

## **CHAPTER 17 ENVIRONMENTAL IMPACT ASSESSMENT**

### **17.1 General**

In this chapter, various negative environmental impacts resulting from the project implementation are estimated and evaluated, and mitigation measures are discussed based on the results of the Initial Environmental Examination in the Master Plan.

### **17.2 Estimation and Evaluation of Environmental Impact and Mitigation Measures**

As in Table 17.1.

### **17.3 Conclusion and Recommendations**

#### **17.3.1 Conclusion**

The Project intends to widen and improve the principle roads in and around Dar es Salaam so that it may develop as a city which is comfortable to live in with sound infrastructure base. In this sense, the Project will play an important role in alleviating the traffic congestion, promoting appropriate land-use, and creating a favorable urban environment. The road development project will bring about many beneficial social, economic, and environmental changes to the city as a whole.

As there is a definite possibility that the road development will adversely affect the social and natural environment in the areas, estimation and evaluation have been conducted to assess mainly the negative impacts. For all five items (flood, resettlement of residents, air pollution, noise and vibration) which were deemed as having probable negative impacts, results show that the impacts of project implementation on the roadside and surrounding areas will be within the allowable level thereby maintaining the quality of the environment at an appropriate level.

The following are the results of the estimation and evaluation:

- (1) The safety margin in flood control is guaranteed and road flooding will be alleviated.
- (2) Social and economic impact of resettlement on the residents will be minimal.
- (3) Air quality at the roadside areas can be protected.
- (4) Noise and vibration hazards will not occur.

### **17.3.2 Recommendations**

Strategies in respect of the environmental issues regarding road construction and measures to create favorable urban environment in Dar es Salaam, are as follows:

- (1) **Prevention of flood hazards and improvement of the safety margin in river flow**
  - Improvement and regular maintenance of rainwater drainage facilities
  - River improvement
  - Regulation, instruction, and survey for land-use in flood-prone areas
  - Monitoring in the principle rivers with suitable observation instruments
  - Comprehensive flood control
- (2) **Resettlement of the residents and assurance of their standard of living**
  - Consideration in the resettlement compensation by securing places to move into and ensuring the living environment at the place of settlement
  - Establishment of a suitable guideline for resettlement
- (3) **Preservation of air quality**
  - Establishment of comprehensive legislations
  - Establishment of an air pollution control law
  - Establishment of environmental quality standards as well as control standards concerning air pollution
  - Establishment of a law stipulating the allowable limit of vehicular exhaust gases
  - Introduction of a periodic and compulsory vehicular inspection system
  - Air pollution monitoring
  - Examining measures for atmospheric preservation in view of global environmental protection
- (4) **Establishment of legislations and monitoring for noise and vibration**
- (5) **Implementation of sufficient environmental impact assessment and mitigation measures for preservation of flora and fauna**

**(6) Establishment of an environmental policy and environmental action plans**

- **Establishing an explicit "National Environmental Protection Act" and a clearer "Planning Act and Policies" allowing the public participation in decision-making.**
- **Preparing complete legislation and establishing various environmental policies and environmental preservation plans.**

**Table 17.1 (1) Estimation, Evaluation and Impact Mitigation Strategies**

Estimation and evaluation items	Estimation items	Estimation			Evaluation		Impact mitigation strategies																													
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Flood damage	1. Influence of increased road surface water displacement on river and waterway management and safety	Kijitonyama R. Sinza R. Ubungo R. Msimbazi R. Waterway	Rational formula	<ul style="list-style-type: none"> <li>Flow coefficient: 0.9 (roads)</li> <li>Rate of rainfall: 153.6 cm/h (50 year probability)</li> </ul>	<ul style="list-style-type: none"> <li>results of river and waterway flood flow volume estimates</li> </ul> <table border="1"> <thead> <tr> <th rowspan="2">Name of river</th> <th rowspan="2">Basin area (km<sup>2</sup>)</th> <th>Flood discharge</th> <th>Drainage (from road surface (additional) (B))</th> <th>(A) + (B)</th> </tr> <tr> <th>(A) (m<sup>3</sup>/sec)</th> <th>(B) (m<sup>3</sup>/sec)</th> <th>(m<sup>3</sup>/sec)</th> </tr> </thead> <tbody> <tr> <td>Kijitonyama</td> <td>3.9</td> <td>32.3</td> <td>4.44 (12.1)</td> <td>36.74</td> </tr> <tr> <td>Sinza</td> <td>24.75</td> <td>65.1</td> <td>3.68 (5.4)</td> <td>68.78</td> </tr> <tr> <td>Ubungo</td> <td>34.20</td> <td>73.6</td> <td>1.33 (1.8)</td> <td>74.93</td> </tr> <tr> <td>Msimbazi</td> <td>240.00</td> <td>381.4</td> <td>5.66 (1.5)</td> <td>387.06</td> </tr> </tbody> </table> <p>Note: Figures in parentheses are the percentages of drainage from road surface to total flood discharge</p>	Name of river	Basin area (km <sup>2</sup> )	Flood discharge	Drainage (from road surface (additional) (B))	(A) + (B)	(A) (m <sup>3</sup> /sec)	(B) (m <sup>3</sup> /sec)	(m <sup>3</sup> /sec)	Kijitonyama	3.9	32.3	4.44 (12.1)	36.74	Sinza	24.75	65.1	3.68 (5.4)	68.78	Ubungo	34.20	73.6	1.33 (1.8)	74.93	Msimbazi	240.00	381.4	5.66 (1.5)	387.06	"Flood hazards will not spread in roadside and downstream areas as a result of road development, and the living environment of the roadside and downstream residents will be protected."	<p>Environmental protection goals will be reached at the Ubungo and Msimbazi Rivers.</p> <p>Flow capacity is insufficient in the Sinza and Kijitonyama Rivers and the Waterway at Gerezani Rd. This necessitates the renovation or replacement of culverts.</p>	<ul style="list-style-type: none"> <li>Improving the flow capacity of rivers and waterways</li> <li>Plan the improvement of the flow capacities of rivers and waterways by renovating or replacing culverts where roads intersect rivers as necessary, and removing</li> </ul>
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	2. Current areas with overflowing on roads, impact on areas with flood occurrences	Priority project roads	Regular periodic estimations (written description)	<p>[Road plan]</p> <ul style="list-style-type: none"> <li>repair damaged roads</li> <li>renovate or replace culverts where roads intersect rivers as necessary</li> </ul>	<ul style="list-style-type: none"> <li>Locations where overflowing roads occur due to damaged road and drainage facilities will be corrected after road surface and drainage facilities are improved during road construction.</li> <li>With road construction, there exists the possibility that flood regions will increase around rivers and waterways with insufficient current flow capacity.</li> </ul>	<p>Current road overflow spots will be corrected after road construction. The management and safety of rivers and waterways with insufficient flow capacities will be guaranteed with the renovation or replacement of culverts.</p>	<ul style="list-style-type: none"> <li>garbage and other clogging material.</li> <li>Prevention of soil erosion through surface protection</li> <li>Soil erosion prevention will be attempted by conducting appropriate surface protection methods on road and protective surfaces.</li> <li>Road drain maintenance and management of Maintenance and management of road drains such as checking and cleaning will be done at regular intervals with strict observance.</li> </ul>																													
Movement of residents	1. The number of building to be moved	Areas alongside roads which are target of the priority project	Estimations based on road plans	<p>[Course of measures to manage problems from the movement of residents in this project]</p> <ul style="list-style-type: none"> <li>Road plan measures</li> </ul> <p>Consideration is given and the route is planned with as few buildings as possible being moved so that the social and economic impacts resulting from the movement of residents in certain areas will be kept minimal.</p>	<ul style="list-style-type: none"> <li>Number of buildings slated to be moved: 577</li> <li>Per road                             <ul style="list-style-type: none"> <li>Ohio St.: 1</li> <li>Sokoine Drive: 1</li> <li>Gerezani Rd.: 2</li> <li>New Kigogo Rd.: 121</li> <li>New Bagamoya Rd.: 73</li> <li>Uhuru Rd.: 75</li> </ul> </li> <li>Per use                             <ul style="list-style-type: none"> <li>Kivuoni Front: 7</li> <li>Bandari Rd.: 13</li> <li>Morocco Rd.: 179</li> <li>Kilwa Rd.: 73</li> </ul> </li> <li>Residence: 189</li> <li>Commercial house or office: 6</li> <li>Small house: 186</li> <li>Kiosk, street stand: 196</li> </ul>	"The standard of living of the residents to be moved will be protected and efforts will be made so they can socially and culturally adapt to their new neighborhood."	<ul style="list-style-type: none"> <li>This road construction will eliminate current traffic congestion, and improve the urban environment and traffic access for roadside residents, allowing social, economic and environmental benefits to be had.</li> </ul>	<ul style="list-style-type: none"> <li>The quick determination of an appropriate resettlement plan</li> <li>An appropriate resettlement plan, which takes into consideration the preservation of the residents' social, economic and environmental standard of living, will be discussed and drafted.</li> </ul>																												

