3－8　関連データの整備状況

(1)　気象

各種の気象に関するデータは、運輸・エネルギー資源省気象サービス局(Department of Meteorological Services, Ministry of Transport and Energy Resources)に取りまとめられており、デジタル・データ（フロッピー・デスクの受け渡しによる）として収集することも可能である。

(2)　水文

マニャメ川上流域には、4ヶ所のダム（マニャメダム、チベロダム、セケダム及びハラバダム）があり、マニャメ川本流の他、各ダムには主要な流入河川が、マニャメダムにはグウェビ川とムズルル川が、チベロダムにはマリンバ川とムクビシ川とニャツメ川が、また、セケダム及びハラバダムにはルワ川等がある。各ダム及び各河川における水位・流量に関するデータは、土地・水資源開発省水資源開発局（Department of Water Development, Ministry of Land and Water Development）において取りまとめられている。

(3)　水質

関係するダム及び河川の水質に関するデータは、ハラレ市の上下水道局の水質試験室及び土地・水資源開発省水資源開発局の水質汚濁対策室（Water Pollution Control Board）において取りまとめられている。

(4)ハラレ市等対象地域の上下水道に関する既往の計画及び検討中の計画

ハラレ市上下水道局には、ハラレ首都圏の上下水道に関する既往の計画及び現在検討中の計画に関する報告書、図面等が取りまとめられている。

(5)　地形図等

地形図等の地図類は、Surveyor General's Department にて入手（購入）することができる。ジンバブエ国の 1:50,000 地形図のインデックス・マップを図３－11 に示す。

航空写真は、1984 年に撮影（縮尺 1:25,000）されたものが最新のもので、地図類と同様に Surveyor General's Department にて入手（購入）することができる。

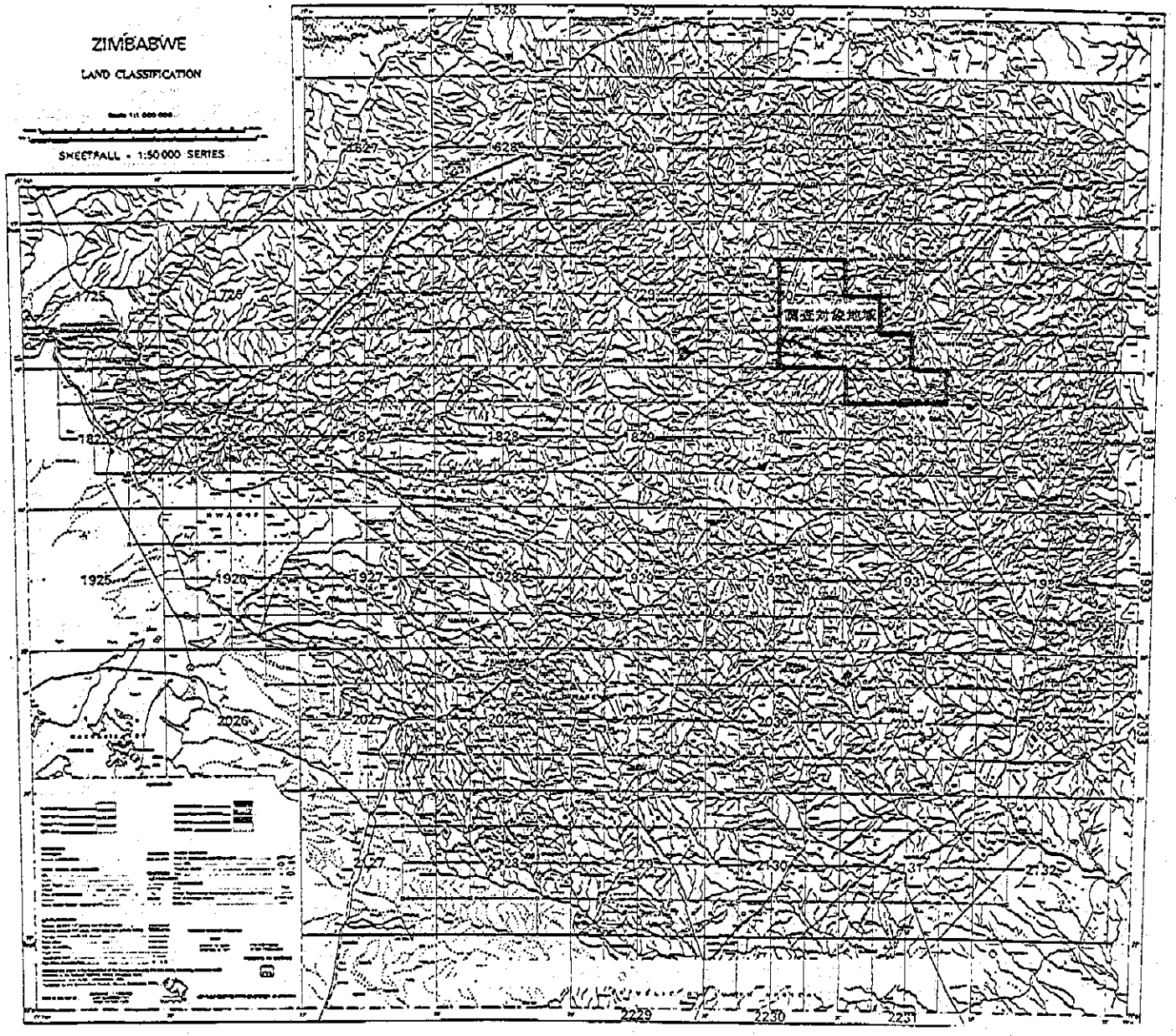


図３－11　1:50,000 地形図のインデックス・マップ

第４章　環境予備調査

「JICA 開発調査環境配慮ガイドライン[V]河川・砂防編－国際協力事業団（1994 年１月）」（以下、「ガイドライン」と略す。）に準じ、ジンバブエ国側の意見、状況説明及び現地調査の結果を踏まえて、スクリーニング及びスコーピングを行った。また，「同開発調査環境配慮ガイドライン[VII]下水道編 国際協力事業団（1994 年１月発行）」を併せて参考にした。

４－１　概要

４－１－１　背景

マニャメダム上流のマニャメ川の流域における水質汚濁対策マスタープランの中の一つの重要な対策オプションとして見込まれているのは、既存の下水処理場の処理能力向上に係る下水道整備計画の立案である。

下水道計画は、保健衛生水準の向上、生活環境の改善、公共用水域の水質保全を目的として実施するものであり、生活環境面に対するプラスのインパクトが強い事業である。また、計画が不適切であった場合の環境等への影響も、他のインフラ整備に比して影響が少ないものと考えられる。特に、本計画調査における一つの対策オプションである既存の下水処理場の処理能力の向上によって公共用水域の水質保全を図り、また、周辺の牧草地や植林地への処理水再利用による環境衛生上の改善という面で、大きく貢献するものと考えられる。

しかしながら、下水処理場から発生する悪臭や、汚泥処分に伴う保健衛生上の問題、及び周辺の牧草地や植林地への灌漑に伴う地下水汚染や悪臭など、下水道計画の際に想定されるマイナス・インパクトの可能性もあり、計画にあたっては十分な配慮が必要である。

４－１－２　地域の概要

マニャメダムより上流のマニャメ川流域には、マニャメダム、チベロダム、セケダム及び ハラバダムによる４つの人造湖があり、各ダムは、ハラレ市を含むチトンギザ町、ノートン町、ルワ村からなるハラレ首都圏への上水道の水源である。首都圏の各都市がその上水道の水源であるダム湖より高位部に位置しているため、各都市からの汚水や生活雑排水、工場排水、及び雨水排水等は上水道の水源である各ダム湖へ直接、或いは下水処理場を経由して流入することになる。特に、ハラレ市の２ヶ所の下水処理場とチトンギザ町の下水処理場からの放流水を直接受けるチベロ湖の水質汚濁が最も懸念されている。

(1)　住民移転

既設の下水処理場は、近隣の住居地域から十分に離れており、当該の下水処理場の処理能力向上に際して施設の拡張が必要となった場合でも、その用地を確保することが可能である。

(2)　野生生物保護

現在ジンバブエ国では、野生生物は再生可能な資源として管理されている。象、ライオン、サイ、水牛などの大型動物は野生動物保護区に限られているが、他の種については、全国土にわたって広く分布している。野生動物保護区は現在 4.6 万 km^2 あり、国土の約 12%を占めてい

る。しかし、耕地の拡大あるいは過放牧が進むにつれて、森林面積が減少し、それに伴い森林に棲息していた野生動物は減少してきていると考えられる。

ハラレ市北部に植物園と植物保護区があるが、本計画対象調査区域内において、保護すべき貴重な動植物の存在については不明である。

(3) 自然遺産及び文化遺産

世界遺産条約に加盟しているが、調査対象区域内に登録されたものがあるかどうかは不明であり、また、宗教上重要な遺産・景観等についても不明である。

ハラレ市南部に位置するマニャメダム湖及びチベロ湖は、レクレーション公園区域に指定されている。

(4) 既存の下水処理場についての地域住民からの苦情

既存の下水処理場についての悪臭や景観についての苦情はない。ただし、ノートン下水処理場の処理水を利用している植林地に隣接した住民から、再利用水による悪臭についての苦情が寄せられている。

4－1－3 環境（影響評価）関連法令等

(1) 関連法令

現在ジンバブエ国には、以下のような10の法律や規制がさまざまな環境分野について制定されている。

- National Resources Act (1941, 1975, 1981)
- Forest Act
- Communal Land Forest Produce Act
- Parks and Wildlife Act
- Mines and Minerals Act
- Rural District Councils Act (1985)
- Hazardous Substances Act (1974)
- Atmospheric Pollution Prevention Act (1977)
- Water Act (1974)
- Water (Effluent and Wastewater Standards) Regulation (1977)

(2) 条約

ジンバブエ国における多国間、または二国間の自然保護、環境保護に関する国際条約への加盟状況はつぎのとおりである。

- 世界遺産条約
- 絶滅のおそれのある野生動植物の種の国際取引に関する条約（ワシントン条約）
- 国連海洋法条約
- オゾン層を破壊する物質に関するモントリオール議定書

4－2　スクリーニング

次に示す理念に基づいた具体的な視点によって、環境インパクト調査の実施が必要となる開発プロジェクトか否かの判断を行う。

4－2－1　スクリーニングの理念

- 開発計画が関係住民の生存、生活に悪影響を与えないようにし、地域の持続的な開発・発展を確保しつつ、社会生活に十分な便益を持たらすようにする。
- 開発計画が現況の自然環境を著しく損なわず、また貴重な環境及び自然資源を保全し、将来にわたって調和の取れた環境を維持する。

4－2－2　プロジェクト概要

表4－1にプロジェクト概要を示す。

4－2－3　プロジェクト立地環境

表4－2にプロジェクト立地環境を示す。

4－2－4　スクリーニング

表4－3にスクリーニングの結果を示す。

スクリーニングの結果より、影響を受ける恐れのある項目があり、M／PにおいてIEE（初期環境評価）を、また、F／SにおいてEIA（環境影響評価）を実施すべきであると判断した。

4－3　スコーピング

開発プロジェクトの考え得る環境インパクトのうち、重要と思われるものを見出し、それらを踏まえた上で環境インパクト調査の重点分野あるいは重点項目を明確にする。

ガイドラインに従ったスコーピングのためのチェックリストを用いるに際しては、次に示す検討条件を踏まえることとし、表4－4にスコーピングチェックリストを示す。

（検討条件）

① 検討対象時期
検討対象時期は、供用開始前及び供用開始後とする。

② 検討対象とする空間的範囲
空間的範囲は、施設周辺部及び関連水域とする。

③ 環境インパクトの対象
環境インパクトの対象は、基本的に現況の環境に与えるマイナスの影響とする。

水質汚濁対策の一つの対策オプションである下水道計画に関する下水処理場の位置・規模、処理方式、汚泥処理・処分法及び処分地等、現段階では未定の事項に関する項目や、関係者からのヒアリングで確認できなかった項目についての評定は困難である。インパクトが見込まれる、もしくは不明な環境項目を大分類すると、次の5項目となる。

① 汚泥に関する項目

下水処理場より発生する汚泥による環境影響が懸念される項目は、表４－４における項目７、８、12、18、20が挙げられる。これらは、今後の調査において、処理・処分法や処分位置等が検討されることにより明らかとなる項目である。

- ・陸上投棄の場合（汚泥処分場） → ７．保健衛生
- ・充分な処分場が確保できない場合 → ８．廃棄物
- ・汚泥処分場の浸出水対策が不十分な場合 → 12．地下水
- ・汚泥焼却の場合 → 18．大気汚染
- ・不十分な処理の工場排水による汚泥の埋め立て → 20．土壌汚染

② 悪臭

既存の各施設付近には居住地等が近接していないが、風向きによっては、下水処理場、汚泥処分場で発生した悪臭が地域住民に悪影響を与えるおそれがある。

③ 遺跡・文化財及び動植物

保存及び保護すべき対象の存在については不明であり、確認が必要である。

④ 水質汚濁

現況の排水系統を変更して下水処理水を放流する場合、処理水の放流先で新たな水質汚濁問題が発生するおそれがある。

⑤ 下水処理水の再利用に関する項目

下水処理水を再利用する場合に懸念される環境影響項目は、次の３項目が挙げられる。

- ・保健衛生上の問題 → ７．保健衛生
- ・地下水の汚染 → 12．地下水
- ・悪臭の発生 → 23．悪臭

以上の検討結果をまとめた総合評価を表４－５に示す。

表４－１　プロジェクト概要のフォーマット　「河川・砂防」

項　　目	内　　容
プロジェクト名	マニャメ川上流域水質汚濁対策計画調査
背　　景	マニャメ川上流域は、ハラレ首都圏への飲料水供給のための重要な水源である。人口が急激に増加し経済活動の活発化した同首都圏からの生活雑排水、ごみ投棄、産業排水等により、その環境悪化が顕著となる。上下水道、ごみ処理施設等都市インフラの整備・拡充が人口の急増及び産業発展により多様化する汚染物質の処理に追い付かず、下水処理場の処理能力の不足は深刻で、処理能力水量を超えるものについては未処理のままマニャメ川流域に放流され、これが同河川の主要な水質汚濁源となっている。
目　　的	ハラレ首都圏の重要な飲料水供給源であるマニャメ川上流域の汚濁した水質状況の改善を図る。
位　　置	ジンバブエ共和国　ハラレ首都圏地域
実施機関	地方行政・農村都市開発省
裨益人口	ハラレ首都圏人口約 150 万人
計画諸元	
計画の種類	既設下水処理場の処理能力の向上 （市街地部の管網はほぼ整備されている。）
主要計画／構造物	下水処理施設
規模	（対象区域）面積：未定　　人口：約 250 万人 下水量，排水量：未定 （排除方式）分流式 （下水処理場）処理方式、処理能力：未定 （汚泥処理、処分方式）未定 （管渠延長等）未定 （放流水域等）放流水域：マニャメ川　　放流水質：未定
付帯設備	未定
その他特記すべき事項	なし。

