urgent replacement needed of bridge on section EA12 to EA13, tunnel lighting and elimination of other safety related problems with tunnels, local safety problems than can be cheaply fixed]
- The current state of the roads by link [some existing sections will last longer without much work being done on them than others]
- Traffic management during construction
- Minimisation of construction waste disposal off site [this is difficult, most of the works sections will generate excess waste material that could be used as construction fill, but only the sections at Kennedy Grove, Kappara Roundabout Grade separation and the grade separated interchanges in the vicinity of Marsa will require imports of fill – which could of course if the timing is right, or if some offsite facilities are used to store material, come from of works sections on Route 1 and 6.

The next funding applications [to the EU for funding as part of the TEN-T network] are in 2005/6, with works potentially commencing in 2006. This funding application is likely to include the urgent bridgeworks on the EA12 to EA13 section.

So a potential updated programme[13] for works is as follows[14]:

Nodes	Description	Priority	Year of Works commencement	Comments
All	Maintenance and Local Rehabilitation: All Sections, except those to be upgraded shortly	1	2006	
-	Urgent Bridgeworks [bridge on EA12 to EA13 section]	1	2006	
-	Urgent Safety works existing tunnels	1	2006	
-	Less urgent Safety works existing tunnels	3	2008	
	ATC system [spread over a number of years]	8	2006	
Existing TEN-T Network - Malta				
Nodes	Description	Priority	Year of Works commencement	
Route 1				
NA1 – NA4	Cirkewwa Ferry - Jct. at Seabank Hotel	3	2008	
NA4 – NA5	Jct. At Seabank Hotel – Jct. to Manikata	3	2008	
NA5 – NA6	Jct. To Manikata – Roundabout at Bellview	5	2010	
NA6 – NA7	Roundabout at Bellview – Xemxija Bay	5[15]	2010	
NA5 to NA8	Manikata Bypass	7	2012	
NA7 – NA8	***Xemxija Bay – Buggiba Roundabout***	***N/A***	***2005***	***F.A.P.***[16]
NA8 – NA9	Buggiba Roundabout – Jct. to Naxxar/Iklin	3	2008	
NA9 – NA10	Jct. to Naxxar/Iklin – Jct. To Splash & Fun	3	2008	
NA10 – NA11	Jct. To Splash & Fun – St. Andrews	5	2010	
NA11 – EA12	St. Andrews - Paceville	6	2011	
EA12 – EA14	Paceville - - Jct. To San Gwann/St. Julians	1[17]	2006	
EA14 – EA15	Jct. To San Gwann/St. Julians – and including Kappara Roundabout Grade separation	1	2006	
EA15 – EA16	Kappara Roundabout – Tal Qroqq Jct.	1	2006, then 2008.	

[13] Obviously as the programme depends upon many criteria this should not be considered as a cast in stone programme, it will need to be revised over time to match current needs, available finance, and actual implementations.

[14] Objective is to start works in 2006, and "finish" around 2015, i.e. a spend over a 10 year period.

[15] Bypassed by Manikata Road, hence this section will receive only essential maintenance and essential safety features, plus importantly a bridge repair

[16] F.A.P. = Funding applied for

[17] Especially for the main bridge on Section EA12 to EA13 which urgently needs replacement. One, with sufficient resources, can redo the pavement works in the vicinity when part of the roadway is shut for bridgeworks