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Movement of residents	2. Problems which may arise from moving	Areas alongside roads which are target of the priority project	Methods based on existing information	<ul style="list-style-type: none"> <li>Discussion and implementation of an appropriate movement plan</li> <li>An appropriate resettlement plan which includes movement compensation, guarantee of new residence, and consideration for standard of living and environment at the new residence shall be made and agreement with the residents to be moved will be reached while detailed plans for future enforcement are carried out.</li> </ul>	<ul style="list-style-type: none"> <li>Anxiety about socially and culturally adapting of the people to be moved</li> <li>There is a possibility that the current living conditions may be lost due to different levels of social and economic infrastructure at the new residences and changed travel distance to place of work resulting from the involuntary movement necessitated in implementing this project.</li> <li>Impact of economic activity and employment</li> <li>Most businesses alongside the road will socially and economically benefit from road improvement.</li> <li>There is the possibility that there will be negative social and economic impacts for the management and employees of some of the businesses which are to be move</li> </ul>		<ul style="list-style-type: none"> <li>All efforts will be made to prevent negative impacts on the residents to be moved by providing compensation, creating an appropriate resettlement plan, and arriving at an agreement with the residents.</li> <li>The environmental protection goal is attainable as shown above.</li> </ul>	<ul style="list-style-type: none"> <li>Arriving at an agreement with the residents</li> <li>Reaching an agreement with the residents will be strove for during the resettlement planning process.</li> <li>Concerns in the detailed plan</li> <li>Consideration will be given in future detailed plans so that the movement of residents will be kept at the lowest level possible.</li> </ul>																																																				
Atmospheric pollution	Impact of car emissions (NO <sub>x</sub> , CO) on the atmospheric environment	The following road areas: Ohio Gerezani Morocco Chang'ombe New Bagamnyo Uhuru Kilwa	Atmospheric pollution in the year 2000 will be predicted using the following diffusion formula: [estimation equation] <ul style="list-style-type: none"> <li>windy conditions (wind speed &gt; 1m/sec) Plume model equation</li> <li>no wind (wind speed &lt; 1m/sec) Puff model equation</li> </ul>	<ul style="list-style-type: none"> <li>Width of disruption, height of emission source</li> <li>Road Construction Manual (Japan Road Construction Association***[check text], 1989) will be referred to.</li> <li>Background concentration</li> <li>Due to lack of existing data, background concentration was set as follows using Japanese atmospheric pollution data.</li> <li>NO<sub>x</sub>: 0.02 ppm</li> <li>CO: 2.0 ppm</li> <li>Traffic conditions:</li> <li>Planned daily traffic volume</li> <li>Ohio 26,345</li> <li>Uhuru 31,821</li> <li>Gerezani 35,541</li> <li>Kilwa 24,891</li> <li>Morocco 41,657</li> <li>Chang'ombe 26,037</li> <li>New Bagamoyo 11,413</li> </ul>	Assessment results of NO <sub>2</sub> and CO (daily mean) <table border="1" style="margin-left: 20px;"> <thead> <tr> <th rowspan="2">Name of road</th> <th rowspan="2">Location No</th> <th colspan="2">NO<sub>2</sub></th> <th colspan="2">CO</th> </tr> <tr> <th>With project (ppm)</th> <th>Without project (ppm)</th> <th>With project (ppm)</th> <th>Without project (ppm)</th> </tr> </thead> <tbody> <tr> <td>Ohio</td> <td>1</td> <td>0.04343</td> <td>0.06899</td> <td>3.60474</td> <td>3.73734</td> </tr> <tr> <td>Gerezani</td> <td>2</td> <td>0.04614</td> <td>0.07586</td> <td>3.61681</td> <td>3.80172</td> </tr> <tr> <td>Morocco</td> <td>3</td> <td>0.04540</td> <td>0.08265</td> <td>3.59261</td> <td>3.86061</td> </tr> <tr> <td>Chang'ombe</td> <td>4</td> <td>0.04445</td> <td>0.06751</td> <td>3.57640</td> <td>3.71713</td> </tr> <tr> <td>New Bagamoyo</td> <td>5</td> <td>0.04284</td> <td>0.05435</td> <td>3.54449</td> <td>3.59859</td> </tr> <tr> <td>Uhuru</td> <td>6</td> <td>0.04642</td> <td>0.07336</td> <td>3.59215</td> <td>3.76969</td> </tr> <tr> <td>Kilwa</td> <td>7</td> <td>0.04455</td> <td>0.06939</td> <td>3.56247</td> <td>3.71412</td> </tr> </tbody> </table>	Name of road	Location No	NO <sub>2</sub>		CO		With project (ppm)	Without project (ppm)	With project (ppm)	Without project (ppm)	Ohio	1	0.04343	0.06899	3.60474	3.73734	Gerezani	2	0.04614	0.07586	3.61681	3.80172	Morocco	3	0.04540	0.08265	3.59261	3.86061	Chang'ombe	4	0.04445	0.06751	3.57640	3.71713	New Bagamoyo	5	0.04284	0.05435	3.54449	3.59859	Uhuru	6	0.04642	0.07336	3.59215	3.76969	Kilwa	7	0.04455	0.06939	3.56247	3.71412	NO <sub>2</sub> : under 0.08 ppm CO: under 10 ppm	The roadside concentrations of gas after project implementation at each position evaluated will be less than 0.05 ppm for NO <sub>2</sub> and less than 4 ppm for CO, making it possible to achieve the environmental protection goals.	<ul style="list-style-type: none"> <li>Dust suppression from regular road surface cleaning</li> <li>Road spraying and cleaning will be conducted regularly to prevent air quality erosion from dust and sand thrown up from passing vehicles.</li> <li>Positive planting of roadside trees in sidewalk areas.</li> <li>Positive roadside tree planting will be conducted to help preserve the air quality of the roadside areas.</li> </ul>
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Atmospheric pollution				<ul style="list-style-type: none"> <li>• Coefficient of hourly variation and ratio of automobile type mixture Determined according to field survey results at Morocco Rd.</li> <li>• Average driving speed: Design speed of each road is employed</li> <li>• Coefficient of exhaust Road Bureau of the Ministry of Construction of Japan (1986) is used</li> <li>• Weather condition Based on observation record of 1992 in Dar es Salaam</li> </ul>																																																								
