給水施設建設による地域住民の経済的便益について評価する。

(13)給水計画の策定

選定された地域毎に給水計画を立案する。計画は次の項目について行う。

①給水システムの策定

②実施工程計画

③運営及び管理体制

④事業費の算定

⑤社会及び経済的評価

⑥環境影響評価：IEEにおいてEIAが必要と判断された場合は，環境影響の調査，予測，評価を行い，環境保全目標の設定，環境影響を回避するための対策の提示を行う。

4－4　調査工程並びに要員計画

本格調査に於ける全体工程は約24カ月が見込まれる。調査地は，5月から10月にかけて雨期となり，アクセス道路の悪化により作業能率の低下が予想される。また調査の性格から次のような3フェーズの工程となる。

・第Ⅰフェーズ：地下水賦存形態に基づく地域区分とボーリングサイトの決定
－資料整理，水文・地質調査，物理探査等－

・第Ⅱフェーズ：区分地域毎の詳細調査と地下水賦存量の評価
－試掘調査，水文調査，水需要調査，地下水収支シミュレーション－

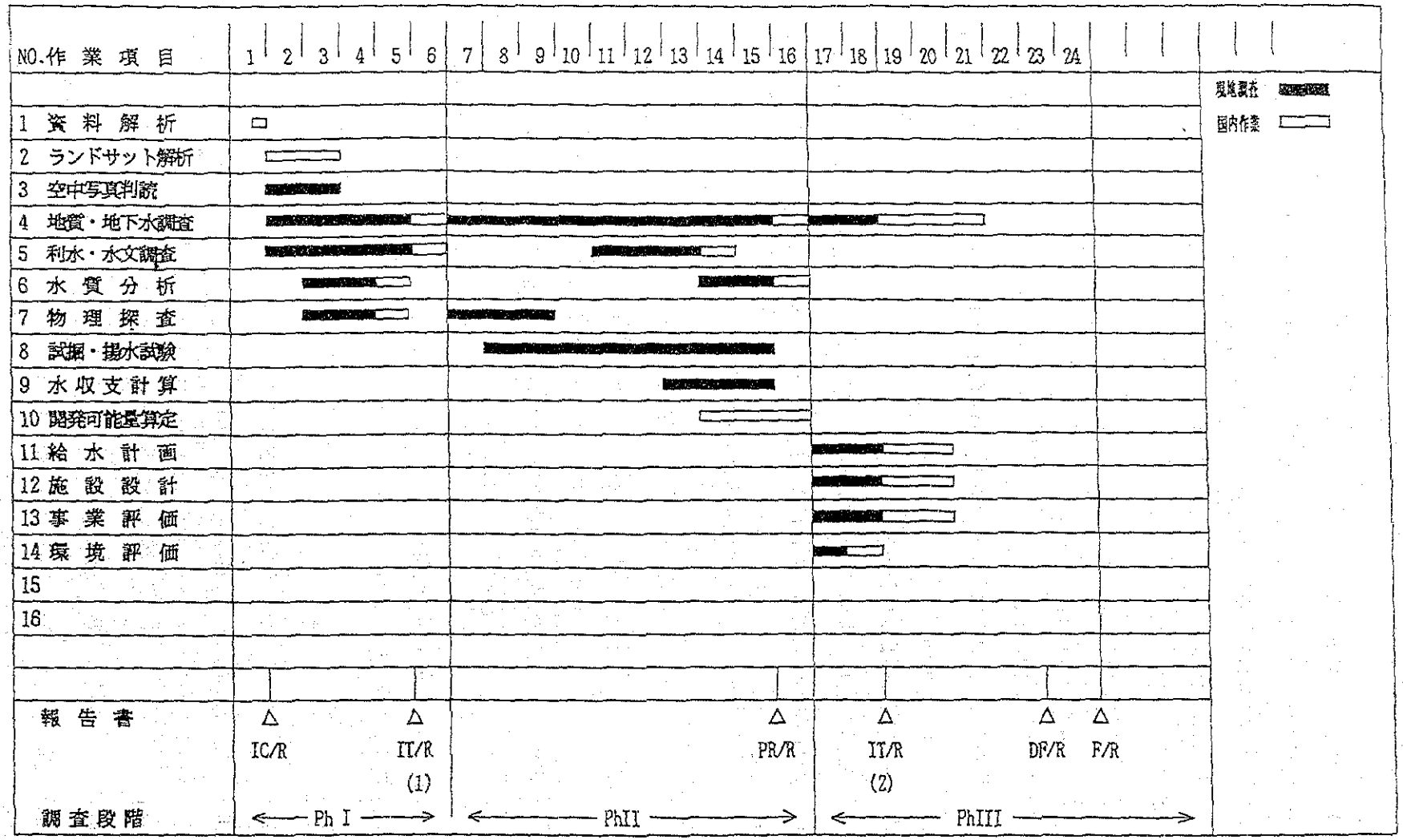
・第Ⅲフェーズ：開発優先地域の選定と給水施設計画の策定
－計画基準，施設設計，実施計画，事業評価－

本格調査の全体工程は暫定的に表－11に示すとおりとする。

調査要員は，次の専門家が必要と考えられる。

①総　　括：団長
②水文地質A：副団長，水文地質全般
③水文地質B：地質調査（空中写真判読を含む）
④リモートセンシング：ランドサット映像解析（国内のみ）
⑤水　　文：水位観測，気象，流量
⑥水　　質：水質分析
⑦物理探査A：電磁波探査，電気探査
⑧物理探査B：電磁波探査，電気探査

表－１２　全体調査計画（案）


NO.作業項目
1 資料解析
2 ランドサット解析
3 空中写真判読
4 地質・地下水調査
5 利水・水文調査
6 水質分析
7 物理探査
8 試掘・揚水試験
9 水収支計算
10 開発可能量算定
11 給水計画
12 施設設計
13 事業評価
14 環境評価
15
16
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
現地調査
国内作業
報告書
IC/R
IT/R (1)
PR/R
IT/R (2)
DF/R
F/R
調査段階
Ph I
PhII
PhIII

⑨ボーリング管理A：井戸削井指導，揚水試験

⑩ボーリング管理B：井戸削井指導，揚水試験

⑪給　水　計　画：給水計画

⑫施　設　計　画：給水施設設計

⑬事　業　評　価：経済・財務分析，事業評価

⑭環　境　評　価：環境影響調査

4－5　報告書作成等

本格調査団によって作成され，JICAに提出されるべき報告書等は以下のとおりである。

①インセプション・レポート：

国内事前準備作業終了時　英文35部（内20部先方提出用）

日本文15部

②インテリム・レポート(1)：

フェーズI現地作業終了時　英文35部（内20部先方提出用）

日本文15部

③プログレス・レポート：

フェーズII現地作業終了時　英文35部（内20部先方提出用）

④インテリム・レポート(2)：

フェーズII国内作業終了時　英文35部（内20部先方提出用）

日本文15部

⑤ドラフト・ファイナル・レポート：

フェーズIII国内作業終了時　英文35部（内20部先方提出用）

日本文15部

フィジー政府は，ドラフト・ファイナル・レポート受領後1カ月以内にJICAにコメントを提出する。

⑥ファイナル・レポート：英文55部（内40部は先方提出用）

日本文15部

ドラフト・ファイナル・レポートに対する先方コメントの受領後2カ月以内に提出する。

⑦月報：契約期間中の各月毎の業務内容及び作業進捗状況等にかかる和文月報を作成し，翌月早期に提出する。

⑧会議記録等：相手国政府との会議記録，収集資料及びそのリストを提出する。

4－6　本格調査資機材計画

4－6－1　井戸計画

(1)調査対象地域における MRD 井戸掘削状況

①井戸構造

事前調査期間中に，入手した井戸掘削データー（本格調査の対象地域内のタバラウ，ラビラビ地区に５本とヤンガラ地区に５本）から井戸構造をまとめると図－16のようになる。掘削は基本的に，7-5/8"にて掘削後6"PVC仕上げとしているが，硬質岩は5-1/2"裸孔仕上げ（一部，5-1/2"掘削後7-5/8"で拡孔し裸孔仕上げ）となっている。

②揚水試験結果

揚水試験結果は表－12のとおりである。タバラウ，ラビラビ地区は，揚水量，比湧出量ともまちまちであるが，ヤンガラ地区は全体に高い湧出量を持っている。

エアーリフトによる揚水試験は，平均して２～３時間程度の揚水と１～２時間程度の回復試験を行っている。

(2)本格調査に於ける井戸設計

本格調査に於いて，地下水ポテンシャル把握のために行われるボーリングは，将来的に生産井として利用される事を考慮して以下のような仕様とする。

①井戸本数

調査地域内の５～６地区に対して20本の井戸を掘削する。井戸の掘削位置は本格調査で決定される。

②掘削深度及び掘削孔径

掘削深度は MRD の実績から判断し，40～100m で平均70m とする。

掘削延長　70mx20本＝1400m

掘削孔径は，6″スティールケーシングに対し8-1/2″仕上げとする。

③掘削方法

調査地内の地質を考慮すると，４タイプの井戸構造が考えられる。各井戸構造は図-19に示した。また基本的な掘削手順は，図－18の作業工程フローに従ったものとなる。

4－6－2　資機材計画

必要資機材リストは，表－15に示した。またそれらの詳細は添付資料７に示した。

(1)補給資機材（TONE TOP-200）

① TOP-200用スペアーパーツ

スペアーパーツは油圧関係を中心に各部分の消耗品の補充が必要である。（特にパワースベル部のオイルモーター，油圧システム部のオイルモーター等）

②掘削ツールス

掘削ツールスは，ドリルパイプの摩耗が激しく，また本格調査での掘削孔径がMRDの通常の孔径と異なるため，ワークケーシング等の補充が必要である。

③コンプレッサー

掘削用のコンプレッサーは，MRDに在庫しているPDSH-500が使用可能であるが，スペアーパーツの補充が必要である。また能力的に8-1/2"用のコンプレッサーとしては容量が小さいので，通常の施工能率よりは低下すると考えられる。

(2)新規井戸掘削用資機材

①主要資機材

掘削機（トップドライブロータリー型トラック登載式掘削機）１台

高圧コンプレッサー　１台

掘削ツールス　１式

支援車両　５台

他

②調査器具

電気探査器，電磁波探査器，水質分析器，検層器，自記水位計，地下水位計，水量計，パーソナルコンピューター，レーザープリンター等

４－７　調査実施体制

本調査のカウンターパーツは地下水開発を担当している土地・鉱物資源省鉱物資源局である。基本設備・公共事業省公共事業局は，給水計画を管轄している。本格調査ではその他関係官庁との接触が必要な為，スムースな調査の実施及び調査終了後の計画実施等を考慮して現地政府によるステアリング・コミッティを設置する。ステアリング・コミッティのメンバーは以下のとおりである。

鉱物資源局

公共事業局

土地・鉱物資源省

住宅都市開発省環境行政課

厚生省

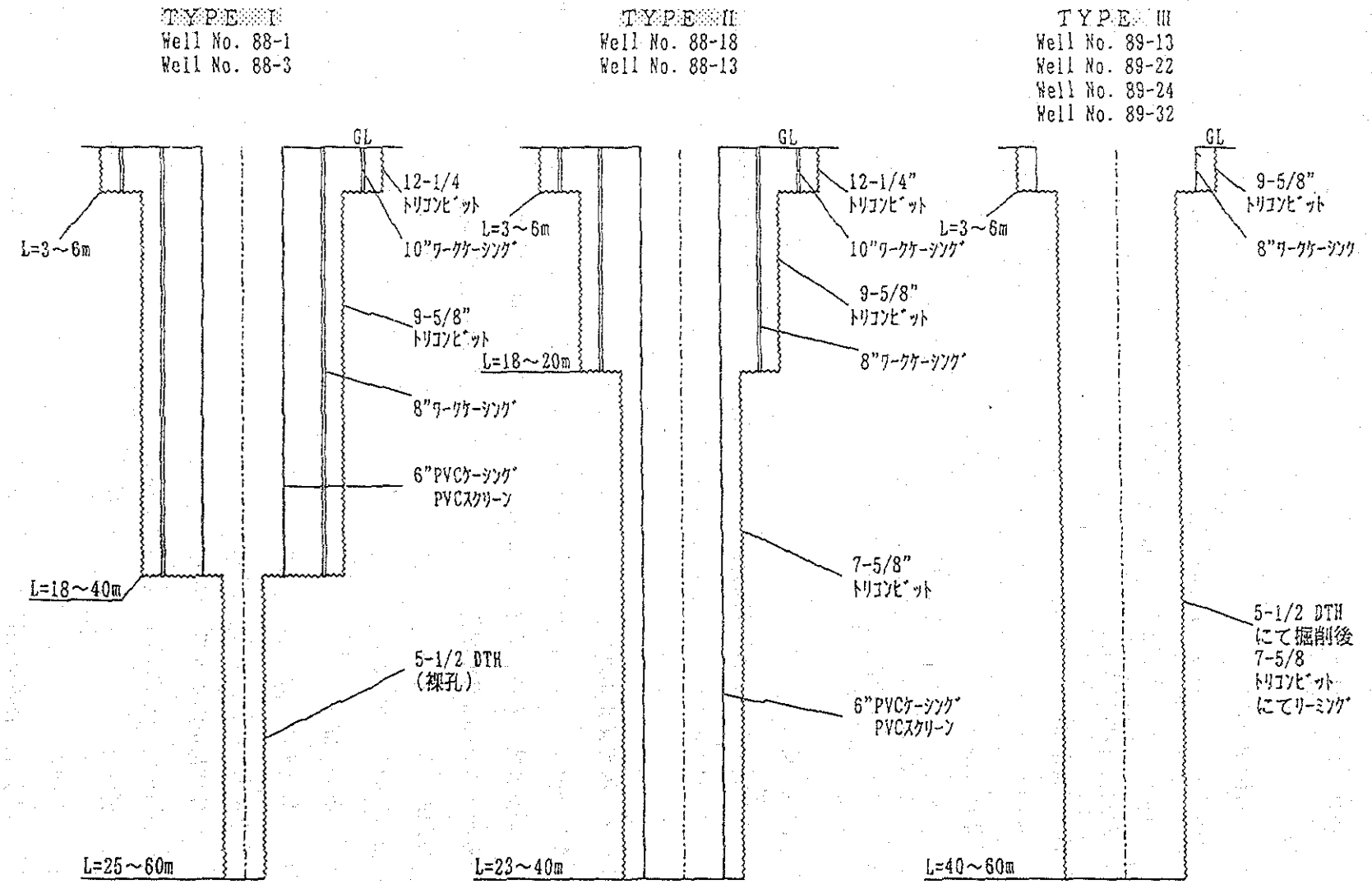
外務省

財務省

フィジー国務・地域開発省

中央計画室

図－１６　調査地域におけるＭＲＤ掘削井戸の構造図



表－１３　作業別施工日数及び揚水試験結果

井戸No.	88-1	88-18	88-3	88-13	89-13	89-22	89-24	89-32
ｻｲﾄ名	TAVARAU	TVARAU	R.RAVI	R.RAVI	YAQARA	YAQARA	YAQARA	YAQARA
掘削深度（m）	25	24.5	60	40	60	40	60	56
作業別施工日数(日)								
仮設	4	4	?	5	?	?	?	?
掘削	3.5	3.5	23	11	13.5	8.5	11.5	7.5
拡孔	3	1	-	-	2	3	2	-
ｴｱｰﾘﾌﾄ,孔内洗浄	9	7	14	6	8	4	11	3
ｹｰｼﾝｸﾞ挿入	3.5	2	5	3	0.5	0.5	1.5	0.5
機械ﾄﾗﾌﾞﾙ	-	-	-	4	2	-	-	-
砂利充填	1	2	?	1	2	-	-	-
撤去	3	?	2	?	?	?	?	?
揚水試験								
揚水量(L/min)	324	17	21	193	261	439	492	318
水位降下(m)	1.65	12.16	23.96	6.51	13.95	0.2	0.4	5.47
透水量係数(　/d)	316.9		0.23	41.38		3895	2574	280
比湧出量(L/m/m)	196	1.4	0.9	29.6	18.7	2195	1230	58
試験方法	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ	ｴｱｰﾘﾌﾄ