			then 2011		
EA16 – EA16a	Tal Qroqq Jct. – Jct. to Msida Valley (incl. Bridge construction)	8	2013		
EA16a – WA18	Jct. To Msida Valley - Hamrun	7	2012		
WA18 – WA19a	Hamrun – Jct. To Valletta	7	2012		
WA19a – EA20	Jct. To Valletta to Roundabout Match Factory	4	2009		
EA20 – EA21	Roundabout match Factory - Marsa Traffic Light Junction	3	2008		
EA21 – WA23	Marsa Traffic Light Junction - Roundabout Freight Terminal Luqa	3	2008		
WA23 – WA24	***Roundabout Freight Terminal Luqa – Roundabout Gudja Airport***	***N/A***	***2005***	***F.A.P.***	
WA26 – SA27	***Jct at Peace Lab. – Jct. At Freeport***	***N/A***	***2005***	***F.A.P.***	
Route 6[18]					
WA19a – EA7a	Jct. To Valletta – Jct. At Triq Dicembru Tiettax	6	2011/2012		
EA7a – EA5	Jct. at Triq Dicembru Tiettax – Jct. at Bieb il-Bombi	6	2011/2012		
EA5 – EA6	Jct. at Bieb il-Bombi - Roundabout War Memorial	6	2011/2012		
EA6 – Sea Pass. Terminal	Roundabout War – Memorial – Sea Passenger Terminal	6	2011/2012		
	Extension of TEN-T Network - Malta				
NA9 – NA10a	*Bypass - Coast Road*	*N/A*	*Never*	*Not viable*	
NA11a – EA12	*Bypass – Coast Road*	*N/A*	*Never*	*Not viable*	
EA20 – EA21 – WA22	Grade Separated Junction [s] - Marsa	3/4	2008/2009	Combine all Marsa works in one	
EA7a – Sea Pass. Terminal	New Link to Sea Passenger Terminal	6	2011/2012	All route 6 works to commence together	
EA15 – Gzira Sea front	New Link to Gzira Sea front [link to Manoel Island]	1	2006	Start by property acquisition	

1.23. RELEVANCE AND SUSTAINABILITY

Refer to following Chapter 3.

1.24. OTHER ISSUES

PEDESTRIAN AND CYCLIST USAGE OF ROUTES 1 AND 6

At present, and depending upon location, Routes 1 and 6 are used by virtually all types of vehicles, plus pedestrians and cyclists.

Throughout the road network, improvements to speed and capacity of the traffic flows have historically been given priority over safety, and the needs of pedestrians. This has resulted in a number of design conflicts, such as at the junction of on-ramps and the main carriageway of Route 1.

[18] 2 separate years are given for Route 6. 2010 is taken as commencement of works for anything to do [on or adjacent to Route 6] with Park and Ride scheme [although piecemeal ADT will have been working since 2004]. 2012 for everything else as it delays need to reconstruct Route 6 pavement as long as possible.

Evidence of pedestrian activity is not easily quantifiable at most locations. This is felt to be the result of the lack of formal pedestrian facilities. The need for individuals to walk in high-trafficked carriageways, and openings in boundary walls leading directly onto carriageways, tend to discourage pedestrians from following these routes. At a number of locations there is evidence of regular, small-scale pedestrian activity, which needs to occupy the carriageway because of the lack of footways. In these situations, it is necessary to either provide some form of infrastructure to accommodate the movements, or to take steps to prohibit the pedestrian movements.

Area for pedestrian prohibition

Consequence of lack of crossing provision

Problem of vulnerability

No specific provision for 2-wheel vehicles

Speed is required

Care is required, even at low speeds

GENERAL FACTORS AFFECTING SAFETY

During the course of the traffic surveys and Safety Audits, a number of general traffic observations were made. A number of issues were identified as contributing to high accident potential on Malta’s roads, which are not always evident in either the Audits or the traffic flows. These factors include the following:

- Relatively low standard of driving
- Lack of driver anticipation
- Poor mechanical condition of many vehicles
- High average age of many vehicles

- High level of vehicle usage
- Poor road surface condition, poor wearing course, worn road markings
- Sub-standard and non-uniform highway layouts
- Lack of pedestrian facilities
- Reduction of geometric standards because of topography
- Social habits – communal activities
- Impatience, and high priority for personal mobility and accessibility

If carried out in isolation, the geometric improvements proposed for Route 1 could result in an increase in traffic speed and a consequential increase in both the number, and the severity, of accidents. The proposed improvements therefore need to be carried out in conjunction with the other factors itemised in the Safety Audit Technical Papers (refer Chapter 7 of this document), including, but not limited to:

- Speed enforcement cameras
- More visible traffic police presence
- Parking regulation enforcement, particularly adjacent to junctions
- Improved and consistent signage
- Use of anti-skid surfacing at problem locations
- Use of reflective studs, chevron signs, and thermo-plastic road markings
- Improved driver education
- Higher standard of driving to pass the driving test
- Higher standard of annual vehicle inspection
- Higher standard and enforcement of drink-drive laws

NETWORK CAPACITY AND TRANSPORT POLICY

Despite the proposed improvements to Route 1, it must be accepted that the road network has a limited, finite, capacity in terms of vehicles per hour, and that the Regional Road is approaching this capacity in the urbanised section. The restricting factor in this area is a combination of the capacity of the three tunnels, and the limits to the amount of traffic which can safely merge or demerge with streams of traffic running at or close to capacity.

