STUDY REPORT
ON
THE PROJECT FOR SUPPLY OF
MOBILE ROAD ASPHALT MIXING PLANTS
AND PAVING EQUIPMENT
IN
THE REPUBLIC OF ZIMBABWE

MARCH 1998

JAPAN INTERNATIONAL COOPERATION AGENCY

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PREFACE

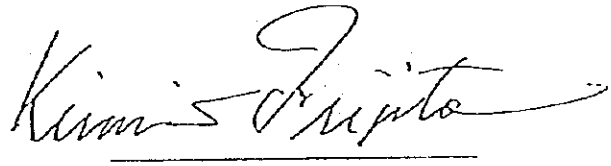
In response to a request from the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct a basic design study on the Project for Supply of Mobile Road Asphalt Mixing Plants and Paving Equipment and entrusted the Japan International Cooperation Agency (JICA) to conduct the study with the assistance of the Japan International Cooperation System (JICS).

JICA sent to Philippines a study team from November 28 to December 13, 1997.

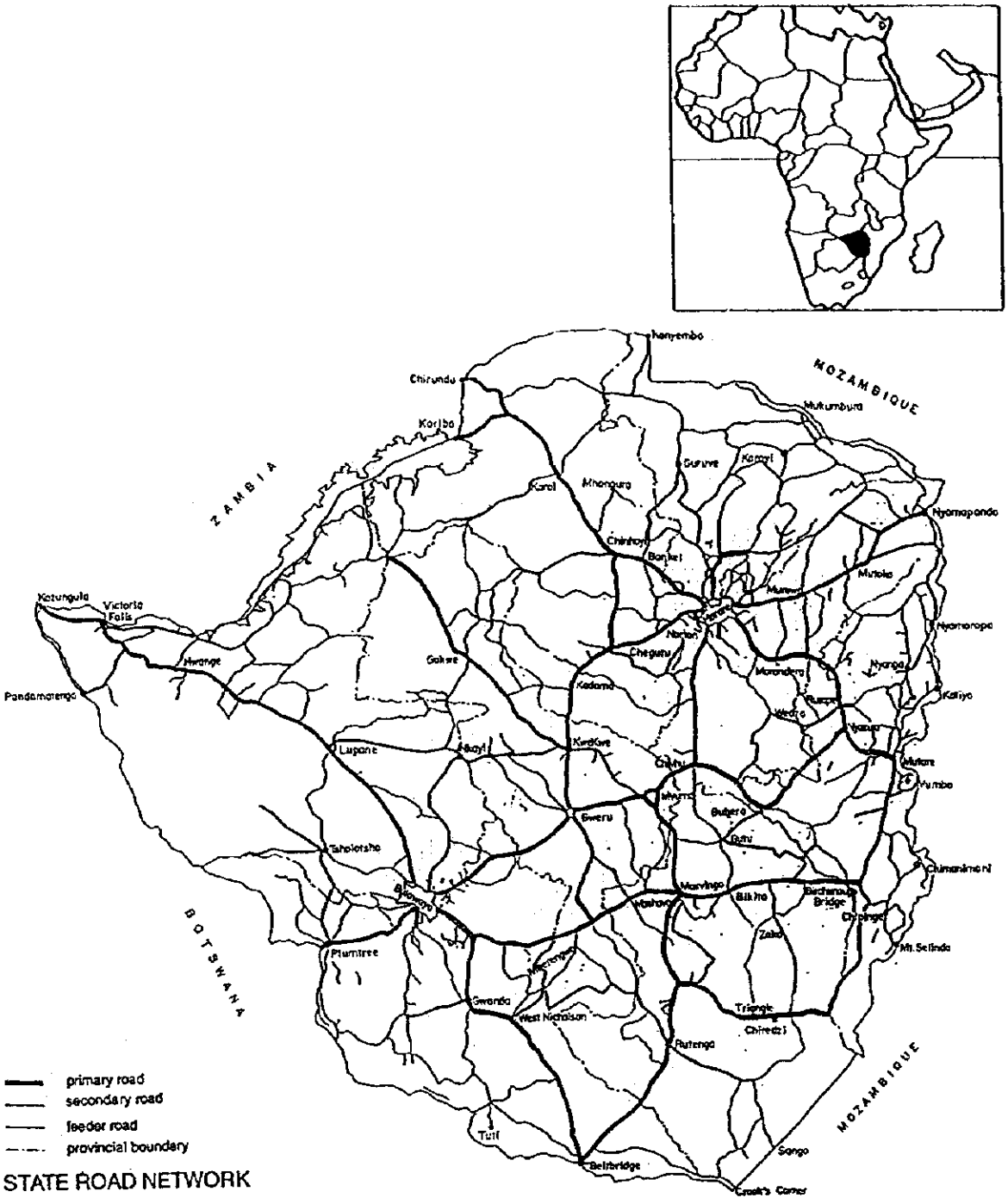
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Zimbabwe for their close cooperation extended to the team.

March 1998



Kimio Fujita
President
Japan International Cooperation Agency



MAP OF THE REPUBLIC OF ZIMBABWE

Abbreviations

DOR : Department of Road

DSR : Department of State Road

CMED : Central Mechanical Equipment Department

SIDA : Swedish International Development Authority

DANIDA : Danish International Development Authority

IDA : International Development Association

Chapter 1 Background of the Project

The Republic of Zimbabwe, an inland country, uses the road transport as the main method of conveyance. Out of the total population of 11.53 million, about 70% live in the provinces. The national road network extending over the whole country transports 90% of all the transported people and 60% of all the transported goods in the provinces. Thus, the improvement of the national road network is an important issue in promoting the socio-economic development of provinces.

However, most of the existing national roads, being more than twenty years old, are significantly dilapidated. Moreover, the civil war and the chronic deficit finances caused the paved roads (both national and local) not to be sufficiently serviced and maintained. Thus, in the rainy season (November through March), many erosions and cave-ins occur on the roads, resulting in traffic accidents and limited goods transport and greatly affecting the economic activities.

The Zimbabwean government listed the economic development through paving and improving roads as one of the important policies in the "Second Five-Year Development Plan". Based on this plan, the Department of Roads (DOR) that manages the national roads established the "Three-Year Periodical Road Repair Plan (1999 ~ 2001)", trying to implement the road paving plan.

It was under such circumstances that the Zimbabwean government requested the government of Japan for grant aid for procuring the road paving equipment in order to promote the said plan smoothly.

Chapter 2 Contents of the Project

2-1 Objectives of the Project

The "Three-Year Periodical Road Repair Plan (1999 ~ 2001)" has a target project of paving every year 800 kilometers of all the 2,368.6 kilometers of the Primary and Secondary national and local roads. This project, succeeding the "Road Maintenance Equipment Improvement Plan" in FY 1995 intended for the unpaved road construction, aims at procuring the road asphalt mixing plants and the paving equipment in order to enhance the road improvement and maintenance capabilities and implement the above target project smoothly. It also aims at repairing the full-type pavement of Primary national road performed using the World Bank's aid and the easy-type pavement of the Primary and Secondary national and local roads. (For detailed plan for each province, see Figure 2-1.)

2-2 Basic Concept of the Project

This project, based on the "Three-Year Periodical Road Repair Plan (1999 ~ 2001)", provides the DOR with the road asphalt mixing plants and the paving equipment required to perform work for 70% to 80% of the total planned distance in repairing the full-type pavement of Primary national road constructed using the World Bank's aid (in seven provinces excluding Mashonaland Central), repairing the lightly trafficed pavement of the Primary and Secondary national and local roads as well as constructing lightly trafficed pavement on the unpaved roads (in all the eight provinces). The priorities of the target sites are determined after the eight provinces are separated into two groups, considering the total repair distance and the equipment placement (see Table 2-1).

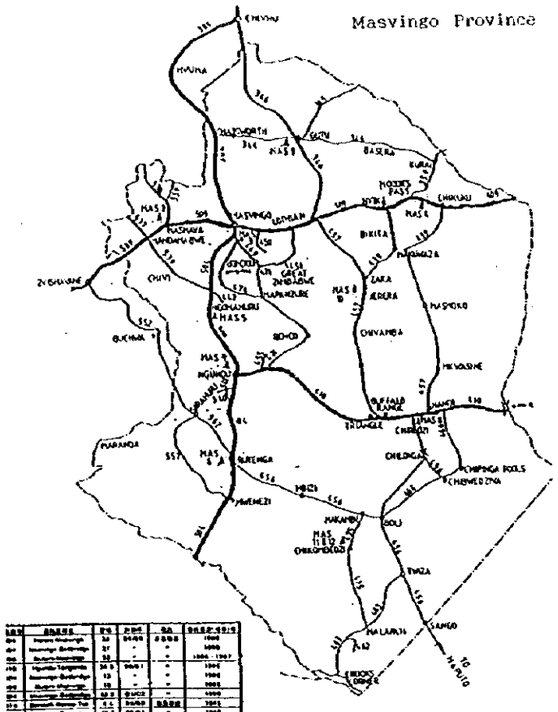
Table 2-1 Priorities of Target Sites

(Unit: kilometer)

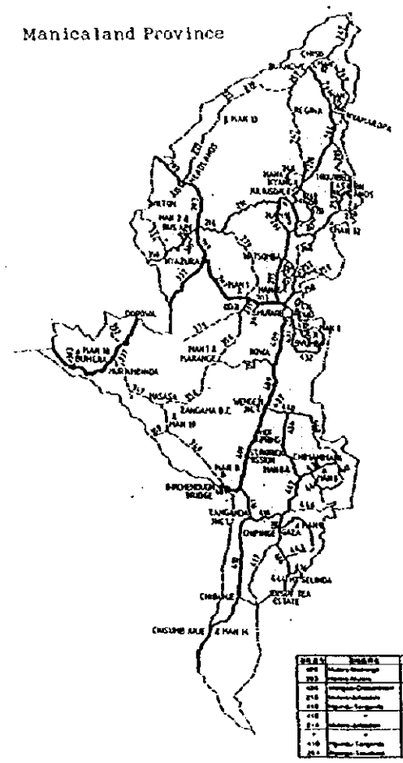
Priority	Province name	Full-type pavement	Lightly trafficed pavement	Total
1	Mashonaland East	129	91	220
2	Mashonaland West	91	243	334
3	Manicaland	120	254	374
4	Mashonaland Central	0	269.5	269.5
Subtotal		240	857.5	1,097.5
1	Masvingo	236.4	254	490.4
2	Matabeleland North	143	136.7	279.7
3	Matabeleland South	116	113.3	229.3
4	Midland	93.7	157	250.7
Subtotal		589.1	661	1,250.1
Total		829.1	1,518.5	2,347.6