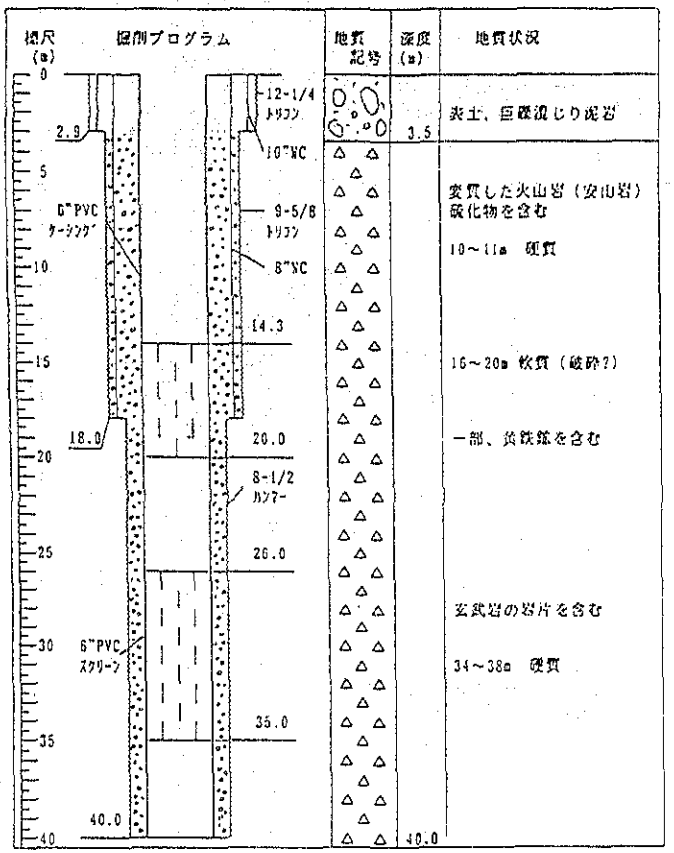
表－１４　調査地域における水井戸掘削実績

井戸No	Site名	位置 経度	位置 緯度	標高 (m)	深度 (m)	掘削 12-1/4"TR	掘削 9-5/8"TR	掘削 7-5/8"TR	掘削 5-1/2"DTH	リーミング 7-5/8"	リーミング 9-5/8"	ワークケーシング 10"	ワークケーシング 8"	ワークケーシング 6"	PVC ケーシング	PVC スクリーン	裸孔	グラベル
88-1	TAVARAU	177° 34.8'E	17° 30.8'S	24.86	25	0～ 3m	--	--	3～25m	--	3～ 18m	--	0～18m	--	0～8m	8～21m	21～25m	6～21m
						0.5日(3.5hr)	--	--	3日(23.0hr)	--	3日(23hr)							
88-18	TAVARAU	177° 34.8'E	17° 30.5'S	24.86	24.5	0～ 3m	3～20m	--	20～24.5m	20～24.5m	--	0～3m	0～20m	--	0～6m、23～24.5	6～23m	--	?
						0.5日(4.0hr)	2日(11.5hr)	--	1日(4.0hr)	1日 (2hr)	--							
88-3	RAVI RAVI	?	?	?	60	0～6.3m	6.3～40m	--	40～60m	--	--	0～6m	0～39m	--	0～7m	7～40m	40～60m	?
						5日(38hr)	13日(107hr)	--	5日(35hr)	--	--							
88-13	KARAVI RAVI RAVI	?	?	34.76	40	0～2.9m	2.9～18m	18～40m	--	--	--	0～3m	0～18m	--	0～14.3m 20～26m 35～40m	14.3～20 26～35m	--	3～40
						3日(17hr)	4日(33hr)	3日(34hr)	--	--	--							
89-13	YAQARA	177° 59'E	17° 26.8'S	4.71	60	--	0～3m	--	3～60m	3～60m	--	--	0～3m	--	--	--	3～60m	--
						--	1日(3hr)	--	12.5日(70hr)	2日(15hr)	--							
89-22	YAQARA	?	?	8.43	40	--	0～3m	--	3～40m	3～38.3m	--	--	0～3m	--	--	--	3～40m	--
						--	0.5日(3hr)	--	8日(41.5hr)	3日(14hr)	--							
89-24	YAQARA	177° 59'18"E	17° 27.4'S	?	60	--	0～3m	3～22.7m	22.7～60m	22.7～60m	--	--	0～3m	0～21m	--	--	3～60m	--
						--	0.5日(2hr)	3日(20hr)	8日(52hr)	2日(11hr)	--							
89-32	YAQARA	?	?	?	56	--	0～6m	6～56m	--	--	--	--	0～6m	--	--	--	6～56m	--
						--	1日 (4hr)	6.5日(43hr)	--	--	--							
88-19	TAVARAU	177° 34.8'E	17° 30.5'S	24.53	25	ＮＸによるコアーボーリング												
89-31	YAQARA	?	?	?	43	ＮＸによるコアーボーリング												