注）　記述は既存資料により分かる範囲内とする。

表４－２　プロジェクト立地環境のフォーマット　「河川・砂防」

項　目		内　容
プロジェクト名		マニャメ川上流域 水質汚濁対策計画調査
社会環境	地域住民 (居住者／先住民／計画に対する意識等)	都市型住民と都市周辺部の農民。 既存の下水処理場周辺に住居はない。
	沿川の土地利用 (都市／農村／史跡／景勝地／病院等)	河川沿いは緑地帯と農地、ダム湖はレクレイション公園、上流部はハラレ市等の市街地である。
	経済／交通 (商業・農漁業・工業団地／ﾌｪﾘｰﾀｰﾐﾅﾙ等)	ハラレ市は首都で、同首都圏は、商業・農業・工業及び住宅地等である。
自然環境	地形・地質 (急傾斜地・軟弱地盤・地滑り地／断層等)	海抜 1300m～1600m の高原で、概ね平坦である。
	海岸・海域 (浸食・堆砂／潮流・潮汐・水深等)	なし。
	貴重な動植物・生息域 (自然公園・指定種の生息域等)	不明。
公害	苦情の発生状況 (関心の高い公害等)	マニャメ川及びダム湖の水質汚濁 下水処理水の灌漑利用による悪臭
	対応の状況 (制度的な対策／補助等)	排水水質の規制と公共用水域の水質の監視 下水処理水の再利用
その他特記すべき事項		なし。

注)　記述は既存資料により分かる範囲内とする。

表4－3　スクリーニングのフォーマット　「河川・砂防」

環境項目			内容	評定	備考（根拠）
社会環境	1	住民移転	用地占有に伴う移転（居住権、土地所有権の転換）	無	既設下水処理場周辺に住宅地なし。
	2	経済活動	土地等の生産機会の喪失、経済構造の変化	無	下水処理場周辺に住居地域なし。
	3	交通・生活施設	舟運等既存交通や学校・病院への影響	無	同上
	4	地域分断	交通の阻害による地域社会の分断	無	同上
	5	遺跡・文化財	寺院仏閣・埋蔵文化財等の喪失や価値の減少	不明	存在が不明
	6	水利権・入会権	漁業権、水利権、山林入会権等の阻害	無	上水道水源と観光資源に利用
	7	保健衛生	ゴミや衛生害虫の発生等衛生環境の悪化	不明	汚泥の処分方法による。
	8	廃棄物	建設廃材・残土、汚泥、一般廃棄物等の発生	有	汚泥が発生
	9	災害（リスク）	地盤崩壊・落盤、事故等の危険性の増大	無	大規模開発はない。
自然環境	10	地形・地質	掘削・盛土等による価値のある地形・地質の改変	無	同上
	11	土壌浸食	土地造成・森林伐採後の雨水による表土流出	無	同上
	12	地下水	過剰揚水や涵養能力の低下による涸渇、浸出水による汚染	不明	汚泥処分及び処理水の再利用
	13	湖沼・河川流境	埋立や放水路等による流量、流速、河床の変化	無	乾期の流況が処理水により増加
	14	海岸・海域	沿岸漂砂の変化による海岸浸食や堆積	無	
	15	動植物	生息条件の変化による繁殖阻害、種の絶滅	不明	生息域の状況不明
	16	気象	大規模造成や建築物による気温、風況等の変化	無	大規模施設はない。
	17	景観	造成による地形変化、構造物による調和の阻害	無	同上
公害	18	大気汚染	車両や工場からの排出ガス、有害ガスによる汚染	不明	焼却による汚泥の処分の場合
	19	水質汚濁	土砂の流入や水量の減少による水質の汚濁	不明	処理水の放流先変更の場合
	20	土壌汚染	排水・有害物質等の流出・拡散等による汚染	不明	汚泥処分による重金属汚染
	21	騒音・振動	車両の走行、ポンプの稼動等による騒音・振動の発生	無	下水処理場周辺に住居地域なし。
	22	地盤沈下	地盤変状や地下水位低下に伴う地表面の沈下	無	発生要因なし。
	23	悪臭	排気ガス・悪臭物質の発生	有	下水処理場、汚泥処分，処理水再利用
総合評価　：　ＩＥＥあるいはＥＩＡの実施が必要となる開発プロジェクトか				要	影響が想定される項目が有る。

表４－４　スコーピングチェックリスト　「河川・砂防」

環境項目			評定	根拠
社会環境	1	住民移転	D	既設下水処理場周辺部に住宅地はない。
	2	経済活動	D	マイナスのインパクトは考えられない。
	3	交通・生活施設	D	交通を妨げになる施設はない。
	4	地域分断	D	地域を分断する施設はない。
	5	遺跡・文化財	C	遺跡・文化財等に関して不明
	6	水利権・入会権	D	水利にマイナスとなるインパクトはない。
	7	保健衛生	C	汚泥の処分方法が未定。処理水の再利用を行う場合
	8	廃棄物	B	発生汚泥の処分法が未定
	9	災害（リスク）	D	大規模な切土等は行わない。
自然環境	10	地形・地質	D	大規模な地形改変を行わない。
	11	土壌浸食	D	同上
	12	地下水	C	汚泥の処分方法未定。処理水の再利用を行う場合
	13	湖沼・河川流況	D	乾期の流況が下水処理水により増加
	14	海岸・海域	D	海に面しておらず、影響がない。
	15	動植物	C	貴重な動植物の存在は不明
	16	気象	D	気象に影響を与える施設はない。
	17	景観	D	下水処理施設が出現するが問題はない。
公害	18	大気汚染	C	汚泥焼却を行う場合は可能性あり。
	19	水質汚濁	C	下水処理水の放流先の変更を行う場合は可能性あり。
	20	土壌汚染	C	不十分な処理の汚泥を埋め立てる場合は可能性あり。
	21	騒音・振動	D	ポンプ場等の発生源は想定されるが、付近に住居がない。
	22	地盤沈下	D	発生の要因なし。
	23	悪臭	B	下水処理場、汚泥処分、下水処理水再利用の場合は可能性あり。

注）１．評定の区分

A　：　重大なインパクトが見込まれる。

B　：　多少のインパクトが見込まれる。

C　：　不明（検討をする必要はあり、調査が進むにつれて明らかにある場合も十分に考慮に入れておくものとする。）

D　：　ほとんどインパクトは考えられないためＩＥＥあるいはＥＩＡの対象としない。

２．評定に当たっては、該当する項目別解説書を参照し、判断の参考とすること。

表４－５　総合評価のフォーマット　「河川・砂防」

環境項目	評定	今後の調査方針	備　考
廃棄物	B	・汚泥処分方法の検討	
悪　臭	B	・気象状況 ・下水処理場等の周辺の土地利用 ・類似施設の現況	風向風速のデータ必要
遺跡・文化財	C	・遺跡・文化財の位置の確認	
保健衛生	C	・汚泥処分方法の検討 ・下水処理水の再利用の際しての滅菌法の検討	
地下水	C	・汚泥処分地の浸出水対策の検討 ・滞水層の確認 ・下水処理水の再利用に際しての地下水への影響の検討	
動植物	C	・貴重種の生息域の確認	
大気汚染	C	・汚泥処分法の検討	汚泥の焼却・搬出を行う場合
水質汚濁	C	・放流先の流量・水質調査	新たに排水系統を変更して下水処理水の放流を行う場合
土壌汚染	C	・汚泥処理・処分方法の検討	工場排水処理が不十分な場合

注)　評定の区分

A：重大なインパクトが見込まれる。

B：多少のインパクトが見込まれる。

C：不明（検討をする必要はあり、調査が進むにつれて明らかになる場合も十分に考慮に入れておくものとする。）

D：ほとんどインパクトは考えられないためIEEあるいはEIAの対象としない。

第５章　本格調査の実施方針

５－１　調査の基本方針

５－１－１　本格調査に当たっての基本方針

ハラレ首都圏の飲料水は、マニャメ川に建設された４箇所のダム湖（貯水池）を源水として２箇所の浄水場で浄水、給水されている。しかし、ダム湖の水質は、窒素とリンの値が富栄養化の目安である値をはるかに超えている。このようなダム湖の富栄養化を裏付けるものとしてチベロ湖におけるホテイアオイの異常発生、ハラバダムとセケダムにおける藻類の異常発生がこれまでに報告されている。また、チベロ湖では、1990 年代に入ってからは余水吐からの越流もなく、慢性的な水不足の状況下にある。

一方、ハラレ市のフィレ下水処理場とクローボロー下水処理場、さらにはチトンギザ町のゼングザ下水処理場の３箇所の下水処理場の処理水は、灌漑用に供給される以外はマニャメ川（同支川を含む）を経由してチベロ湖に流入している。灌漑用に供給されている処理水の水質はほとんど流入下水に近く、非灌漑期にはこの未処理同様の処理水がマニャメ川を経由してチベロ湖に流入している。ハラレ市のフィレ下水処理場とクローボロー下水処理場の一部で採用されている嫌気好気の活性汚泥法の処理水は良好であり、河川に直接放流していても問題は生じないものと考えられる。

ハラレ首都圏への人口と産業は今後ともますます集中するとともに、また生活向上による水消費量の増大等から、下水量と汚濁負荷量の増加は言うまでもなく、さらには住宅地や工場用地への転用による灌漑用地の一層の減少は避けられない。この結果、下水処理場での下水処理量の増大と処理水質のより一層の向上が求められている。しかし、水質汚濁防止に大きく寄与する下水道施設の建設も、財政難から遅々として進んでいない。また、下水道施設の維持管理にもこうした財政難が大きな影響を与えていることも指摘される。

従って、首都圏の重要な水瓶であるチベロ湖の水質は、このまま放置しておいても改善の見込み等は全くなく、加速度的に悪化するだけである。チベロ湖の水質の悪化は、飲料水源だけでなく漁業、観光、レクリエーション等にとっても大きな脅威となっていることから、下水道の整備等を含む総合的な水質保全計画（マスタープラン）を関係行政機関等が一体となってすみやかに策定し、この計画に基づいた実行性のある水質保全対策の実施、関係法令等の整備、さらには住民に対する啓蒙等が急務である。

５－１－２　検討事項

(1)　基礎資料の収集と汚濁解析

調査対象流域であるマニャメ川上流域には、マニャメ湖の他に首都圏の重要な水瓶であるチベロ湖、さらにはハラバダム、セケダムの４つのダム湖がある。これらの４箇所のダム湖を含むマニャメ川上流域の汚濁解析を実施するに当たって、湖沼の富栄養化の指標である窒素とリン等を含む汚濁負荷量の算定と水収支に関する基礎資料等が不可欠である。また、汚濁解析を行うに当たっては、資料のレベル、収集・整理の程度、さらには汚濁解析結果の利用方法等によって、汚濁解析の内容が簡易解析程度から精緻かつ高度な内容を有するコンピュータシュミュレーションまで種々のものが考えられる。

飲料水源の水質悪化という社会生活上の基本的な問題であることが憂慮された結果、従来の類似の調査内容と比較して短期間である 14 ヶ月が本格調査の期間と定められた。このような経緯等から判断して、汚濁解析を行うに際しては、出来るだけ既存の観測・解析資料等を有効に活用することとする。従って、新たな観測、測定を必要とするようなものにあっては、出来る限り最低限に絞るとともに、こうした状況を加味、考慮した当該流域に最も適合した汚濁解析法を採用することとする。

なお、ハラレ市等の既存の水質分析結果と合せて水質汚濁解析の基礎資料とするために，調査対象地域内の河川及び湖等を対象とした水質調査を表５－１に示す実施要領（案）に従って行う必要がある。

(2) ダム湖の水質目標値の設定

調査対象流域には４つのダム湖があり、汚濁解析に当たっては、これらのダム湖に水質目標値を設定しなければならない。この際に留意すべきことは、長期目標と短期目標を設定することとし、その際、当該流域の自然的・社会的・経済的な諸条件を十分に考慮するとともに、関係行政機関等との十分な調整と合意に基づいて設定しなければならない。また、汚濁負荷量の削減計画についても同様である。

なお、これらの水質目標値等は、未来永劫にわたって固定されたものと考えるのではなく、発展途上国の水質保全計画であるという特殊な状況等を考慮すると、おおむね 10 年毎に見直しを図っていく必要がある。

(3) 実現可能性の検討

目標達成に必要な投資額と関係行政機関等の財政状況に基づき投資可能な範囲について検討を加え、目標達成に必要なそれぞれの対策（事業等）の段階的な整備計画を策定する。フィージビリティ調査の対象プロジェクトは、これらの中からとくにチベロ湖の水質の改善度、事業費の規模、緊急度、環境・健康への影響、財政・経済的な効果等を総合的に比較検討して選択する。

対象事業の整備手法の選定は、とくに維持管理体制と担当者の技術レベル、維持管理に必要な資金の確保、機器や設備類等の日常点検と定期点検の考え方、等に関する関係行政機関の考え方と実行レベルを十分に反映したものとなるように検討して決定する。

表５－１　水質調査実施要領（案）

調査項目	採水箇所	実施回数	調査時期
河川	①６ヵ所	４回	５月、６月、11月、12月
	②２ヵ所	２回	11月、12月
湖	③２ヵ所×２層×２回/日	２回	５月、11月
	④２ヵ所×２層×２回/日	２回	５月、11月
下水処理場 放流	⑤３ヵ所×３回/日	２回	５月、11月
	⑥３ヵ所×３回/日	１回	６月
下水処理場 流入	⑦３ヵ所×３回/日	２回	５月、11月
	⑧３ヵ所×３回/日	１回	６月
発生源(工場)	⑨３ヵ所×20工場×３回/日	１回	５月～６月
	⑩３ヵ所×10工場×３回/日	１回	５月～６月

注）１．採水箇所

① MANYAME本流の上流域、NYATSIME川のZENGEZA下水処理場の下流域、MANYAME本流のNEW ROAD BRIDGEとSKYLINE BRIDGEの２地点、MAKUVISI川の下流域、MARIMBA川の下流域の６ヵ所

② GWEBI川、MUZURURU川河口付近の２ヵ所

③ SEKEダム内の上流側とダム付近の２ヵ所で上層と下層の２層についてサンプリング

④ CHIVERO湖内のMAKUVISI川流入後、MARIMBA川流入後の２ヵ所で上層と下層の２層についてサンプリング

⑤ CROWBOROUGH、FIRLE、ZENGEZA下水処理場の３ヵ所

⑥ NORTON、RUWA、DONNYBROOK下水処理場の３ヵ所

⑦ CROWBOROUGH、FIRLE、ZENGEZA下水処理場の３ヵ所

⑧ NORTON、RUWA、DONNYBROOK下水処理場の３ヵ所

⑨ CROWBOROUGH、FIRLE、ZENGEZA下水処理場の３ヵ所ごとで、20ヵ所の工場についてサンプリング

⑩ NORTON、RUWA、DONNYBROOK下水処理場の３ヵ所ごとで、10ヵ所の工場についてサンプリング

２．分析項目

pH、BOD、COD、DO、SS、Cℓ、大腸菌群数（MPN）、硬度、T-N、NH_4-N、NO_2-N、NO_3-N、T-P、PO_4-P、重金属、油分、農薬、流量、水温等

３．重金属

Aℓ、Cu、Hg、Zn、Pb、Ni、Fe、As、Cr^{6+}、Cdなどの１０項目

４．農薬

代表的な３種類程度

（現地ではカートリッジによるサンプリングのみを行い、分析は日本国内で行う。）

５．サンプル総数

384サンプル

5－2　調査実施上の留意点

(1)　限られた調査期間ではあったが、現地踏査、地方行政・農村都市開発省をはじめとする関係機関との協議等は効率的に実施することができたと考えられる。これは地方行政・農村都市開発省関係者の極めて熱心な対応に起因するところが多かったことによる。現地踏査には必ず担当者が同行し、現場では技術者が良く対応してくれた。この真摯かつ誠実な対応からも本調査への期待の大きさが伺われた。担当者は、我が方の開発調査／無償資金協力の制度についても良く理解しており、開発調査を実施する下地は十分にできているとの印象を得た。但し、通信事情、基本的インフラの未整備・不備等の調査を実施していく上での支障も予想されるため、この点は調査実施に際して留意する必要がある。