	Impact of dust from road construction and passing vehicles	Roads subject to improvement in this project	Method based on existing information		<ul style="list-style-type: none"> <li>• Due to the paving of road surfaces in this road construction, the amount of dust given off from roads currently in bad condition or unpaved will be reduced and the atmospheric pollution of roadside areas will be improved.</li> <li>• Impact on air quality of road construction during strong winds can be reduced by water spraying.</li> </ul>	"The living environment of the roadside residents will not be harmed by atmospheric pollution due to dust."	The paving of roads will suppress the amount of dust released into the atmosphere and improve roadside air quality. Further, impact on the roadside environment due to dust will be kept minimal during the construction period by spraying water and other appropriate environmental protection measures. With the above, it is possible to achieve the environmental protection goals.	<ul style="list-style-type: none"> <li>• Appropriate environmental protection strategies such as water spraying will be enforced during road construction</li> </ul>																																																				
Noise	Impact on the living environment of roadside residents from passing vehicle noise (road traffic noise level $L_{50}$ )	The following road areas: Ohio Gerezani Morocco Chang'ombe New Bagamoyo Uhuru Kilwa	Estimated at 1.2 meter above the ground by the roadside of each road. [estimation equation] An estimation equation proposed by the Japan Acoustics Society	<ul style="list-style-type: none"> <li>• Traffic conditions Daily traffic volume, hourly traffic volume, and mean vehicle speed to be used in the estimation are the same as predetermined in the estimation of the air pollution.</li> </ul>	<ul style="list-style-type: none"> <li>• Results of traffic noise estimations</li> </ul> <table border="1"> <thead> <tr> <th rowspan="2">Name of road</th> <th rowspan="2">Location No.</th> <th colspan="4">Estimated noise (dB(A))</th> </tr> <tr> <th>Morning 7:00</th> <th>Daytime 17:00</th> <th>Evening 19:00</th> <th>Nighttime 22:00</th> </tr> </thead> <tbody> <tr> <td>Ohio</td> <td>1</td> <td>64</td> <td>64</td> <td>65</td> <td>57</td> </tr> <tr> <td>Gerezani</td> <td>2</td> <td>65</td> <td>66</td> <td>66</td> <td>59</td> </tr> <tr> <td>Morocco</td> <td>3</td> <td>65</td> <td>66</td> <td>66</td> <td>59</td> </tr> <tr> <td>Chang'ombe</td> <td>4</td> <td>66</td> <td>66</td> <td>66</td> <td>58</td> </tr> <tr> <td>New Bagamoyo</td> <td>5</td> <td>62</td> <td>62</td> <td>62</td> <td>54</td> </tr> <tr> <td>Uhuru</td> <td>6</td> <td>67</td> <td>68</td> <td>68</td> <td>60</td> </tr> <tr> <td>Kilwa</td> <td>7</td> <td>65</td> <td>65</td> <td>65</td> <td>58</td> </tr> </tbody> </table>	Name of road	Location No.	Estimated noise (dB(A))				Morning 7:00	Daytime 17:00	Evening 19:00	Nighttime 22:00	Ohio	1	64	64	65	57	Gerezani	2	65	66	66	59	Morocco	3	65	66	66	59	Chang'ombe	4	66	66	66	58	New Bagamoyo	5	62	62	62	54	Uhuru	6	67	68	68	60	Kilwa	7	65	65	65	58	<ul style="list-style-type: none"> <li>• Morning, afternoon and evening noise levels below 70 dB(A) Evening levels below 60 dB(A)</li> </ul>	Road traffic noise levels will achieve environmental protection levels at all points for all time brackets.	<ul style="list-style-type: none"> <li>• The positive planting of roadside trees along sidewalks Roadside trees will be planted along sidewalks to prevent noise hazards.</li> </ul>
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Noise	Influence of construction noise on roadside residents (construction noise level: maximum allowable mean)	Roads subject to improvement in this project	Estimations were made 1.2 meters above the edge of the road [estimation equation] A theoretical propagation equation for the point sound source in semi-free space is employed for the estimation.	<ul style="list-style-type: none"> <li>Location of sound source Set at 5.0 meters away from the road side in consideration of range of construction at each site and revolving radius of operating construction machines.</li> <li>Power level of the noise source.</li> </ul>	<ul style="list-style-type: none"> <li>Construction noise estimation results</li> </ul> <table border="1"> <thead> <tr> <th>Type of work</th> <th>Job description</th> <th>Construction machine (standard)</th> <th>Estimated noise (dB(A))</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Earth work</td> <td>Pavement breaking</td> <td>Concrete crusher</td> <td>70</td> </tr> <tr> <td rowspan="2">Excavating</td> <td>Back hoe (0.6 m<sup>3</sup>)</td> <td>80</td> </tr> <tr> <td>Dump truck (11 ton)</td> <td>80</td> </tr> <tr> <td rowspan="2">Ground leveling</td> <td>Bulldozer (7 ton)</td> <td>80</td> </tr> <tr> <td>Dump truck (11 ton)</td> <td>80</td> </tr> <tr> <td rowspan="3">Paving work</td> <td rowspan="2">Roadbed preparation</td> <td>Bulldozer (7 ton)</td> <td>76</td> </tr> <tr> <td>Macadam roller (10 to 12 ton)</td> <td>76</td> </tr> <tr> <td rowspan="2">Paving</td> <td>Asphalt finisher (4.5 m)</td> <td>80</td> </tr> <tr> <td>Dump truck (11 ton)</td> <td>80</td> </tr> <tr> <td rowspan="2">Roll finishing</td> <td>Macadam roller (10 to 12 ton)</td> <td>76</td> </tr> <tr> <td>Tire roller (8 to 20 ton)</td> <td>76</td> </tr> </tbody> </table>	Type of work	Job description	Construction machine (standard)	Estimated noise (dB(A))	Earth work	Pavement breaking	Concrete crusher	70	Excavating	Back hoe (0.6 m <sup>3</sup> )	80	Dump truck (11 ton)	80	Ground leveling	Bulldozer (7 ton)	80	Dump truck (11 ton)	80	Paving work	Roadbed preparation	Bulldozer (7 ton)	76	Macadam roller (10 to 12 ton)	76	Paving	Asphalt finisher (4.5 m)	80	Dump truck (11 ton)	80	Roll finishing	Macadam roller (10 to 12 ton)	76	Tire roller (8 to 20 ton)	76	Less than 85 dB(A) within the construction site	All construction noise is under 80 dB(A) and the environmental protection goal is reached.	<ul style="list-style-type: none"> <li>Prevention of construction noise hazard</li> <li>Appropriate construction methods such as avoiding piling work as much as possible during bridge or overpass construction shall be set to prevent noise hazards. To further prevent noise hazards and traffic congestion due to construction transport vehicles, night time construction and shifting construction hours will be considered.</li> </ul>