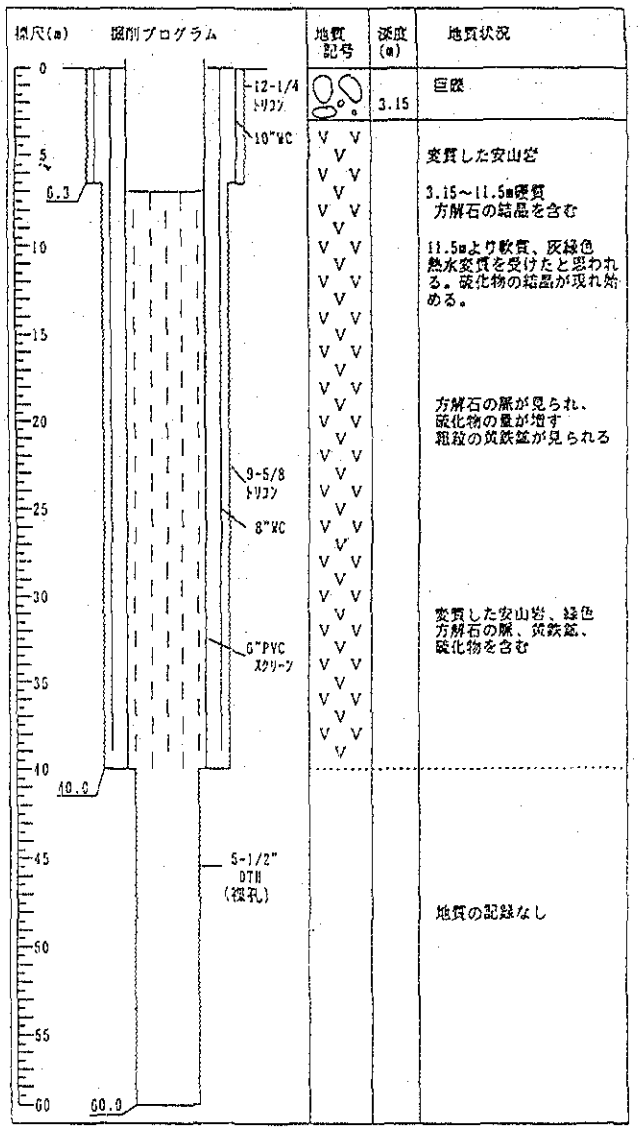
※表中の日数と時間は、現地の日報より計算したものである。

（図－１７）

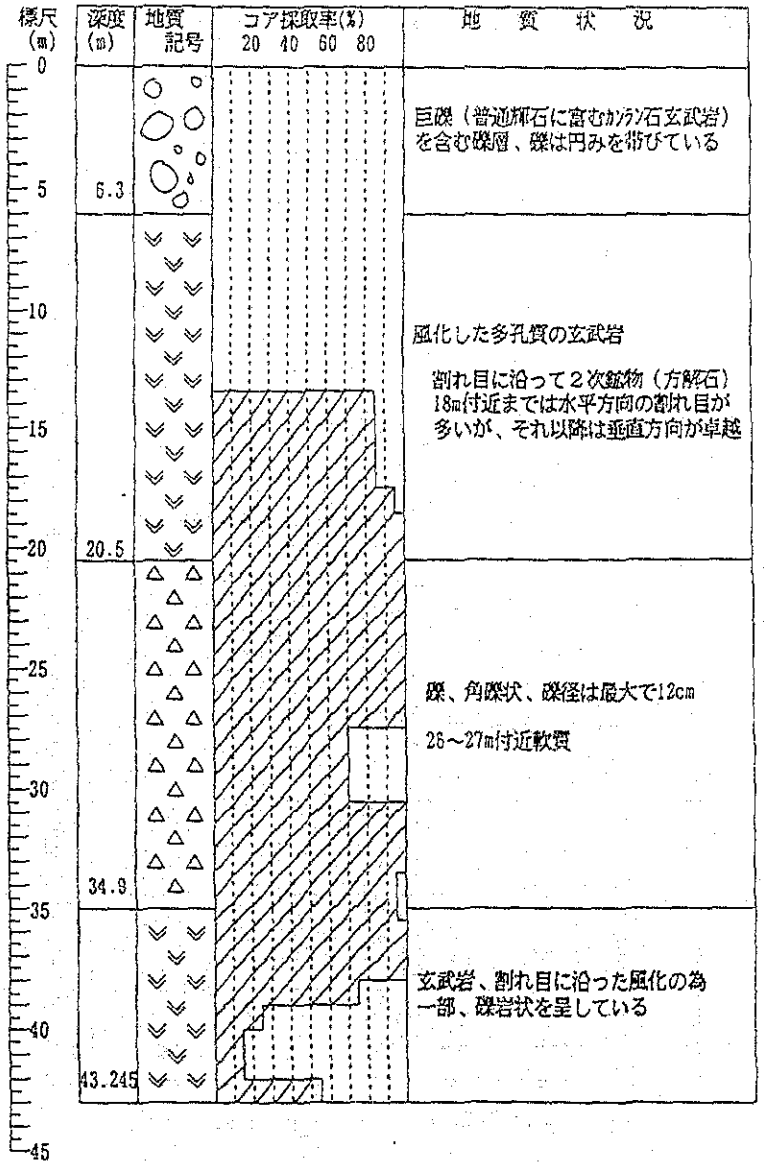
地質柱状図　88－13 RA.I RAVI

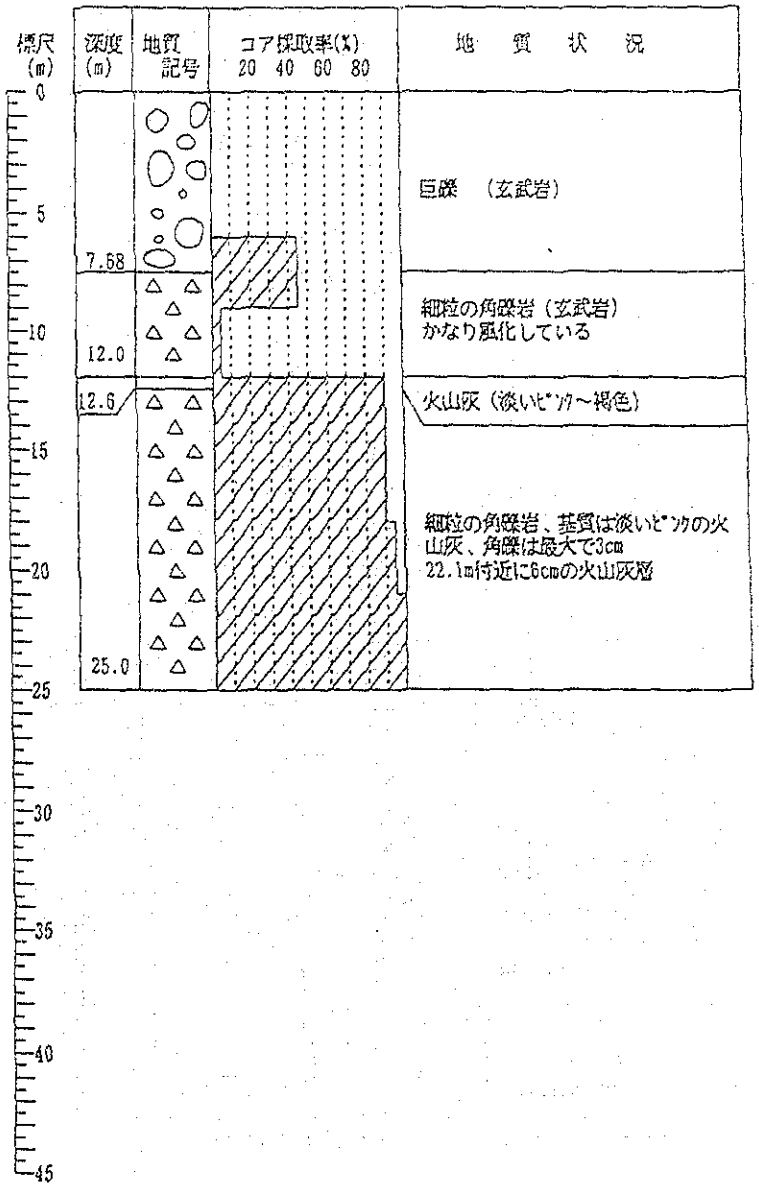


地質柱状図　88－ 3 RAVI RAVI

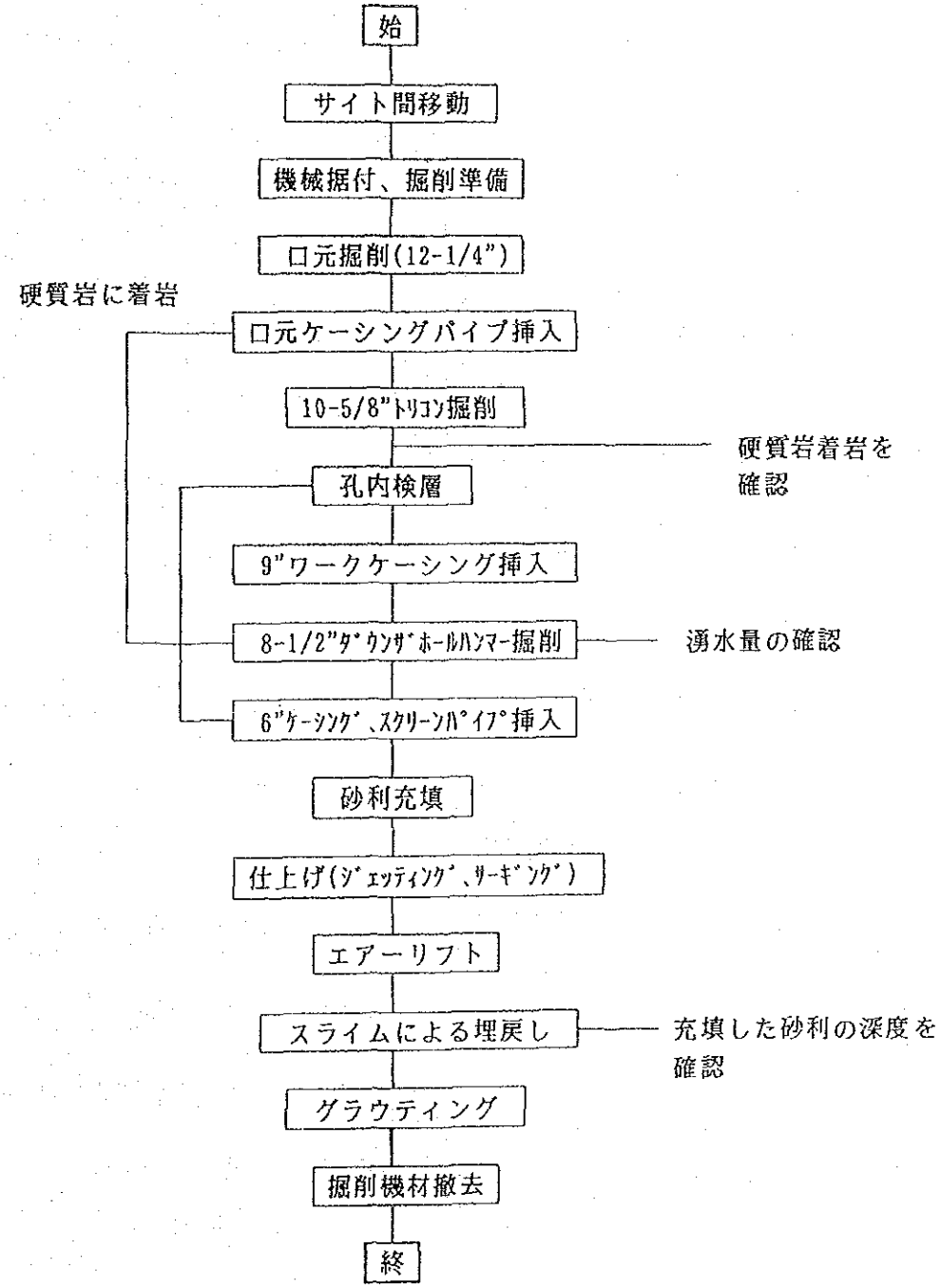


地質柱状図　89-31　YAQARA　　（図－１７）　　地質柱状図　88-19　TAVARAU

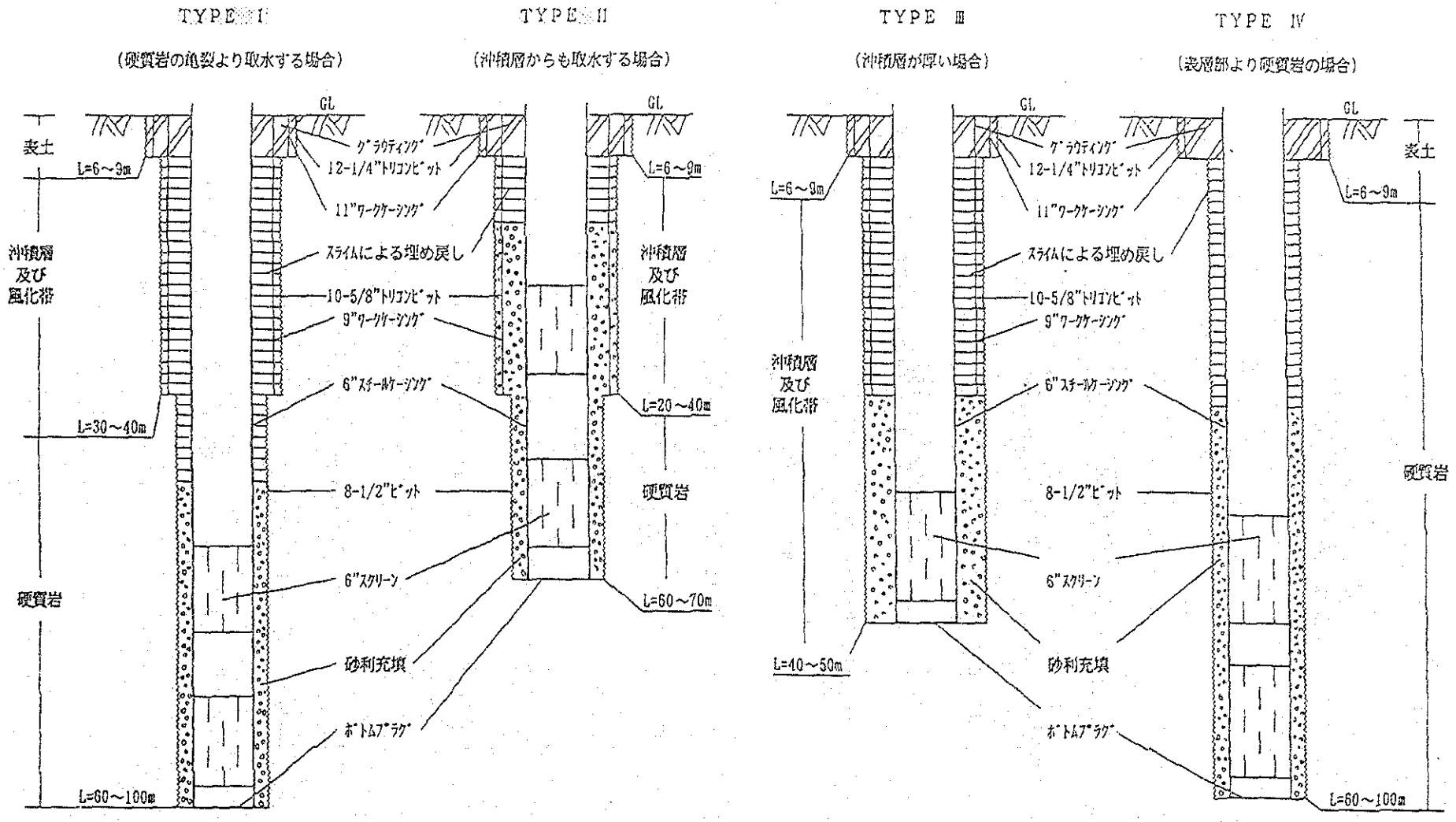




図－１８　井戸掘削作業工程フロー



図－１９　本格調査における井戸構造図



表－１５　調査用資機材リスト

品　　名	仕　　様	数　量
(1)　補給資機材		
1.　TOP-200用 ｽﾍﾟｱﾊﾟｰﾂ		1　式
2.　掘削ツール		1　式
3.　ｴｱｰｺﾝﾌﾟﾚｯｻｰ(PDSH-500)用 ｽﾍﾟｱﾊﾟｰﾂ		1　式
(2)　新規井戸掘削用資機材		
1.　ﾄﾗｯｸ搭載型掘削機	型式 ﾄｯｼﾞﾄﾞﾗｲﾌﾞ型、泥水ﾛｰﾀﾘｰ/DTH掘削用削井機 掘削能力 100m以上8-1/2"DTH/10-5/8"ﾋﾞｯﾄ泥水掘削 駆動方式:ﾄﾗｯｸｴﾝｼﾞﾝPTO 4WD ﾃﾞｨｰｾﾞﾙｴﾝｼﾞﾝ 泥水ﾎﾟﾝﾌﾟ 複動２連ﾋﾟｽﾄﾝ型 600　/min×22kg/	1　式
2.　掘削機用標準付属品		1　式
3.　泥水掘削工法用ｱｸｾｻﾘｰ		1　式
4.　ﾀﾞｳﾝｻﾞﾎｰﾙﾊﾝﾏｰ工法用ｱｸｾｻﾘｰ		1　式
5.　高圧ｴｱｰｺﾝﾌﾟﾚｯｻｰ	ｽｸﾘｭｳｰ回転型、 吐出空気量　25 m^3/min 吐出圧力　24 kg/cm^2	1　台
6.　支援車両	ｶｰｺﾞﾄﾗｯｸ、軽車両	1　式
7.　井戸仕上げ用機材		1　式
8.　揚水試験用資機材	水中ﾎﾟﾝﾌﾟ,発電機、他	1　式
9.　井戸用ｹｰｼﾝｸﾞ・ｽｸﾘｰﾝ	6"	1　式
10.　掘削用調泥剤	ﾍﾞﾝﾄﾅｲﾄ,CMC,発泡剤	1　式
11.　ｽﾍﾟｱﾊﾟｰﾂ/ｱｸｾｻﾘｰ		1　式
12.　作業用工具、その他		1　式
(3)　調査器具、その他		
1.　電気探査器		1　式
2.　ＥＭ探査器		1　式
3.　ﾄﾗﾝｼｰﾊﾞｰ	水平距離　1km程度	1　式
4.　水質分析器具	ﾎﾞｰﾀﾌﾞﾙ水質計	2　式
5.　自記水位計	1ヶ月巻	20　台
6.　地下水位計	100　m	2　台
7　井戸検層器	比抵抗、自然電位、温度、ｶﾞﾝﾏｰ	2　台
8.　ﾊﾟｰｿﾅﾙｺﾝﾋﾟｭｰﾀｰ	ﾚｰｻﾞｰﾌﾟﾘﾝﾀｰ共	1　台
9.　流量計	0.03～3.0m/sec	1　台
10.　電気伝導度計	100m	1　台

付属資料—1. 要請書

PROJECT PROPOSAL

NORTH VITI LEVU GROUNDWATER PROJECT

A. SUMMARY

1.	Project Title	: NORTH VITI LEVU GROUNDWATER PROJECT
2.	Sector	: Water Resources
3.	Implementing Agency	: Mineral Resources Department
4.	Project	: To carry out detailed groundwater resource assessment of northern Viti Levu and drilling of atleast 20 test/production boreholes with the aim of providing adequate water supplies for all the population. The objective also addresses the improved health and economic status of the rural people through the development of proper, adequate reliable and safe water supplies.
5.	Project Area	: An area that extends eastward from Lautoka toward Raki Raki (see Figure 1).
6.	Population	: Some 88 522 people live within the proposed study area (1986 Census).
7.	External Funding Requirements	: FULL
8.	Project Description	: The proposed project will be carried out in two phases.

Phase 1
During the first phase of the survey deatailed groundwater investigation of the area will be undertaken with the aim of selecting drilling sites. The work will include:

i) Review of all existing geological, hydrological, meteorological and hydrogeological data. This includes a review of all previous work undertaken.

ii) Interpretation of aerial photographs, SLAR and satellite imagery.

iii) Selection of sites and areas for geophysical investigations.

iv) Compilation of preliminary geological and hydrogeological maps from available data.

iv) Field survey to carry out geological and geophysical work. This will include geophysical techniques suitable for the particular environment (EM-conductivity, resistivity, etc.). Hydrometric survey to produce water-table measurements, sampling for chemical analysis data and a survey of present water supply systems.

v) Interpretation of geological, geophysical, chemical, and hydrometric data.

vi) Revision of preliminary geological and hydrogeological maps.

vii) Selection of drilling sites and areas on the basis of analysis of geophysical and geological data.

viii) Preparation for second phase survey and drilling of some boreholes.

Phase 2

i) Continuation of detailed geological, hydrogeological and geophysical surveys of more specific sites selected during phase 1 of the project.

ii) Test drilling and pumping tests. Drilling of atleast 20 test/production boreholes during both the phases is envisaged.

iii) Interpretation of all data collected, water balance calculations and updating of preliminary geological and hydrogeological maps.

iv) Assessment of groundwater resources and development potential. Identification of areas or sites for future production boreholes.

9. Project Duration : 2-3 years

B. PURPOSE

The principal outputs of the project are :

i) Production of a 20-year plan for groundwater supply development for northern Viti Levu. This will include detailed assessment of groundwater resource and planning for safe reliable supply for the demand period.

ii) Open-up general all-round development of the annually drought-prone area.

iii) Provision of on-job training to technical and professional staff to strengthen the capabilities of the Mineral Resources Department to carry out groundwater resource exploration, assessment, development, protection and planning.

C. BACKGROUND

Geology and Geomorphology

The study area includes a coastal strip of northern Viti Levu that extends eastward from Lautoka to Rakiraki. The area can be divided into three regions.

i) A narrow coastal strip 1 to 2 km wide, of gently rolling hills with flat coastal margins. This area is underlain by alluvial sediments and fine-grained volcaniclastics.

ii) Intervolcanic basins with flat to gentle slopes that are mainly underlain by fine-grained volcaniclasitcs and

epiclastic sedimentary rocks, the latter being mainly sandstones and mudstones.

iii) steep-sided hills encompassing volcanic centres or their eroded remnants.