Figure2—1 Detailed Plan for Each Province

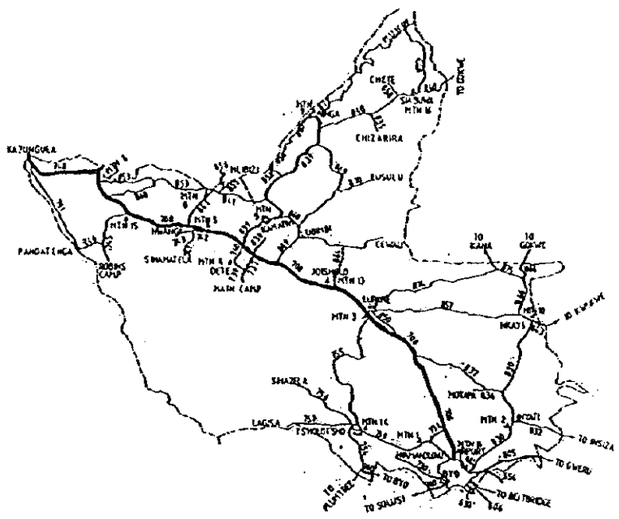
Masvingo Province



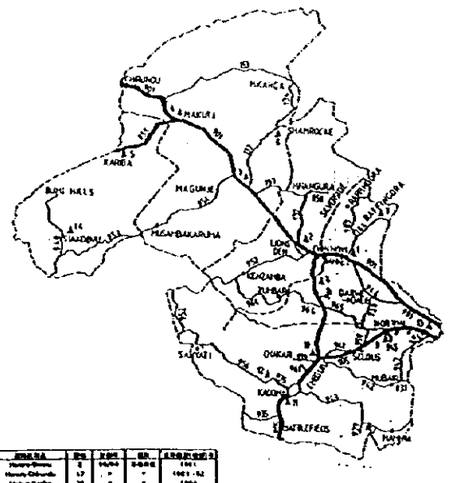
Manicaland Province



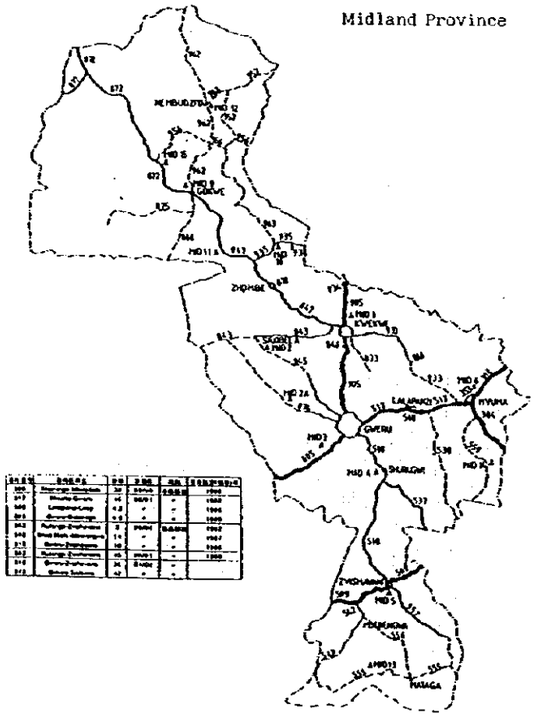
Matabereland North Province



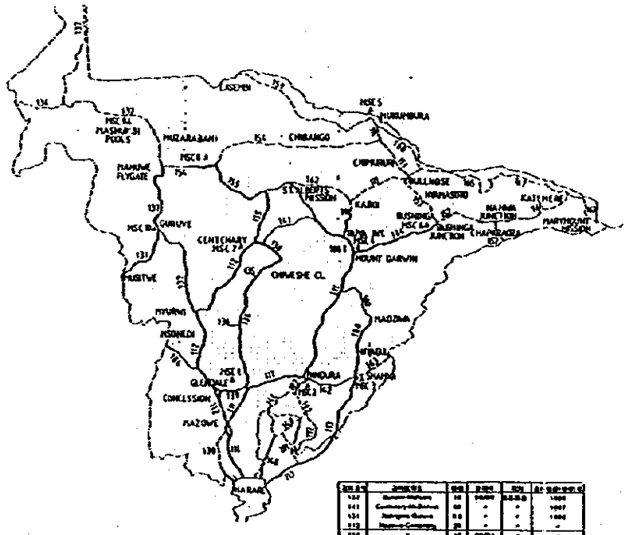
Mashonaland West Province



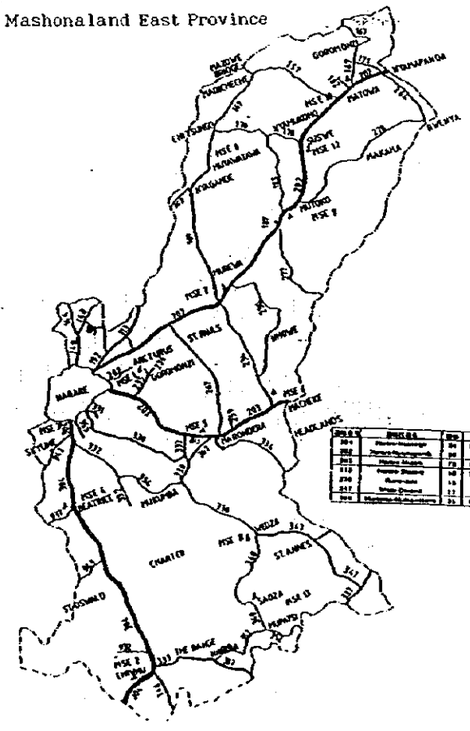
Midland Province



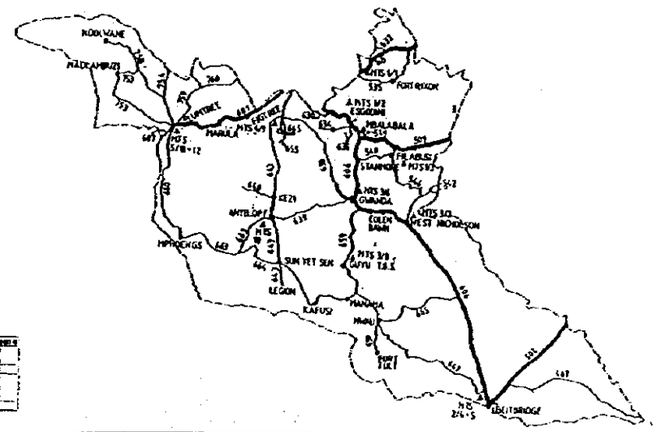
Mashonaland Central Province



Mashonaland East Province



Matabereland South Province



primary road
secondary road
feeder road
provincial boundary

The priorities of equipment for the provinces are determined as follows. The full-type paving equipments are special equipments (asphalt plants and finishers) and, considering the maintenance, the delivery of aggregates and the nature of these devices to be used in combinations during work, should be delivered to the DOR headquarters in the capital, Harare and the second-largest city, Bulawayo, both of which are located in the middle of the above four-province groups (see Figure 2-2 for information on where they should be placed). The lightly trafficed paving equipment should be placed in the four provinces (Harare headquarters, Bulawayo city, and Mashonaland West and Masvingo provinces) depending on the plan regions and work load. Although only the full-type paving equipment was requested initially, we added these devices (distributors, chip spreaders, and truck lorries) because the lightly trafficed paving is required in the repair plan and these devices are strongly demanded in the field sites. The chip spreaders are currently used in the work and they requested for easy-to-use models. (The model for this work type, being not produced in Japan, will be procured from a third country.) Additionally, the equipment of the same types as provided last time (in 1995 through 1997) (such as bulldozers and wheel loaders) were deleted from the request because such devices were provided only a few years ago and, if necessary, can be easily rented on site.

We determined the required number of devices, based on the data created under supervision of the Economic Affairs Bureau, Ministry of Construction and using the workload for each device calculated from the total distance of roads to be repaired, considering also the environment of Zimbabwe at the moment. We determined the specifications of these devices, considering the worker's experience of using them and their serviceability. These construction machines have inferior mobility and cost efficiency at the time of transportation than vehicles. However, to transport these machines, we determined to use the trucks procured in the grant aid in 1995, being in a good condition.

2-3 Basic Design

2-3-1 Design Concept

(1) Design conditions

① The equipment, which is to be used in a dry land, must be protected against dust.

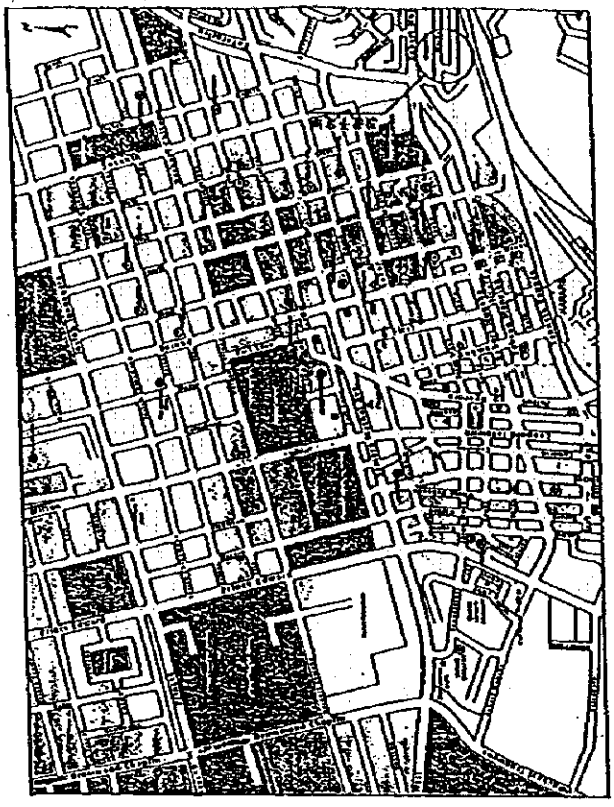
② The equipment must meet the local safety standards.

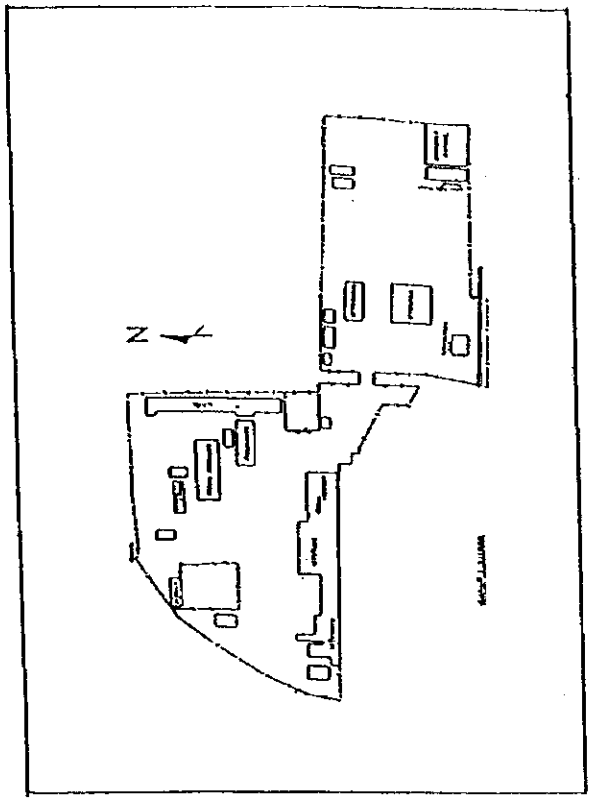
③ The equipment must be chosen, with the existing equipment of the DOR and the worker's experience of using them taken into consideration.