(2)　本調査の要請以前には「ゼンゲザ下水処理場」の無償資金協力の要請がなされたが、6月に実施された平成7年度対ジンバブエ国政策協議ミッションの指摘にもあるとおり、ハラレ首都圏全体のマスタープランを策定し、その中で同下水処理場の位置付けを明確にする必要があるとの判断から、本調査を実施するに至った経緯がある。したがって、マニャメ川の水質汚濁対策は緊急かつ重要な対策であり、かかる経緯を鑑みると、本調査も出来るだけ調査期間を短縮し、その後の事業化に結び付ける必要があると考えられる。但し、今回のマスタープランではハラレ市、チトンギザ町、ノートン町及びルワ村が対象となるため、F／Sの対象地域の選定に当たっては地方行政・農村都市開発省とも十分に協議の上、明確な選定基準を設定する必要がある。参考までに、今回の事前調査では、会議にはすべての市から担当者が出席していたが、特に熱心であったのは、チトンギザ町の担当者との印象を得た。しかしながら、現地踏査においては、ルワ村を除く3自治体が非常に熱心に対策の緊急性を訴えており、本格調査において十分な調整が必要となる。

(3)　ジンバブエ国側は、富栄養化対策として下水道の整備・改修を主に考えており、事前調査団内の共通理解も概ね同様であるが、湖の現状水質と水道水源として求められる水質との比較では、下水処理対策のみでは十分な解決が困難と考えられることから、マスタープランの検討にあたっては、様々な対策の可能性について検討することが必要である。

このため、現在実施している灌漑処理に加えて、

① 漁業による栄養塩類の系外除去、

② 河川及び湖沼等に“ケナフ”などのパルプ資源を植樹することによる栄養塩類の系外除去などの生産に結びつく対策についての検討とともに、

③ 工場における対策による削減効果の検討等

が必要である。

(4)　ジンバブエ国で行われている水質の分析方法と日本の方法とが異なる可能性があり、測定結果をそのまま同一基準で評価できない可能性がある。本格調査の実施にあたっては、この点について、再度確認する必要がある。

(5)　本調査に関する‘Terms of Reference（1994年4月）’によると、マニャメ川上流域（マニャメダム上流）の流域面積は、2,700 km² と記されているが、今回収集した地形図（縮尺 1:250,000 及び 1:50,000）を基に流域界を設定し、その流域面積を算出すると、マニャメダム上流の流域面積は、3,930 km² を得た。この件についても、現地調査時に確認する必要がある。

(6) 土地・水資源開発省水資源開発局（DWD）の水質汚濁対策セクション（Water Pollution Control Section）において、マニャメ川流域の水質モニタリングのネットワーク化に関する事業計画（Integrated Water Pollution Control Project ： March 1995）がある。本開発調査におけるマスタープラン策定に際しては、DWDの水質汚濁対策セクションの他に、水文部（Hydorlogical Branch）等から情報の提供及び協力が不可欠であると考えられる。DWDの関係部署との良好な協力関係を構築するための配慮が必要である。

(7) ハラレ首都圏の飲料水の水源をマニャメ川水系外の他水系に求める計画（The Harare Water Supply Study ： July 1994）が検討されている。これによると、2ヶ所のダムの内で、まず、ニャグイ川のクンズウィ（約1億6千万 m3）ダムの建設を先行させ、少なくとも2005年までに関係都市への飲料水の供給を可能とする計画である。2015年を目標年次とするマスタープランの策定にあたっては、ハラレ首都圏の将来の上水道計画におけるマニャメ川水系の飲料水水源としての位置づけを確認し、各貯水池の水質保全対策を策定する上での目標水準（環境基準）を設定する必要がある。なお、目標水準を達成するための汚濁負荷量は、シミュレーションモデルを作成・運用して算定する。ここで用いるシミュレーションモデルは、例えば湖全体を均一な系とし、窒素・燐等の濃度が予測できる精度を有するレベル以上のものとする。

5－3 調査の内容

5－3－1 調査対象地域

マニャメダム堤から上流のマニャメ川本流及びその支流のマニャメ川流域、その周辺の農場、ハラレ市、チトンギザ町、ノートン町及びルワ村の各地方自治体の行政界をカバーするものとし、対象面積は約3,900km^{2}とする。

ただし、マニャメ川の支流であるグウェビ川及びムズルル川流域については、ジンバブエ国側と協議の上、調査の必要がなければ省略できるものとする。

5－3－2 目標年次

公衆衛生、経済発展、生態系の保全等の見地から、M／Pの策定は、2015年を目標年次とする。

5－3－3 調査の範囲

調査の範囲は、ジンバブエ国における現地踏査、及びジンバブエ国と日本におけるデータの収集と分析により構成される2015年を目標年次とする総合的水質汚濁対策計画（M／P）の策定、並びにこれにより選定された緊急対策（優先）プロジェクトに対するF／Sの実施とする。

本計画調査では、生活排水を主たる対象とするが、工場排水、廃棄物処理及び農薬による影響とその分析も調査の対象に含める。

5－3－4 調査の内容

本開発調査は、ハラレ首都圏の重要な飲料水供給源であるマニャメ川上流域の水質汚濁の改善を図るための水質汚濁対策に関するマスタープラン（M／P）の策定（フェーズI）とその中で選定された緊急対策（優先）プロジェクトに対するフィージビリティスタディ（F／S）の実施（フェーズII）から構成される。

フェーズⅠ：マスタープランの策定

(1) 既存資料、データの収集・整理及び分析
(2) 水質汚濁源調査
(3) 水質、水量、モニタリング体制の現況把握
(4) 計画目標設定
(5) 技術的方策の検討
(6) 組織・制度面の検討
(7) モニタリング体制の検討
(8) 代替案の検討及び対策案の選定
(9) 概算事業費積算
(10) 優先プロジェクトの選定
(11) 初期環境評価（IEE）

フェーズⅡ：フィージビリティスタディの実施

(1) 補足調査
(2) 施設計画、施設概略設計及び資機材調達計画、施工計画
(3) 運転・維持管理計画
(4) 組織・制度、モニタリング体制整備計画
(5) 組織強化、人材養成計画
(6) 概算事業費積算及び投資計画・資金調達計画、財務計画
(7) プロジェクト実施・運営体制の検討
(8) 環境影響評価（EIA）
(9) プロジェクト評価（技術・財務・社会・経済的評価）
(10) 実施計画の策定

5－4　調査期間及び工程

本計画調査の期間及び工程は、全体で約14カ月とし、次の作業に分けて実施する。

フェーズⅠ：マスタープランの作成

(1) 国内事前準備
  1) 既存資料・情報の収集・整理及び検討
  2) 調査の基本方針、調査方法、作業計画等の検討
  3) インセプション・レポートの作成

(2) 第1次現地調査作業
  1) インセプション・レポートの説明・協議
  2) 既存資料、データ等の収集・整理及び分析
  3) 現地踏査
  4) 水質調査
  5) 総合的水質汚濁対策の概定
  6) 初期環境調査（IEE）
  7) プログレスレポートⅠの作成・提出（説明・協議）

(3) 第1次国内解析作業
  1) 水質データ・資料の整理及び分析
  2) 発生源データの整理・解析
  3) 汚濁物質排出量の算定と発生源の関係の検討
  4) 気象、発生源及び汚濁物質濃度との関係の検討
  5) 汚濁水拡散シミュレーションモデルの作成
  6) 水質汚濁に関連する社会・経済・産業の指標等の現状の取りまとめ、水質汚濁物質の発生に関する指標等の将来的シナリオの作成手法の検討
  7) 発生源対策の現状を取りまとめ、対策技術の代替案の検討
  8) 組織・制度の現状の整理
  9) 環境目標値の検討
  10) 総合的水質汚濁対策計画の検討・立案
  11) 優先プロジェクトの選定
  12) 初期環境評価（IEE）
  13) インテリムレポートの作成

フェーズⅡ：フィージビリティスタディの実施

(4) 第2次現地調査作業
  1) インテリムレポートの現地説明及び協議
  2) 補足調査
  3) 地形測量・地質調査
  4) 施設計画、概略設計、施工計画

5) 組織体制整備計画
6) 概算事業費積算及び投資計画・資金調達計画
7) 環境影響評価（EIA）
8) プログレスレポートIIの作成・提出（説明・協議）

(5) 第２次国内解析作業
1) 優先プロジェクトの施設概略設計、資機材調達計画
2) 運転・維持管理計画
3) 組織強化、人材養成計画
4) 概算事業費積算、財務計画
5) 環境影響評価（EIA）
6) 技術・財務・社会・経済評価
7) 総合評価
8) 実施計画
9) ドラフトファイナルレポートの作成

(6) ドラフトファイナルレポートの現地説明及び協議

(7) ファイナルレポートの作成・提出

５－５ 報告書

本開発調査の報告書の提出部数は以下のとおりとする。

(1) インセプション・レポート
記載事項：調査の基本方針、方法、作業工程、要員計画等
部数 ：英文 ３２部（うち、先方政府へ ２０部）

(2) プログレス・レポートI
記載事項：第１次現地調査作業までの結果
部数 ：英文 ３２部（うち、先方政府へ ２０部）

(3) インテリム・レポート
記載事項：第１次国内作業までの結果
部数 ：英文 ３２部（うち、先方政府へ ２０部）

(4) プログレス・レポートII
記載事項：第２次現地調査作業までの結果
部数 ：英文 ３２部（うち、先方政府へ ２０部）

(5) ドラフト・ファイナル・レポート
記載事項：全調査結果
部数 ：各分冊毎に以下のとおりとする。

a メインレポート	英文 ３２部（うち、先方政府へ	２０部）
b サポーティング	英文 ３２部（うち、先方政府へ	２０部）
c データ（図面を含む）	英文 ３２部（うち、先方政府へ	２０部）
d サマリー	英文 ３２部（うち、先方政府へ	２０部）

e　要約　　和文　１０部

(6)　ファイナル・レポート

記載事項：ドラフト・ファイナル・レポートに対するジンバブエ国側のコメントを受け、必要な加筆修正を行ったもの。

部数　：　各分冊毎に以下のとおりとする。

a　メインレポート	英文	５５部（うち、先方政府へ　４０部）
b　サポーティング	英文	５５部（うち、先方政府へ　４０部）
c　データ（図面を含む）	英文	５５部（うち、先方政府へ　４０部）
d　サマリー	英文	５５部（うち、先方政府へ　４０部）
e　要約	和文	１５部

５－６　調査の実施体制

本開発調査におけるジンバブエ国側の実施機関は、地方行政・農村都市開発省である。同省は、ＪＩＣＡ調査団のカウンターパート機関であるとともに、調査に関係するその他の省庁、機関等との調整を行う。

「ジ」国側は、本調査を効果的・効率的に実施するため、地方行政・農村都市開発省が統括するステアリング・コミッティを設置する。ステアリング・コミッティを構成する機関は、未定であるが、地方行政・農村都市開発省の他、環境・観光省、土地・水資源開発省、厚生省、大蔵省、外務省、ハラレ市等４関係市町村等が想定される。

５－７　要員計画（案）

本開発調査には、概ね以下のような分野をカバーする要員が必要である。

- 総括
- 下水計画
- 水質汚濁解析
- 下水施設計画
- 水利用計画
- 組織／制度
- 経営／財務
- 施工計画・積算
- 水質・モニタリング
- 測量・地質
- 環境配慮

5－8　調査用資機材

現地調査に必要な資機材として、以下の機器が考えられる。

(1) 水質測定機器

① イオンメーター（本体、電極、パソコン等一式）

② 携帯用ＣＯＤメーター

③ 全有機体炭素計

④ イオンクロマトグラフ

⑤ 試料保管用冷蔵庫

⑥ 携帯式ｐＨメーター

⑦ 携帯式ＤＯ計

⑧ 携帯式導電率計

(2) データ処理・分析用パソコン

(3) コピー機

5－9　相手国の便宜供与事項

平成７年11月29日に締結したＳ／Ｗ及びＭ／Ｍを参照のこと。

付　属　資　料

1．Terms of Reference
2．Scope of Work
3．Minutes of Meetings
4．Questionaire
5．主要面会者リスト
6．現地調査経費資料
7．主要収集資料リスト

1. Terms of Reference

REPUBLIC OF ZIMBABWE

TECHNICAL AID PROPOSAL

FOR

WATER POLLUTION CONTROL PROJECT

IN

THE UPPER MANYAME RIVER BASIN

August 1994

Ministry of Local Government, Rural and Urban Development

1. INTRODUCTION

1.1 Background

Zimbabwe is a landlocked country with a territorial area of 390,757 km² extending approximately between 15°-40' and 22°-20' in south latitude and between 25°-30' and 33°-00' in East longitude. The capital of Zimbabwe is Harare, which is the centre of administration, commercial and industrial activities.

More than half of the country is drained by the Zambezi River, which forms the boundaries with Zambia and Mozambique in North to East. The remaining area falls in the Runde and Limpopo River basins. One fifth of the country lies above 1,200 m and three fifths between 600 and 1,200 m above the mean sea level. Communal farming is the predominant land use, occupying about 164,000 km², followed by commercial farming land with a total area of 142,000 km².

Climate in Zimbabwe is characterized by two distinct seasons : summer rainy season prevails from November to March and dry and cool season lasts from May to August. The annual rainfall varies in the range of 400 mm in the hot low-lying lands to 1,500 mm in the Eastern Highlands.

Population grew to 10.4 million in 1992 from 7.61 million in 1982, indicating an average annual growth rate of 3.13% More than 25% of the population is concentrated in the towns, which have an average population of 15,000 or more Large numbers of people are migrating from the rural areas to the urban areas. Thus urban areas are being subjected to rapid population increase, about 6% per annum. In particular Harare and its satellite towns accommodate more than 15% of the total population.

Gross Domestic Product was US$ 4,414 million in 1990 at 1980 constant price. Manufacturing sector is the largest contributor, accounting for almost 27% of the total, followed by agricultural sector with a share of about 12%

Rapidly increasing population and concentration of economic development activities have been severely straining civil amenities, creating undesirable social problems and deteriorating the natural environment in the urban areas and their surroundings. The Government of Zimbabwe therefore places emphasis on the improvement in living conditions and urban infrastructures and conservation of the environment in its "Second Five-Year National Development Plan, 1991 -1995"

In response to Government's emphasis, it is proposed to implement "The Water Pollution Control Project in the Upper Manyame River Basin", where the City Of Harare and its satellite towns of Chitungwiza, Norton and Ruwa exist. The ultimate purpose of the project is to conserve and preserve the important water resources of the upper Manyame River basin through reduction and control of pollutant loads, which cause contamination of the important water resources of the Manyame River.

1.2 Needs for the Project

The Manyame River is one of the tributaries of the Zambezi River and drains directly into the Cabora Bassa Reservoir in the Republic of Mozambique. The upper Manyame River is defined as upstream reach above the Manyame Dam and its drainage area extends over about 2,700 km². Its water resources are substantially the lifeline for more than 1.5 million people and for the vital economic development activities within its drainage area. Thus the Government of Zimbabwe keenly intends to implement the Project in order to ensure the public health of the people and sustain economic development. The project will also add an impetus to efforts to conserve the ecosystem of the Cabora Bassa Reservoir.