The bulk of the population of the study area live within regions i) and ii) where sugar cane is extensively cultivated. Within region iii) the steep-sided volcanic hill slopes are utilised for pine-tree cultivation or as grazing areas.

The study area is underlain by geologic strata belonging to the Ba Volcanic Group. These strata are composed of material that erupted from a number of volcanic centres during the Pliostocene era. Rocktypes present range from andesitic to shosonitic in character. Andesitic rocktypes are confined to the northern parts of the study area around Vatia, Raviravi and Rakiraki. Within the greater of the study area predominant rock forms are volcanic breccias interbedded with lava flows. Within the intervolcanic basins such as the Ba Valley, distal erosional sedimentary products of the volcanoes were deposited as sandstones and mudstones. The rocks within the study area (eg. in the Tavua area) have undergone tectonic tilting and uplift.

Hydrology and Meteorology

The study area is located within the drier, northwestern part of Viti Levu. Annual rainfall in the area varies considerably from year to year . The rainfall recorded at the Nadi Airport during the last 46 years range from 895 mm to 3087 mm per annum. The area often experiences prolonged drought periods. Flows of minor streams which drain across the coastal strip are not regularly gauged. During the drier season it can be clearly seen that smaller catchments have negligible or no flows. Hydrological analysis of some flow records indicate high base flow indices suggesting the presence of an important groundwater baseflow component. The bigger catchments however, have substantial flows except during very severe drought conditions.

Present Water Supply

Within the area described only the towns (Ba, Tavua and Rakiraki) and nearby areas have reticulated water supply. Surface water is the major source for this supply. These sources often fail to provide adequate and continuous supply throughout the year. At present the Ba water supply is facing difficulties due to a marked increase in silt content of surface waters, presumably resulting from an increase in logging operations within the catchment area.

Most of the areas falling outside the town boundaries do not

have a reliable and permanent supply. Water is obtained from hand-dug wells, boreholes (drilled privately or through a Government Subsidy Scheme), streams and roof-catchment facilities. These areas suffer the most during drought periods. Road tankers are regularly used to cart water during these dry periods. This is almost an annual event and the government spends a great deal to provide water to the affected areas during droughts.

Previous groundwater investigations

The Mineral Resources Department (MRD) has carried out groundwater investigations and exploratory drilling in the past. In mid 1980's MRD's Groundwater Resource Assessment and Development Unit (GRADU), set up with the assistance of the British Government, began investigations to study the fractured volcanic aquifers with the aim of assessing its resource potential. By the end of 1989 when the UK input ceased eleven boreholes were drilled.

The exploration drilling and resource assessment work has not adequately progressed due to the difficulty in obtaining funds and MRD's declining drilling capabilities. Groundwater investigation and drilling is costly and MRD's work largely depends on funding from other government departments (usually Public Works Department) or from external overseas donors.

D. RESOURCES NEEDED

Technical Assistance

The project will require one or two hydrogeologist in addition to a counterpart provided by MRD. Also required is a Driller/Supervisor to provide on-job training to MRD drilling crew. The Mineral Resources Department will provide Technical Assistants for the project.

Financial Resources

An estimation of the Project budget is given below.

	(F$)
Personnel (expatriate staff)	500 000
Support staff	60 000
Equipment	
-drilling rig	600 000
-drilling ancillary equipment	100 000
-crane truck	100 000
-compressor	100 000
-vehicle (landcruiser 4x4)	40 000
Miscellaneous	50 000

TOTAL 1 550 000

Equipment

MRD has no suitable drilling rig to carry out all the drilling works required for the project. A drilling rig with ancillary equipment and support vehicles will be required. The approximate costs of these equipment are given above.

E. EXPECTED BENEFITS

a) Sets groundwater evaluation and the assessment of a major resource on a firm footing and provides MRD personnel with essential expertise to develop and further assess the resource;

b) Provides PWD and or Rural Authorities with groundwater options for water supply;

c) Solve short term water supply problems;

d) Provides essential information for long and short term development planning of all projects that requires water (e.g. agricultural irrigation, tourism);

e) Improved health of rural populations;

f) Improved water supplies for new and existing industries (gold mining);

g) Provides essential continued staff training;

h) Potential key for opening-up general all-round development of the relatively neglected 'dry-side' of the island.

FIGURE 1

付属資料--2. S/W

SCOPE OF WORK

FOR

STUDY

ON
GROUNDWATER DEVELOPMENT
IN
NORTH VITI LEVU

IN

THE REPUBLIC OF FIJI

AGREED UPON BETWEEN

MINISTRY OF LANDS AND MINERAL RESOURCES
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SUVA, DECEMBER 14, 1992

Hon. Ratu Ovini Bokini
Minister,
Ministry of Lands and
Mineral Resources

Dr. Yuji Maruo
Leader,
Preparatory Study Team
of Japan International
Cooperation Agency

I. INTRODUCTION

In response to the request of the Government of the Republic of Fiji (hereinafter referred to as "the Government of Fiji"), the Government of Japan has decided to conduct the Study on groundwater development in the North Viti Levu (hereinafter referred to as "the Study"), in accordance with the related 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 programmes of the Government of Japan, will undertake the Study, in close cooperation with the authorities concerned of the Government of Fiji.

The present document sets forth the Scope of Work for the Study.

II. OBJECTIVE OF THE STUDY

The objective of the Study is to evaluate groundwater resources potential and formulate the groundwater development plan for adequate reliable and safe water supply in the north Viti Levu.

III. STUDY AREA

The study area will extend eastward from Lautoka toward Raki Raki in the north Viti Levu. The area is estimated at about 1,000 km^2.

IV. SCOPE OF THE STUDY

In order to achieve the above objective, the Study will cover the following items:

1. Phase I

(1) Review and analysis of previous studies and existing data:

(a) Socio-economic conditions

(b) Relevant ongoing and planned projects

(c) Water supply system

(d) Water demand

(e) Existing wells data

(f) Topographical, geological and hydrogeological maps

(g) Satelite and aerial photos

(h) Land use

(i) Physical conditions

-Meteorology, hydrology and hydraulics

-Geology and geography

-Vegetation and soil

(j) Environmental conditions

(k) Law, regulation, policies and customary practices

(l) Institutions, organizations and administrations

(m) Others

(2) First field investigation

(a) Field reconnaissances

-General

-Existing facilities

-Geology

-Environmental aspects

(b) Survey on the condition of water utilization

(c) Survey on water demand condition

(d) Preliminary hydrogeological mapping

(e) Selection of the points for geophigical survey

(f) Geophygical survey

(g) Estimation of groundwater resources potential

(h) Classification of areas based on groundwater resources potential

(i) Selection of test boring sites

2. Phase II

(1) Second field investigation

(a) Test boring

-Geophygical logging

-Pumping test

-Water quality test

(b) Hydrological investigation

(c) Simultaneous Observation of groundwater level

(2) Study and analysis

(a) Water quality analysis

(b) Water balance analysis

(c) Water demand projection

(e) Evaluation of groundwater resources potential

3. Phase III

(1) Groundwater development planning

(a) Formulation of groundwater development plan

(b) Project evaluation

(c) Initial environmental examination

(d) Identification of the prior area for rural water supply

(2) Water supply system planning

(a) Supplementary survey

(b) Formulation of water supply system

(c) Implementation schedule

(e) Operation and mentenance

(f) Estimation of cost and benefit of the projects

(g) Social and economic analysis

(h) Environmental impact assesment

V. SCHEDULE OF THE STUDY

The Study will be carried out in accordance with the tentative schedule attached in the Annex2.

VI. REPORTS

JICA shall prepare and submit the following reports in English to the Government of Fiji.

1. Inception Report:

Twenty(20) copies at the commencement of the field survey in Fiji.

2. Interim Report(1) :

Twenty(20) copies within five(5) months from the date of the commencement of the study.

3. Progress Report:

Twenty(20) copies within thirteen(13) months from the date of the commencement of the study.

4. Interim Report(2)

Twenty(20) copies within seventeen(17) months from the date of the commencement of the study.

5. Draft Final Report:

Twenty(20) copies within six(6) months after the presentation of the Interim Report (2).

The Government of Fiji will submit their comments to JICA within thirty(30) days after the receipt of the Draft Final Report.

6. Final Report:

Forty(40) copies within two(2) months after JICA's receipt of the said comments on the Draft Final Report.

VII. UNDERTAKINGS OF THE GOVERNMENT OF FIJI

1. To facilitate the smooth conduct of the Study, the Government of Fiji shall

take the necessary measures as follows:

(1) to secure the safety of the Team,

(2) to permit the members of the Team to enter, leave and stay in Fiji 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 taxes, duties and any other charges on equipment, machinery and other materials brought into and out of Fiji for the conduct of the Study,

(4) to provide the necessary facilities to the Team for unrestricted re-export of equipment and machinery brought into Fiji for the conduct of the Study,

(5) to exempt the members of the Team from income tax and charges of the 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,

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

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

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

(9) to provide medical services as needed. Its expenses will be chargeable on members of the Team, and

(10) to secure permission to use walkie-talkie and other wireless telecommunications for the execution of the field survey.

2. The Government of Fiji shall bear claims, if any arises, 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 of willful misconduct on the part of the members of the Team.

3. The Mineral Resources Department (hereinafter referred to as "MRD"), as counterpart and contact agency to the Team, shall act in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.

4. MRD shall, at its own expense, provide the Team with the followings in co-operation with relevant organizations:

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

(2) counterpart personnel

(3) suitable office with necessary equipment and furniture in Suva

(4) credencials or identification cards

VIII. UNDERTAKINGS OF JICA

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

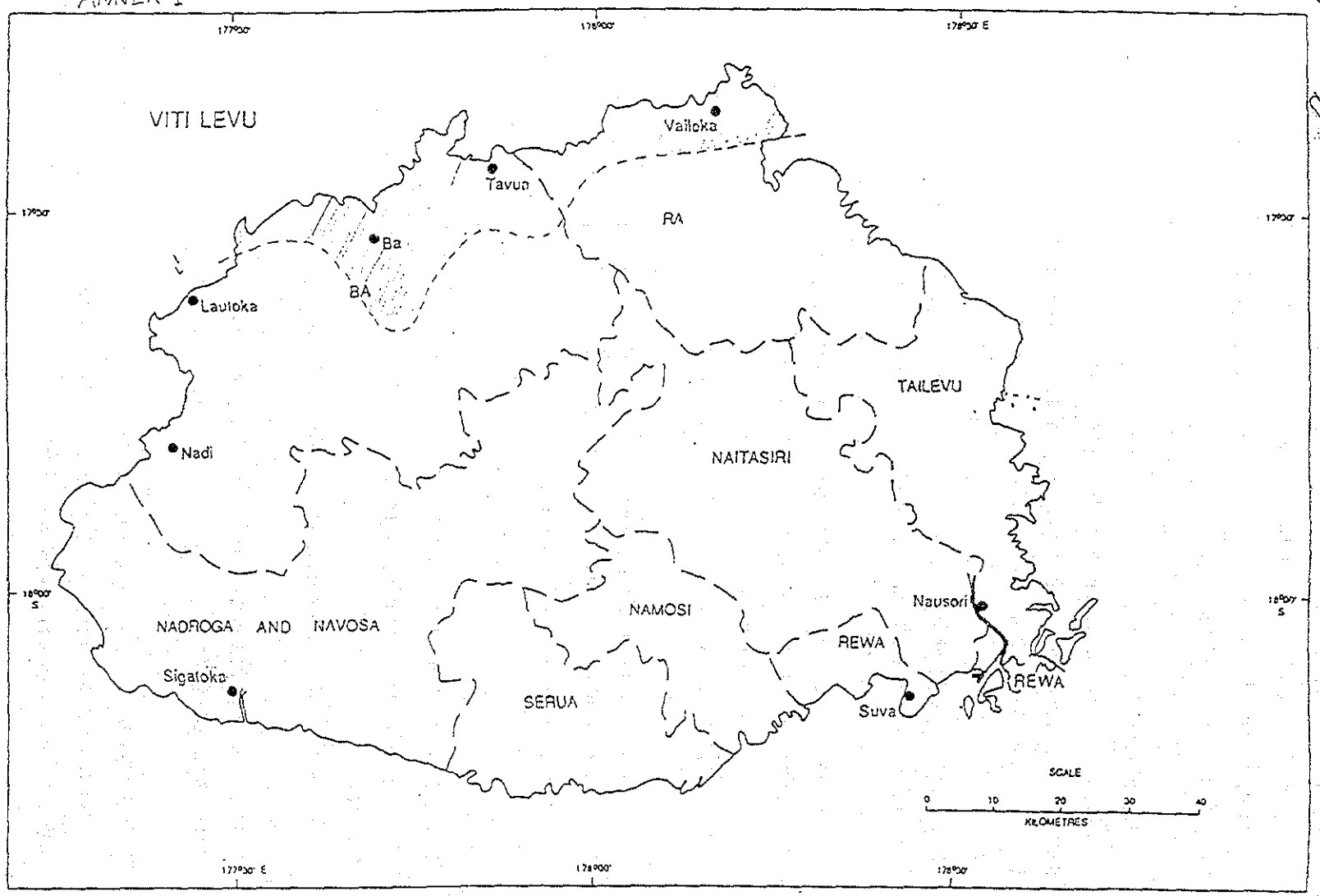
1. to dispatch, at its own expense, the study team to Fiji,

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

IX. CONSULTATION

JICA and MRD shall consult each other in respect of any matter that may arise from or in connection with the Study.