④ The equipment must run on light oil. (Gasoline is not desirable because, although sold at a low price in the said country, it is high in both volatility and in moisture absorbency,

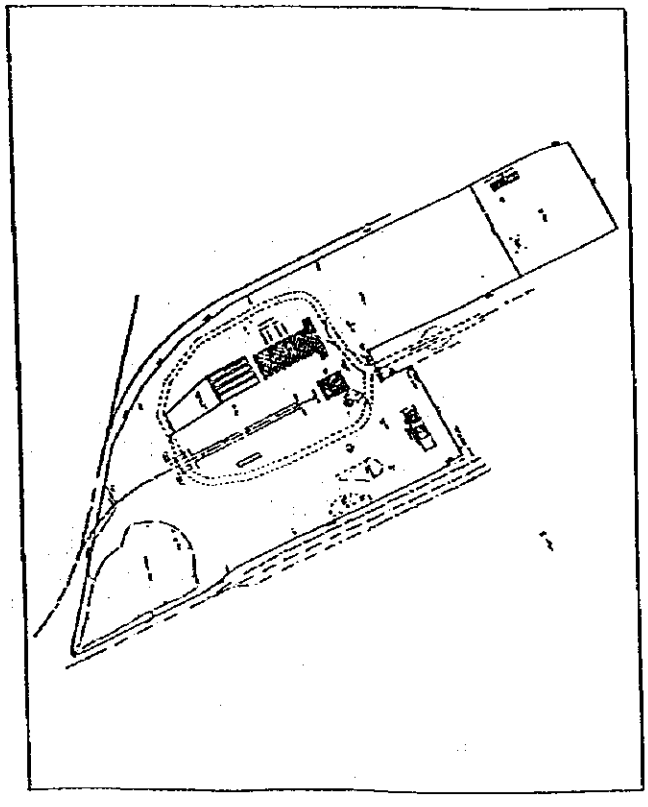
Figure2-2 Site for Installation of the Plant

Harare





Bulawayo



adversely affecting the useful lives of devices.)

(2) Policies in selecting equipment

We calculated the proposed number of units for each equipment by using the 70% to 80% of the total repair plan distance as the project target distance and estimating the required amount of mixture (asphalt) and emulsion (tar). Basically, we concluded that Zimbabwe can handle for itself the construction work required as a preliminary stage of paving work, considering the availability and duplication of the equipment provided in the past projects, and excluded the equipment for this work from the current project.

(3) Standards for calculating mixture and emulsion

The DOR constructs or repairs an lightly trafficed paved road by using various equipment for the classified processes of banking, gravel transport, leveling, and emulsion spraying (see Table 2-2 for the paving work) but has never constructed by itself the full-type pavement using asphalt.

Table 2-2 Classifications of paving work

Classification	Work type	Used equipment
Full-type paving	(Preliminary work), asphalt mixture, leveling of crushed-stone, transportation, asphalting, and rolling compaction	Asphalt plant, crusher plant, dump truck, asphalt finisher, and road roller
Lightly trafficed paving	(Preliminary work), emulsion dissolving and spraying, leveling of crushed-stone, rolling, and stone crushing	Distributor, truck lorry, chip spreader, and road roller

These work items were used as the basis of calculating the asphalt mixture, emulsion and crushed stones. We determined that the existing equipment will be sufficient for the preliminary work, banking (compacting earth, digging ground, etc.) and that we need not cooperate in this regard.

(4) Methods and equations for calculating the aggregates (asphalt mixture and emulsion)

① To calculate asphalt mixture: We assumed the road pavement as 50 mm thick and 8m wide. As a standard, the mixture should 1.4 tons per cubic meter.

② To calculate emulsion (tar): We assumed the road as 6m wide and to be paved in two layers including the prime coating, for which 1.9-liter tar should be used per cubic meter.

(5) Methods and equations for calculating workload for each device

We calculated the workload for each device, based on the data created under supervision of the Economic Affairs Bureau, Ministry of Construction and considering also the environment in

Zimbabwe at the moment. Table 2-3 shows the methods and equations for calculating workload for each device.

Table 2-3 Calculating workload for each device

Equipment name	Daily workload	Description of numbers	Workload for three years (900 days)
Mobile Mixing Asphalt plant	40 x 8 = 320 ton	40 tons are processed per hour. 8 hours are the operation time per day.	320 ton x 900 = 288,000 ton
Asphalt finisher	5 x 60 x 3 = 900 m	5 meters are covered in one minute. 60 minutes are in one hour. 3 hours are the work time per day.	900 m x 900 ÷ 1,000 m =810 km
Macadam and vibrating rollers	3,500 ÷ 4.5 x 3 = 2,334 m	3,500 meters are covered per hour. 4.5 is the work efficiency per meter. 3 hours are the work time per day.	2,334 m x 900 ÷ 1,000 = 2,100.6 km
Dump truck	8.7 x 6 x 1.4 =73 ton	8.7 m^3 are the loading capacity. 6 times are the number of times of operation per day. 1.4 tons are the specific gravity per 1 m^3 of mixture.	73 x 900 = 65,700 ton
Asphalt distributor	5,000 x 3 = 15,000 lt	5,000 liters can be sprayed per time. 3 times are the number of spraying per day.	15,000 x 180 = 2,700,000 lt
PortableStone crusher	15 x 12 = 180 ton	15 tons can be produced per hour. 12 hours are the operation time per day.	180 x 900 = 162,000 ton
Chip spreader	50 x 5 = 250 ton	50 meters can be covered per hour. 5 hours are the work time per day.	250 x 600 ÷ 1,000 m =150 km
Truck lorry	7 x 7 = 49 ton	7 tons are the loading capacity. 7 times are the number of operation per day.	49 x 900 = 44,100 ton

(6) Calculated numbers of units for equipment

The numbers of units are calculated, based on the amount of aggregates and emulsion and the workload.

Tables 2-4A and 2-4B show the proposed number of units for each target site and for full-type and lightly trafficed pavements.

Tables 2-4A Proposed number of units for each target site (full-type pavement)

Priority	Target site	Total distance of repair (km)	Amount of asphalt mixture (ton)	Mobile Mixing Asphalt plant		Asphalt finisher		Macadam roller *1		Vibrating roller *2		Dump truck	
				Calculated	Proposed	Calculated	Proposed	Calculated	Proposed	Calculated	Proposed	Calculated	Proposed
1	Midland	93.7	52,472	0.2		0.12		0.05		0.05		0.8	
	Mashonaland West	120	67,200	0.3		0.15		0.06		0.06		1.0	
	Mashonaland East	129	72,240	0.4		0.16		0.06		0.06		1.1	
	Manicaland	91	50,960	0.2		0.12		0.05		0.05		0.8	
	Harare headquarters				1		1		1		1		4
	Subtotal	433.7	242,872	1.1	1	0.55	1	0.22	1	0.22	1	3.7	4
2	Matabeleland North	143	80,080	0.35	1	0.18	1	0.07	1	0.07	1	1.3	4
	Matabeleland South	116	64,960	0.28		0.14		0.06		0.06		1.0	
	Masvingo	236.4	132,384	0.58		0.29		0.11		0.11		2.0	
	Subtotal	495.4	277,424	1.21	1	0.61	1	0.24	1	0.24	1	4.3	4
	Total	929.1	520,296	2.31	2	1.16	2	0.46	2	0.46	2	8.0	8

*1, 2: Includes those for lightly trafficed pavement

Tables 2-4B Proposed number of units for each target site (lightly trafficed pavement, two permeable layers)

Priority	Target site	Total distance of repair (km)	Amount of asphalt mixture (ton) *1	Asphalt distributor		Portable Stone crusher		Chip spreader		Truck lorry	
				Calculated	Proposed	Calculated	Proposed	Calculated	Proposed	Calculated	Proposed
1	Mashonaland Central	269.5	7,007,000	0.87		0.50		1.8		1.83	
	Mashonaland West	254	6,604,000	0.82	1	0.47		1.7	3	1.72	3
	Mashonaland East	91	2,366,000	0.30		0.17		0.6		0.62	
	Manicaland	243	6,318,000	0.78		0.58		1.62		1.65	
	Harare headquarters				1		1		2		2
	Subtotal	857.5	22,295,000	2.77	2	1.72	1	5.72	5	5.82	5
2	Matabeleland North	136.7	3,554,200	0.44	1	0.33	1	0.91	2	0.93	2
	Midland	157	4,082,000	0.51		0.37		1.05		1.07	
	Masvingo	254	6,604,000	0.82	1	0.47		1.70	3	1.73	3
	Matabeleland South	113.3	2,945,800	0.37		0.27		0.75		0.77	
	Subtotal	661	17,186,000	2.14	2	1.44	1	4.41	5	4.5	5
	Total	1,518.5	39,481,000	4.91	4	3.16	2	10.13	10	10.32	10

*1: Pavement tar

2-3-2 Basic Design

(1) Equipment Plan

The major specifications, quantities, purposes of the equipment are as follows:

Table 2-5 Equipment plan

Equipment name	Specifications	Purpose	Quantity
Mobile Mixing Asphalt plant	42-48 tons/h, mobile	Creating asphalt mixture	2
Asphalt finisher	Laying width 2.5-6.0 m, with wheel	Laying asphalt mixture	2
Macadam roller	80PS, 12.2 tons (two-wheel drive)	Rolling asphalt (including lightly trafficed pavement)	2
Vibrating roller	105PS, 9.7 tons	Compacting lower layer (including lightly trafficed pavement)	2
Dump truck	8.7 m^3, 300PS	Transporting asphalt mixture	8
Asphalt distributor	Loading capacity: 5000LT	Spraying asphalt emulsion	4
Portable stone crusher	10-16 tons/h, mobile	Producing crushed stones for easy-type pavement	2
Chip spreader	Width: 2.0-3.5 m, Rear wheel clamped type	Laying crushed stones	10
Truck lorry	Loading capacity: 7 tons, long wheel base	Transporting crushed stones	10

(2) Specifications of each device

Mobile Mixing Asphalt plant: Will be a small, mobile type with the capacity of 42 to 48 tons, considering the wide range of planned areas, the ease of movement and transportation, the distance that can be planned per year, and the workers' technical level of maintenance.