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Vibration	The impact of vibration from passing vehicles on the living environment of roadside residents (road traffic vibration level L <sub>10</sub> )	The following road areas: Ohio Geregani Morocco Chang'ombe New Bagamoyo Uhuru Kilwa	Measured at 0 m above the side of the road [estimation equation] Equation proposed by the Public Works Research Institute of the Ministry of Construction of Japan.	<ul style="list-style-type: none"> <li>Traffic conditions: same as for noise</li> </ul>	<ul style="list-style-type: none"> <li>Results of road traffic vibration estimations</li> </ul> <table border="1"> <thead> <tr> <th rowspan="2">Name of road</th> <th rowspan="2">Location No.</th> <th colspan="2">Estimated vibration (dB)</th> </tr> <tr> <th>Daytime (17:00)</th> <th>Nighttime (19:00)</th> </tr> </thead> <tbody> <tr> <td>Ohio</td> <td>1</td> <td>53</td> <td>53</td> </tr> <tr> <td>Geregani</td> <td>2</td> <td>58</td> <td>58</td> </tr> <tr> <td>Morocco</td> <td>3</td> <td>60</td> <td>60</td> </tr> <tr> <td>Chang'ombe</td> <td>4</td> <td>56</td> <td>57</td> </tr> <tr> <td>New Bagamoyo</td> <td>5</td> <td>55</td> <td>55</td> </tr> <tr> <td>Uhuru</td> <td>6</td> <td>58</td> <td>58</td> </tr> <tr> <td>Kilwa</td> <td>7</td> <td>56</td> <td>56</td> </tr> </tbody> </table>	Name of road	Location No.	Estimated vibration (dB)		Daytime (17:00)	Nighttime (19:00)	Ohio	1	53	53	Geregani	2	58	58	Morocco	3	60	60	Chang'ombe	4	56	57	New Bagamoyo	5	55	55	Uhuru	6	58	58	Kilwa	7	56	56	Daytime: less than 65 dB Night: less than 60 dB	The road traffic vibration in both time slots and all points is below 60 dB, reaching the environmental protection goal.	
	Name of road	Location No.	Estimated vibration (dB)																																							
Daytime (17:00)			Nighttime (19:00)																																							
Ohio	1	53	53																																							
Geregani	2	58	58																																							
Morocco	3	60	60																																							
Chang'ombe	4	56	57																																							
New Bagamoyo	5	55	55																																							
Uhuru	6	58	58																																							
Kilwa	7	56	56																																							
Others	Impact of construction vibration on the living environment of the roadside residents (construction vibration level: greatest mean)	Road subject to improvement in this project	Measured at 0 m above the side of the road [estimation equation] A vibration distance attenuation equation	<ul style="list-style-type: none"> <li>Position of vibration source: same as for noise</li> <li>Power level of vibration</li> </ul>	<ul style="list-style-type: none"> <li>Results of construction vibration estimations</li> </ul> <table border="1"> <thead> <tr> <th>Type of work</th> <th>Job description</th> <th>Construction machine (standard)</th> <th>Estimated noise (dB(A))</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Earth work</td> <td>Pavement breaking</td> <td>Concrete crusher</td> <td>53</td> </tr> <tr> <td rowspan="2">Excavating</td> <td>Back hoe (0.6 m<sup>3</sup>)</td> <td>60</td> </tr> <tr> <td>Dump truck (11 ton)</td> <td>68</td> </tr> <tr> <td rowspan="2">Ground leveling</td> <td>Bulldozer (7 ton)</td> <td>68</td> </tr> <tr> <td>Dump truck (11 ton)</td> <td>68</td> </tr> <tr> <td rowspan="3">Paving work</td> <td rowspan="2">Roadbed preparation</td> <td>Bulldozer (7 ton)</td> <td>64</td> </tr> <tr> <td>Macadam roller (10 to 12 ton)</td> <td>64</td> </tr> <tr> <td rowspan="2">Paving</td> <td>Asphalt finisher (4.5 m)</td> <td>67</td> </tr> <tr> <td>Dump truck (11 ton)</td> <td>67</td> </tr> <tr> <td rowspan="2">Roll finishing</td> <td>Macadam roller (10 to 12 ton)</td> <td>53</td> </tr> <tr> <td>Tire roller (8 to 20 ton)</td> <td>53</td> </tr> </tbody> </table>	Type of work	Job description	Construction machine (standard)	Estimated noise (dB(A))	Earth work	Pavement breaking	Concrete crusher	53	Excavating	Back hoe (0.6 m <sup>3</sup> )	60	Dump truck (11 ton)	68	Ground leveling	Bulldozer (7 ton)	68	Dump truck (11 ton)	68	Paving work	Roadbed preparation	Bulldozer (7 ton)	64	Macadam roller (10 to 12 ton)	64	Paving	Asphalt finisher (4.5 m)	67	Dump truck (11 ton)	67	Roll finishing	Macadam roller (10 to 12 ton)	53	Tire roller (8 to 20 ton)	53	That it is below 75 dB within the construction site	Construction vibration is less than 70 dB and the environmental protection goal is attained.	<ul style="list-style-type: none"> <li>Vibration hazard prevention for road construction (same as for noise)</li> </ul>
	Type of work	Job description	Construction machine (standard)	Estimated noise (dB(A))																																						
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	Tire roller (8 to 20 ton)	53																																								
Others	Traffic safety	Roads subject to improvement in this project	Estimations based on road plans	Pedestrians and vehicles will have separate pathways and the sidewalks will be widened in this project. Traffic management facility will be provided.	<ul style="list-style-type: none"> <li>With the widening of the roads, separation of pedestrians and vehicles and the provision of a traffic management facility in this road project, the safety level will be improved over the current level.</li> </ul>																																					
	Area separation	Roads subject to improvement in this project	Estimations based on road plans	Pedestrian crossings and over paths will be constructed in this road construction project.	<ul style="list-style-type: none"> <li>Impact on the neighborhood due to area separation will be almost nonexistent as pedestrian crossings and over paths will be located with consideration given to the daily routines of area residents.</li> </ul>																																					