There are four urban areas in the upper Manyame River basin, namely Harare, Chitungwiza, Norton and Ruwa. The latter three act as the satellite towns of Harare, absorbing population and industrial development. Population in these four areas are as follows :

Urban Area	Population in 1992 (1,000)	Average Annual Growth Rate (%)
Harare, urban	1,184.2	6.0
rural	20.6	-
Chitungwiza	274.0	7.2
Norton	20.4	6.1
Ruwa	1.4	8.0
Total	1,500.6	6.9

These four urban areas are adequately provided with urban infrastructural services such as piped water supply, sewerage, storm-water drainage and garbage collection, but the level of such services has tended to deteriorate in recent years. Quantity of pollution loads increase year after year at a higher rate than expansion of treatment facilities and type of pollution loads diversified due to a variety of industrial development. Thus it is most important to formulate and implement a comprehensive water pollution control plan urgently.

1.3 Present Condition of Sanitary Infrastructure in the Study Area

The current public water supply, sewerage and garbage disposal services area as summarized below.:

(1) Pipe water supply

(1.a) Harare

The existing pipe water supply extends over an area of 350 km² out of the entire administrative area of 540 km². The present water demand is 360,000 m3/day, which is being fed by two waterworks as follows :

Waterworks	Treatment Capacity	Type Of Treatment	Source Of Raw Water
Morton Jaffery		Rapid Sand	- Lake Chivero with a storage capacity if 250 million m3 - Lake Manyame with a storage capacity of 490 million m3
Prince Edward		Rapid Sand	Seke Reservoir with a storage capacity of 3.6 million m3.

Lakes Chivero and Manyame and Seke Reservoir were constructed on the upper Manyame River and are important water resources not only as a source of water supply but as a valuable recreational facility for the landlocked people of Zimbabwe Their water quality is unfortunately contaminated by a large inflow of pollutants. A huge amount of alum is currently used to produce proper potable water and treated water is sometimes not good in taste with an offensive odour. The Harare City Council is deeply concerned with the quality of the present potable water supply.

(2) Chitungwiza, Norton and Ruwa

These urban areas depend on bulk water supply from Harare for potable water. The present water supply is summarized below :

Area	Administrative Area (km^2)	Water Serving Area (km^2)	Water Demand (m^3/day)
Chitungwiza	48.0	45.0	50,000
Norton	19.5	4.8	4,310
Ruwa	-	-	1,000

These urban centres are facing the same water problems as the Harare city:

(2) Sewerage

(a) Harare City

The city is being served by three separate central treatment facilities, Firle, Crowborough and Donnybrooks, although there are a couple of sewage treatment works exclusively for specific services. The existing sewer serving area and population is 540km^2 and 1.18 million. The present sewage treatment is as summarized below :

Sewage Treatment Works	Type Of Works	Sewerage Inflow (m^3/day)	Sewerage Treatment Capacity
Firle	Conventional trickling filter	100,000	100,000
Crowborough	Waste stabilization ponds	4,000	50,000
Donnybrook	Activated sludge	50,000	4,000

Quality of influent and effluent is as summarized below for Crowborough sewage works :

Item	Influent (mg/l)	Effluent (mg/l)
BOD	500	100
COD	800	200
SS	400	50
T-N	50	25
T-P	6	6

The effluent from sewage works is either diverted into pasture land as irrigation water or rivers. Sludge is primarily treated by digester and then disposed into drying beds.

The existing sewage works are seriously over-loaded, resulting in very poor quality of effluent. This is deemed to be the major source of pollution.

(b) Chitungwiza and Norton Towns

The present sewage treatment is as summarized below :

Description	Chitungwiza		Norton	
Sewer served area (km^2)	45		-	
Sewer served population	408 x 103		-	
Type of sewerage works	Modified Conventional		Conventional	
Treatment Capacity	20,000		3,400	
Quantity of inflow	34,000		2,970	
Water quality (mg/l)	Influent	Effluent	Influent	Effluent
BOD	800	8	610	190
COD	1,000	200	965	Nil
SS	14	1,2	502	1.2
T-N	45	15	-	-
T-P	11	6	-	-

At both towns, treated effluent is being used as irrigation water on pasture lands. Sludge is treated by sludge drying bed.

The sewage works at both sewage treateent works are also operated under over-loading conditions. In case of Norton, the existing works are sited in proximity to Lake Manyame, giving rise to problems of disposing treated effluent.

Also the works suffer from frequent breakdown of pumping and treatment facilities. In Chitungwiza Town, sewer pipes frequently burst due to increased pressure and pumping facilities are less than the required capacity.

(c) Ruwa Local Board

There is a sewage works of waste stabilization ponds. The total pond capacity is 13,100m3 while sewage inflow is 200m3/day, giving average retention period of 65 days. The treated effluent is used on pasture lands and sludge is treated by drying bed

(3) Garbage Disposal

Every urban centre substantially depends on dumping pits for garbage and solid waste disposal.

The Harare City has two dumping pits (Golden and Teviotdale), a waste oil treatment plant and a compost plant. Its annual waste volume is currently as follows :

Type of Water	Volume (ton/year)
Paper and cardboard	31,000
Glass and ceramics	6,000
Plastics	16,000
Pats and oils	6,000
Leather and rubber	5,000
Textile hessians	1,500
Vegetable and putrescible	65,000
Soil, ash and builders rubble	32,000
Total	162,000

The waste contains such hazardous substances as metal waste (2 to 5 ton/year), cadmium waste (less than 1 ton/year) and other metal containing waste. The future life of the dumping sites is only 6 years.

Of the four urban centres, Chitungwiza Town is most seriously affected by insufficient infrastructural services problem. Especially, existing sewage treatment works is operated under severe over-loading conditions and therefore requires its rehabilitation and expansion.

2. OBJECTIVE OF THE STUDY

The objective of the Study is :

(1) To formulate a comprehensive master plan for water pollution control for the proposed study area, including the phased implementation programme for the plan.

(2) To identify project(s) to be implemented urgently in order to mitigate water pollutant loads, which are currently contaminating very important water resources in the study area, and to prepare its implementation programme, and

(3) To conduct a feasibility study on the first phase Project to be prioritized among a number of measures to be involved in the master plan.

As part of the process of meeting the above objectives, emphasis should be placed on the transfer of knowledge and skills to local staff.

3. STUDY AREA

The study area covers the upper Manyame River basin with a drainage area of about 2.700 km², extending upstream from Manyame Dam. Location map of the Study Area is as shown in Figure 1.

4. SCOPE OF THE STUDY

4.1 Phasing of the Study

The study will basically be divided into three phases as follows :

Phase 1 : Master Plan Study

Phase 2 : Urgent Project Study

Phase 3 : Feasibility Study

The Phases 1 and 2 studies shall be carried out in parallel in order to allow the implementation of the urgent Project as early as possible.

4.2 Scope of the Study

4.2.1 Phase 1 : Master Plan Study

The Phase 1 Study aims at revealing the sources, types and quantities of pollutant loads generated in the Study Area and discharged into the existing reservoirs/lakes and other important water supply siteworks and formulating the adequate plan to control such pollutant loads for conservation and preservation of the water resources. The sources of pollutant generation will be classified into point and non-points, depending on how pollution is emitted or discharged into the receiving body, and further into man-made and other water supply sites.

The planning horizon is a 20-year period from 1995 to 2015. The pollutant loads should therefore be estimated for both present and future conditions at intervals of 5 years, in due consideration of various influential factors such as land use, urban development, population, industrial and agricultural developments, urban infrastructure, etc.

The master plan shall be a comprehensive one, focusing not only on the improvement/development of physical facilities for such infrastructure as water supply, sewerage, drainage, solid waste disposal, etc. but also on the non-physical measures such as improvement/strengthening of institutional services, relevant laws/regulations/acts, etc. The proposed plan shall be technically and economically optimal in view of various conditions prevailing over the Study Area and environmentally sound in the light of the existing relevant environmental laws/acts/regulations.

The Government of Zimbabwe will provide the existing environmental regulations/laws/acts, trade effluent by-laws, water quality standards of receiving body and effluent from sewage treatment works, etc. in order to facilitate the Study.

For the formulation of the master plan, the principal activities will include, but not limited to the following:

(1) Collection and analysis of existing data

- Climate and hydrology
- Water quality of river, ground-water, sewage works, industrial waste-water, drainage, etc.
- Socio-economic conditions
- Agricultural and industrial products and their production

- Soil and geological conditions
- Watershed management
- Natural environment and ecology oflakes/ reservoirs, rivers

(2) Review of previous/on-going studies and projects

A review will be required to provide the background to formulation of the master plan and will include the following fields :

- Land use plan of the Manyame River basin
- Agricultural development plan
- Urban development plan, covering Harare, Ruwa, Chitungwiza, Norton, etc.
- Sewage works and sewer Development Plan
- Garbage and solid waste disposal plan
- Water supply Development Plan

(3) Investigation of existing urban infrastructure

The investigation will be carried out for such systems as water supply, sewerage, individual waste-water treatment and disposal, drainage, and garbage and solid waste collection and disposal. It should cover not only the public facilities but also private facilities such as individual water supply and pre-treatment facilities of industrial waste-water. It should further include an evaluation of existing facilities, including but not necessarily limited to :

- Capacity, type and present O & M conditions of existing facilities
- past expenditures
- deficiencies on operation and maintenance of current services
- environmental and health considerations

As to waste treatment and disposal, attention should be drawn to the following aspects, in addition to the above items:

- Re-use of treated effluent and sludge from sewage works
- Disposal of sludge from any treatment facilities in the Study Area.

Flow measurement should be conducted at selected points of rivers, sewers and drainage channels to confirm existing data and to facilitate the pollutant loads analysis.

(4) Institutional Study

The institutional matters are a key component in the formulation of a Pollution Control Plan for the Study area. The Study on institutional matters will cover the following issues:

- Exsisting Organizations concerning urban infrastructure development, public health and environmental protection and their tasks and roles.
- Annual budgets and expenditure details of the respective organisations.
- Staffing, operation and maintenance equipment of the respective organizations
- Prevailing service charges for water supply, sewage, garbage collection, sludge disposal of individual treatment facilities, etc.

(5) Climatological and hydrological investigation

- Long term run-offs of the Manyame River and its major tributaries.
- Storm rainfall characteristics
- Run-off analysis or urban drainage system
- Operation mode and water supply capability of reservoirs/lakes
- Existing water intake facilities in the upper Manyame river basin and their seasonal intake volume

6. Aqua-environmental condition survey

In order to address the formulation of a water pollution control plan, it is necessary to carry out an aqua-environmental condition survey on major water bodies in the Study Area. The survey should be conducted to cover the following aspects:

- Physical environmental conditions, covering water quality, sedimentation quality, water flowrate, etc.
- Ecological environmental condition, covering vegetation, fauna and flora, economic system, etc.
- Usage of the water bodies, such as water supply, irrigation, recreation, fishery, etc.

As the investigation encompasses a wide area and many aspects and is limited in time, it will be efficient and rational to employ a qualified local firm. The Study team shall engage for the survey a well qualified environmental expert to organise and supervise the environmental investigation under the Study. The water quality items are tentatively selected as given in Table 1.

(7) Pollution Source Survey

It can be said pollution on a water body depends on pollutant amount generated in its catchment area. For the estimate of total pollutant amount generated in the Study Area, it necessary to survey the pollutant source.

(a) Industrial Pollutant Source

In major urban areas effluent discharged from several major factories accounts for a large volume of total pollution amount in the catchment area. The Effluent condition of the major factories shall be investigated, such as effluent water quality and discharge amount and condition of pre-treatment system. Questionnaire survey and/or effluent sampling testing shall be conducted.

(b) Domestic Pollution Source

Domestic pollution source survey shall be conducted on sewered and un-sewered areas respectively.

The pollutant load generated in a sewered area can be estimated by the study of influent condition on sewage treatment works. The survey on sewered area shall cover the following items:

- Water quality and discharge amount of influent of sewerage treatment works in the Study Area
- Population and living condition in the sewered area

The domestic pollutant generated in an un-sewered area can be estimated by survey of the following items:

- Population and living conditions (income level, etc.) in the area
- Individual wastewater treatment method
- Water consumption pattern
- Topographic and geological conditions

(c) Others

In a big urban area like Harare, most of the pollutant loads generated in the catchment area originate from man-made point pollution sources. The pollution source survey shall cover not only point pollution source, but non-point source also, such as agricultural land, live-stock land, stormwater first flash in urban areas etc.

The method and item of non-point pollution source survey will be determined by the results of site survey in the Study Area.

The water quality testing items are tentatively selected as given in Table 1. The pollution route survey shall be carried out with qualified local investigation firm.

(8) Pollutant inflow Route Survey

For the estimate of pollution load on the water bodies, it is necessary to identify the pollutant inflow route into the water bodies. After the routes are identified, flow measurement and water quality survey shall be conducted at selected points on each route, such as rivers, spring, ditch and any effluent into the water bodies.

The water quality testing items are tentatively selected as given in Table 1. The pollution route survey shall be carried out with qualified local investigation firm.

(9) Model simulation for pollution analysis

In order to establish a pollution control plan, it is necessary to study the impact of pollutant loads, discharged from each pollution source to water bodies. An adequate simulation model should therefore be developed to qualitatively and quantitively analyze the following:

- Pollutant load inflow into reservoirs/lakes on each pollutant inflow route, in relation to pollutant amount generated in the catchment area.

- Water quality in reservoirs/lakes in relation to pollutant load inflow and inflow water amount.

Above simulation model will be established on base of the results of item (6), (7), (8).

(10) Establishment of framework of a master plan

For the formulation of the master plan, a basic framework shall be set up at intervals of 5 years until ultimate target year 2015. It shall include, but not limited to the following:

- Population at present and at the target year
- Land use and urban development plans
- Strategy of potable water supply, domestic and industrial wastewater treatment and disposal, garbage and industrial refuse collection and disposal, urban drainage, including role of public and private sectors.
- Potable water supply, including water serving area and population, water demand by category, source of water.
- Domestic and industrial wastewater treatment and disposal, including quantity of domestic and industrial wastewaters and their quality.
- Agricultural and industrial development plans

The basic framework shall be discussed and agreed upon by a steering committee prior to commencement of formulation of a master plan study.

(11) Formulation of master plan

The master plan on water pollution control shall be the end product of the Phase 1 Study and established on the basis of the results of various investigations and analyses and the established framework. The proposed water pollution control plan shall comprise both structural and non-structural measures and shall be ensured to be economically, technically and environmentally sound.

(a) Determination of target water quality level (condition) in the water bodies

Target water quality level and environmental standard on major water bodies in the Study Area shall be established on the basis of various conditions and situations prevailing over the Study Area.

(b) Optimization of structural measures

A Pollution control plan shall be formulated to fully meet the water quality and environmental standards. The structural measures will involve various alternatives and optimal measures shall be selected through elaboration of technical and economic comparative study.

(i) Domestic wastewater treatment and disposal

- Identification of sewered area and sewerage district
- Sewer expansion plan
- Sewage treatment works expansion plan
- Strategy for individual wastewater treatment
- Strategy for sludge treatment and disposal
- Strategy for re-use of treated effluent

(ii) Rehabilitation of existing sewerage and urban drainage systems

(iii) Other structural measures for major pollution sources

(c) Non-structural measures

The non-structural measures will include but not limited to the following:

- Revision/modification of existing laws/regulation/acts and their implementation.
- Enactment and implementation of "Trade Effluent By-Laws"
- Role and task of organisations concerning urban infrastructure services and environment and their cooperation and coordination

- Motivation of people

- Monitoring of watershed management, sewage generation, water quality and environment.

(d) Forecast of pollutant loads

The future pollutant loads shall be forecast quantitavely and qualitatively on the two conditions : with and without pollution control plan, and for the following cases

- Case A : Total pollutant loads generated from the Study Area

- Case B : Pollutant loads flowing into each receiving body

- Case C : Changes in water quality of receiving body

(e) Layout design

For every structural measure, layout designs shall be prepared for major structural components in order to facilitate estimate of capital cost required to achieve the proposed master plan and annual operation and maintenance costs for sustainable operation and maintenance of the proposed projects.