The spare parts ratio will be 7% of the CIF price. Mainly the components that will not be easily procured locally, especially the electrical system and burner components will be considered in terms of types and quantities.

Asphalt finisher: Will have a paving width of 2 to 4 meters so that half the width of a road (planned to be 8 meters) can be paved at once. Will be equipped with wheels as a transport mechanism so that it can be easily transported between sites.

The spare parts ratio will be 7% of the CIF price. Since the hydraulic units (screed, hopper, feeder, spreader, etc.) and engine parts will be procured locally, mainly the engine, starter, and

alternator components will be considered.

Macadam roller: Used to roll a paved road. Will be a heavy one around 12 to 14 tons considering the construction scale and the mixed use for general and paving work. Will be provided with the all-wheel drive that offers a good balance and a corresponding engine output of 60 to 80 HP.
The spare parts ratio will be 7% of the CIF price and mainly the hydraulic components will be provided. Concerning the engine, mainly the electrical system components (starters, generators, etc.) that will not be easily procured locally will be provided.

Vibrating roller: Used to compacting a pavement. This roller, compared with a general type, can sufficiently compact a pavement with less times of rolling and, like a macadam roller, can be used both for a full-type and easy-type paving. To correspond to these conditions, we will examine one with a mass of 8 to 10 tons and an output of 90 to 110 HP.
The spare parts ratio will be 7% of the CIF price and mainly the hydraulic components will be provided. Concerning the engine, mainly the electrical system components (starters, generators, etc.) that will not be easily procured locally will be provided.

Dump truck: Will be a right-handed drive for transporting aggregates, mixture, and earth and sand (6x4). We decided that the dump truck should have a maximum loading capacity of 7 to 9 m^3 and an output of 280 to 320 HP. For this conclusion, we assumed that a wide variety and a large quantity of materials will be transported, and that the asphalt mixture and crushed stones will have a specific gravity of 1.4 and 1.5 tons per cubic meter, respectively. Then, we considered how much the plants can produce mixture and crushed stones to calculate the maximum production, on which we based our decision. The dump trucks will have seat belts as safety devices.
The spare parts ratio will be 3% of the CIF price and mainly the PTO shafts, cables, hydraulic pump components, hub bearings will be considered.

Asphalt distributor: Mainly used to spray the emulsion for lightly trafficed paving. Will have a tank capacity of about 5,000 liters and provide an easy-to-use

mechanical operation. The vehicle part will be a right-handed drive and have seat belts as safety devices. This decision was made, based on the plan distance and the workers' experience of using such a device.

The spare parts ratio will be 3% of the CIF price and mainly the hydraulic pumps, subengines, and hose components and, for the vehicle part, brakes and hub components will be considered.

Portable stone crusher: Used to produce aggregates (crushed stones) for pavement. Will be a mobile type with a capacity of 10 to 16 tons per hour, considering the wide range of plan areas, the aggregate sizes (over 40, 20 to 40, 5 to 20, and 0 to 5 mm) and the demand. The spare parts ratio will be 5% of the CIF price and mainly the V belts, engine filters, air cleaners, and internal engine parts will be considered.

Chip spreader: Used to spray sand and aggregates for easy-type paving and surface-treat a road (cover the aggregates). Will have a hopper capacity of 1 to 1.5 m^3, a laying width of 2 to 3.5 m, and be attached to the rear wheels of a cargo (dump) truck. For this conclusion, we examined the possibility of paving half a road at once, the emulsion spraying vehicle capacity, and the vehicle installation specifications. The spare parts ratio will be 5% of the CIF price and mainly the electrical and hydraulic components will be considered.

Truck lorry: Will be a right-handed drive for transporting construction materials and equipment (4x2), with a maximum loading capacity of 7 tons or more to be compatible with this project. The truck lorry will have seat belts as safety devices. As simple maintenance parts, a grease pump and an air hose for compressor output will be equipped. The spare parts ratio will be 3% of the CIF price and mainly the brakes, clutches, and engine components will be considered.

The bodies and cabins of all the proposed equipment listed above will be painted yellow or golden yellow as specified by the DOR.

(3) Situations of local agents of Japanese manufacturers

The DOR wishes to be provided with Japanese-made equipment for which a high quality is guaranteed and the system of service is established including the component supply in

Zimbabwe. There are several Japanese manufacturers that supplied construction equipment in the past grant aid projects, having an excellent system of service and component supply. There is a Japanese manufacturer that produces vehicles on a knockdown basis in Zimbabwe and South Africa, having an established system of service and component supply.

(4)Procurement in a third country or in Zimbabwe

After surveying about procurement in a third country or in Zimbabwe, we plan to procure chip spreaders in a third country for the following reasons:

Chip spreader: An equivalent product as the one proposed in this project is manufactured in Europe (Sweden and the U.K.). Although there will be a problem in the system of service and component supply, we have no other choice because the equipment with the proposed specifications are not currently produced in Japan. Since the said equipment, being structurally simple, does not fail or break so often, a European product will not cause so much of a problem.

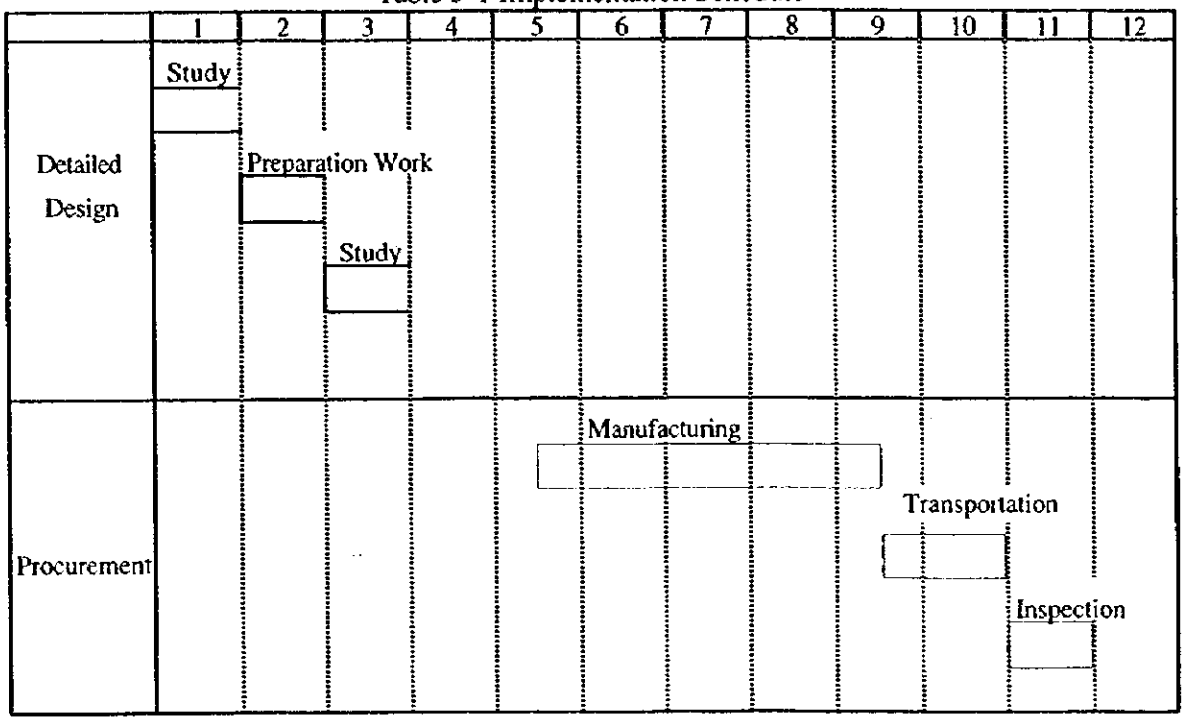
Chapter 3 Implementation Plan

3-1 Implementation Plan

3-1-1 Implementation Schedule

Based on the grant aid system of Japan, the project will be implemented in the processes shown in Table 3-1.

Table 3-1 Implementation Schedule



3-1-2 Obligation of Zimbabwe

For the grant aid to be implemented, the Zimbabwean government must take the following actions:

① In principle, the Zimbabwean government must bear the expenses for and carry out promptly the customs clearance and the local transportation of the procured equipment.

② Concerning the equipment and services procured based on the authorized contract, the Zimbabwean government must exempt any Japanese nationals from the customs duties, inland duties, and any other financial surcharge to be imposed on them.

③ Concerning the services provided by any Japanese nationals based on the authorized contract, the Zimbabwean government must provide them with required facility for their entrance and stay in Zimbabwe in order to provide such services.

④ The Zimbabwean government must establish a Banking Arrangement with a certified foreign exchange bank in Japan and issue an Authorization to Pay.

⑤ The installation work is needed for an asphalt plant. The said equipment in this project is a mobile type and currently needs no installation expenses unless one is to be installed on an excessively inclined slope. However, the Zimbabwean government must bear the installation expenses, if any required during the implementation of this project.

3-2 Maintenance Plan

Each provincial office to which the equipment provided in this project is placed has a workshop for maintenance, where brief servicing of equipment such as tire replacement service, specification check, quick maintenance service, and welding are performed. However, due to the shortage of facilities and engineers, heavy maintenance requiring special skills cannot be performed. To improve this situation, the DOR has contracted each of the local agents of manufacturers to perform periodical maintenance for every 5,000 km or every 100 to 200 hours and provide the DOR with technical instructions. The equipment provided in the "Road Maintenance Equipment Improvement Plan" in FY 1995 were maintained in a good condition.

Additionally, the DOR tries to improve its technical level by having its personnel in charge and engineers to take a course of vehicle maintenance skills provided by the Vehicle Inspection Department of the Ministry of Transportation and Energy.

The budget for having more equipment management expenses and ten more maintenance persons (five for the Harare headquarters and five for Matabeleland North province) is under examination.

The required budget, calculated based on the construction machinery rent calculation chart and considering the environment in Zimbabwe, is 77,390,343 yen (Z$8,794,352.7) as shown in Table 3-3. This amount, accounting for 3% of the yearly road repair budget of the DOR, will not affect the operation of the DOR. There will be no problem because, considering the current 20 to 40% rise of the equipment management budget, this amount can be appropriated within the said budget.

Table 3-3 Equipment management expenses

Item	Amount (yen)
Management	3,556,000
Maintenance and repair	7,086,240
Personnel	3,600,000
Consumable parts	5,020,000
Fuel	53,804,845
Oil	4,323,258
Total	77,390,343

The equipment management expenses are calculated as follows:

① Management expense

The management expense is the total of the public taxes and imposts, insurance premium, storage facility expenses, and equipment management office expenses. This expense is calculated by multiplying the basic price of equipment by the yearly management ratio (1%).