**Table 17.1 (5) Estimation, Evaluation and Impact Mitigation Strategies**

Estimation and evaluation items	Estimation items	Estimation			Evaluation		Impact mitigation strategies	
		Methods, conditions, etc. of estimation			Estimation results	Environmental protection goals		Evaluation results
		Points and scope of estimation	Estimation method	Estimation conditions, etc.				
Others	Flora and fauna	Greater Dar es Salaam	Method based on existing information	It is assumed that a road network will be created in the wider area around Dar es Salaam	<ul style="list-style-type: none"> <li>Because the planned roads of this project are not routed through the habitats of rare flora and fauna such as mangroves, construction of the roads will not have any impact on them</li> <li>However, in the future when improvement of a broader road system is accelerated and an impact on these rare flora and fauna are predicted, appropriate route planning and environmental impact assessment should be taken from the viewpoint of environmental protection. Further, natural protection measures must be enforced and efforts must be made to protect these precious resources. (valuable coastal forests—Pugu, Pande and Ruve south forest reserves)</li> <li>Through positive roadside tree planting which will be conducted along most of the sidewalks in this project, and consideration give to save as many existing trees as possible, a good roadside environment will be created.</li> </ul>			
	Scenery	Roads subject to improvement in this project	Will be predicted based on road plans	<ul style="list-style-type: none"> <li>The project plans to save existing trees and plant new roadside trees.</li> <li>At Kivukoni Front coastal improvement will be conducted along with road widening.</li> </ul>	<ul style="list-style-type: none"> <li>Under this project, it is likely that road vistas will improve on most roads through the saving if existing trees and the planting of new ones.</li> <li>Reclamation of part of the foreshore will be conducted during the improvement of Kivukoni Front, however, as a gently sloping embankment will be employed, the coastal scene will not be significantly effected.</li> </ul>			
	Tide and drift sand	Kivukoni Front	Estimated based on road plans	<ul style="list-style-type: none"> <li>At Kivukoni Front coastal improvement will be conducted along with road widening.</li> </ul>	<ul style="list-style-type: none"> <li>Although part of the foreshore will be reclaimed in the road improvement plan of Kivukoni Front, because the reclamation is limited to a strip only about 30 meters wide along the existing foreshore, its impact on the tide and drift sand is anticipated to be minimal. Judging from the current situation in which the shore is not used as a bathing place although it is a beach and also that the adjacent shores along the coastline are not used for sea bathing either, impact of the reclamation of part of the foreshore on utilization of the sea shore will be minimal.</li> </ul>	<ul style="list-style-type: none"> <li>In constructing the shore protecting bank, it is necessary to carry out sufficient investigation of the site in advance and develop a safe design of the embankment in consideration of stability so that the shore protection banks may not collapse.</li> </ul>		





## **CHAPTER 18 IMPLEMENTATION PLAN**

### **18.1 Executing Agency**

The Director of Roads and Aerodromes, Ministry of Works, Communications and Transport is the government agency responsible for the execution of the construction of the project roads.