ANNEX 1


VITI LEVU
177°00'
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REWA
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Sigatoka
SERUA
Suva
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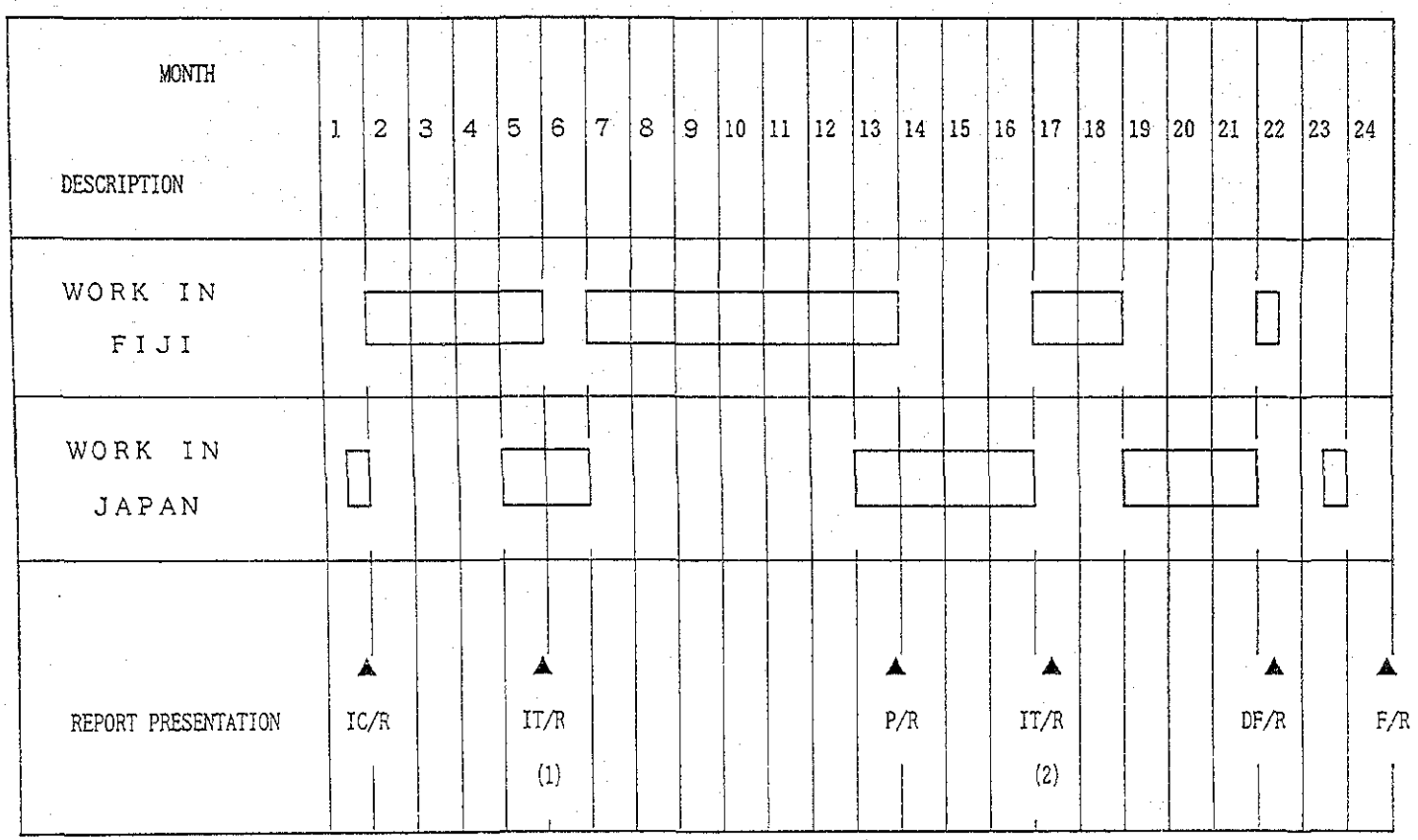
ANNEX 2

TENTATIVE STUDY SCHEDULE



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

付属資料—3. M/M

MINUTES OF MEETING

FOR

STUDY

ON
GROUNDWATER DEVELOPMENT
IN
NORTH VITI LEVU

IN

THE REPUBLIC OF FIJI

AGREED UPON BETWEEN

MINISTRY OF LANDS AND MINERAL RESOURCES
AND
JAPAN INTERNATIONAL COOPERATION AGENCY

SUVA, DECEMBER 14, 1992

Hon. Ratu Ovini Bokini
Minister,
Ministry of Lands and
Mineral Resources

Dr. Yuji Maruo
Leader,
Preparatory Study Team
of Japan International
Cooperation Agency

In response to the request of the Government of Fiji, the Government of Japan has dispatched a Preparatory Study Team for the Study on Groundwater Development in the North Viti Levu, from 7th to 19th December 1992, through the Japan International Cooperation Agency (JICA).

The Preparatory Study Team headed by Dr. Yuji Maruo and Fiji official headed by Mr. Alf Simpson had a series of discussions and exchanged view on the draft of the Scope of Work (S/W) for the Study. As a result of the discussions, both Fijian and Japanese sides agreed upon and signed the Scope of Work.

In addition to the Scope of Work, both sides confirmed the followings;

1. STUDY METHODOLOGY and AREA

(1) STUDY AREA

The Study Area covers part of the north Viti Levu as shown in the Scope of Work. The boundary of the Study Area is made according to geological and hydrogeological conditions.

(2) STUDY METHODOLOGY

The Study Methodology are as follows :

a) General Hydrogeological Research in the entire Study Area,
b) Geophysical Surveys, Drilling, Pumping Test in some selected areas which will be identified after the field reconnaissance,
c) Computer Simulation Analysis in a selected urban area and
d) Formulation of Groundwater Development and Framework of Water Supply System Planning in some priority areas.

(3) STUDY SCHEDULE

The term of the Study is proposed as about 24 months as shown in the Scope of Work, however, both Fijian side and Japanese side agreed that the term may be flexibly changed due to the difficulties in access to the Study area and drilling of boreholes during the wet seasons.

2. TARGET YEAR

The target year of groundwater development plan should be decided in the course of the Study after examination of groundwater potential and water demand.

3. INITIAL ENVIRONMENTAL EXAMINATION (IEE)

The Initial Environmental Examination should be done in the course of the Study and GROUNDWATER QUALITY is selected as the environmental component to be studied. Scope of the IEE is as follows:

(1) Study on Salt Water Intrusion.
(2) Study on Contamination by Fertilizer and Pesticide.

4. The following equipment and machinery are necessary for the Study :

(1) Drilling rig with DTH tools and accessories.
(2) Casing pipes, screening pipes and other materials for drilling.
(3) Supporting tracks.
(4) Air compressor.
(5) Welder and generator.
(6) Submersible pump and equipment for pumping test.
(7) Geophysical survey equipment.
(8) Water flow meter.
(9) Water level indicators and recorders.
(10) Water quality analysis kit.
(11) Micro computer with laser printer.
(12) 4-wheel drive station wagon.
(13) Walkie talkie and
(14) Electric logging unit

There are two local private drilling companies, but their capacities are not competent enough for the drilling part of the Study. At least two drilling unit will be required to conduct drilling during the Study.

Since Fijian side wishes to implement the development of groundwater based on

the result of the Study as well as to develop future investigation capability within the country. Mineral Resources Department stressed the need for the equipment to remain in Fiji at the end of the Study.

Japanese side agreed to convey the request to JICA Head Quater considering present Fijian capability for groundwater development.

5. Training in Japan

Fijian side enthusiasticly requested to provide counterpart personnel with the opportunities of training in Japan in order to transfer technology.

Japanese side agreed to convey the request to JICA Head Quater.

Fijian side also expressed the necessity of long-term training, such as JICA's group training course, in hydrogeology and drilling to master the skill of groundwater development planning.

6. STEERING COMMITTEE

Both side agreed to establish the steering committee to review and faclitate the progress of the Study. The steering committee consists of the following organizations :

Mineral Resources Department,
Public Works Department,
Ministry of Lands and Mineral Resources,
Environmental Management Unit,
Ministry of Health,
Ministry of Foreign Affairs,
Ministry of Finance,
Ministry of Fijian Affairs and Regional Department and
Central Planning Office

7. Mineral Resources Department shall take necessary measures to exempt the Study Team from customs duties, internal taxes, Value Added Tax(VAT) and other fiscal levies which may be imposed in the Republic of Fiji with respect to the supply of the products, services and equipment associated directly with the execution of the Study.

LIST of ATTENDANCE

Fijian Side

1. Mr. Alf Simpson	Director of Mineral Development and Mines
2. Mr. Bhaskar Rao	Assisstant Director of Mineral Development, Mineral Resource Department
3. Mr. Prem B. Kumar	Senior Hydrogeologist of Mineral Resource Department
4. Mr. John Ferry	TCO Hydrogeological Adviser of Mineral Resource Department
5. Mr. R. S. Shandil	Principal Engineer of Water, Public Works Department
6. Ms. Sivia Tora	Senior Administration Officer of Aid Unit, Ministry of Finance
7. Mr. Charlie Yuen	Economic Planning Officer of Central Planning Office
8. Mr. David Hamilton	Senior Economic Planning Officer of Central Planning Office
9. Ms. Judy Harm Nam	Senior Assistant Secretary of Ministry of Foreign Affairs & Civil Aviation

Japanese Side

1. Dr. MARUO Yuji	Leader/Groundwater Development	Development Specialist of Japan International Cooperation Agency (JICA)
2. Mr. NAKAMURA Haruhiko	Hydrogeology/ Environment	SANYU CONSULTANTS INC.
3. Mr. HAMADA Iwao	Hydrology	SANYU CONSULTANTS INC.
4. Mr. TAKAHASHI Shinji	Well Planning	EARTHTECS CO., LTD.
5. Ms. TAKEBAYASHI Fumiko	Study Planning	Staff, Second Development Study Division, Social Development Study Department, JICA
Mr. YAMASHITA Makoto	Second Secretary	Embassy of Japan

付属資料—4.　面会者リスト

付属資料－４．面会者リスト

(1)MINISTRY OF LANDS AND MINERAL RESOURCES

Mr. Rota Ovini BOKINI	Minister
Mr. Mosese VOLAVOLA	Permanent Secretary
Mr. Alf SIMPSON	Director, Mineral Resources Department
Mr. Bhaskar RAO	Assisstant Director, Mineral resources Department
Mr. John FERRY	TCO Hydrogeological Adviser, Mineral Resources Department
Mr. Prem B. KUMAR	Senior Hydrogeologist, Mineral Resources Department
Mr. Vijendra PRASAD	Senior Geophysist, Mineral Resources Department
Mr. Samisoni RATUYAWA	Senior Technical Officer, Mineral Resources Department
Mr. Don FLINT	Senior Economic Geologist, Mineral Resources Department
Mr. Peter RODDA	Principal Geologist Information Service, Mineral Resources Department
Mr. John LEWIS	Hydrogelogist, Mineral Resources Department
Ms. Dhanhegian NARAYAN	Engineer, Analysis Laboratory, Mineral Resources Department
Ms. Anjina PRASAD	Engineer, Analysis Laboratory, Mineral Resources Department

(2)MINISTRY OP INFRASTRUCTURE AND PUBLIC WORKS

Mr. Geoff GREEN	Director of Water and Sewerage
Mr. R. S. SHANDIL	Principal Engineer, Water Public Works Department
Mr. Pole WILSONI	Principal Engineer, Suba Water Supply
Mr. Laitia NAKAUTOGA	Water Superviser, Tavua Reservoir, Western Division
Mr. Chandra PAL	Supervisor High Grade, Lautoka, Western Division

(3)RELEVANT ORGANIZATIONS

Ms. Judy Harm NAM	Senior Assisstant Secretary, Ministry of Foreign Affairs & Civil Aviation
Ms. Sivia TORA	Senior Administration Officer, Aid Unit, Ministry of Finance
Mr. N. TABUNAKAWAI	Duputy Permanent Secretary, Ministry of Primary Industries
Mr. Charlie YUEN	Economic Planning Officer, Central Planning Office
Mr. David HAMILTON	Senior Economic Planning Officer, Central Planning Office
Mr. Sakiusa BALEKIWAI	Bureau of Statistics
Mr. P. TUILOMA	Assisstant Director, Mapping and Land Information, Lands Department

(4)PRIVATE COMPANY

Mr. Mike PALMER	Chief Engineer, Radial Drilling Pacific Co., LTD
Mr. Gordon K. MONKMAN	Drilling Expert, Chemdrex Chemicals, Australia
Mr. Thiu NADAN	General Manager, G. N. S. Well Drilling

付属資料—5.　質問状及び結果

SS.. 303 # 6/n

JF Copy

Questionnarie for Data Request

ITEM	AVAILABILIT	SOURCE	REMARKS
I. General Information			
1. Name of authorities and government agencies concerned	MRD PWD		
2. Outline of water supply system - Policy of the water supply - Present condition and perspective - Development plan	Yes	PWD	
3. Recent and future activity for the management of groundwater	Yes	PWD/MRD	
4. Laws, regulations, standard and customs related to the groundwater		Nothing	Two reports on Environment
(5) Study report related to groundwater Well Locations are on the report of Mr. Prem. Private well — BP 16/74	Yes	MRD	Hydrogeology Rpt of Fiji Gale & Booth
6. Socio-Economic conditions in the Study Area			
1) Population and household (trends and forecast)	Yes	1986 Census	
2) Living cost (Standard)			Some details can be obtained from various different Departments.
3) Infrastructure (Road and Transportation)			
4) Living conditions (Accommodations, Prices and availability)			
5) Labor Circumstances (Labor condition, wage level, law, regulations and customs, social security system and Labor level			

SS : 303 # 1/1

Thursday afternoon

1. Lautoka ✓
2. Ba-Tavua
3. Vaileka
4. Nanukloa

↓

1. missing, out of stock.