(f) Estiamte of cost and benefit

The construction cost and annual operation and maintenance costs shall be estimated based on the layout design of the proposed Projects facilities. It should also be required to quantify benefits, either tangible or intangible, to be derived from implementation of the proposed Projects.

(g) Implementation program

The proposed water polution control plan will include a number of measures to be realized during a given planning horizon. Their implementation schedule shall be programmed in the light of the progressively increasing pollutant loads and changes in water quality and environment.

(h) Orgainzation and management

For every respective Project, the following issues shall be addressed:

- Executing agency for the respective project
- Organisation responsible for operation and maintanance
- Structure and staffing of O & M orgainzation
- Operation and maintenance equipment.

(i) Comprehensive evaluation of the pollution control plan.

4.2.2. Phase 2 : Urgent Project Study

Through the investigation of the present pollutant loads generation mechanism and existing urban infrastructures, it will emerge that there is an urgent need for implementation of adequate pollutant load reduction measure for preservation and conservation of water resources in the Study Area. Among the urban areas within the Study Area, Chitungwiza Town is not being provided with adequate infrastructure to properly treat the pollutant loads currently generated from its administrative area. In particular the sewerage system is envisaged to be expanded and strengthened urgently among the others.

The Phase 2 Study will comprise, but not limited to the following:

(1) Identification and confirmation of urgent project

In the course of Phase 1 Study, emphasis shall also be placed on identification of a project, which is, from technical, economical and environmental view points, jusitfiable to be implemented urgently. The selected Project should further be confirmed through discussion with the Steering committee.

(2) Topographic survey and geotechnical investigation

It will be necessary to carry out topographic survey and geotechnical investigations such as test drilling with standard penetration test and soil test for basic designs of major structure sites proposed. The requirements for such survey and investigation should be assessed and technical specifications shall be prepared to enable the local firms to undertake the required survey and investigation.

(3) Supplemental survey on existing facilities

The existing sewerage facilities in Chitungwiza Town should be surveyed in detail in order to assess their rehabilitation, improvement and expension requirements.

Special attention shall be drawn to structural requirement and operation mode of facilities for re-use of treated effluent and sludge disposal.

(4) An Inventory of existing operation and maintenance equipment for sewerage system in Chitungwiza Town shall be prepared and their appropriateness and efficiency evaluated. Proposal shall be prepared for additional procurement of equipment and machinery required for ensuring a sustained operation upon completion of the urgent Project.

(5) Basic design

Basic design of the selected urgent Project shall be made to such an extend and grade that resultant construction cost estimate could be practically adaptable for financial arrangement of the Project.

Land necessary for realization of the urgent Project shall also be demarcated to enable the executing agency to proceed with land exploration and compensation.

(6) Construction plan and cost estimate

Based on basic designs, construction method of the major project components shall be studied to allow proper cost estimate and plan construction time schedule. The cost estimate shall include the construction cost, procurement cost of the proposed O & M equipment and annual operation and maintenance cost of the Project as well as engineering services costs necessary for detailed design and construction supervision.

(7) Environmental impact assessment

The environmental impact assessment should be conducted in detail and in accordance with environmental standards.

(8) Evaluation project

The urgent Project shall be evaluated financially, economically and environmentally. Particulary, its effect on pollutant loads reduction shall be assessed qualitatively and quantitatively.

4.2.3. Phase 3 : Feasibility Study

The Feasibility Study shall be conducted for the first priority Project eligible among the Projects consisting in the master plan. The Phase 3 study will include, but not limited to the following:

(1) Supplementary data collection and analysis

Data collection and analysis should be carried out to supplement those conducted under the Phase 1 study.

(2) Topographic survey on geo-technical investigation

The same method as stated in Article (2) of the sub-section 4.2.2. shall be applicable. Although actual quantity will be clarified upon completion of the Phase 1 Study tentative requirments are as follows:

(a) Topographic survey

Aerial photography and mapping over sewered area : 30km(square)
(scale 1 : 1,000, contour interval : 1 m)

Longitudinal profile and cross-section of trunk sewers : 50km

(b) Test drilling and standard penetration test

Test drilling at sewage works : 240m
(15m/borehole x 4 borehole/sites)

Standard penetration test : 80 nos.
(each at 3m intervals along borehole)

(c) Soil test at sewage works

Test pitting (Depth : 3m. 4 pits/site)	:	12 nos.
Sampling		
Distributed sample	:	12 nos.
Undistributed sample	:	12 nos.
Soil mechanical test	:	24 samples

(3) Preliminary design

Based on the concepts of the master plan and results of the topographic survey and geo-technical investigation, preliminary designs should be worked out for major components of the Project. Each major component shall be of technically and economically optimal among the alternatives. Special attention shall be directed to such consideration that the Project shall be well fitted to local climate and technical skills and capable of absorbing financial situation of agency responsible for operation and maintenance.

(4) Construction plan and cost estimate

The construction plan should deal with:

- Estimated quantity of construction machinery and equipment by type
- Labour requirement
- Supply and transportation of construction materials and plants
- Construction package and mode of construction
- Construction time schedule

The construction cost and annual operation and maintenance cost should also be estimated. For the purpose of proper cost estimat, a survey should be conducted in the Study Area on such items as:

- Labour wages
- Capability of local contractors
- Prices of construction machinery and equipment

- Availability of construction machinery and equipmen

- Procurement cost of O & M equipment

All the costs shall be estimated in foreign and local currency components.

(5) Organization, operation and maintenance

For ensuring a sustained operation and maintenance of the Project existing operation and maintenance system should be adequately improved/strengthened with particular views to the following points:

- Structure of orgainsation responsible for operation and maintenance

- Staffing

- Procurement of O & M equipment

- Source of finance for routine and recurrent costs

(6) Environmental impact assessment

The environmental impact of the Project shall be conducted along the same methodology as stated in Article (11.g) of the sub-section 4.2.1. but it should be a more elaborate one in terms of depth of analysis than that of the Phase 1 Study.

The further investigation shall be conducted for essential items, which are to be scooped out from the results of the initial environmental impact assessment. It should be carried out by the same local firm as the Phase 1 Study in compliance with the specifications to be prepared beforehand and guidance to be directed by the study team.

(7) Project evaluation

The Project evaluation shall comprise:

- Technical evaluation,

- Economical evaluation,

- Financial evaluation,

- Environmental evaluation and

- Overall evaluation

All the benefits, either direct and indirect shall be quantified and be as much attainable as possible.

(8) Operation guidance and monitoring plan

Basic guidelines for operation and maintenance shall be prepared based on the preliminary design concepts.

It is also one of the major objectives of the Project to establish adequate monitoring system of the pollutant loads generation and water quality in the Study Area. In this context the structure, requirement of staffing equipment, role and function of organization and estimated annual budget should be studied and reported.

4. OUTPUTS OF THE STUDY

The following reports shall be prepared:

(1) Inception Report

The report shall be prepared within one (1) month after commencement of the Study and shall include the approach to the study, method and plan of operation of the Study, work schedule and staffing arrangment.

(2) Report on master plan for Water Pollution Control Plan

The report shall be prepared within ten (10) months after commencement of the study and shall include the process and results of the Phase 1 Study.

(3) Report on Urgent Project Formulation

The report shall be prepared within eight (8) months after commencement of the study and include the process, studies and results of the Stage 2.

(4) Feasibility Study Report

The draft report shall be prepared within eighteen (18) months after commencement of the Study and shall include the process, studies, results, conclusions and recommendations of the Phase 3 Study. The Final report shall be prepared within two (2) months after receipt of comments on the Draft Report by the Government of Zimbabwe.

6. WORK SCHEDULE

The Study shall wholly be completed within a period of twenty (20) months after commencement of the Study. A tentative work schedule is given in Fig 3.

7. UNDERTAKINGS OF THE GOVERNMENT OF ZIMBABWE

(1) To facilitate the smooth conduct of the Study, the Government of the Republic of Zimbabwe shall take necessary measures as follows:

(a) To ensure the safety of the members of the Study Team when and as required in the course of the Study.

(b) To permit the members of the Study Team to enter, leave and sojourn in the Republic of Zimbabwe for the duration of their assignment therein and exempt them from foreign registration requirements and consular fees.

(c) To exempt the members of the Study Team from taxes, duties, fees and any other charges imposed on equipment, machinery and materials brought into the Republic of Zimbabwe for the conduct of the Study.

(d) To exempt the members of the Study Team from income tax and any other charges imposed on or in connection with any emoluments or allowance paid to the members of the Study Team for their services in the course of Study.

(e) To provide necessary facilities to the Study Team for the remittances as well as the utilization of the funds introduced into the Republic of Zimbabwe in the course of the Study.

(f) To secure permission for entry into private properties or restricted areas for the conduct of the Study within the laws and regulations inforce in the Republic of Zimbabwe.

(g) To secure permission for the Study Team to take all data and documents including photographs related to the Study out of the Republic of Zimbabwe, within the laws and regulations in force in the Republic of Zimbabwe.

(h) To provide medical services when needed, and the expenses will be chargeable on the members of the Study Team.

(2) The Government of Republic of Zimbabwe shall bear claims, if any arises, against the members of the Study Team resulting from, occuring in the course otherwise connected to the discharge of their duties in the implementation of the study, except when such claims arise from gross negligence or wilful misconduct on the part of the members of the Study Team.

(3) The Ministry of Local Government shall, as counterpart and conduct agency to the Study Team, shall act in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the study.

(4) The Ministry of Local Government shall, at its own expense, provide the Study Team with the following in cooperation with other organizations:

(a) Available data and information related to the Study,

(b) Counterpart personnel necessary for the Study,

(c) Suitable office with necessary equipment and furniture in Harare;

(d) Credentials or identification cards.