On-ramp capacity is limited by through traffic

Safety problems combined with capacity

As flows on the main carriageway approach the theoretical limit, the gaps needed for traffic to join the main stream become smaller, and the queues become longer. Drivers become more impatient and are tempted to accept smaller gaps than are practical, and this increases the accident potential to both slip-road and main carriageway traffic.

Problems of merging traffic

Limited road space for links and junctions

The problem of limited capacity is not unique to Malta, and is experienced in all motorised urban environments. It can only be addressed through a coordinated transport policy which promotes forms of transport other than the private car, and in Malta's case this will be primarily through promotion of the bus and minibus network. A number of elements need to be combined, in addition to those already outlined above, to provide a 'carrot and stick' approach, to encourage a change in transport habits, including :

- Parking restraint and charging
- Road tolls
- Increased vehicle and fuel taxation
- Increased legislation enforcement
- Improved pedestrian and cycling facilities
- Improved bus routes, frequency and quality
- Improved interchange and bus stop facilities
- A public awareness program

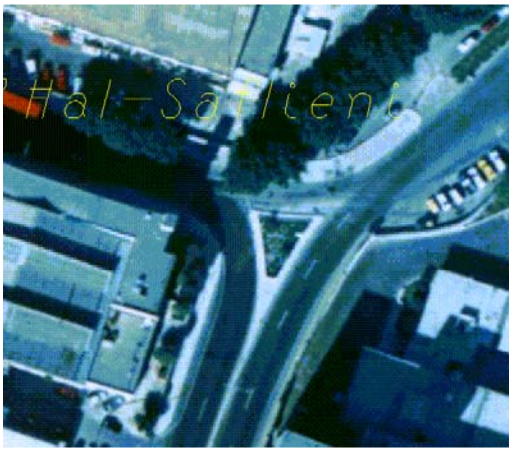
A finite capacity to the road network within the central urbanised area need not be a restriction on personal mobility and economic growth, but needs to be accepted so that the limitations of the transport network can be incorporated into the development plans and policies for the area. In the example of the Msida Valley Road area, improved safety can be achieved, but delays and a limited capacity for private capacity needs to be accepted.

A number of issues of Transport Policy are outside the Brief for the improvements to Route 1, but need to be resolved early as part of the coordinated strategy for sustainable development along the route corridor.

EA20

EA20A

EA21



EA21A

Traffic queuing back on gyratory

Bumper-to-bumper accident

2.0 BACKGROUND

The Transport Infrastructure Needs Assessment (TINA) process was designed to initiate the development of a multi-modal transport network within the territory of the candidate countries for accession.

During screening for the Transport Chapter of the Acquis (in November 1999), Malta formally expressed its interest to the Commission in the development of the Trans-European Transport Network (TEN-T) and, as a candidate accession country, in the extension of the TINA activities to the Maltese Islands.

The extension of the TINA process to Malta was to assess the transport infrastructure of the Maltese islands in relation to the provisions of the TINA Network in other acceding countries and the TEN Guidelines (European Parliament and Council's Decisions 1692/96 and 1346/2001).

The TINA Report (April 2002) identified the transport network that can be considered as a basis for the future extension of the Trans-European transport network on the island. The identification of this multi-modal network took into consideration the needs of the country, its specific characteristics and its economic capacity to realise the proposed infrastructure (based on the same realistic assumptions of TINA, i.e. allocation of 1.5% of annual GDP for transport infrastructure). In the report, the definition of the network is followed by the identification of those investment measures, which –in a horizon up to 2015- will modernise and upgrade the existing transport infrastructure to a level, which complies with the European requirements.

No footways or crossing facilities [WA22]

High speed vehicles turning left from arm C [WA22]

The first phase of the TINA process for Malta was developed with the intention to define TINA multi-modal transport network, which could be realised in the time horizon of 2015[19], taking into consideration the expected development of the country. The second phase concerned the identification of possible investment measures, and their pre-assessment in a view of a first prioritisation of their importance. Cost estimates for the identified measures are also included in the Report.