Questionnaire for Data Request

ITEM	AVAILABILITY	SOURCE	REMARKS
II. NTURAL CONDITIONS			
1. Topographical and geological data	1:50,000 Geol	MRD	
1) Topographic map (Scale 1:200,000, 1:50,000 etc.)	1:50,000	Lands	
2) Location of bench-mark stations	Yes	Lands Dept.	
3) Aerophotographs	Yes	" "	
4) Land use map (Current and future)	~~Yes~~ → only sugar cane area map	MRD	
5) Gelogical and hydrogeological map	Yes → 1/250,000, detail on the "Hydrogeology of Fiji",		
6) Geological survey report • BP 16/74, BP 29/23, BP 44/5 • Hydrogeological conditions are stated	Yes on British report	MRD	Geology maps together with bulletins exists with MRD
2. ~~Hydrology and~~ Meteorology ← 16/pec.	Hydrology	Hydrology Dept-PWD Meterology Dept.	
1) Meteorology data			
a) Location of weather station	Yes	" "	
b) Meteorological data			
- Precipitation			
- Temperature			
- Humidity			
- Barometric pressure			
- Sunshine hour			
- Wind			
- Evapotranspiration	Yes	PWD	
2) River flow and sea level			
a) Location of gauging stations			
b) Guging data of river flow	Yes	PWD	
c) Guging data of sea level			

SS 303 # 8/17

Questionnarie for Data Request

ITEM	VAILABILITY	SOURCE	REMARKS
III GROUNDWATER OBSERVATION EXISTING SYSTEM AND FUTURE PLAN 1. Groundwater (Level and quality) 1) Method of groundwater observation 2) Location of observation points 3) Piezometric level data 4) Water quality data 5) Saline water intrusion data → BP 29/23	Yes level — not quality — Ba only	MRD	Some monitoring done by MRD These are available
IV. PROJECT INFORMATION 1. MRD 1) Outline of MRD ✓ - Organization - Function and roles of each division - Qualification and speciality of probable counterpart - Number of staff and employees (inclusive foreign experts) - Annual budget and balance in last 5 years → 16/Dec - Budgetary year - Water tariff structure Mr. Salaimat ✓ - Equipment owned related to the study - Competency and Task ✓ - Relevant organizations last contract in before 1987 - Tender and contract system to subcontractor	Yes N/A Yes Yes	MRD MRD can be provided by MRD	MRD organisation chart available C J Drilling Radial Drilling G. Nadan & Sons

SS 303 # 9/17

Questionnarie for Data Request

I T E M	AVAILABILITY	SOURCE	REMARKS
2) Water works of DMR a) Existing Wells - Location - Well inventory - Ground condition of well - Pumping test data - Water quality - Water level - Pumping discharge late - Damage record - Specification of well structure and Pumping facility - Possible well for observation of groundwater	Yes	MRD	Data on boreholes drilled by MRD is available
b) Operation of the facilities (Operation records, water quality etc.)	→ PWD, some on the report		
c) Laws, regulations and customs related to water	→ Environment reports		Water legislation does not exist
Small Islands Projects ← d) On-going projects and budgetary arrangement	Yes	MRD	Other details can be provided
e) Future development plan and budgetary arrangement			
f) Relevant water project financed by foreign aid agency	Yes	MRD	
g) Design and construction of facilities related to water - Standard - System - Manual			

SS 303 #1/11

Questionnarie for Data Reques

I T E M	AVAILABILITY	SOURCE	REMARKS
2 . PWD 1) Outline of PWD - Organization - Function and roles of eah sector - Qualification and speciaity of probable counterpart - Number of staff and enplyees (inclusive foreign expers) - Annual budget and balanc in last 5 years - Budgetary year - Water tariff structure - Equipment owned related o tbe study - Competency and Task - Relevant organizations - Tender and contract systm to subcontractor	Yes	PWD	PWD should be able to provide these information
2) Water Works of PWD a) Present water supply syste - Aea of service - Water resources - Purification plant - Water supply pipe line - Water distribution - Design criteria of water consumption per capita pr day b) Existing Wells - Location - Well inventory - Ground condition of well - Pumping test data - Water quality - Water level	Yes	PWD	

SS 303 #11/11

Questionnarie for Data Request

ITEM	AVAILABILITY	SOURCE	REMARKS
- Pumping discharge late - Damage record - Specification of well structure and Pumping facility - Possible well for observaion of groundwater	Yes	PWD	
C) Operation of the facilities (Operation records, water qality etc.)			
d) Laws, regulations and custos related to water			
e) On-going projects and budgeary arrangement			
f) Future development plan and budgetary arrangement			
g) Relevant water project finaced by foreign aid agency			
h) Water demand forecast - Population in service are - Water consumption for eac usage			
i) Design and construction of facilities related to water - Standard - System - Manual			

SS 303 #12/17

Questionnarie for Data Request

I T E M	AVAILABILITY	SOURCE	REMARKS
V. Ecology and Environment			
1. Present ecological and environmental problems and countermeasures relating to water resources development			
1) Water pollution	Yes	PWD/MRD	
2) Fish and wild life	Yes	MPI	
3) Vegitation			
4) Serious epidemic disease	Yes	Health	
2. National Standard for Environmnt			
1) Environment quality act (Amendent)			
2) Environment quality regulation	Yes	NEMU	Not under Fiji Legislation
3) Environment impact assesment procedure			
4) Superintendency of E.I.A.		NEMU	
3. Location map of national park nd game reserve		Ministry of Forests NEMU	
4. National forestry plan			State of Environment report
5. Previous study report on environmental conservation	Yes		
6. Other related data			

ITEM	AVAILABILITY	SOURCE	REMARKS
VI. RELEVANT INFORMATION			
1. Domestic well drilling cotractors - Total number of contracors - Capital and number of eployees - Equipment owned (Drilling machine, In-situ testing and labratory test equipment) - Annual turnover - Association - Unit price of drilling and rehabilitation works	Yes	MRD	Details present with contractors
2. Domestic consultants - Number of consultants firm - Capital - Number of qualified engineers - Annual turnover - Association	Nil		
3. Cost estimation and Work schedule 1) Available organizations for surveying. - Topographic survey - Geological survey 2) Price list for construction materials 3) List of wages (laborer, river, typist and others) 4) Working hour - Working time per day - Working day per month - Workability during raiy season 5) Conditions around the stdy office	Yes	Lands/MRD	

SS 303 # 14/17

Questionnarie for Data Request

I T E M	AVAILABILITY	SOURCE	REMARKS
(Location, accommodation, charges, communication facilities, hospital and personnel security) 6) Formalities for useing transceiver	Yes	P & T	

QUESTIONNAIRE ON ENVIRONMENTAL ASSESSMENT

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.

No.

Ministry of Housing and Urban Development's Environment Unit

b)Do you have the environmental quality standard(s) ?
Please attach the detail, e.g. values, penalties, if any.

All informations are in the reports attached

2.INTERNATIONAL CONVENTIONS ON ENVIRONMENTAL CONSERVATION

Have you affiliated to bilateral or multilateral convention(s) concerning environmental conservation, e.g. Ramsar Convention, Wasington Convention, ?

Give teh name(s) of the convention(s) affiliated and the date of affiliation, if any.

3.PRESENT SITUATION OF THE PROPOSED PROJECT AREA

Describe the following, please.

a)socio-economic environment

-Use of spring/river/lake/sea water, i.e. domestics, industrial and agricultural

-existance of common land

b)natural environment

-Availability of hydrogeological map or data

-distribution of particular areas officially protected such as national parks and natural parks

c)quality of life

-Present water quality

-Regulation on effluent

-Present condition of noise and vibration

-Regulation for prevention of noise and vibration

付属資料—6．収集資料リスト

付属資料 — 6. 収集資料リスト

（1）中央官庁関係

国－1 Population Census 1986, Analytical Report on the Demographic, Social and Economic Characteristics of the Population
国－2 Report on Population Cencus 1986, Volume 2- Small Area Data on Enumeration Areas and Maps
国－3 同上, Volume 3-Economic Charatesristics
国－4 Population Census 1986, Volume 3-Economic Characteristics
国－5 Social Indicators for Fiji NO.5
国－6 Fiji Budget Estimate 1992
国－7 Report of the Fiji Constitution Inquiry and Advisary Commity, 1989
国－8 Fiji National Agricultural Census, 1991
国－9 Environment:Fiji, The National State of the Environment Report, Prepared by the National Environment Management Project
国－10 National Environment Strategy, Draft Report, Prepared by the National Environment Management Project
国－11 Current Economic Statistics, January 1990
国－12 同上, April 1992
国－13 同上, July 1992
国－14 Customs Tariff (Ammedment), Bill NO.5, 1992
国－15 Fiji's Ninth Development Plan 1986-1990

（2）鉱山資源局（MRD）関係

MRD－1 Geology of Fiji, Peter RODDA, 1989
MRD－2 Outline of the Geology of Viti Levu, Vol.10, NO.5,1967
MRD－3 Report on the Cooperative Mineral Exprolation in the Viti Levu Area, The Republic of Fiji, Phase 1, Metal Mining Agency of Japan, February 1991
MRD－4 1.Report on Geological Surveys of Ravirari and Tavarau, 10 February, 1989
MRD－4 2.Geological Survey in Vatia-Bulolo Area, Note BP25/1
MRD－5 Reort on Geological Surveys at Yagara, Note BP25/21
MRD－6 A Survey of Private Boreholes in North West Viti Levu, Note BP16/74
MRD－7 Northern Viti Levu Groundwater Investigations, March 1990, Note BP44/5

MRD－8 The Hydrogeology of the Bilolo-Vatia Area and Potential for Groundwater Development, A Desk Study, April 1987
MRD－9 Hydrogeology of Fiji, Technical Report WD/91/36, N. Gale and S. K. Booth (Copy)
MRD－10 Groundwater Assessment in Fiji Using Hydrological Records (Final Report), Institute of Hydrology Wallingford, UK, December,1987
MRD－11 Cost of Materials (Hand writing)
MRD－12 Climatrogical Summary Information Sheets, NO.58, January 1990
MRD－13 Distribution Map of Sugercane Area (Copy)
MRD－14 Management Plan - 1992 (Copy)
MRD－15 Land Right (Interview)
MRD－16 Budget on Hydrogeological Section (Interview)
MRD－17 Computer System in MRD (Copy)
MRD－18 Organization Chart in MRD (Copy and Interview)
MRD－19 List of Equipment in MRD (Hand writing)
MRD－20 Other Interview Records (Hand Writing)

（3）建設局（PWD）関係

PWD－1 Country Paper, September 1991
PWD－2 Rural Water Supply Design Manual, November 1984
PWD－3 Water Supply Design Manual (Draft, 1990)
PWD－4 Tavau/Valukoula Regional Water Supply Scheme, November 1989
PWD－5 Location Map of Water Supply in the Project Area (Hand writing)
PWD－6 Organization Chart of Water and Sewerage
PWD－7 Other Interview Records (Hand Writing)

（4）地図類

1.地形図

1./25万 Sheet 4 Viti Levu
1/5万 Sheet M26 Ba
Sheet M27 Balevuto
Sheet L26 Vono
Sheet L27 Lautoka
Sheet Vitilevu3 Nanukuloa
Sheet Vitilevu2 Vaileka

２．地質図

１／５万　Lautoka Area
Nanukuloa Area
Vaileka Area

３．水文地質図

１／２５万　Vitilevu

４．航空写真

１／５万　43 Sheets

（５）その他

他－１ Price of Materials, Labour Rate, Williams Associated Limited

他－２ A history of Fiji, Volume 1, R. A. Derrick

付属資料—7.　資機材の詳細リスト
(補給及び新規)

調査用資機材リスト

NO.1

品名及び仕様	数量
(1) 補給資機材	
1) 掘削機本体用 (利根製 TOP - 200 形)	1 式
1-1) パワースイベル部	1 式
1-2) 油圧システム部	1 式
1-3) シリンダー・ジャッキ部	1 式
1-4) フィード部	1 式
1-5) マッドポオンプ部	1 式
1-6) 搭載用トラック部	1 式
2) エアーコンプレッサー用 (北越製 PDSH - 500)	1 式
2-1) コンプレッサー部	1 式
2-2) エンジン部	1 式
3) 掘削ツール	1 式
1) ドリルパイプ、外径4-3/4", 3-1/2 IFツールジョイント及びネジ保護ソケット付き、3 m長さ	20 本
2) ドリルカラー、外径6-3/4", 4 IFツールジョイント及びネジ保護ソケット付き、3 m長さ	2 本
3) ビットスタビライザー、10-5/8"ビット用 6-3/4"ボディ径、4 IF ツールジョイント及びネジ保護ソケット付き、1 m長さ	2 本
4) サーフェスケーシング、フラッシュジョイント 11" × 3 m 長さ	4 本

品名及び仕様	数量
5) ケーシングヘッド、 11"	2 本
6) ケーシングスイベル、11"	1 個
7) ケーシングバンド、 11"	2 個
8) ケーシングメタルシュー 11"	10 個
9) ダウンザホールハンマードリル 8" - 8-1/2" 孔径用	1 式
10) 同上用分解工具	1 式
11) ワークケーシング、ネジ付き 9" × 3 m 肉厚=10mm	14 本
12) ワークケーシング、ネジ付き 9" × 1 m 肉厚=10mm	2 本
13) ケーシングヘッド、 9"	2 本
14) ケーシングスイベル、 9"	1 個
15) ケーシングバンド、 9"	2 個
16) ケーシングメタルシュー 9"	5 個
17) サブソケット 2-3/8 IFメス×3-1/2 IFオス	1 個
18) 高圧スイベルホース 50 mm × 10 m 金具付き	1 個
19) バックアップレンチ、4-3/4"ドリルパイプ用	1 個

品名及び仕様	数量

（２）　新規井戸掘削用資機材

１　トラック搭載型掘削機

（掘削機本体仕様）

概　要

掘削機はトップドライブ・ロータリー式で、硬岩に対してはダウンザホールハンマーを使用でき、また泥水・エアーフォーム方式も使用可能である事。掘削機本体はＰ．Ｔ．Ｏ．を介して、トラックのディーゼルエンジンで駆動され、油圧給圧付きマスト、トップ・ヘッド・ドライブ・ロータリーヘッド、ホイスト、その他掘削に必要なシステムより構成されているもの。

能　力

８－１／２径ダウンザホールハンマー及び１０－５／８”ビットを使用した泥水工法で１００ｍ以上掘削できる。

ドリルヘッド

回転数	高速で 0 ～ 120 rpm
	低速で 0 ～ 60 rpm
耐荷重	7000 kg以上
最大トルク	500 kg-m以上

ドローワークス

最大巻き上げ荷重	3000 kg.（シングル・ベアドラム時）以上
巻き上げ能力	14mmケーブルで50m
巻き上げスピード	30 m/min

マスト

耐荷重	10000 kg 以上
最大フック荷重	6000 kg 以上

プルダウン

最大給圧	3200 kg 以上
最大バランス力	7000 kg 以上
降下スピード	0 ～ 5 m/min （掘削時）
	0 ～20 m/min （急速降下時）
上昇スピード	0 ～35 m/min
フィード長	7.5 m 以上

泥水ポンプ

泥水ポンプは２連シリンダー式、複動形ピストンタイプである事。

最大圧力	22 kg/㎠ 以上
吐出量	600 L/min 以上
サクション径	100 mm
デリバリー径	50 mm

品名及び仕様	数量

付属品　　圧力計、サージチャンバー、リリーフバルブ、
ピストンロッド用ルーフリケーター

ウォーター／フォームインジェクションポンプ
最大吐出量　　30 L/min以上
最大圧力　　20 kg/cm² 以上

ラインオイラー
ダウンザホールハンマー掘削用にラインオイラーが装備されている。

(搭載用トラックの仕様)