Table 3-4 shows the breakdown of the management expense for each device

Table 3-4 Breakdown of management expense for each device

(Thousand yen)

Equipment name	Basic price	Yearly management ratio	Quantity	Total
Asphalt plant	57,120	1 %	2	1,143.3
Asphalt finisher	11,200	1 %	2	224
Macadam roller	7,360	1 %	2	147.2
Vibrating roller	7,380	1 %	2	147.6
Dump truck	6,860	1 %	8	548.8
Asphalt distributor	10,800	1 %	4	432
Stone crusher	7,600	1 %	2	152
Chip spreader	3,530	1 %	10	353
Truck lorry	4,080	1 %	10	408
			42	3,556

Note: The basic price is the prevailing market price of the machine with the standard specifications. The yearly management ratio is the percentage by which to multiply the price of the equipment lent by the Japanese government at no cost.

① Maintenance and repair expense

The maintenance and repair expense covers the maintenance and repair required to maintain the effectiveness of equipment, except for the running expense.

This expense is calculated as follows:

(Basic price x Maintenance and repair expense x Quantity - Provided component expense) ÷ 10 (assuming the life of equipment as ten years).

Table 3-5 shows the breakdown of the maintenance and repair expense.

Table 3-5 Breakdown of maintenance and repair expense

Equipment	Basic price (thousand yen)	Maintenance and repair expense (%)	Quantity	Provided component expense (thousand yen)	Life (years)	Total (thousand yen)
Mobile Mixing Asphalt plant	57,120	28 %	2	8,000.8	10	2,401.14
Asphalt finisher	11,200	32 %	2	1,568	10	560
Macadam roller	7,360	28 %	2	1,030.4	10	309.12
Vibrating roller	7,380	30 %	2	1,030.4	10	339.12
Dump truck	6,860	25 %	8	2,744	10	1,097.6
Asphalt distributor	10,800	30 %	4	2,160	10	1,080
Portable Stone crusher	7,600	22 %	2	1,064	10	228
Chip spreader	3,530	20 %	10	2,471	10	458.9
Truck lorry	4,080	20 %	10	2,040	10	612
Total			42	22,114.4		7,086.24

① Personnel expense

The personnel expense (for maintenance) is calculated as follows:

30,000 (yen/month) x 12 months x 10 people = 3,600,000 yen

② Consumable parts expense

The consumable parts expense covers those parts whose wear and tear is closely related to the rate of operation and which no special skill is required for replacing (tires). Table 3-6 shows the breakdown of the consumable parts expense for each device.

Table 3-6 Breakdown of consumable parts expense for each device

(Unit: thousand yen)

Equipment name	Component expense for each vehicle	Quantity	Total
Mobile MixingAsphalt plant	300	2	600
Asphalt distributor	210	4	840
Portable Stone crusher	50	2	100
Dump truck	210	8	1,680
Truck lorry	180	10	1,800
Total			5,020

① Fuel expense

The fuel expense is calculated based on the yearly use time for each device calculated according to the project plan as follows:

Fuel consumption of device x Estimated horsepower x Yearly use time (varying depending on device) x Quantity x Local light (heavy) oil price

Table 3-7 shows the breakdown of fuel consumption.

Table 3-7 Breakdown of fuel consumption

Equipment	Fuel consumption (liter/PS.h)	Horsepower (PS)	Yearly use time	Quantity	Yearly consumption (liter)
Asphalt plant	560		2,400	2	2,688,000*
Asphalt finisher	0.19	38	900	2	12,996
Macadam roller	0.173	76	900	2	23,666.4
Vibrating roller	0.178	120	900	2	38,448
Dump truck	0.05	240	1,500	8	144,000
Asphalt distributor	0.04	180	1,080	4	31,104
Stone crusher	0.02	20	3,600	2	2,280
Truck lorry	0.04	190	1,500	10	114,000
Total					Heavy oil: 2,688,000 Light oil: 367,094.4
Cost	Heavy oil 2,688,000(LT) x 1.8 (Z$/LT) x 8.84 (¥/Z$) = 42,771,456 (Yen) Light oil 367,094.4 (LT) x 3.4 (Z$/LT) x 8.84 (¥/Z$) = 11,033,389.3 (Yen) Total 42,771,456 + 11,033,389.3 = 53,804,845.3 (Yen)				

* For an asphalt plant, heavy oil is used in calculation although both light and heavy oil can be used.

Oil expense

The oil and fat expense covers engine hydraulic oil for construction machinery and engine oil for vehicles. This expense is calculated as follows: Engine (hydraulic) oil capacity x Times of replacement x Quantity x Price per liter. Table 3-8 shows the breakdown of oil and fat expense.

Table 3-8 Breakdown of oil expense

Equipment	Engine oil capacity	Required times of replacement per year	Quantity	Required amount of engine oil	Required amount of hydraulic oil (once a year)	Required amount of hydraulic oil
Asphalt finisher	8LT	5	2	80LT	85 LT	160 LT
Macadam roller	20LT	5	2	200 LT	55 LT	110 LT
Vibrating roller	20LT	5	2	200 LT		
Dump truck	20LT	5	8	800 LT		
Distributor	20LT	5	4	400 LT		
Stone crusher	3LT	5	2	30 LT		
Truck lorry	20LT	5	10	1,000 LT		
Total				2,700 LT		270 LT

Engine oil: 2,710 (LT) x 85 (Z$/LT) x 8.84 (yen/Z$) = 2,036,350 yen

Hydraulic oil: 270 (LT) x 105 (Z$/LT) x 8.84 (yen/Z$) = 2,286,908 yen

Total of oil expense: 2,036,350 + 2,286,908 = 4,323,258 (yen)

Chapter 4 Project Evaluation and Recommendation

4-1 Project Effect

The Zimbabwean government listed the economic development through paving and improving roads as one of the important policies in the "Second Five-Year Development Plan". Based on this plan, the DOR establishes every year a periodical road repair plan and tries to implement it.

If the paving equipment is provided as planned in this project, the current repair distance of about 200 kilometers per year will be improved to 70 to 80% of the DOR yearly goal of 800 kilometers (i.e., around 600 kilometers per year) and enable the smooth implementation of the "Three-Year Periodical Road Repair Plan". Additionally, the full-type paving of lightly trafficed paved roads and the lightly trafficed paving of earthen roads will have the following direct effects:

① Extension of life of roads (from three to seven years to 10 to 13 years)
② Reduction of maintenance expenses (average of 100 million yen per year)
③ Reduction of personnel (from 435 to 317)
④ Reduction of equipment charter expense (accounts for 25 to 30% of the development budget every year up to 1996 but may be reduced by 50 to 80 million yen if equipment is provided in this project)

Additionally, the following indirect effects are also expected. This project will surely contribute to the beneficiary effects on the local residents and vitalization of the economy and will be consistent with the provincial development, mitigation of poverty, and stabilization of public investment in the national development plan. This project will:

① Promote the improvement of the road network connecting the provinces and cities and neighboring countries and thus contribute to the realization of the provincial development and resettlement plan intended for fair ownership of farming land.
② Stabilize the prices and facilitate the access to the educational and medical institutions in the provinces.
③ Increase the employment opportunities due to the regional development and contribute to raising the standard of living.
④ Improve the road surface conditions, realize the smooth flow of traffic, secure the sidewalks, enhance the considerations to the pedestrians, prevent traffic accidents, and reduce the consumption of tires and frames of vehicles and cost of transportation.

Thus, we conclude that it is adequate to provide this grant aid.

4-2 Recommendation

Although there seems to be no particular problem in the system of the Zimbabwe government concerning the operation and management of this project, this project would be more smoothly and effectively implemented if the following items were improved:

① Since the DOR has never used the equipment provided in this project (asphalt plants and finishers), the personnel should be trained on the preparation of mixtures and the appropriate management of materials in cooperation with the manufacturers. For the training on running and management, the delegation of short-term (or long-term) specialists should be considered.
② For the general equipment, the DOR should provide the operators with the periodical operation training by itself or in cooperation with the manufacturer agents.
③ For the maintenance and management, the similar actions as above are required.
④ After the engineers are educated, some action should be taken to prevent them from leaving the DOR and joining private companies (in order to secure the system of properly managing the equipment and stabilize the equipment operation ratio).
⑤ The personnel and budget required for the maintenance of equipment should be secured without fail.
⑥ Since mixtures must be secured for asphalt plants at the time of operation without fail, the budget for them should be secured.

Appendix 1

Member List of the Survey Team

1.Yoshikazu ITO Road Construction Planner
Japan International Cooperation System

2.Masanori TAKEISHI Equipment Planner
Japan International Cooperation System

Appendix 2

Survey Schedule

NO	Date		Flight	Contents	Accommodation
1	28 Nov.	Fri.	Arr. Harare (SA026)	Courtesy Call to Japanese Embassy and JICA Office	Harare
2	29 Nov.	Sat.		Road Condition Check	
3	30 Nov.	Sun.		Internal Meeting	
4	1 Dec.	Mon.		Courtesy Call to the Ministry of Transport and Energy and discussion with the Department of Road	
5	2 Dec.	Tue.		Road Condition Check	
6	3 Dec.	Wed.		Road Condition Check	
7	4 Dec.	Thu.		Discussion with DOR and confirmation of the Parking for project equipment	
8	5 Dec.	Fri.		Discussion with DOR and Market research	
9	6 Dec.	Sat.		Road Condition Check	
10	7 Dec.	Sun.		Road Condition Check	
11	8 Dec.	Mon.		Discussion with DOR and Internal Meeting	
12	9 Dec.	Tue.		Signing of Minutes of Meeting and Report to Japanese Embassy and JICA Office	
13	10 Dec.	Wed.	Harare-Johannesburg	Courtesy Call to JICA South Africa Office	Johannesburg
14	11 Dec.	Thu.		Market Research	
15	12 Dec.	Fri.		Market Research	
16	13 Dec.	Sat.	Johannesburg-Tokyo		Japan

Appendix 3

List of Party Concerned in the recipient Country

(1) Ministry of Transport and Energy

Eng. Paul Kozwa	Secretary, Ministry of Transport and Energy

(2) Department of Roads

Mr. Nelson Kudenga	Director
Mr. John Makandho	Deputy Director (Operations)
Mr. Francis Hwekwete	Chief Engineer Maintenance
Mr. Ian Cannel	Director,Midland Provincial Office
Mr. Brian Granger	Staff
Mr. J. Moyo	Director, Matabeleland South Provincial Office
Mr. S. Kapundanga	Provincial Road Engineer (Matabeleland North)
Ms. Willet Patience Phut	〃
Mr. Mubato Mazode	Director, Mashonaland West Provincial Office
Mr. Stanley Marega	Staff
Mr. F. Marangwanda	Staff, Masvingo province