The required land/house acquisitions and compensations shall be undertaken by the same agency prior to the commencement of the Project.

### **18.2 Construction Period of Each Project Road**

The construction period for each project road was estimated taking into account the work volume, site conditions, weather conditions, right-of-way situation, etc. The roads have been divided into the following three basic categories:

- (i) Arterial Roads in the City Center consisting of the Ohio, Kivukoni, Sokoine, Gerezani and Bandari Roads (total length of 6.0 km). The estimated construction period for this work is 2 years.
- (ii) The Middle Ring Road (total length of 9.9 km) consisting of widening the Morocco, New Kigogo and Chang'ombe Roads and the construction of the Missing Link. The estimated construction period is also 2 years.
- (iii) Radial Trunk Roads consisting of the New Bagamoyo Road, Uhuru Road and Kilwa Road. These should be implemented individually. Length of the required work and the estimated construction period for each road is as shown below.
  - New Bagamoyo Road (4.3 km) : 1 year
  - Kilwa Road (3.1 km) : 1 year
  - Uhuru Road (4.8 km) : 1.5 years

### **18.3 Construction Packages**

The above project roads are to be combined into two packages for implementation purposes, taking into consideration the annual project cost required, scale of the work volume, location of project site, land acquisition situation and nature of the project. The two construction packages are listed below.

Package A: The Middle Ring Road and New Bagamoyo Road

Package B: Arterial Roads in the City Center, Kilwa Road and Uhuru Road

### **18.4 Implementation Schedule**

The implementation schedule was set up taking into consideration the construction period estimated above for each project road, annual construction cost for, ease of implementation from the viewpoint of land/house acquisition, etc.

The recommended implementation schedule for each package is presented in Fig. 18.1 and summarized as follows:

Package A: Widening of the Middle Ring Road and New Bagamoyo Road (total length of 14.2 km)  
- 3 years

Package B: Widening of Arterial Roads in the City Center and Kilwa and Uhuru Roads (Total length of 13.8 km)  
- 2 years

### **18.5 Investment Program**

The investment program of the Project has been made on the basis of the implementation schedule. Table 18.1 shows the tentative investment program for the proposed road projects.

**Fig. 18.1: Proposed Implementation Schedule of High Priority Projects**

Package No.	Proposed Roads and Bridges To be Improved	Project Length (km)	High Priority projects to be implemented in the Short-term Plan				
			1st Year 1995	2nd Year 1996	3rd Year 1997	4th Year 1998	5th Year 1999
Package A:	Widening of The Middle Ring Road and New Bagamoyo Road	14.15					
Package A-1:	Middle Ring Road	9.88					
	Widening of the Middle Ring Road consisting of Morocco, New Kigogo and Changombe with construction of Missing Link						
Package A-2:	New Bagamoyo Road	4.27					
	Widening of New Bagamoyo Road from Morocco Road Junction up to Mpakani Road Junction						
Package B:	Widening of Arterial Roads in the City Center and Kilwa and Uhuru Roads	13.84					
Package B-1:	Arterial Roads in the City Center	5.98					
	Widening of Arterial Roads in the City Center consisting of Ohio Street Kivukoni Front, Sokoine Drive, Gerezani and Bandari Roads						
Package B-2:	Kilwa and Uhuru Roads	7.86					
	Widening of Kilwa Road (3.06 km)						
	Widening of Uhuru Road (4.80 km)						

**Table 18.1: Tentative Investment Programme of High Priority Projects**

Unit: Tsh. million

Phase	Project Length (km)	High Priority projects to be Implemented in the Short-term Plan										Total
		1st Year		2nd Year		3rd Year		4th Year		5th Year		
		Const. Cost	House Comp.	Const. Cost	House Comp.	Const. Cost	House Comp.	Const. Cost	House Comp.	Const. Cost	House Comp.	
<b>High Priority Projects</b>												
(1) Construction Cost												
Package A	9.88		151		4,500							
- Widening of the Middle Ring Road	3.56											
- Morocoo Road	2.78		130		3,510						4,500	151
- New Kigogo Road	0.74		20		850						850	130
- Missing Link	2.80				2,270						2,270	20
- Changombe Road												
Package A-2: Widening of New Bagamoyo Road	4.27	5,090	15									
Sub Total (a)	14.15	5,090	186		5,350		133		5,780		0	5,090
Package B	5.98							11				
Package B-1: Widening of Arterial Roads in the City Center												
- Ohio, Kivukoni, Sokoine, Gererzani and Bandari Roads								11	3,310			2,350
Package B-2: Widening of Kilwa and Uhuru Roads	7.86											
- Kilwa Road	3.06							68	2,820			3,510
- Uhuru Road	4.80							79	6,130			2,820
Sub Total (b)	13.84	0	0		0		0	79	6,130		0	11,990
Total Construction Cost (Tsh million):	(a)+(b)	5,090	186		5,350		133		5,780		0	28,210
(2) Consultant Fee: D/D & S/V = 10 % of Construction cost		510			540				580			2,820
(3) Contingency for Price Escalation and Physical Change (10% of Const. cost)		510			540				580			2,820
(4) Administration cost of Tanzanian Government (1% of Const. cost)		1,020	51		1,080		54		1,160		57	5,640
Total of other project Cost (Tsh million):		1,020	51		1,080		54		1,160		57	5,640
Grand Total (Tsh million):	(1)+(2)+(3)	6,110	237		6,430		189		7,350		57	33,850
												34,614

Exchange Rate: 1 US\$ = Tsh. 530.0 = ¥ 100.0 (July, 1994), or Tsh. 1.0 = ¥ 0.188679

## **CHAPTER 19 EVALUATION ON PROJECT IMPLEMENTATION**

### **19.1 Economic Evaluation**

The proposed high-priority project packages have been evaluated in terms of economic feasibility as well as viability of implementation, to which conventional method of economic evaluation was applied.