概　要
リグ用搭載車両は、ディーゼルエンジン駆動４輪駆動型で、右ハンドル操作で、ドリルユニットを搭載するために必要な改造・補強が施されている事。

エンジン
ディーゼルエンジン、４気筒、直噴式、水冷、最高出力215 HP, 2700rpm以上

ホイールベース長
5000 m

車両総重量
16000 kg以上

2　掘削機用標準付属品　　1 式

1) 本体用分解工具　　1 式

2) 高圧スイベルホース、金具付き
(耐熱用)、50 mm × 5.7m　　1 本

3) 高圧中間ホース、金具付き
(耐熱用)、50mm × 1.3m　　1 本

4) サクションホース、金具付き
100 mm × 6 m　　1 本

5) フートバルブ、ニップル付き、100 mm　　1 個

6) 高圧リターン／ミキシングホース
金具付き、50 mm × 6 m　　1 本

品名及び仕様	数量
7) エアー／ウオータースベル 6トン 50mmホース及びフランジ接続	1 個
8) ホイスティングプラグ, 3-1/2 IF オス接続	1 個
9) ホイスティングワイヤーロープ クレピス付き、14 mm × 40 m	1 巻
10) ダンパー、3-1/2 IFドリルパイプ用 サブ付き	1 個
11) ブレークアウトレンチ、4-3/4" ドリルパイプ用	1 個
12) ブレークアウトレンチ、6-3/4" ドリルカラー用	1 個
13) バックアップレンチ、4-3/4" ドリルパイプ用	1 個
14) バックアップレンチ、6-3/4" ドリルカラー用	1 個
15) ドリルカラーリフティングプラグ	1 個
16) トラベリングブロック 305 mm × 1 車	1 個
17) ジェットホッパー式マッドミキサー 50 mm ホース接続	1 式
18) ダストコレクター	1 個
19) ドリルパイプハンガー	1 式
20) ドリルパイプローリー	1 式

品名及び仕様	数量
3　泥水掘削工法用ツールス	
1) ドリルパイプ、外径4-3/4", 3-1/2 IFツールジョイント及びネジ保護ソケット付き、3 m長さ	34 本
2) ドリルカラー、外径6-3/4", 4 IFツールジョイント及びネジ保護ソケット付き、3 m長さ	3 本
3) ビットスタビライザー、10-5/8"ビット用 6-3/4"ボディ径、4 IF ツールジョイント及びネジ保護ソケット付き、1 m長さ	2 本
4) 3翼ビット、12-1/4",3-1/2 IF メスネジ付き	4 個
5) トリコンビット　軟岩用、サイズ 12-1/4" 6-5/8" REG オスネジ接続	4 個
6) トリコンビット中硬岩用、サイズ 12-1/4" 6-5/8" REG オスネジ接続	4 個
7) トリコンビット　硬岩用、サイズ 12-1/4" 6-5/8" REG オスネジ接続	4 個
8) トリコンビット　軟岩用、サイズ 10-5/8" 6-5/8" REG オスネジ接続	4 個
9) トリコンビット中硬岩用、サイズ 10-5/8" 6-5/8" REG オスネジ接続	8 個
10) トリコンビット　硬岩用、サイズ 10-5/8" 6-5/8" REG オスネジ接続	8 個
11) ビットブレーカー　12-1/4"	1 個
12) ビットブレーカー　10-5/8"	1 個

品名及び仕様	数量
13) サブ、3-1/2 IF メス × 4 IF オス	1 個
14) ビットサブ、4 IF メス × 6-5/8 REG メス	1 個
15) ビットサブ、3-1/2 IFメス×6-5/8 REG メス	1 個
16) オスタップ、 4-3/4" ドリルパイプ	1 個
17) ロッドバンド、4-3/4" ドリルパイプ	1 個
18) 2連式油圧ジャッキ、油圧ホース、ハンドポンプ付き、50トン	1 式
19) サーフェスケーシング、フラッシュジョイント 11" × 3 m 長さ	4 本
20) ケーシングヘッド、 11"	2 本
21) ケーシングスイベル、11"	1 個
22) ケーシングバンド、 11"	2 個
23) ケーシングメタルシュー 11"	10 個
4 ダウンザホールハンマー工法用アクセサリー	
1) ダウンザホールハンマードリル 8" - 8-1/2" 孔径用	1 式
2) 同上用分解工具	1 式
3) ハンマーサブ、3-1/2 IF メス×4 IFオス	1 個
4) ハンマービット 8-1/2"	4 個
5) 高圧エアーホース、金具付き 50 mm × 10 m	2 本

品名及び仕様	数量
6) ワークケーシング、ネジ付き 9" × 3 m 肉厚=10mm	14 本
7) ワークケーシング、ネジ付き 9" × 1 m 肉厚=10mm	2 本
8) ケーシングヘッド、 9"	2 本
9) ケーシングスイベル、 9"	1 個
10) ケーシングバンド、 9"	2 個
11) ケーシングメタルシュー 9"	5 個
5 高圧エアーコンプレッサー	1 台
(仕 様) タイプ ロータリースクリュー、2段式、油冷形 空気吐出量 900 cfm (425 L/min)以上 作動圧力 350 psi (24 bar) 以上	
6 支援車両	1 式
1) カーゴトラック、4トンクレーン付き 4 × 4	3 台
(トラック仕様) タイプ 右ハンドル、4 × 4 積載荷重 6000 kg 車両総重量 14820 kg ホイールベース長さ 5000 mm エンジン ディーゼル、6気筒、水冷式、 最高出力 219 HP/2700 rpm タイヤサイズ 11.00 - 20 - 16 PR. (クレーン仕様) 最大吊り上げ能力 4 トン	

品名及び仕様	数量

2) ピックアップ、ダブルキャブ、
右ハンドル、４ＷＤ　　2 台

（仕様）

定員	5 名
ホイールベース長	2850 mm
エンジン	ディーゼル、最高出力 65KW/4000rpm
車両総重量	2590 kg

7 井戸仕上げ用機材、その他

1) 揚水パイプ、ソケット付き
2-1/2" × 5.5m　　20 本

2) 曲がり管、1"パイプ用穴付き
2-1/2" × 0.5m　　1 個

3) エアーパイプ、ソケット付き
1" × 5.5 m　　18 本

4) 曲がり管、1" × 0.3 m　　1 個

5) パイプバンド、2-1/2"　　1 個

6) パイプバンド、1"　　1 個

7) パイプハンガー、2-1/2"　　1 個

8) パイプハンガー、1"　　1 個

9) 高圧エアーホース、金具付き
1" × 10m　　1 巻

10) ニップル、1", PT × PF　　1 個

11) レジューサー、2" × 1"　　1 個

品名及び仕様	数量
8 揚水試験用資機材	1 式
1) 水中モーターポンプ、 6" ケーシング用 (仕様) 吐出量 600 L/min,以上 揚程 60 m モーター 415 V, 3相, 50 Hz, 11 kw 付属品 揚水管、80 mm × 2.75 m (22 本) 操作盤 (1 式) 電極、ケーブル付き (1 個) スリースバルブ、チェッキバルブ (1 式) 井戸カバー、エルボー付き (1 個) 自動エア抜きバルブ (1 個) 連成ゲージ (1 個)	1 式
2) ディーゼル発電機、37 KVA, 3 相 415 V, 50 Hz	1 台
3) 電気電導度計	1 台
4) 水位測定器、 100 m	1 台
5) PH メーター	1 台
9 井戸用ケーシング・スクリーン	1 式
1) 井戸用スティールケーシング、鉄製 カップリング付き (SGP) 6" (165.2 mm 外径) × 5.5 m	200 本
2) 井戸スクリーン、カップリング付き ステンレス製ウエッジワイヤー巻 スロット幅 1 mm 173 mm 外径 × 5 m	80 本

品名及び仕様	数量
3) ケーシングエレベーター、5 トン, 6"	2 個
4) エレベーターリンク、 5 トン	2 個
１０ 掘削用調泥剤	1 式
1) ベントナイト	1 式
2) ＣＭＣ	1 式
3) 発泡剤	1 式
１１ スペアパーツ／アクセサリー	1 式
1) 掘削機本体用	1 式
2) 高圧コンプレッサー用	1 式
3) 支援車両用	1 式
4) 水中モーターポンプ用	1 式
5) ディーゼル発電機用	1 式
１２ 作業用工具、その他	
1) 作業用工具、	1 式
2) エンジン溶接器 ディーゼルエンジン、ＤＣ最大250 A以上 ＡＣ 最大10 KVA, 200V/50HZ以上	1 台
3) プラスチックタンク 6 m^3	4 個
4) エンジンポンプ,吐出量400 L/min以上 揚程 10 m ,ホース等付属品付き	1 台

品名及び仕様	数量
5) グラウト用エンジン付きミキサー　撹拌容量 300L/min	1 台
(3) 調査器具、その他	
1 電気（比抵抗）探査器 交替直流式、探査深度 100 m以上	1 台
2 電磁探査器 EM-34または同等品	1 台
3 トランシーバー 、水平距離 1 km程度	1 セット
4 水質分析器具、現場測定用簡易式	2 台
5 自記水位計、1ケ月巻	20 台
6 地下水位計 100 m	2 台
7 軽車両	
1) 4WD、ステーションワゴン 定員 4～5名 水冷ディーゼルエンジン	1 台
2) 4WD、ピックアップ 最大積載量 700 kg 以上	1 台
8 パーソナルコンピューター ﾚｰｻﾞｰﾌﾟﾘﾝﾀｰ共	1 台
9 流量計 0.03～3.0m/sec	1 台
10 井戸検層器 比抵抗、自然電位、温度	1 台

付属資料—8. 環境配慮にかかわるスクリーニング結果

付属資料－８．環境配慮にかかわるスクリーニング結果

Screeninig of the Environment Components to be Affected

Important Environment Component	Consideration of the Impact
1.Groundwater	-Seawater intrusion by over-pumping will cause salination along coastal area -Groundwater will be contaminated by fertilizer and pesticide

Scoping of the environment Components to be Studied in IEE

Environment Components	Studies
・Groundwater quality	-Study on seawater intrusion -Groundwater contamination by fertilizer and pesticide -Appropriate planning -Proper well siting

SCREENING FORMAT FOR PRELIMINARY ENVIRONMENTAL SURVEY

ENVIRONMENTAL COMPONENTS	PRESUMED ACTIVITIES AND ENVIRONMENTAL IMPACTS	IMPACT CONSIDERATIONS Adverse impact : Negrigible impact : : Unkown impact : : : Enhancement	REMARKS
1.SOCIAL ENVIRONMENT		: : : :	
1.1 Resettlement	Relocation and resettlement for land aquisition	□ ☒ □ □	Spotted facility
1.2 Economic activities	Damaging of productive opportunities i.e. changes of land and economic situation and structure	□ □ □ ☒	Betterment for local people living
1.3 Transportation and public facilities	Traffic problems and accidents to existing transportation system. Impacts to schools and hospitals	□ □ □ ☒	〃
1.4 Collaps of communities	Separation of communities by traffic routes, water channels and transportation problems	□ □ □ ☒	〃
1.5 Archaeological and cultural heritage	Damages and affections to religious structures, archaeological, cultural monuments and remains	□ □ ☒ □	Transfer of facility is possible
1.6 Vested rights	Damages and compensations for fishery, water use and common public land use	□ ☒ □ □	Short period during construction
1.7 Public health and hygienic conditions	Degradation of hygienic conditions caused by waste disposal and generation of vector insects	□ ☒ □ □	Betterment of those conditions
1.8 Waste disposals	Arising of construction debris, wastes, sludges and abandonments	□ ☒ □ □	No arising
1.9 Accidental danages	Arising accidental dangers on earth collaptions, slides	□ ☒ □ □	Small facilities

ENVIRONMENTAL COMPONENTS	PRESUMED ACTIVITIES AND ENVIRONMENTAL IMPACTS	IMPACT CONSIDERATIONS Adverse impact : Negrigible impact : : Unkown impact : : : Enhancement	REMARKS
2.NATURAL ENVIRONMENT		: : : : : : : :	
2.1 Geographic and geological condition	Changes of significant land forms and geological features caused by earthwork, excavation and enbankment	☐ ☒ ☐ ☐	No earthworks
2.2 Soil erosion	Soil erosion originated by runoff through earthworks and timber felling	☐ ☒ ☐ ☐	No changes of land form
2.3 Surface water quality	Water turviditation caused runoff through excavation activities and water pollution by effusion	☐ ☒ ☐ ☐	No earthworks
2.4 Groundwater quality	Water turviditation caused by runoff through excavation activities and water pollution by effusion	☒ ☐ ☐ ☐	Drop of groundwater table and pollution by overpumping
2.5 Hydrological situations	Variation changes of flow regime, lake and river bed causing reclamation and effusion of drained water	☐ ☒ ☐ ☐	No reclamation and effusion
2.6 Terrestrial fauna	Environmental changes and impacts to habitation of endangered species and communities	☐ ☒ ☐ ☐	1.No source of origin & endangered species 2.Small facility
2.7 Aquatic fish fauna	Environmental changes and impacts to habitation of endangered species and communities	☐ ☐ ☐ ☒	1.No source of origin 2.Small facility
2.8 Vegitation	Environmental changes and impacts to habitation of endagered species and communities	☐ ☒ ☐ ☐	Betterment for vegetation

ENVIRONMENTAL COMPONENTS	PRESUMED ACTIVITIES AND ENVIRONMENTAL IMPACTS	IMPACT CONSIDERATIONS Adverse impact : Negrigible impact : : Unkown impact : : : Enhancement	REMARKS
2.9 Climatic conditions	Climatic changes arising by implementation of large scale development of earth-works and structures	☐ ☒ ☐ ☐	No source of origin
2.10 Aesthetic conditions	Land form and landscape changes by earthworks and structures	☐ ☒ ☐ ☐	Small facilities
3. PUBLIC NUISANSE			
3.1 Air pollution	Air pollution originated from facilities, vehicles etc.	☐ ☒ ☐ ☐	No source of origin
3.2 Water pollution	Water pollution caused by soil erosion and toxic effusion through facility. waste and drainage	☐ ☒ ☐ ☐	〃
3.3 Soil pollution	Dangerous materials and toxic effusion caused by facility wastes and drain-age	☐ ☒ ☐ ☐	〃
3.4 Noise and seismicity	Generation of noise and seismicity originated traffics and facility equip-ment	☐ ☒ ☐ ☐	〃
3.5 Ground subsidence	Ground surface subsidence caused by changes of ground and down of groundwater level	☐ ☒ ☐ ☐	Small depth of unconsolideted layer
3.6 Odour	Generation of exhaust and waste gas, and odour produced by facilities and equipment	☐ ☒ ☐ ☐	No source of origin

付属資料—9.　環境保護に関する政策と法律

An acknowledgement of lower sugar production levels based on cane to sugar ratio and lower farm productivity. Although not stated, this is likely to be a result of declining soil fertility.