(3) Japanese Embassy

Mr.Asao Tsukahara	Ambassador
Mr.Hironobu Yasumura	Councellor
Mr. Hideji Senda	Secretary

(4) JICA Zinbabwe Office

Mr. Tomohiro Seki	Assistant Representative
Mr.Ichiro Ito	JOCV Cordinator
Mr.Akira Watanae	ditto
Ms.Michiyo Morohashi	ditto
Mr.Katsumi Hikone	JOCV

(5) JICA South Africa Office

Mr.Norio Shimomura	Resident Representative

(6) Dealer in Zimbawe

Mr. J. F. Mutugeazi	Manager-Government, Parastatals.Zemco CAT
Mr. D. D. Parbhoo	Part manager
Mr. Ramsey Maclagan	Managing Director Plant and Equipment KOMATSU
Mr. Fungai G Gowe	Workshop Manager 〃
Mr. Rose Hansen	General Manager HINO
Mr. Alan Shumba	Vehicle Sales Consultant NISSAN

(7) Dealer in South Africa

Mr. Kimiya Nakano	Director-Business Development KOMATSU
Mr. Yousuke Shimano	Managing Director KOMATSU
Mr. Douglas R Noiles	Area Manager CAT
Mr. Johan du Plessis	Manager-Dealer Service CAT
Mr. Carlo Miconi	Area Manager FIAT-HITACHI
Mr. Courter E Leppan	National Manager Premier equipment CO.,LTD
Mr. Buddy de Gasperi	Marketing Manager Premier equipment CO.,LTD

MINUTES OF DISCUSSIONS

THE STUDY
ON
THE PROJECT
FOR
SUPPLY OF MOBILE ROAD ASPHALT MIXING PLANTS
AND
PAVING EQUIPMENT
IN
THE REPUBLIC OF ZIMBABWE

In response to a request from the Government of the Republic of Zimbabwe, the Government of Japan decided to conduct a study on the Project for Supply of Mobile Road Asphalt Mixing Plants and Paving Equipment in the Republic of Zimbabwe (hereinafter referred to as "the Project") and entrusted the study to Japan International Cooperation Agency (JICA).

JICA sent to the Republic of Zimbabwe a study team which stayed in the country from November 28th, to December 10th,1997.

The Team held discussions with the responsible technical officials (Director.Mr N.Kudenga and Deputy Director Mr.J.Makadho) of the Government of the Republic of Zimbabwe and conducted field surveys covering the study area.

In the course of discussions and field survey, both parties have agreed on the main items described on the attached sheets. The team will proceed to further works and prepare the Study Report.

December,9th,1997.

Mr.Yoshikazu ITO
Leader,
The Study Team
Japan International
cooperation Agency(JICA)

Mr.Nelson Kudenga
Director,
Department of Roads
for secretary,for Transport
Ministry of Transport & Energy

1. Objective of the Project

The objective of the Project is to increase maintenance levels of the national road network and to improve accessibility to the rural areas and promote rural development.

2. Project Sites

The proposed sites of the project have been prioritized as follows through a series of discussions,and a map of the sites is shown in ANNEX-1-1 and 1-2.

		Construction	Rehabilitation
Priority	1: Matabeleland North	(147km)	(313.4km)
	2: Midlands	(75km)	(253.3km)
	3: Mashonaland East	(101km)	(209.3km)
	4: Mashonaland Central	(130km)	(272.5km)
	5: Mashonaland West	(11km)	(333.8km)
	6: Manicaland	(101km)	(209.9km)
	7: Masvingo	(230km)	(285.4km)
	8. Matebereland South	(0km)	(229.9km)
	TOTAL	795KM	2,106.7KM

3. Responsible Ministry and Executing Agencies

Responsible Ministry

- Ministry of Transport & Energy

Executing Agency

- Department of Roads(DOR) (see ANNEX-2-1 and 2-2)

4. Items Requested by the Government of the Republic of Zimbabwe

After discussions with the Study Team, the items shown in ANNEX -3 are finally requested by the Zimbabwean side.

However, the final components of the Project will be decided after further studies .

5. Japan's Grant Aid System

(1) The Government of the Republic of Zimbabwe (hereinafter referred to as "the Government of Zimbabwe") has understood the system of Japan's Grant Aid in ANNEX-4 as explained by the Team.

(2) The Government of of Zimbabwe will take the necessary measures described in ANNEX-5 for smooth implementation of the Project, on condition that Japan's Grant Aid is extended to the Project.

6. Schedule of the Study

JICA will complete the final report and send it to the Government of Zimbabwe by the end of March,1998.

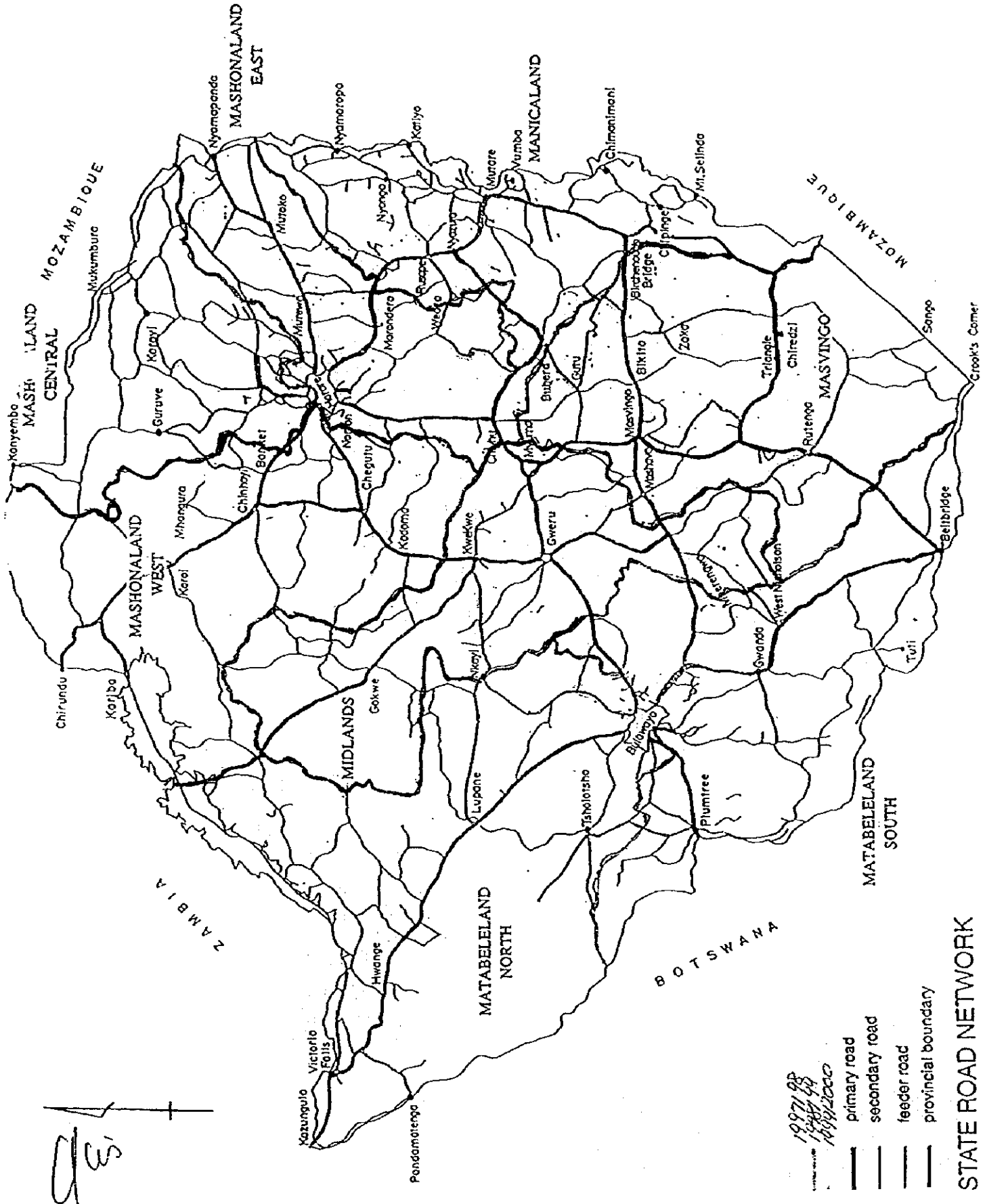
7. Other relevant issues

(1) The Zimbabwean side will allocate the necessary budget and personnel for execution of the project.

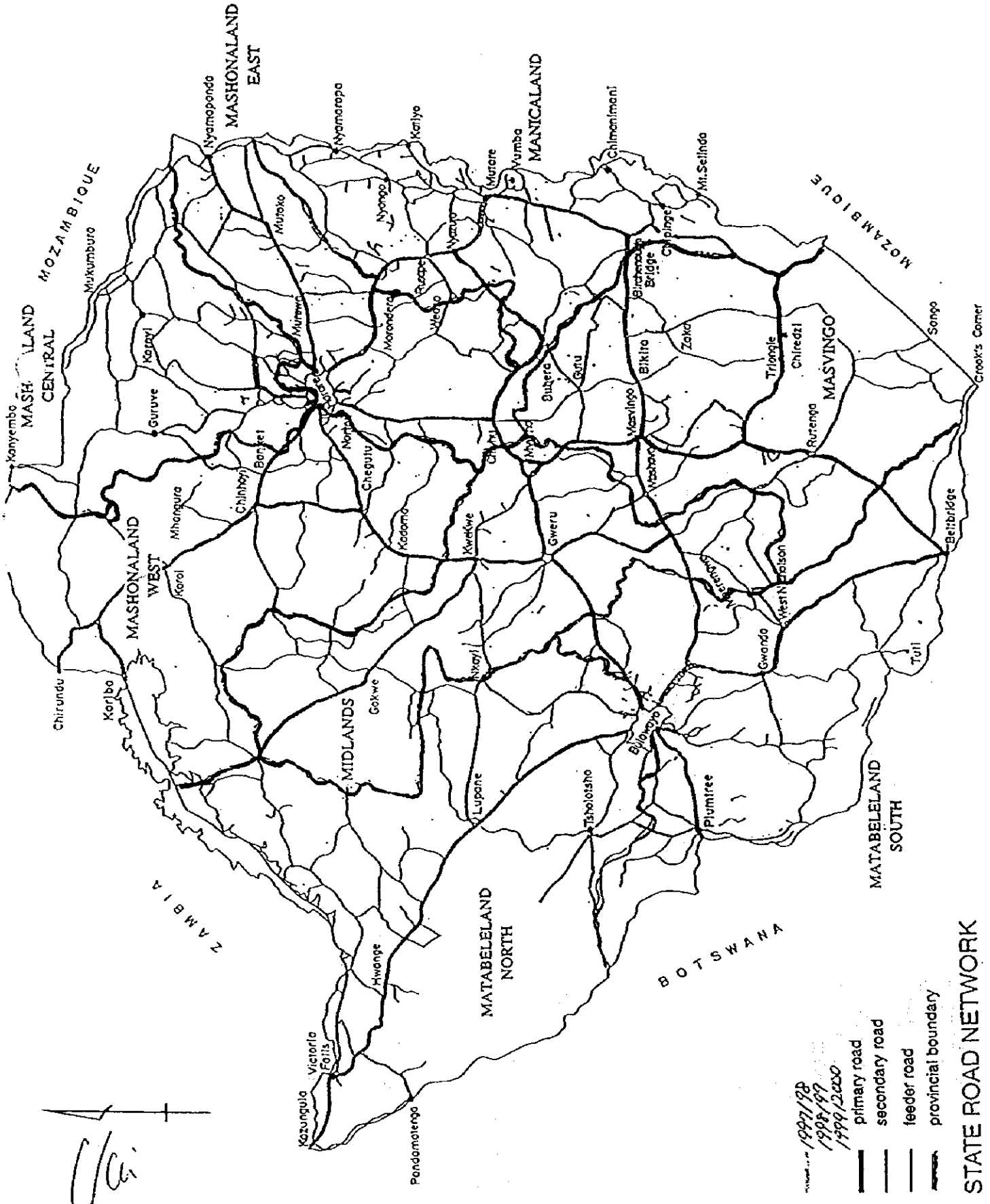
(2) Although Department of Roads(DOR) has been sub-contracting some of its road maintenance services under current structural changes, Maintenance Units of DOR, which are directly in charge of road maintenance, shall remain under DOR which shall have the ownership of the equipment purchased under the Grant Aid. The Zimbabwean side will maintain and use the equipment purchased under the Grant Aid