#### **19.1.1 Procedures**

##### **(1) Cost Estimation**

Economic cost, both capital investment and maintenance, was obtained after deleting transfer element and price escalation portion due to inflation. Cost stream was prepared to meet the proposed disbursement schedule until after 15 years from the opening of the Project.

##### **(2) Benefit Calculation**

Expectant benefits are mainly the road users' benefits comprising the savings of vehicle operation cost (VOC) and of passengers' time cost (TC). Saving amount was calculated as a balance of VOC/TC between the cases "without project" and "with project", by applying the traffic assignment results. Benefit flow was prepared for 15 years, based on an assumed annual increase rate.

##### **(3) Evaluation Indicators**

The following 3 evaluation indicators were calculated, using the prepared cost/benefit streams:

B/C	(Benefit - Cost Ratio)
NPV	(Net Present Value)
IRR	(Internal Rate of Return)

##### **(4) Evaluation Cases**

Indicator values were calculated in 8 cases, of which the principal 3 cases are:

Case 1 : Implementation of Package A  
(Widening the Middle Ring Road and New Bagamoyo Road)

Case 2 : Implementation of Package B

(Widening City Center Arterial Roads and Kilwa and Uhuru Roads)

Case 3 : Joint implementation of Packages A and B

(Case 1 plus Case 2)

Other 5 cases correspond to the individual component roads inside both the Packages.

### 19.1.2 Evaluation

#### (1) Results of Indicator Calculation

In the principal 3 cases, the resultant indicator values are as follows:

Indicator	Case 1	Case 2	Case 3
1. B/C <sup>*)</sup>	2.7	3.1	2.8
2. NPV <sup>*)</sup> (Tsh. Billion)	27.1	26.8	47.3
3. IRR (%)	28.6	35.6	29.7

\*) : at discount rate 10%

#### (2) Economic Feasibility

It is concluded that the implementation of Packages A and B both being economically feasible with the high values of the respective indicators.

Taking into accounts the indicator figures in other cases (components in the Package), the following considerations might be made:

- Package A should be implemented exclusively as a package, because multiplication effects are observed between the components.
- Separate implementation might be possible in case of Package B.
- Joint implementation of Packages A and B would not be so effectual, compared to the implementation of the respective Packages alone.

#### (3) Viability of Project Implementation

According to sensitivity analysis, the project implementation will be stable to the probable cost/benefit alteration. It is concluded that Packages A and B be viable in their respective, as well as joint, implementation.

#### **(4) Conclusion**

Considering the proved economic feasibility and implementation viability, Packages A and B should be implemented with "high-priority" inside the nationwide road development program. Priority order would be : Package A, first; and Package B, in the next. Although the economic feasibility is higher in implementing Package B, it is judged that Package A implementation be placed first in the priority order, in consideration with the importance of involved roads' functions; especially, of the Middle Ring Road, in constituting a basic frame of urban trunk road network in Dar es Salaam; and, in addition, compensation arrangements required for the removal of commercial/business facilities located within the proposed right-of-way.

### **19.2 Other Socio-economic Effects**

Other than the road users' direct benefits, foreseeable socio-economic effects by the project implementation are delineated as follows:

- Contribution to the non-motorized transport users (inside road facilities)
- Improvement of accessibility to public transport services
- Enhancement of daily life of the residents
- Enhancement of economic activity level
- Promotion of the planned urban development
- Improvement of roadside environment

### **19.3 Financing and Budgetary Arrangements**

#### **(1) Development Budget and Financing**

It is revealed, from the analysis of Development Expenditures, more than 80% of funds come from external sources in which grant portion occupy 80% of the foreign funds. Development allocation to the Works Sector as well as to MWCT shows a slightly higher contribution of foreign funding. By analogy, the Works Sector/MWCT development funds might be financed; almost 65% in the form of grant-in-aid, 15% by foreign loans and the remaining 20% with the local funds.

Of MWCT development allocation, construction cost required for the project implementation will become equivalent to around 30%. Local funding (only a 20% share in the development funds as clarified above) probably will not meet the requirements. However, a heavy proportion of the MWCT development accounts



might be justified due to the urgency for improving urban traffic as well as by the significance/magnitude of the Dar es Salaam Region in the socio-economic context.

**(2) Recommended Action and Financing Measures**

The project implementation should be given a "high-priority" rating in the nationwide road development program under MWCT, even though the required capital investment might occupy a large portion of development funds available to the Ministry.

In view of availability of funds and the actual possibility of financing, it is recommended that the required capital investment cost shall be financed by means of a grant-in-aid.

To take note in financial arrangements, road maintenance expense shall be borne by local funds. The government should secure supply measures for the required maintenance cost, by strengthening of the existing Road Fund accounts.

## CHAPTER 20 CONCLUSION AND RECOMMENDATIONS

The following are the conclusion and recommendations related to the project.

### 20.1 Conclusion

The feasibility study proved that project roads of Package A and B are technically, economically and environmently feasible having a high economic internal rate of return of 28.6% and 35.6%, respectively.

Therefore, the projects should be realized within the earliest possible time, in the following priority order taking into consideration the functions of the involved roads; especially the Middle Ring Road which constitutes the basic frame of urban trunk road network, necessary arrangements for land/house acquisitions, resettlement and compensation for commercial/business proprietors located within the proposed right-of-way.

Priority	Proposed Roads
1st	Widening of Middle Ring Road and New Bagamoyo Road (total length of 14.15 km) including: <ul style="list-style-type: none"><li>- Widening of Morocco, New Kigogo and Chang'ombe Roads from 2 to 4 lanes with construction of Missing Link between New Kigogo and Chang'ombe Road (length of 9.88 km)</li><li>- Widening of New Bagamoyo Road from Morocco Rd. Junction up to Mpakani Rd. Junction to 4 lanes (length of 4.27 km)</li></ul>
2nd	Widening of Arterial Roads in the City Center and Kilwa and Uhuru Roads (total length of 13.84 km) including: <ul style="list-style-type: none"><li>- Widening of Arterial Roads in the City Center consisting of Ohio Street, Kivukoni Front, Sokoine Drive, Gerezani and Bandari Roads (5.98 km)</li><li>- Widening of Kilwa Road (3.06 km)</li><li>- Widening of Uhuru Road (4.80 km)</li></ul>

Table 20.1 shows the summary of the project features for the above roads.