In April 2001, the European Commission Services contacted the Vienna-based TINA Office to carry out a Transport Infrastructure Needs Assessment for road, sea and air transport in Malta. The TINA study has been completed taken full account of the provisions of Decision 1692/96/EC on Community guidelines for the development of the Trans-European transport network (refer to above paragraph).

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[19] The nine Pan-European transport corridors identified, for further work, at the Crete conference, formed part of a three-layer concept by which the infrastructure for Pan-European transport should be adjusted to the needs of current and future traffic. The three layers addressed network needs :

Layer (1)	in a longer time horizon (over 2015);
Layer (2)	more urgently needed corridors with a time horizon of up to 2010-2015;
Layer (3)	projects to be implemented within five years.

Wide approach on arm B [WA23]

Short weaving length between arm B and C [WA23]

In the light of funding possibilities, the Malta Ministry of Transport and Communications through the Malta Transport Authority put forward a number of potential projects identified in the TINA process for the upgrading and possible extension of the TEN-T for further and more detailed economic feasibility and environmental studies.

Boundary wall and poor sight lines [WA24]

Wide approach at arm B [WA24]

Currently a study related to “Feasibility and Environmental Impact Studies for Transport Infrastructure Projects in MALTA” with identification number EUROPEAID/114473/D/SV/MT is under performance by an external Consultant (starting on 9th February 2004 and with a scheduled end date of 8th October 2004[20]). The wider objective of this study is to provide supporting information to the TINA final report in line with Council Regulation EC 2236/95 that lays down the general rules for the granting of Community financial aid in the field of Trans-European Network for possible co-financing through “Structural/Cohesion” funds. The study will take into account the Council and Parliament decisions on the development of TEN-T (1692/96 and 1346/2001).

HGV access and egress to Hal Far Estate

Ready-Mix wagon parking within junction

A list of documents consulted is attached as Administrative Appendix IV.

[20] Later extended to middle November 2004

3.0 SUSTAINABILITY

The four priority objectives from ADT and the Transport White Paper are:

- Modal shift
- Healthier travel
- Safer Travel
- Accessibility to all

The principles of Sustainable Development (SD) have been integrated into the design philosophy throughout the transport feasibility and environmental studies. A Task Force appointed by the National Commission for Sustainable Development (NCSD) prepared a draft SD Strategy for Malta that was published for consultation in July 2004 and the first public workshop on Transport and Energy was held in October 2004. In the absence of adopted SD policy for Malta, the transport studies drew upon SD policy and practical experience from Europe, the UK and the experience of the project team. This was refined through discussions with SD Task Members, other Maltese SD initiatives including the Sustainability Indicators-Malta Observatory (SI-MO) and emerging priorities for SD in Malta. The major issues identified by the NCSD in 2002 were Coastal Zone Management, Rehabilitation of Valletta, Transport and Waste.

Sustainability principles relevant to the proposed Transport Feasibility Project were used to guide the engineering design and EIA teams as follows:

- Improve safety
- Reduce polluting emissions and waste
- Respect for people and communities
- Support economic activities
- Value culture and heritage
- Value natural resources

There are no standard Sustainability (Impact) Assessment methods yet in Europe or Malta for transport strategies or projects. However, Sustainability Appraisal (SA) and Assessment methods are established in the land use planning and development sectors in the UK. These tend to use an objectives-based framework with multi-criteria analytical approaches to ensure that all relevant aspects, including integration and cumulative effects, are addressed by the Plan or Proposal. Objectives and criteria or decision-aiding questions were identified according to their relevance to Malta and the sphere of influence of the transport feasibility studies; the Sustainability Impact Appraisal is detailed in Technical Appendix VIII.

4. CONCLUSIONS AND PROPOSALS

As at the preparation of this Final Feasibility Study Report preferred options have been developed and costed. These preferred options are shown [on drawings] in Technical Appendix V.

Trucks queuing for Freeport [South end Route 1]

Approach from Pretty Bay, arm B

The preferred options are economically viable.. Even with implementation of the preferred options other measures[21] will be needed to reduce the increasing dependency of the Maltese population on private vehicles, otherwise traffic growth projections show an increasing likelihood of major traffic jams on Route 1 in particular.

[21] Notably encouragement of Public Transport