(3) The Government of Zimbabwe will maintain and use the equipment purchased under the Grant Aid properly and effectively, and shall assign the necessary staff members for operation and maintenance of the equipment as well as to bear all the expenses other than those to be borne by the Grant Aid.

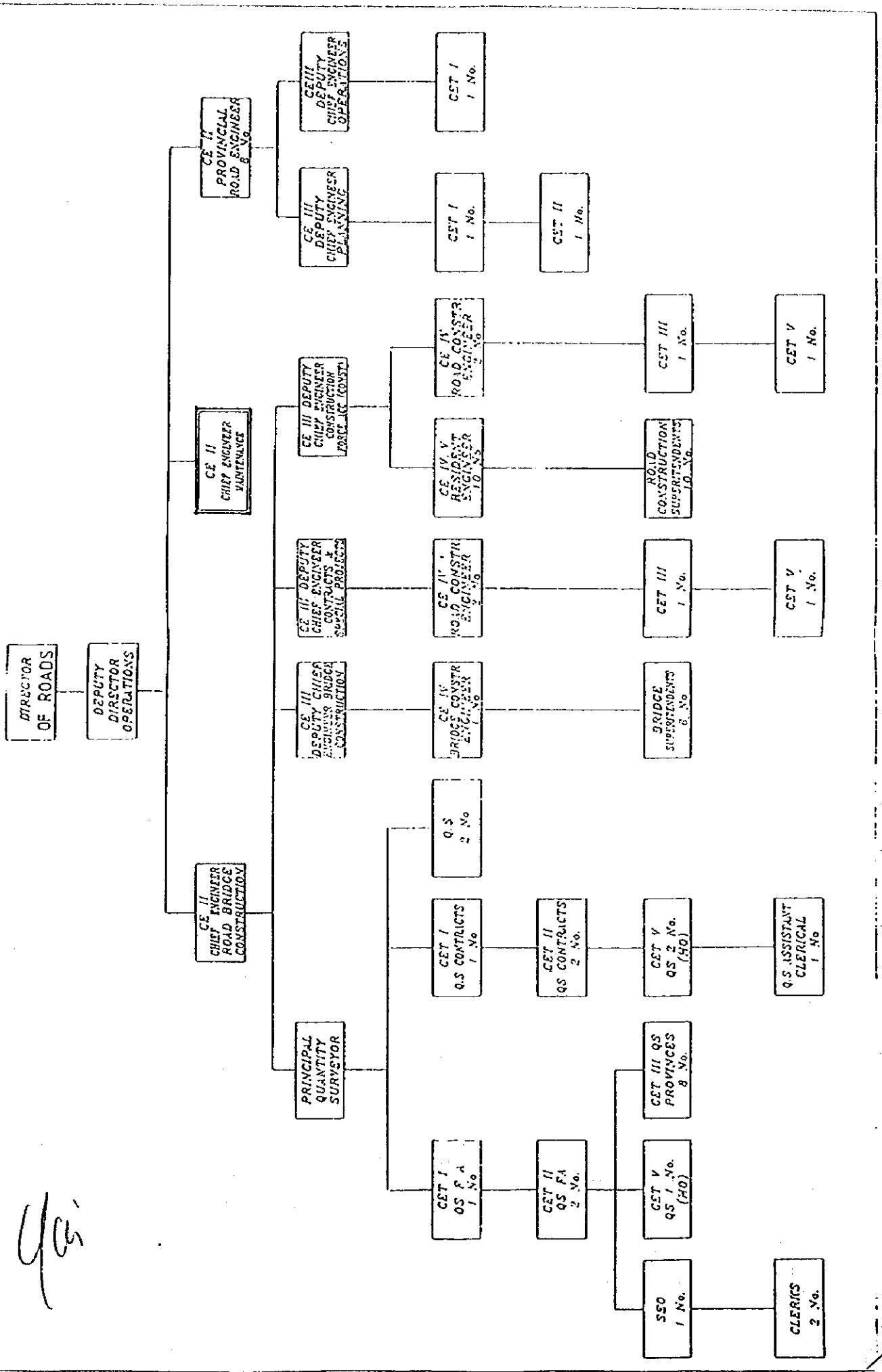
ANNEX- I-I Proposed sites of the Project (Construction)



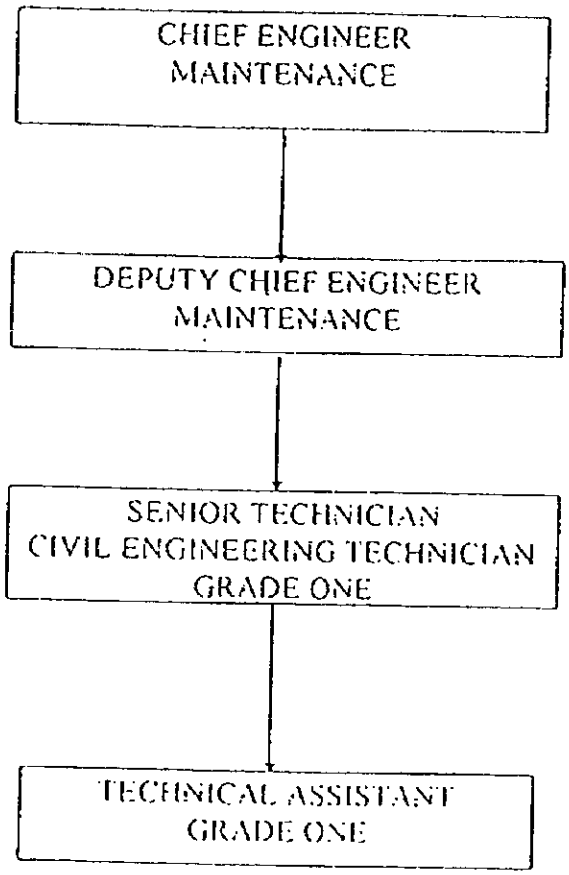
ANNEX-1-2 Proposed sites of the Project (Rehabilitation)



ANNEX-2-1 ORGANIZATION CHART



MAINTENANCE BRANCH STRUCTURE



ANNEX-3

Items requested by the Government of the Republic of Zimbabwe

Priority and Name of Equipment	Priority			Total	Remark
	A	B	C		
Asphalt Plant 42-48ton, portable batch type	2	1	1	4	Use Phase I
Asphalt Finisher paving width 6M	2	1	1	4	
Motor Grader 135HP W/ROPS Canopy	–	–	–	0	Use Phase I
Vibrating Roller 9.7ton, 105HP W/Soft Canopy	2	–	–	2	
Hydraulic Excavator 84HP W/0.5M3 Back Hoe Bucket	–	–	–	0	Own possession
Bull Dozer 200HP W/Straight Brade,ROPS	–	–	–	0	Use Phase I
Wheel Loader 140HP W/ROPS Cab, 2.3M3 Bucket	–	–	–	0	Use Phase I
Tipping Truck 8.7M3 300PS	6~8	4~2	2~2	12	
Macadam Roller 80PS 12.2ton	2	1	1	4	
Portable Stone Crusher 10~15ton/PH	2	–	–	2	
Air Compressor 2.5M3/Minm.-Min.	–	–	–	0	Own possession
Generator 10KVA/50Hz	–	–	–	0	Own possession
Asphalt Distributor 5000L,with Track mounted	4	2	2	8	
Chip Spreader 2-3m width with wheel attached type	10	3	3	16	
Truck Lorry Cap, 7ton Long wheel base	10	10	10	30	
Spare part	10%	10%	10%		

ANNEX-4

ON JAPAN'S GRANT AID PROGRAM

1. Japan's Grant Aid Procedures

(1) The Japan's Grant Aid Program is executed by the following procedures.

- **Application** (request made by a recipient country)
- **Study** (Study conducted by JICA)
- **Appraisal & Approval** (Appraisal by the Government of Japan and Approval by the Cabinet of Japan)
- **Determination of Implementation** (Exchange of Notes between both Governments)
- **Implementation** (Implementation of the Project)

(2) Firstly, an application or a request for a project made by the recipient country is examined by the Government of Japan (the Ministry of Foreign Affairs) to see whether or not it is suitable for Japan's Grand Aid. If the request is deemed suitable, the Government of Japan entrusts a study on the request to JICA (Japan International Cooperation Agency).

Secondly, JICA conducts the Study, using a Japanese consulting firm. If the background and objective of the requested project are not clear, a Preliminary Study is conducted prior to a Study.

Thirdly, the Government of Japan appraises to see whether or not the Project is suitable for Japan's Grant Aid Program, based on the Study report prepared by JICA and the results are then submitted for approval by the Cabinet of Japan.

Fourthly, the Project approved by the Cabinet becomes official when pledged by the Exchange of Notes signed by both Governments.

Finally, for the implementation of the Project, JICA assists the recipient country in preparing contracts and so on.