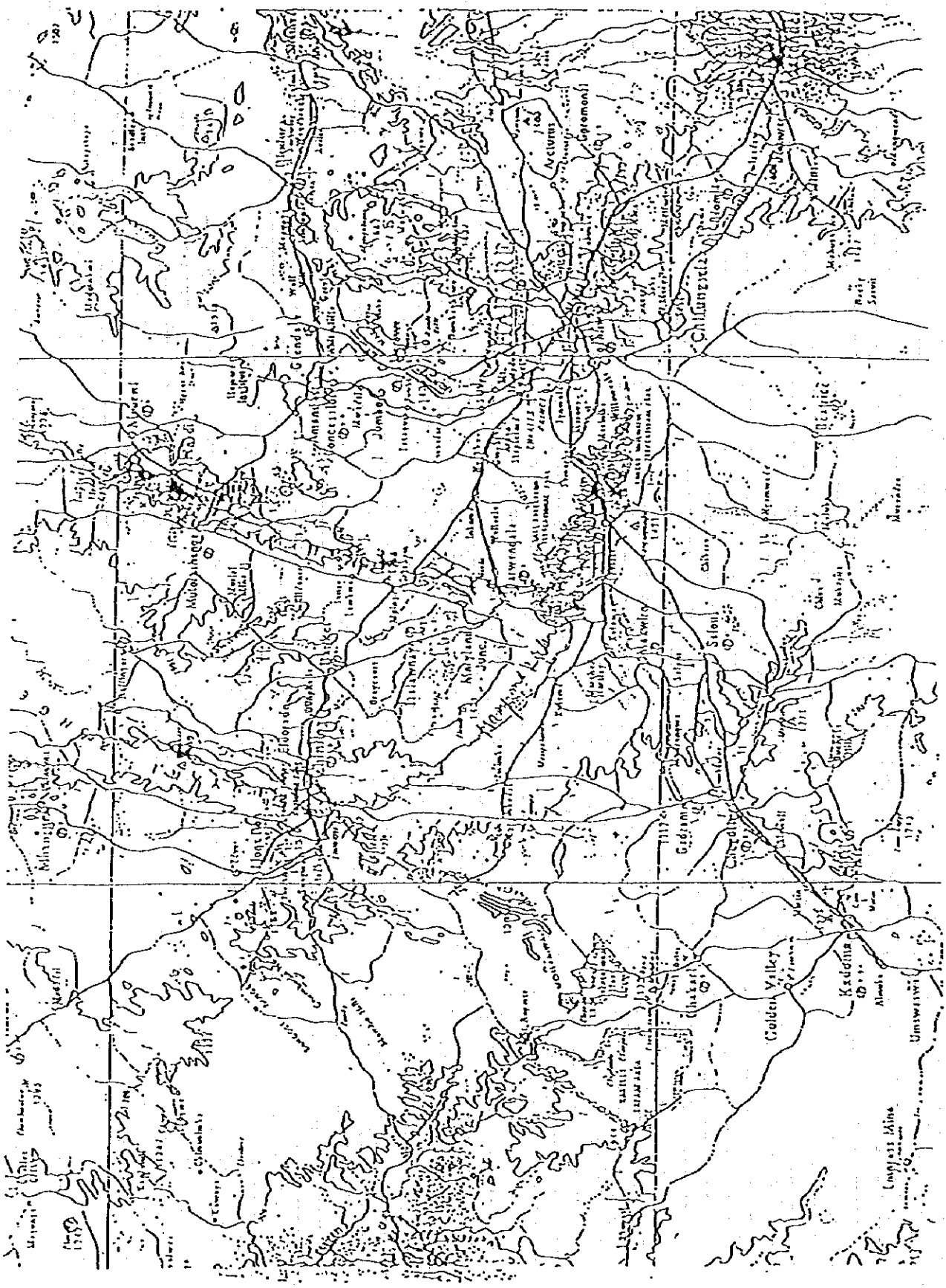


FIG: 1 MAP OF UPPER MANYAME RIBER

Fig. 2 Schematic Diagram of Water Supply and Sewerage System

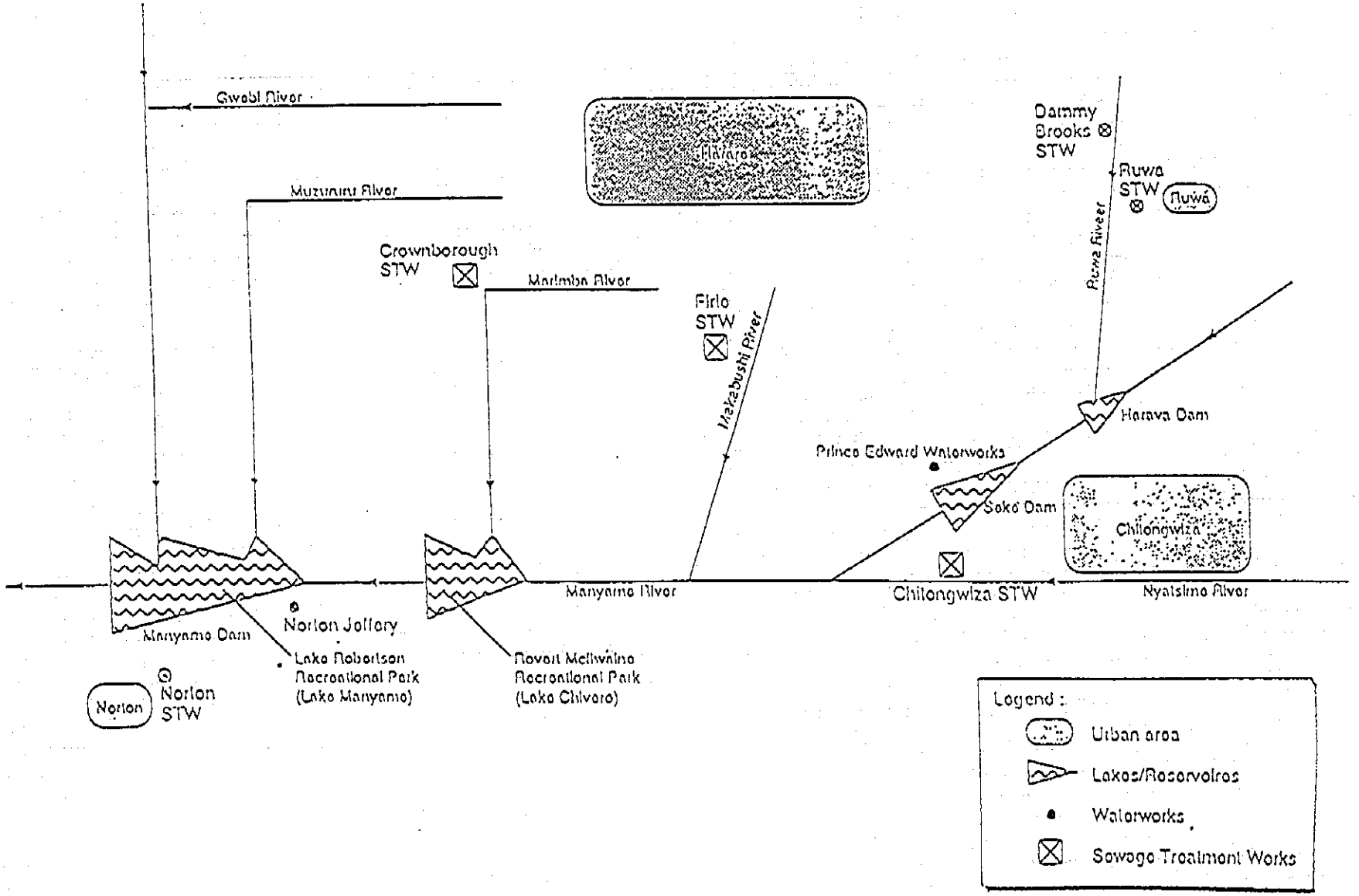
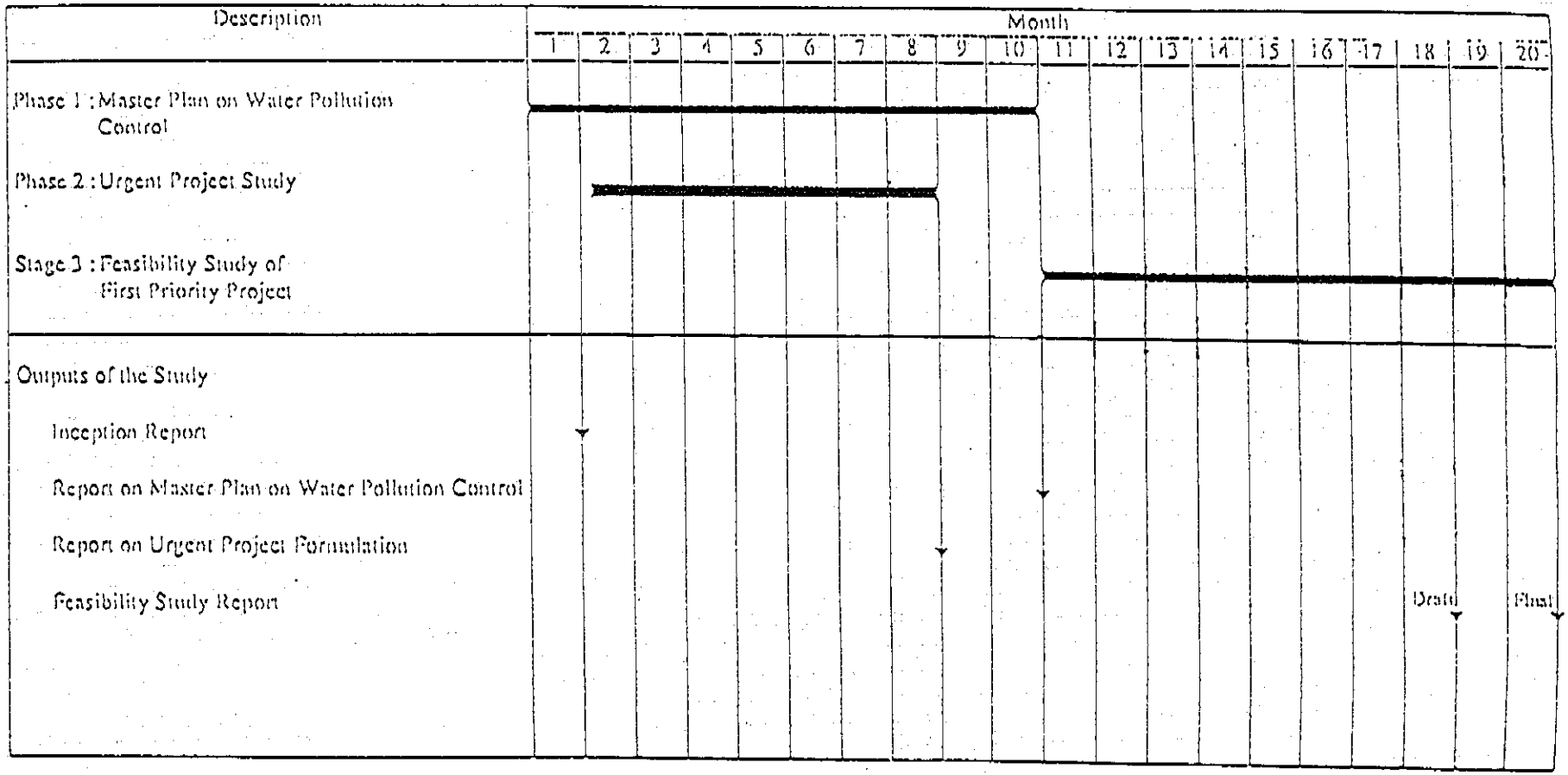


Fig. 3 · Tentative Work Schedule



2. Scope of Work

SCOPE OF WORK
FOR
THE STUDY
ON
WATER POLLUTION CONTROL
IN
THE UPPER MANYAME RIVER BASIN
IN
THE REPUBLIC OF ZIMBABWE

AGREED UPON BETWEEN
THE MINISTRY OF LOCAL GOVERNMENT, RURAL AND URBAN DEVELOPMENT
AND
THE JAPAN INTERNATIONAL COOPERATION AGENCY

HARARE, NOVEMBER 29, 1995

Mr. A. C. Mpanthanga
Deputy Secretary,
Development Planning and Co-ordination,
for Senior Secretary,
The Ministry of Local Government,
Rural and Urban Development

Mr. Kuniharu Yoshimoto
Leader,
Preparatory Study Team,
Japan International Cooperation Agency

MIN. OF LOCAL GOVERNMENT, RURAL & URBAN DEVELOPMENT
29 NOV 1995
PRIVATE BAG 7706, CAUSEWAY

Ⅰ. INTRODUCTION

In response to the request of the Government of the Republic of Zimbabwe (hereinafter referred to as "the Government of Zimbabwe"), the Government of Japan has decided to conduct the Study on Water Pollution Control in the Upper Manyame River Basin (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Zimbabwe.

The present document sets forth the Scope of Work with regard to the Study.

Ⅱ. OBJECTIVES OF THE STUDY

The objectives of the Study are :

1. to formulate a master plan for water pollution control in the upper Manyame river basin for the target year 2015, in order to secure a potable water supply with acceptable water quality and to establish sustainable pollution control systems,

2. to conduct a feasibility study for the priority (urgent) project(s) identified in the master plan, and

3. to pursue technology transfer to the counterpart personnel in the course of the Study.

Ⅲ. STUDY AREA

The Study will cover the upper basin of the Manyame river (with an area of 2,700km^2).

Ⅳ. SCOPE OF THE STUDY

In order to achieve the objectives mentioned above, the Study will cover the following :

Phase Ⅰ. Formulation of Master Plan

1. Collection and analysis of existing data and documents on the following:
   a. physical conditions of the Manyame river basin such as meteorology, topography, geology, hydrology, etc.
   b. social and economic conditions and trends in Zimbabwe, Harare, and the Manyame river basin
   c. present conditions and future plans of population settlements and land use in the Manyame river basin

2. Field survey

3. Review of present legal and institutional arrangements, studies and on-going projects for environmental management related to the Manyame river basin such as:
   a. national and local government's environmental policies, strategies, programs and projects
   b. laws and regulations related to environmental protection, water resources, watershed management, and urban water supply
   c. institutional arrangements for environmental protection, water resources, watershed management, and urban water supply

4. Review of the present condition of the Manyame river basin

a. pollution sources inventory
   a) analysis of studies conducted by other organizations
   b) review and supplement of shortcomings in the existing studies regarding pollution sources
b. water quality of the Manyame river
c. monitoring system of water flow, water quality, and waste water discharge
d. use of water from Manyame river
e. operating conditions of water works and waste water treatment facilities
f. industrial wastewater, refuse disposal and agricultural chemicals
g. others

5. Key issues and problems related to the environmental management of the Manyame river basin
   a. physical aspects such as quality and quantity of water
   b. legal aspects
   c. organizational, managerial, and financial aspects
   d. public awareness

6. Baseline pollution projection

7. Formulation of Master Plan
   a. formulation of objectives of the proposed project(s)
   b. strategies for the environmental improvement of the Manyame river basin
   c. selection of a target for priority project(s)
      (a) target level of water quality
      (b) target level of water supply
      (c) target polluters and pollutants for the pollution control
   d. applicable technical measures for water pollution reduction and water quality improvement
   e. policies and regulatory measures and institutional arrangements
   f. monitoring system of water quality and wastewater discharge
   g. study on an educational program to promote public awareness
   h. preliminary cost estimation for alternative measures
   i. evaluation of alternative measures and selection of the priority measures based on such criteria as:
      (a) technical soundness
      (b) financial soundness
      (c) effectiveness for environmental improvement
      (d) institutional and social acceptability
   j. formulation of priority project(s)
   k. phased implementation plan

8. Conduct of Initial Environmental Evaluation(IEE) for the priority project(s)

Phase II Feasibility Study of the priority project(s)

1. In-depth survey and supplementary data collection such as topography, geology, hydrology, meteorology, water qualities and river conditions etc.

2. Preliminary design of facilities and equipment plan

3. Organizational and personnel requirements for the project implementation

4. Cost estimation and financing plan
   a. cost estimation for the investment, operation and maintenance of the project(s)
   b. cost estimation for the monitoring system
   c. project finance plan

5. Estimation of environmental effects
   a. water quality improvement
   b. increase in water supply
   c. other positive environmental effects

6. Project evaluation
   a. financial evaluation
   b. economic evaluation
   c. social evaluation

7. Institutional arrangements for the implementation of the project(s)

8. Environmental Impact Assessment (EIA)

9. Project implementation plan

V. STUDY SCHEDULE

The Study will be conducted in accordance with the tentative schedule attached in the Annex. The schedule is tentative and subject to change on the agreement of both parties when such necessity arises during the course of the Study.

VI. REPORTS

JICA will prepare and submit the following reports in English to the Government of Zimbabwe.

1. Inception Report
   Twenty(20) copies at the commencement of the first field survey in Zimbabwe.

2. Progress Report (I)
   Twenty(20) copies at the end of the first field survey.

3. Interim Report
   Twenty(20) copies at the beginning of the second field survey.

4. Progress Report (II)
   Twenty(20) copies at the end of the third field survey.

5. Draft Final Report
   Twenty(20) copies within two(2) months after the completion of the third field survey.
   The Government of Zimbabwe will submit their comments to JICA within one(1) month after the receipt of the Draft Final Report.

6. Final Report
   Forty(40) copies within two(2) months after receipt of the comments on the Draft Final Report.

Ⅶ. UNDERTAKING OF THE GOVERNMENT OF ZIMBABWE

1. To facilitate the smooth conduct of the Study, the Government of Zimbabwe will take the following necessary measures:

(1) to secure the safety of the Japanese study team (hereinafter referred to as "the Team")

(2) to permit the members of the Team to enter, leave and sojourn in Zimbabwe for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees,

(3) to exempt the members of the Team from income taxes, duties, and other charges on equipment, machinery and other materials brought into Zimbabwe for the implementation of the Study,

(4) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study,

(5) to provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Zimbabwe from Japan in connection with the implementation of the Study,

(6) to secure permission for entry into private properties or restricted areas for the implementation of the Study,

(7) to secure permission for the Team to take all data and documents (including maps and photographs) related to the Study out of Zimbabwe to Japan,

(8) to provide medical services as needed, expenses for which will be chargeable to the members of the Team.

3. The Government of Zimbabwe shall bear claims, if any arise, against the members of the Team resulting from, occurring in the course of, or otherwise connected with the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

4. For the smooth implementation of the Study, the Ministry of Local Government, Rural and Urban Development shall act as a counterpart agency to the Team and also as a coordinating body in relations with other governmental and non-governmental organizations concerned.

5. The Ministry of Local Government, Rural and Urban Development shall, in cooperation with the other organizations concerned and at their own expense, provide the Team with the following:

(1) available data and information (including maps and photographs) related to the Study

(2) counterpart personnel and supporting staff necessary for the Study

(3) suitable office space with necessary equipment and furniture in Harare

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(4) credentials and identification cards

(5) appropriate number of vehicles with drivers

Ⅷ. UNDERTAKING OF JICA

For the implementation of the Study, JICA shall take the following measures;

1. to dispatch, at its own expense, the Team to the Republic of Zimbabwe,

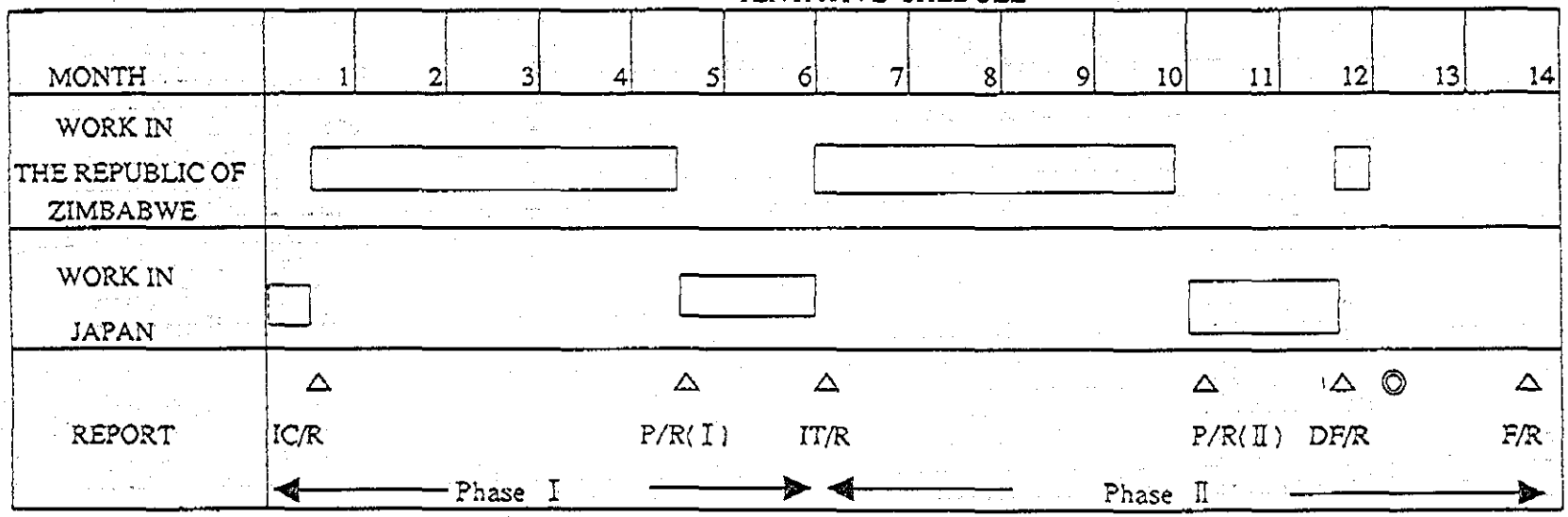
2. to pursue technology transfer to Zimbabwe's counterpart personnel in the course of the Study.