**Table 20.1 Summary of Project Feature**

Project Description	Design Speed (km/hr)	Length (km)	Carriage Way (m)	Pedestrian Footway (m)	Cycle Track (m)	Right-of-way (m)
<b>Package A Widening of Middle Ring Road and New Bagamoyo Road</b>						
A.1 Widening of New Bagamoyo Road from 2 to 4 lanes	80	4.30	Dual 2x3.75	2.0~5.0	2.0~3.0	30~50
A.2 Widening of Middle Ring Road with construction of Missing Link	9.88					
Morocco Road	60	3.58	Dual 2x3.75	2.0~5.0	2.0~3.0	35~50
New Kigogo Road	60	2.76	Dual 2x3.75	2.0~5.0	2.0~3.0	35~50
Missing Link	60	0.75	Dual 2x3.75	2.0~3.0	Combined Use	25
Chang'ombe Road	60	2.79	Dual 2x3.75	2.0~3.0	2.0~3.0	20~25
<b>Package B Widening of Arterial Roads in City Center and Kilwa and Uhuru Roads</b>						
<b>B.1 Widening of Arterial Roads in City Center</b>						
Ohio Street	40	1.05	Dual 2x3.5	2.0~3.0	Combined Use	20
Kivukoni Front	40	0.56	Dual 2x3.5	2.0~3.0	Combined Use	20
Sokoine Drive	40	0.54	Dual 2x3.5	2.0~3.0	Combined Use	20
Gerezani Street	40	1.42	Dual 2x3.75	2.0~3.0	Combined Use	20
Bandari Road	40	2.15	Dual 2x3.75	2.0~3.0	Combined Use	20
<b>B.2 Widening of Kilwa and Uhuru Roads</b>						
Kilwa Road	60	3.115 (3.12)	Dual 2x3.75	2.0~5.0	2.0~3.0	35~45
Uhuru Road	40	4.85	Dual 2x3.75	2.0~5.0	2.0~3.0	25

## 20.2 Recommendations

In order to materialize the projects, the Study Team recommends MWCT to take the following actions:

### (1) Financing Measures Required

Since the project implementation will greatly enhance the urban traffic in and around Dar es Salaam, financing measures for capital investment are recommended to be obtained by means of foreign aid from the viewpoint of the government budgetary situation and the past experience of road improvement in Dar es Salaam.

It is also recommended that supply measures of the required maintenance cost for the Project should be secured by strengthening of the existing Road Fund account.

### (2) Allocation of Local Budget for Acquiring Land/House

It is recommended to allocate the necessary amount of local funds for acquiring the lands and houses which might be necessary for implementation of the Project.

Land and house acquisition should be conducted according to the project implementation schedule as follows:

Year	Schedule of Land/House Acquisition
1st year (1995)	Acquiring land and houses located at the Mpakani Road intersection on New Bagamoyo Road
2nd year (1996)	Acquisition/relocation of land and houses within the ROW along Middle Ring Road
3rd year (1997)	Acquisition/relocation of land and houses within the ROW along the Arterial Roads in the City Center and Uhulu Road
4th year (1998)	Acquisition/relocation of land and houses within the ROW along Kilwa Road

Furthermore, it is recommended that the land required for the road development should be controlled by the government until the actual development takes place.

### (3) Forming a Suitable Resettlement Plan

Resettlement of the residents and workers along the project roads will be required before the implementation of the projects is started.

In order to prevent social, economic and environmental impacts of the resettlement on the residents, it is recommended that a suitable resettlement plan should be established paying due attention to the following items:

- Funding the resettlement compensation
- Securing places to move the person to be resettled
- Ensuring the living standards in the places to move into
- Holding discussions with the residents to be resettled to reach a mutual consent

**(4) Improvement of Storm Drainage System**

Although storm water drainage system is provided, two areas along Kijitonyama River and Gerezani Creak become inundated due to insufficient capacity of the existing channel and low land lying near the sea level, respectively.

On the other hand, the proposed improvement measures for two inundated areas in terms of construction cost, construction period, etc. are too large to include as a part of the road construction project.

Therefore, it is recommended that the two inundated areas be incorporated into a river improvement or storm drainage improvement project that should be implemented in parallel with the road construction.

**(5) Regulations for River Basin Land-use**

Since houses are being randomly built in the river basins, it is recommended to establish proper land-use regulations for river basin and to properly maintain the storm water drainage systems for them.

**(6) Establishment of Comprehensive Legislation for Air Pollution Prevention**

It is predicted that air pollution will worsen in Dar es Salaam by motor vehicles and factories due to accelerating industrialization.

It is therefore recommended to establish national legislation, including air pollution control law and periodic motor vehicle inspection system, as soon as possible.

**(7) Confirmation of Actual Location of Proposed Bus Service Facilities**

As the proposed roads are now being utilized for major bus service routes, improvement of bus service facilities has been proposed as one of the components of the High Priority Projects.

It is recommended that the actual location of the proposed bus stops, bus bays and bus stations be determined after holding discussions with bus operating companies and the agencies concerned in order to realize smooth and safe bus operation.

**(8) Development of DRIMP Office as On-the-Job Training Center**

Road maintenance contract has been introduced in line with the MWCT's policy for using the private sector to maximize the efficiency of maintenance work in terms of cost, quality and progress. The full extent of contract maintenance will, however, need sufficient transition period due to the lack of resources and maintenance experience of local contractors.

In this regard, the Study Team recommends to develop the Office of DRIMP (Des es Salaam Road Improvement and Maintenance Project) located in Ilala Garden as a maintenance training center for urban roads. The purpose of this will be to provide on-the-job training for the staff of MWCT, DCC and private contractors, not only to meet the above-mentioned requirements of MWCT's policy but also to encourage maintenance on a contract basis.







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