2. Contents of the Study

(1) Contents of the Study

The purpose of the Study conducted on a project requested by JICA is to provide a basic document necessary for appraisal of the project by the Japanese Government. The contents of the Study are as follows:

a) to confirm background, objectives, benefits of the project and also institutional capacity of agencies concerned of the recipient country necessary for project implementation,
b) to evaluate appropriateness of the Project for the Grant Aid Scheme from a technical, social and economical point of view,
c) to confirm items agreed on by both parties concerning a basic concept of the project,
d) to prepare a basic design of the project,
e) to estimate cost involved in the project.

Final project components are subject to approval by the Government of Japan and therefore may differ from an original request.

Implementing the project, the Government of Japan requests the recipient country to take necessary measures involved which are itemized on Exchange of Notes.

(2) Selecting (a) Consulting Firm(s)

For smooth implementation of the study, JICA uses (a) consulting firm(s) registered. JICA selects (a) firm(s) through proposals submitted by firms which are interested.

The consulting firm(s) used for the study is(are) recommended by JICA to a recipient country after Exchange of Notes, in order to maintain technical consistency and also to avoid possible undue delay in implementation caused if a new selection process is repeated.

3. Japan's Grant Aid Scheme

(1) What is Grant Aid?

The Grant Aid Program provides a recipient country with non reimbursable funds needed to procure facilities, equipment and services for economic and social development of the country under the following principles in accordance with relevant laws and regulations of Japan. The Grant Aid is not in a form of donation or such.

(2) Exchange of Notes (E/N)

The Japan's Grant Aid is extended in accordance with the Exchange of Notes by both Governments, in which the objectives of the Project, period of execution, conditions and amount of the Grant, etc. are confirmed.

(3) "The period of the Grant Aid" means one Japanese fiscal year (commencing from 1st April ending on 31st of March) which the Cabinet approves the Project for. Within the fiscal year, all procedure such as Exchange of Notes, concluding a contract with (a) consulting firm(s) and (a) contractor(s) and a final payment to them must be completed.

(4) Under the Grant, in principle, products and services of origins of Japan or the recipient country are to be purchased.

When the two Governments deem it necessary, the Grant may be used for the purchase of products or services of a third country origin.

However the prime contractors, namely, consulting, contractor and procurement firms, are limited to "Japanese nationals". (The term "Japanese nationals" means Japanese physical persons or Japanese juridical persons controlled by Japanese physical persons.)

(5) Necessity of the "Verification"

The Government of the recipient country or its designated authority will conclude into contracts in Japanese yen with Japanese nationals. Those contracts shall be verified by the Government of Japan. The "Verification" is deemed necessary to secure accountability to Japanese tax payers.

(6) Undertakings required to the Government of the recipient country

In the implementation of the Grant Aid, the recipient country is required to undertake necessary measures such as the following:

a) to secure land necessary for the sites of the project and to clear and level the land prior to commencement of the construction work,

b) to provide facilities for distribution of electricity, water supply and drainage and other incidental facilities in and around the sites,

c) to secure buildings prior to the installation work in case the Project is providing equipment,

d) to ensure all the expenses and prompt execution for unloading, customs clearance at the port of disembarkation and internal transportation of the products purchased under the Grant Aid,

e) to exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which will be imposed in the recipient country with respect to the supply of the products and services under the Verified Contracts,

f) to accord Japanese nationals whose services may be required in connection with the supply of the products and services under the Verified Contracts, such facilities as may be necessary for their entry into the recipient country and stay therein for the performance of their work.

(7) Proper Use

The recipient country is required to maintain and use facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign staff necessary for their operation and maintenance as well as to bear all expenses other than those to be borne by the Grant Aid.

(8) Re-export

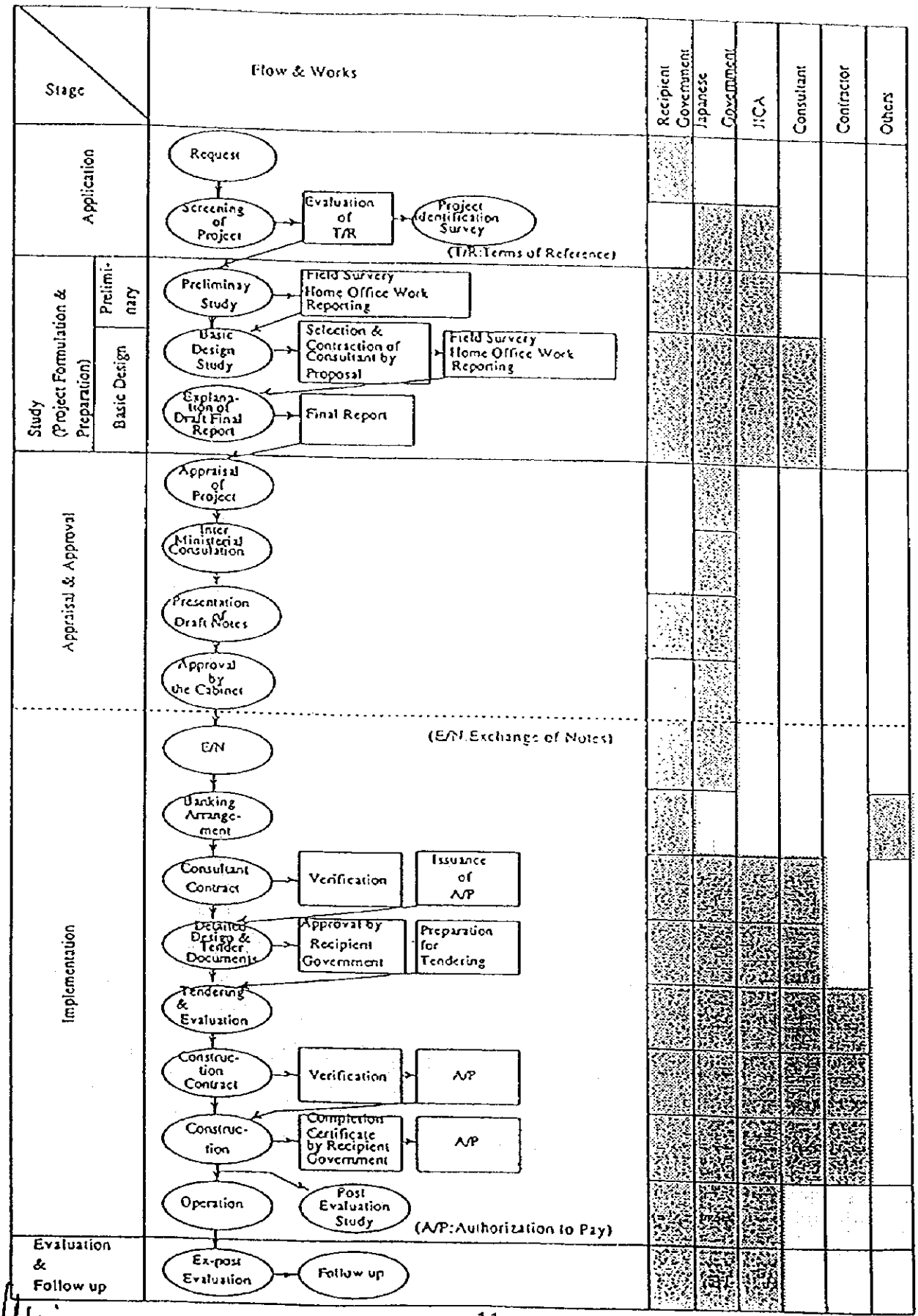
The products purchased under the Grant Aid shall not be re-exported from the recipientcountry.

(9) Banking Arrangement (B/A)

a) The Government of the recipient country or its designated authority shall open an account in the name of the Government of the recipient country in an authorized foreign exchange bank in Japan (hereinafter referred to as "the Bank"). The Government of Japan will execute the Grant Aid by making payments in Japanese yen to cover the obligations incurred by Government of the recipient country or its designated authority under the contracts verified.

b) The payments will be made when payment requests are presented by the Bank to the Government of Japan under an Authorization to pay issued by the Government of the recipient country or its designated authority.

Flow Chart of Japan's Grant Aid Procedures



Major Undertaking to be taken by Each Goverment

No.	Items	To be covered by Grant Aid	To be covered by Recipient side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct gates and fences in and around the site		●
4	To construct the parking lot	●	
5	To construct roads		
	1) Within the site	●	
	2) Outside the site		●
6	To construct the buildings	●	
7	To provide facilities for the distribution of electricity, water supply, drainage and other incidental facilities		
	1) Electricity		
	a. The distributing line to the site		●
	b. The drop wiring and internal wiring within the site	●	
	c. The main circuit breaker and transformer	●	
	2) Water Supply		
	a. The city water distribution main to the site		●
	b. The supply system within the site (receiving and elevated tanks)	●	
	3) Drainage		
	a. The city drainage main (for storm, sewer and others) to the site		●
	b. The drainage system (for toilet sewer, ordinary waste, storm drainage and others) within the site	●	
	4) Gas Supply		
	a. The city gas main to the site		●
	b. The gas supply system within the site	●	
	5) Telephone System		
	a. The telephone trunk line to the main distribution frame/panel (MDF) of the building		●
	b. The MDF and the extension after the frame/panel	●	
	6) Furniture and Equipment		
	a. General furniture		●
	b. Project equipment	●	
8	To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the B/A		
	1) Advising commission of A/P		●
	2) Payment commission		●
9	To ensure unloading and customs clearance at port of disembarkation in recipient country		
	1) Marine (Air) transportation of the products from Japan to the recipient country	●	
	2) Tax exemption and custom clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site		●
10	To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contact such facilities as may be neccessary for their entry into the recipient country and stay therein for the performance of their work.		●
11	To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the supply of the products and services under the verified contracts.		●
12	To maintain and use properly and effectively the facilities constructed and equipment provided under the Grant.		●
13	To bear all the expenses, other than those to be borne by the Grant, necessary for construction of the facilities as well al for the transportation and installation of the equipment.		●

ANNEX-5

Necessary measures to be taken by the Government of the Republic of Zimbabwe in case Japan's Grant Aid is executed.

1. To provide necessary facilities for the Project such as electricity and other incidental facilities.
2. To bear the following commissions to the Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.

(a) Advising Commission of Authorization to Pay

(b) Payment Commission

3. To exempt taxes and to take necessary measures for customs clearance of the materials and equipment brought for the Project at the port of disembarkation.
4. To accord Japanese nationals whose services may be required in connection with the supply of products and the services under the Verified Contracts such facilities as may be necessary for their entry into Zimbabwe and stay therein for the performance of their work.
5. To maintain and use the equipment procured under the Grant properly and effectively.
6. To bear all expenses other than those to be borne by the Grant, necessary for the execution of the Project.
7. To ensure the necessary budget and personnel for the proper and effective implementation of the Project, including operation and maintenance of the equipment procured under the Grant.