Ⅸ. OTHERS

JICA and the Ministry of Local Government, Rural and Urban Development will consult with each other in respect of any matters that may arise from or in connection with the Study.

ANNEX

TENTATIVE SHEDULE



REMARKS:
- IC/R: Inception Report
- P/R : Progress Report
- IT/R : Interim Report
- DF/R: Draft Final Report
- F/R : Final Report

◎: comments from Zimbabwe side

3. Minutes of Meetings

MINUTES OF MEETING
ON
THE SCOPE OF WORK
FOR
THE STUDY
ON
WATER POLLUTION CONTROL
IN
THE UPPER MANYAME RIVER BASIN
IN
THE REPUBLIC OF ZIMBABWE

HARARE, NOVEMBER 29, 1995

Mr. A. C. Mpamhanga
Deputy Secretary,
Development Planning and Co-ordination,
for Senior Secretary,
The Ministry of Local Government
Rural and Urban Development

吉本國春

Mr. Kuniharu Yoshimoto
Leader,
Preparatory Study Team,
Japan International Cooperation Agency

In response to the request of the Government of the Republic of Zimbabwe, (hereinafter referred to as "the Government of Zimbabwe") the Government of Japan has decided to conduct a Study on Water Pollution Control of the Upper Manyame River Basin (hereinafter referred to as "the Study") through the Japan International Cooperation Agency (hereinafter referred to as "JICA").

The Japanese Preparatory Study Team (hereinafter referred to as "The Study Team"), headed by Mr. Kuniharu Yoshimoto, visited the Republic of Zimbabwe from November 22nd to December 7th, 1995, where field survey of the study area was carried out and a series of meetings were held with Ministry of Local Government, Rural and Urban Development (hereinafter referred to as "MLGRUD") and other authorities concerned. The list of attendants is shown in Annex.

The draft S/W proposed by the Study Team was discussed in detail between MLGRUD and the Study Team and both side agreed to adopt the S/W with the following understandings.

I OBJECTIVES OF THE STUDY

As is mentioned in S/W, main objective of the study is (1) to formulate the master plan for the target year 2015, on the environmental improvement program of the upper Manyame river basin in order to secure potable water supply with acceptable water quality and to establish sustainable pollution control systems and (2) to conduct a feasibility study on the priority (urgent) project(s) identified in the master plan, and (3) to pursue technology transfer to the counterpart personnel in the course of the Study.

II TARGET YEAR

Both sides agreed that the target year for the priority project (s) shall be discussed and decided in the course of the master plan study.

III STUDY AREA

The Study shall cover the catchment area of Manyame river, its tributaries from the origin of Manyame river up to the Manyame Dam wall, farms around them, the municipal area of City of Harare, Chitungwiza and Norton Town Councils, and Ruwa Local Board as the Study Area.

IV SCOPE OF THE STUDY

Both sides agreed to add analysis on industrial wastewater, refuse disposal and agricultural chemicals in the master plan study.

V REPORTS

As for the Final Report, MLGRUD agreed to make it open to the public for the maximum use of the Study result.

VI UNDERTAKING OF THE GOVERNMENT OF ZIMBABWE

1. The Study Team requested MLGRUD to assign necessary technical counterpart personnel and

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supporting staff for the smooth implementation of the Study and MLGRUD accepted the request.

2. The Study Team requested that MLGRUD will provide with two vehicles with drivers, fuel and maintenance cost. MLGRUD, however, expressed a difficulty over this request due to the budgetary constraint.

3. The Study Team confirmed that MLGRUD will provide office space within MLGRUD with necessary furniture.

Ⅶ UNDERTAKING OF JICA

1. MLGRUD requested the Study Team to carry out counterpart training in Japan and the Study Team agreed to convey the request to JICA H.Q. for the necessary arrangement for the training.

2. MLGRUD requested the Study Team to hold a seminar as a part of technology transfer twice in the course of the Study (at the time of Interim Report / Draft Final Report) and the Study Team agreed to convey the request to JICA H.Q. for the positive consideration.

Ⅷ STEERING COMMITTEE

Both sides agreed to establish the steering committee for more effective and efficient implementation of the Study. The committee will be comprised of the representatives of MLGRUD, other ministries, agencies and organizations concerned.

Ⅸ OTHERS

The Study Team explained the JICA's Development Study Program and MLGRUD fully understood the Program.

Annex 1.

LIST OF THE ATTENDANTS

Ministry of Local Government, Rural & Urban Development

1.Mr.W.A.Chiwewe	Senior Secretary	
2.Mr.A.C.Mpamhanga	Director	Development planning & Co-ordination
3.Mr.J.T.Mutamiri	Deputy Director	〃
4.Mr.P.F.Duri	Senior Administrative Officer	〃
5.Mrs.S.N.Musungwa	Assistant Secretary	〃
6.Mr.J.Chimoto	Municipal Engineer	〃

Ministry of Finance

1.Mr.O.M.Matshalaga	Deputy Secretary	Domestic and International Finance

City of Harare

1.Mr.S.J.Mtongwizo	Deputy Town Clerk	Town Clerk's Dept.
2.Mr.M.M.Magwenjere	Chief Committee Officer	〃
3.Mr.C.Rwazemba	Chief Public Relations	〃
4.Mr.E.Mudzuri	Deputy Chief Engineer	Dept. of Works
5.Mr.M.Chiriwe	Norton Jaffrey Works Superintendent	〃
6.Mr.B.C.Gwenzi	Crowborough Sewerage Works Superintendent	〃
7.Mr.M.L.Chizema	Senior Engineer	
8.Mr.G.Mkudu	Chief Chemist	
9.Mr.M.G.T.Zata	City Amenities Manager	
10.Mrs.E.Mhambo	City Treasure Principal Accountant	
11.Mrs.M.Chikungwa	Senior Accountant	

Chitungwiza Town Council

1.Mr.M.Khosla	Town Engineer
2.Mr.Govero	Sewerage Works Superintendent
3.Mr.P.Mbira	Water & Sewerage Engineer

Norton Town Council

1.Mr.F.P.Zimunya	Chief Executive Officer	
2.Mr.G.Magombedze	Town Engineer	
3.Mr.S.V.Lingen	Hunyani Agroforestry Manager	
4.Mr.T.A.Mashingaidze	Pulp Plant & Quality Manager	Hunyani Paper & Packaging Ltd.

Ruwa Local Board

1.Mr.S.H.Ushe	Town Engineer
2.Mr.C.Nyarudzo	Sewerage Operator

JICA Preparatory Study Team

1.Mr.K.Yoshimoto	Leader/Sewerage and Waste Water Treatment Planning
2.Mr.K.Fukuda	Study Planning
3.Mr.K.Morita	Water Pollution Control
4.Mr.M.Togawa	Program Planning
5.Mr.N.Okabe	Hydrology/Environmental Impact
6.Mr.T.Hirotsu	Water Quality Analysis/Monitoring

Embassy of Japan in the Republic of Zimbabwe

1.Mr.H.Yasumura	Councilor

4. Questionaire

Request for Information

The Study on Water Pollution Control in Upper Manyame River Basin
in Republic of Zimbabwe

JICA Preparatory Study Team

To maximize the efficiency and quality of the Study, the following data and information are requested to provide the Preparatory Study Team during their stay in Zimbabwe.

It would be greatly appreciated if the following data and information are prepared with summaries in English, and if they are advanced permissions to take out the document containing these information from Zimbabwe to Japan are required for the purposes.

1. GENERAL INFORMATION

1-1 National Development Plan (existing long-term plan or five-year plan)

1-2 Sectorial and regional development plans related to the Study

1-3 National census related to the Study

1-4 Socio-economic conditions related to the Study

a. Administrative district (provinces, districts, cities, towns and villages)

b. Population and household
- statistics of population during the last decade
- distribution of population
- estimation of future population

c. Beneficiaries from the project

d. City planning

e. Land use

f. Infrastructure
- road condition
- transportation system (bus, railway, etc)
- electricity
- telecommunication / postal service
- water supplies including the spread rate and the charging system
- sewerage and drainage including the spread rate and the charging system
- public facilities

g. Industry
- estimation of future production

h. Agriculture (irrigation)
   - estimation of future production
i. Tourism and historical area
j. Inflation
   - inflation during the last 10 years
   - estimation of future inflation
k. whole scale and consumer price index

1-5 Budget in the last five years
a. National budget for infrastructure
b. Sewerage construction / flood mitigation and drainage / dam construction / erosion control / forestation (whole country)
c. - ditto - (the upper Manyame river basin)
d. Maintenance cost for sewerage system, water works, road, and other public facilities (the upper Manyame river basin)

1-6 Organization
a. Central / Local government organizations related to the Study
b. System governing the Study area
c. Other agencies related to the Study

2 TOPOGRAPHY AND GEOLOGY

2-1. Topography maps covering the Study area
a. Key map and area covered by the above maps
b. Scale
c. Interval of contour line
d. Agency and administrative office

2-2. Aerophotographs covering the Study area (the latest photos)
a. Key map and area covered by the above maps
b. Scale
c. Photographing year
d. Agency and administrative office
e. Control point (location and altitude)
f. Triangulation station
g. Permission for the Study Team to take them out of Zimbabwe to Japan

2-3. River plan, profile and cross-section
   a. Plan, profile and cross-section of existing river
   b. Agency and administrative office

2-4. Geological maps covering the Study area
   a. Area covered by the above maps
   b. Scale
   c. Agency which prepared map/administrative office

2-5. Land use maps covering the Study area
   a. Scale
   b. Year of publication or investigation
   c. Agency and administrative office

2-6. Soil-mechanical data (boring log data) at major river structure

3. CLIMATIC AND HYDROLOGICAL DATA

3-1. Location map of meteorological and hydrological observation stations in and around the Study area
   a. Meteorological stations
   b. Hydrological gauging stations (water level and discharge)

3-2. List of meteorological and hydrological observation stations
   a. Station name
   b. Location / address
   c. Code number of station
   d. Observation items
   e. Period of observation
   f. Authorities concerned

3-3. Meteorological data
   a. General climate features in the Manyame river basin
      (Rainfall, temperature, humidity, sunshine hour, direction and velocity of wind, etc.)
   b. Rainfall data in and around the Study area
      - annual rainfall data
      - monthly rainfall data
      - daily rainfall data

- hourly rainfall data

c. Temperature

d. Direction and velocity of wind

e. Evaporation

f. Seismological observation data

3-4 Hydrological data

a. Water level and discharges at stations
   - average (yearly, monthly, daily)
   - maximum and minimum water level
   - maximum and minimum discharge

b. Lake water level at stations
   - average (yearly, monthly, daily)
   - high water level
   - low water level

3-5 Groundwater data at major points along the Manyame river

a. Location map and number of wells

b. Groundwater level at major points

c. Water quality of the above wells

3-6 Water quality data at major points of the Manyame river

a. Location map of observatories

b. Water quality of rivers and lakes aforementioned

3-7 Flood and its damage

a. Habitual inundation area / maps (area, population, duration, depth, times, etc.)

b. Flood damage due to heavy storm in the past

c. Cause and reason of flooding (rainfall, defect / shortage of facilities)

4. WATER POLLUTION CONTROL AND RELEVANT INFORMATION

4-1. Water demand and supply

a. System to serve water to hotels, household, governmental offices, public facilities, industrial factories, farming land and others (if specific classification is available, please classify)

b. Numbers of users of each system classified above, and amount of water consumed (annual total, monthly average / maximum, hourly average / maximum)

c. Sources of water supply and intake locations
d. Present condition / quality of the water sources
e. Map of existing water supply system
f. Laws and regulations relevant to water quality
g. Charging system for the service users

4-2. Night soil data
a. Classification of systems installed to dispose night soil
b. Percentage of the household which uses above classified night soil disposal system
c. Charging system for the service users
d. Quality of raw and treated night soil / sludge (BOD, COD, SS, TS)

4-3. Existing sewerage and drainage data
a. Map of sewerage and drainage systems and facilities
(including size, grade and flow direction)
b. Wastewater treatment plants
(list of treatment plants)
- treatment process
- amount of sewage treatment
- water quality of influent and treated sewage
- amount t of sewage sludge and its disposal systems
c. Charging system for the service users
d. Progress of construction of sewerage systems and facilities
e. Any other information in detail concerned to be related to the Study

4-4. Pollution
a. Water pollution
- present water quality of rivers and lakes during the last decades
- regulations and penalties on effluent
- causes of water pollution (industrial, agricultural and soil etc.)
- location and number of factories and agricultural area responsible for water pollution
- pollution load (industrial, household, agricultural etc.)
- quantity and quality of wastewater and treatment system of the above factories
b. Air pollution
- present air quality
- regulation on emission gas

c. Solid waste
- Solid waste collection and disposal system

4-5. Information regarding the existing, on-going and proposed studies and plans in and around the Study area covering project name, title and contents of project reports including projects assisted by international agencies

a. City planning
b. Sewerage system
c. Night soil collection, treatment and disposal
d. Water supply system
e. Tourism development
f. Related studies and plans

4-6. Land conservation of the basin

a. Forestation
b. Erosion control
c. Record of landslides

5. ENVIRONMENT

5-1. Legislation

a. Do you have the law/guidelines on environmental impact assessment?
Please attach the detail , e.g. responsible ministry or agency, procedure, if any.
b. Do you have the environmental quality standards on air, water and earth?
Please attach the detail, e.g. values, penalties, if any.

5-2. International conventions on environmental conservation

Have you affiliated to bilateral or multilateral conventions concerning environmental conservation, e.g. Ramsar convention, Washington Convention, etc.?
Give the name(s) of the convention(s) affiliated and the data of affiliation, if any.

5-3. Present situation of the Study area

Describe the following, please.

a. Socio-economic environment
- Number of people to be resettled and plan of resettlement or compensation
- Experience of resettlement in previous projects, if any
- Number and distribution of schools, hospitals religious facilities
- Location of the community which will be split by the project, if any
- Location of important cultural property or archaeological sites, if any

- Condition of public health (including existing diseases, especially due to pollution)

b. Natural environment
- Availability of vegetation map
- History of natural disaster such as landslide, earthquake and flood
- Change of water level of rivers and lakes in recent years
- Location of environmentally vulnerable areas such as tropical rain forest, wetland, if any
- Species of valuable animals and plants in the area, if any
- Location of particular areas officially protected such as national parks and natural parks
- Distribution of important landscape and scenery for tourism or religion

6. OTHERS

6-1. List of Consultant Firm in Zimbabwe which specialize in Survey, Water quality analysis and Environment

a. Survey, geological survey and soil exploration
b. Water analysis
c. Hydrology and hydraulic
d. Environment assessment

6-2. Unit price and wages of local consultants, technical and supporting staff, typist, driver and workers

5．主要面会者リスト

地方行政・農村都市開発省	Ministry of Local Government, Rural & Urban Development	
1. Mr. W. A. Chiwewe	Senior Secretary	
2. Mr. A. C. Mpamhanga	Director	Development Planning & Co-ordination
3. Mr. J. T. Mutamiri	Deputy Director	〃
4. Mr. P. F. Duri	Senior Administrative Officer	〃
5. Mrs. S. N. Musungwa	Assistant Secretary	〃
6. Mr. J. Chimoto	Municipal Engineer	〃
7. Mr. Ziracha	Senior Planner	Dept. of Physical Planning
大蔵省	Ministry of Finance	
1. Mr. O. M. Matshalaga	Deputy Secretary	Domestic and International Finance
ハラレ市	City of Harare	
1. Mr. S. J. Mtongwizo	Deputy Town Clerk	Town Clerk's Dept.
2. Mr. M. M. Magwenjere	Chief Committee Officer	〃
3. Mr. C. Rwazemba	Chief Public Relations	〃
4. Mr. E. Mudzuri	Deputy Chief Engineer	Dept. of Works
5. Mr. M. Chiriwe	Norton Jaffrey Works Superintendent	〃
6. Mr. B. C. Gwenzi	Crowborough Sewerage Works Superintendent	〃
7. Mr. M. L. Chizema	Senior Engineer	〃
8. Mr. G. Mkudu	Chief Chemist	〃
9. Mr. M. G. T. Zata	City Amenities Manager	
10. Mrs. E. Mhambo	City Treasure Principal Accountant	
11. Mrs. M. Chikungwa	Senior Accountant	
チトンギザ	Chitungwiza Town Council	
1. Mr. M. Khosla	Town Engineer	
2. Mr. Govecro	Sewerage Works Superintendent	
3. Mr. P. Mbira	Water & Sewerage Engineer	
ノートン	Norton Town Council	
1. Mr. F. P. Zimunya	Chief Executive Officer	
2. Mr. G. Magombedze	Town Engineer	
3. Mr. S. V. Lingen	Hunyani Agriforesty Manager	
4. Mr. T. A. Mashingaidze	Pulp Plant & Quality Manager	Hunyani Paper & Packaging Ltd.
ルワ	Ruwa Local Board	
1. Mr. S. H. Ushe	Town Engineer	
2. Mr. C. Nyarudzo	Sewerage Operator	

交通エネルギー省	Ministry of Transport and Energy Resources	
1. Mr. T. C. Temba	Consultant Meteorologist	Dept. of Meteorological Services
健康・児童福祉省	Ministry of Health and Child Welfare	
1. Mr. S. Musingarambwi	Director	Environmental Health Services
土地・水資源開発省	Ministry of Lands and Water Development	
1. Mr. Sengayi	Senior Hydrogeologist	Dept. of Water Development
2. Dr. M. S. Mupanduki	Senior Hydrogeologist	〃
3. Mr. G. Mawere	Chief Hydrologist	〃
4. Mr. S. Mtetwa	Senior Water Pollution Control Officer	〃
環境・観光省	Ministry of Environment and Tourism	
1. Mr. Jamare	Secretary	Dept. of Natural Resources
2. Mr. Muswibe		
スタンダード協会	Standards Association of ZIMBABWE	
1. Mrs. Chikomba		
国際協力事業団　青年海外協力隊		
1. 奈良輪　睦美	ジンバブエ調整員	
2. 尾崎　保子	〃	
在ジンバブエ日本国大使館		
1. 小西　正樹	大使	
2. 岡本　治男	公使	
3. 安村　廣宣	参事官	
4. 小路　康雄	一等書記官	
5. 西谷　真也	派遣員	

6．現地調査経費資料

（1）傭人費

1）地方行政・都市農村開発省提供の資料による。

項　目	年　収（Z$）	月　額（Z$）	日　額（Z$）
技術者（A）	95,496	7,958	398
技術者（B）	63,108	5,259	263
タイピスト	53,652	4,471	224
電話番等	13,008	1,084	54
ドライバー （ドライバー）	24,276	2,023	101 70

注）1．（ドライバー）の日額（Z$）は、今回現地調査で借り上げた「ELITE CAR RENTAL」社の料金表による。
2．月額の20分の1を日額とする。

2）Surveyor General's Department 提供の資料による。

項　目	時間額（Z$）	日　額（Z$）
コンサルタント	300	2,100
上級専門家	60	420
専門家	50	350

注）一日7時間労働とする。

（2）水質調査費

ハラレ市上下水道局の水質試験室提供の資料による。

試験項目	金額 (Z$)	試験項目	金額 (Z$)
(a) Bacteriological Examination of Water and Sewage Effluents		(c) Sewage Effluent Analyses	
		pH	11.25
Presumptive Coliform Count (Water)	27.00	Total Hardness	11.25
Confirmatery Test (44℃+Indale) (Water)	12.50	*Total Alkalinity*	11.25
Total Plate Count (Water)	15.75	Chloride	11.25
E. Coli Count (Sewage Effluents)	31.45	Chlorine Residual	11.25
		Settleable Solids	11.25
(b) Water Analyses		Nitrade	14.65
		Stability	19.15
pH	11.25	Ca/Mg Ratio	19.15
Total Hardness	11.25	Preparation for Metals	19.15
Total Alkalinity	11.25	Screening for Heavy Metals	19.15
Alkalinity 'P'	11.25	Physical Properties (colour etc.)	19.15
Colour	11.25	Dissolved Oxygen	19.15
Calcium	11.25	Ammonia (Free and Saline)	21.30
Magnesium	11.25	Total Phosphate	21.30
Chloride	15.75	Permanganate Value	28.15
Suspended Solids	18.00	Arsenic	28.15
Dissolved Solids	19.15	Phanol	28.15
Total Solids	19.15	C.O.D	29.20
O - Phosphate	19.15	Detergents	29.20
Silicete	19.15	Soap, Oil, Crease etc.	27.00
Free Carbon Dioxide	19.15	Barium	27.00
Chromate	21.30	Boron	27.00
Iron	21.30	Copper	27.00
Manganese	21.30	Iron	27.00
Plouride	21.30	Manganese	27.00
Lime Dosage	21.30	*Sulfate*	27.00
Chloride Demand	15.75	Total Undissolved Solids	27.00
Total Phosphate	21.30	Total Dissolved Solids	27.00
Nitrate	21.30	Total Solids	27.00
Aluminum	21.30	B.O.D	27.00
Dissolved Oxygen	21.30	Chronium	27.00
Free and Saline Ammonia	21.30	Cyanides	27.00
Alluminoid Ammonia	21.30	Flouride	27.00
B.O.D	27.00	Total Nitrogen	27.00
Permanganate Value	28.05	Lead	28.15
Detergent	27.00	Nickel	28.15
Sulphate	27.00	Calcium	28.15
Floculation Test	27.00	Mercury	33.70
Langelier Index	27.00	Zinc	33.70
Turbidity	15.75		
Conductivity	17.75		

（3）地形図等購入費

Surveyor General's Department より入手した資料による。

Section	Scale	Description	Recommended Price (Z$)	Current Price (Z$)
1	1:1,000,000	ICAO 4 Maps Series	20.00	15.00
	1:1,000,000	Aeronautical Single Map	25.00	20.00
	1:1,000,000	Relief-unlayered with overprint showing 1:50,000 Sheetfall	25.00	20.00
	1:1,000,000	Hydrological Zones Map	25.00	20.00
	1:1,000,000	Provisional Soil Map	25.00	20.00
	1:1,000,000	Land Classification	25.00	20.00
	1:1,000,000	Land Classification showing showing 1:50,000 & 1:250,000 sheetfall	25.00	20.00
	1:1,000,000	Land Classification showing showing 1:50,000 & 1:250,000 sheetfall & UTM Grid	25.00	20.00
	1:1,000,000	Natural Regions & Farming Areas	25.00	20.00
	1:1,000,000	Admin. Areas Map	25.00	20.00
	1:1,000,000	Population Density	25.00	20.00
	1:1,000,000	Population Distribution	25.00	20.00
	1:1,000,000	Road Map of Zimbabwe	40.00	35.00
2	1:500,000	Topographical 4 Map Series	25.00	20.00
3	1:250,000	Topo-Cadastral 32 map Series	25.00	20.00
4	1:25,000	Orthophoto Maps Ammonia Paper	16.00	12.00
		Special Ammonia Paper	20.00	16.00
5	1:50,000	Topo-Cadastral 570 Map Series	20.00	15.00
	1:25,000	Topo-Cadastral Map Series	25.00	20.00
	1:25,000	Bulawayo 6 Map Series	20.00	15.00
	1:40,000	Airport Crash Maps 7 Map Series	10.00	6.00
6	1:5,000	Topo-Cadastral Map Series	18.00	15.00
		Ammonia Print	15.00	12.00
	1:5,000	Harare Civic Centre	8.00	5.00
7	1:2,500	Topo-Cadastral Harare 39 Maps pre 1963	12.00	12.00
8	1:1,000,000	Kariba Lake Charts 3 Map Series	25.00	20.00
12	Various	Contract Mapping Various Areas	15.00	12.00
Reconnaisance		Mapping Various Areas	15.00	12.00

Section	Scale	Description	Recommended Price (Z$)	Current Price (Z$)
13	1:2,500,000	Federal Atlas 24 Maps	12.00	10.00
14	1:7,500	Harare: Highfield Mbare	12.00	10.00
	1:10,000	Bulawayo: Njube, Mzilikazi, Luveve, Westgate	12.00	10.00
	1:15,000	Central Harare	12.00	10.00
	1:20,000	Livingstone/Victoria Falls Street Map	8.00	6.00
	1:33,333	Harare Street Map (with Gazeteer)	30.00	25.00
	1:33,333	Bulawayo Street Map	20.00	15.00
	1:20,000	Tourist Map of Victoria Falls	25.00	20.00
	1:25,000	Lake McLlwaine Tourist Map	25.00	20.00
	1:42,000	Lake Kyle & Great Zimbabwe Tourist Map	25.00	20.00
	1:63,360	Nyanga Tourist Map	25.00	20.00
	1:50,000	Rhodes Matopos National Park	25.00	20.00
	1:200,000	Hwange Tourist Map	25.00	20.00
	Various	Kariba Tourist Map	20.00	15.00
	Various	Mana Pools Tourist Map	12.00	10.00
	1:50,000	Banket 1730 A4 Soil Map	20.00	15.00
	1:1,250,000	African Population Distribution Map 1969	15.00	15.00
	1:1,250,000	African Population Density Map 1969	12.00	12.00
	1:2,500,000	Relief Map - Layered	15.00	12.00
	1:2,500,000	Relief Map - Unlayered	15.00	12.00
	1:2,500,000	Relief Map with 1:250,000 sheetfall	15.00	12.00
	1:2,500,000	Climate Comfort & Discomfort Belts & Building Design	12.00	12.00
	1:2,500,000	Average Rainfall Maps for the Months January to December 1968	12.00	12.00
	1:2,500,000	Mean Annual Rainfall Map	12.00	12.00
	1:2,500,000	Highest 24 Hour Rainfall Totals On Record	12.00	12.00
	1:3,000,000	Skeleton Map	5.00	5.00
	1:100,000	Old Map Series	15.00	15.00
	1:500,000	Aeronautical Series Old Maps	20.00	20.00

7. 主要収集資料リスト

No.	名　　称	制作者	入手先
1.	HARARE COMBINATION MASTER PLAN	HARARE COMBINATION MASTER PLAN	MLGRUD
	WRITTEN STATEMENT	PREPARATION AUTHORITY	
	REPORT OF STUDY	26 AUGUST 1992	
	MAP KEY DIAGRAM PROPOSALS PIAN		
	CITY OF HARARE		
	CHITUNGWIZA		
2.	NORTON MASTER PLAN FIRST DRAFT	NORTON TOWN COUNCIL	MLGRUD
	WRITTEN STATEMENT	DECEMBER 1994	
	REPORT OF STUDY		
	MAP NORTON LOCAL DEVELOPMENT PLAN		
	EXISTING TOWN BOUNDARY		
	WATER SUPPLY		
	INFRASTRACTURE (EXISTING) MAP3		
	LAND USE MAP5		
	MASTER PLAN PROPOSALS MAP6		
	PRESENT NORTON TOWN COUNCIL BOUNDARY		
	SEWER RETICULATION WARDS 1 TO 12		
	WATER RETICULATION WARDS 1 TO 12		
3.	CENSUS 1992	CENTRAL STATISTICAL OFFICE (CSO)	CSO
	ZIMBABWE NATIONAL REPORT	NOVEMBER 1994	
	PROVINCIAL PROFILE MASHONALAND WEST		
	PROVINCIAL PROFILE MASHONALAND EAST		
	PROVINCIAL PROFILE HARARE		
4.	MAP	SURVEYOR-GENERAL'S DEPT. (SGD)	SGD
	ZIMBABWE LAND CLASSIFICATION	1:1,000,000 (1994)	
	ZIMBABWE SHEET 2	1:500,000 (1984)	
	ZIMBABWE SHEET SE-36-5 HARARE	1:250,000 (1992)	
	ZIMBABWE SHEET SE-36-6 MUTOKO	1:250,000 (1991)	
	ZIMBABWE SHEET SE-36-9 CHEGUTU	1:250,000 (1990)	
	ZIMBABWE SHEET SE-36-10 MUTARE	1:250,000 (1990)	
	NORTON 1730 D3	1:50,000 (1990)	
	LAKE CHIVERO 1730 D4	1:50,000 (1994)	
	HARARE 1731 C3	1:50,000 (1993)	
	GOROMONZI 1731 C4	1:50,000 (1984)	
	STREET MAP OF THE CITY OF HARARE	1:33,333 (1989)	
	CHITUNGWIZA STREET MAP	1:15,000 (1995)	
	ZIMBABWE	1:2,500,000 (1983)	
	MEAN ANNUAL RAINFALL	1:2,500,000 (1984)	
	HIGHEST 24 HOUR RAINFALL TOTALS ON RECORD	1:2,500,000 (1968)	
	HARARE 1984 1:25000 ZIMBABWE BLANKET PHOTOGRAPHY 6th SERIES		
	ZIMBABWE HYDROLOGICAL ZONES	1:1,000,000 (1984)	

5.	THE NATIONAL RURAL WATER SUPPLY AND SANITATION PROGRAMME (DRAFT) ANNUAL PROGRESS REPORT FOR FY 1994/95 (HEAD OFFICE PROJECTS)	THE NATIONAL COORDINATION UNIT	EMBASSY OF JAPAN
6.	MAP (7 SHEETS) OF MASTER PLAN FOR WATER DISTRIBUTION VOLUME 3 : INTERIM MASTER PLAN (DRAFT FINAL ISSUE)	DEPT. OF WORKS, CITY OF HARARE NOVEMBER 1993	CITY OF HARARE
7.	MAP (6 SHEETS) OF CROWBOROUGH SEWAGE TREATMENT WORKS CONTRACT NO. ST/11/91 VOLUME 1 : CATCHMENT STUDY (FINAL REPORT)	DEPT. OF WORKS, CITY OF HARARE AUGUST 1993	CITY OF HARARE
8.	STATISTICAL YEARBOOK 1989	CENTRAL STATISTICAL OFFICE(CSO) APRIL 1989	GOVERNMENT PUBLICATIONS
9.	THE ATMOSPHERIC POLLUTION PREVENTION ACT CHAPTER 318	THE GOVERNMENT PRINTER, HARARE JUNE 1971	PRINTING AND STATIONERY DEPT.
10.	BUDGET ESTIMATES FOR THE YEAR ENDING JUNE 30, 1996	MINISTER OF FINANCE JULY 1995	GOVERNMENT PUBLICATIONS
11.	BUDGET STATEMENT, 1995	MINISTER OF FINANCE JULY 1995	GOVERNMENT PUBLICATIONS
12.	SECOND FIVE-YEAR NATIONAL DEVELOPMENT PLAN 1991-1995	THE GOVERNMENT PRINTER, HARARE DECEMBER 1991	GOVERNMENT PUBLICATIONS