With respect to the ginger industry the plan acknowledged that 'soil erosion and the adverse effects on the environment under present methods of production' was a constraint.

Forestry

'Ensure sound forest management and land conservation practices so that forest resources are further developed and maintained in perpetuity'.

A commitment was made to expanding the system of forest nature reserves and recreation areas.

Mining

A commitment to safeguard the environment and improve pollution monitoring.

Tourism

For the first time in a development plan this sector acknowledged the role of national parks in tourism.

Water supply and sewerage

A commitment to finalise and enact a Water Resources Act. This was also a commitment in DP7 and DP8. It has yet to occur.

18.2 RECENT POLICIES AND STRATEGIES

18.2.1 'Policies and strategies for the short and medium term', National Economic Summit 1989

Table 18.1 DP9 INDICATIVE EXPENDITURE FOR ENVIRONMENT MANAGEMENT PROGRAMME ($000, 1985 PRICES)

Programmes	1986	1987	1988	1989	1990	Total
Environment Management Committee						
1. Environment Management Unit	25	43	54	59	64	245
2. Environment Protection Legislation		20	2			22
3. Coastal Zone Management Plan		50	50			100
4.Environment Impact Assessment Procedures for Fiji		2				2
5. Sigatoka Sand Dunes Reserve	1	1	1	1	1	5
Sub-Total	26	116	107	60	65	374
National Trust for Fiji						
6. Organisational Structure	78	215	225	234	115	867
7. National Conservation Strategy	72	4				76
8. Historic Site Survey		30	10			40
9. Environmental Education Programme	25	17	15	25	15	97
10. National Parks and Reserves System	16	45	20	50	50	181
11. Momi Guns Historic Park and Military Museum	4	9	4	4	4	25
Sub-Total	195	320	273	313	184	1,286
Total	221	436	380	373	249	1,660

The environmental policy strategies contained in this document reflect more of the broader environment development relationships identified in DP7, although the environment was still 'sectorised' within the Social and Community Development sector. The report presented the environment-development overview as:

> "Environment issues have become increasingly important as manufacturing activities develop and agriculture becomes dependent on a more intensive exploitation of land. Increasing consideration has to be given to competing uses of land for industry, tourism, settlement, agriculture, and mineral resources exploitation. The quality and productivity of water resources, inland as well as for estuary, lagoon and reef ecosystems, are becoming endangered by increases in polluting discharges. Water catchments are subject to siltation through deforestation and other poor land use practices.
>
> Effective support for environmental planning and management at this stage of the development process is likely to yield high economic benefits through savings on much higher future costs for clean-up and regeneration. Preventive strategies are considered the most cost-effective.
>
> The policy is to integrate environmental management into the planning and development process in order to safeguard the environment and its regenerative capacity while improving economic productivity of resources. A key to success is a comprehensive effort by all relevant ministries and their involvement in the formulation and implementation of a comprehensive national environment strategy. Environmental concerns and requirements must be internalised through each department, in programme and project preparation, and in implementation".

Effective support for environmental planning and management is likely to yield high economic benefits.

After almost 20 years of post-Independence development planning, the links between environmentally sustainable development and long term economic benefits were more fully emphasised in national development policy. Also important was recognition of the need for a multi-sectoral approach in implementing environmental planning and management strategies. Other specific issues and initiatives identified in the report included the preparation of the National Environment Strategy (then in its project planning stage), the need for improved legislation, a national physical development plan, national parks and reserves; and the need to plan for climatic change.

The report was notable for the relatively detailed presentation of key environment policies/strategies in different sectors. Specifically: agriculture (scarcity of arable land, need for watershed management, and development of MPI-Environment Unit interaction on land use and environment issues); fisheries (preparation of a Marine Environment Management Plan); forestry (land conservation issues, establishment of a Trust Fund for landowner compensation); Mining (EIA implementation); tourism (role of environment in development of secondary tourism and landowner participation) and manufacturing and commerce (need for strict standards of environmental protection in development of industrial infrastructure).

18.2.2 'Review of performance and prospects - Fiji economy', National Economic Summit 1991

This review largely reproduced the sentiments of the 1989 report. One important difference was the inclusion of the following statement on envi-

ronmental policy in Chapter 3 -'Economic Policies and Strategies':

> "Many countries have found that apparently rapid economic growth has been achieved only at the cost of a serious depletion of both renewable and non-renewable assets and to the detriment of their living environment. It is recognised that measures have to be taken early to prevent these hidden and often inadequately accounted costs .....
>
> The objective is to promote sustainable development, incorporating a framework of project design, approval and monitoring that ensures the prevention of adverse environmental effects".

Within the forestry sector review it is acknowledged that "the sector needs to be developed in a sustainable manner which does not damage the environment". Additionally, by way of support, it is stated that international lobbies for rainforest conservation are already affecting the trade in tropical timber.

[Box 18.1] *INTERNATIONAL ENVIRONMENTAL / RESOURCE CONVENTIONS TO WHICH FIJI IS PARTY (DATE: YEAR OF FIJI'S ENTRY)*

- International Plant Protection Convention (1956)
- Convention on the Continental Shelf (1970)
- Convention on the High Seas (1970)
- Convention on Fishing and Conservation of the Living Resources of the High Seas (1971)
- Plant Protection Agreement for South East Asia (1971)
- Treaty Banning Nuclear Weapon Tests in the Atmosphere, Outer Space and Underwater (1972)
- Treaty on the Non-proliferation of Nuclear Weapons (1972)
- International Convention for the Prevention of Pollution of the Sea by Oil (1972)
- Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological and Toxic Weapons and their destruction (1973)
- International Convention Relating to an Intervention of the High Seas in Cases of Oil Pollution Casualties (1975)
- International Convention on Civil Liability for Oil Pollution Damage (1975)
- South Pacific Forum Fisheries Agency Convention (1979)
- United Nations Convention on the Law of the Sea (1982)
- International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (1983)
- South Pacific Nuclear Free Zone Treaty and Protocol (1985)
- Vienna Convention and Montreal Protocol on Substances that Deplete the Ozone Layer (1989)
- Convention on the Conservation of Nature in the South Pacific or Apia Convention (1989)
- Convention for the Protection of Natural Resources and Environment of the South Pacific and their Related Protocols - the SPREP Convention (1989)
- Convention Concerning the Protection of the World Cultural and Natural Heritage - the World Heritage Convention (1990)

18.3 INTERNATIONAL CONVENTIONS AND INTERACTION

Fiji has actively participated for many decades in international conventions and treaties related to the environment.

Most of these conventions and treaties place a legal commitment on Fiji to adhere and apply their various articles at both national and international levels. With respect to the Montreal Protocol, the Government is already taking action to phase out the use of chlorofluorocarbons (CFCs) by the specified dates. Fiji's obligations under the Apia Convention to adequately conserve representative ecosystems and to implement effective environmental management procedures under the SPREP Convention have yet to be met, although the outcome of the National Environment Management Project (if implemented) will address these requirements. The recent establishment of the National Oil Pollution Committee and development of a national oil pollution contingency plan will also meet some of the anti-pollution requirements of the convention and its protocols.

Fiji also undertakes an active role in regional and some international environmental issues. The country has participated in the South Pacific Regional Environment Programme since 1983 and maintains a relatively high profile on regional environmental issues. On the wider international scene Fiji has participated in environmental meetings and conferences on the Asia-Pacific region organised by ESCAP in Bangkok. It is also participating in preparations for the UN Conference on Environment and Development (UNCED) in Brazil in June, 1992 and participating in activities relating to global climate change issues, including the development of a convention on climate change to be adopted at UNCED.

Also at the international level, Fiji's involvement with bilateral and multilateral aid donors and lenders has also had an effect on its national environmental management activities. Most, if not all these donors and lenders now require environmental assessments of proposed projects as a pre-condition of granting aid or loans for development.

18.4 CONCLUSION : POLICY OR PRACTICE?

The first development plan, DP6, reviewed in this chapter identifies the key resource management issues of soil, water, and vegetation conservation as a basis for maintaining economic productivity. In one form or another these sentiments have been repeated in all the following development plans spanning the last 20 years. Yet, the condition of the country's critical environmental resources continue to decline. Although some progress has been made (most in the last three years, see Table 18.2) generally there has been a marked lack of implementation of strategies and programmes specified in the plans.

The reasons for this can be attributed to:

- lack of integration of development and environmental policies;
- scattering of environmental laws in numerous acts and environmental responsibilities at the administrative level;
- inadequate expertise and resources; and
- the predominance of economic and social development goals in national decision making which are isolated from any environmental framework.

The best environmental policy formulated and/or adopted at both national and international levels will be meaningless if implementation strategies are not enacted through provision of funds and technical resources. Above all, sustainable development will not be possible until environmental planning

and management implementation strategies are closely linked with those for national economic development in a cross-sectoral manner. A good start to such an approach, for example, would be the inclusion of environmental implications and justification on the forms used for new project expenditure submitted by ministeries/departments to the Ministry of Finance and Economic Planning. Currently the forms are entirely economic and socially oriented in terms of project justification.

Table 18.2 Environmental Planning & Management in Fiji: Policy and Implementation 1976-1990

YEAR	ENVIRONMENTAL POLICY/COMMITMENT/ACTION	COMMENT
1976	Comprehensive environmental planning and management objectives and programme proposed in Development Plan 7 (1976-1981) including concepts of a national policy and advisory council.	Not acted upon during DP period
1980	1. Establishment of the interministerial Environmental Management Committee under the chair of the Director of Town and Country Planning. 2. Establishment of Fiji's first wildlife sanctuary:the Crested Iguana Sanctuary on Yadua Taba Island.	1. Still operative 2. Requires management and research
1981	A system of national parks proposed in Development Plan 8; proposal to enact a National Parks and Reserves Act; additional support to National Trust.	Not acted upon.
1982	1. New Zealand expert commissioned to draft formal EIA procedures. 2. Approval by Public Service Commission to establish Environmental Management Unit (EMU) within Department of Town and Country Planning.	1. Procedures operational 2. Not acted upon.
1983	Establishment of Mangrove Management Committee	Still operational
1985	Preparation of national Mangrove Management Plan Phase - 1	Endorsed by Government.
1986	1. Development Plan 9 proposes comprehensive national environmental planning and management objectives. 2. Preparation of national Mangrove Management Plan Phase 2. 3. Registration of archaeological sites by the National Trust of Fiji.	1. Some objectives implemented in 1989/90/91. 2. Not yet endorsed by Government 3. Not acted upon.
1987	Public Service Commission approval to advertise EMU's principal officer position.	
1988	1. Advertising of EMU principal officer position. 2. Argricultural Diversification Loan Programme agreed to between Government and Asian Development Bank, including a condition to establish EMU. 3. Establishment of Fiji's first national park: Sigatoka Sand Dunes National Park 4. FAO Forestry Sector review completed.	1. No locally qualified personnel. 2. Negotiations between Ministry of Primary Industries, Ministry of Finance and Economic Planning & ADB 3. Requires management & development. 4. About 75% of recommendations implemented.
1989	1. Appointment of expatriate environment specialist to EMU principal officer position. 2. Cabinet agreed to accept an ADB Technical Assistance Grant to prepare a National Environment Stategy. 3. National environmental policy and strategies paper endorsed by National Economic Summit. Other sectors included environment policies in their sectoral policy papers. 4.Government acceded to the Convention for Conservation of Nature in the South Pacific.	1. EMU operational: increased level of project environmental assessment and development of Government Policy

	5. Government acceded to the Convention for the Protection of Natural Resources and Environment of the South Pacific and Related Protocols.	
	6. Government signs the Vienna Convention and Montreal Protocols on Substances that Deplete the Ozone Layer.	
	7. Cabinet agreed to pruchase a section of freehold coastline to establish a National Coastal Park for community recreation.	2. Subject of negotiation
	8. Cabinet agreed to accede Convention Concerning the Protection of World Cultural and Natural Heritage (World Heritage Convention).	
1990	1. Commencement of National Environment Strategy Project 2. Government ratified World Heritage Convention.	1. Due to be completed in August 1992.
1991	1. Ministry for Housing and Urban Development agreed to establish a Committee to oversee phasing out of CFC use. 2. Environment Unit prepared National Report for UN Conference on Environment and Development 3. Marine Department establishes National Oil Pollution Committee 4. National Environment Management Project prepares 'State of the Environment' Report. 5. Anti-Litter Decree gazetted 6. Environment Unit separated from Department of Town and Country Planning and established as a separate function of Ministry of Housing and Urban Development.	1. To comply with obligations under the Montreal Protocol.
1992	1. Ministry of Housing and Urban Development establishes Consulative Committee on Ozone Depleting Substances (as per 1991 - 1 above). 2. New Anti-Litter Laws come into force.	

19 ENVIRONMENTAL LAWS AND ADMINISTRATION

19.1 OVERVIEW

Fiji's environmental laws are many and varied, a relic of the colonial period when environmental problems were limited and clearly sectoral. At least 25 Acts have some important role in what is today perceived as environmental management, and they are administered by at least 14 different ministries, statutory bodies or other agencies. Most of the laws are ineffective in a modern environmental management context or suffer from lack of enforcement of regulations through inadequate staffing, lack of technical resources and funding, or through administrative failures.

An annotated list of these laws is provided in Table 19.1. What is immediately apparent from the table are the insignificant penalites which can be imposed. Even the 1990 Ports Authority of Fiji Regulations provide for a maximum fine of only $400. A chemical spill in Suva harbour would cost the Government perhaps millions of dollars to clean up, and the polluter does not have to pay! The future must lie in legislation which binds the polluter (or forester, farmer, miner etc.) to clear up any mess he/she causes.

Currently it is the Town Planning Act 1946 which provides the mechanism for environmental impact procedures. Under the Act the Director of Town and Country Planning can impose such (pre)conditions on proposed developments as he/she believes appropriate or necessary under the circum-

stances. It is through the application of conditions to private and some public sector development approvals that requirements for environmental impact assessments (EIAs) are imposed. Tourism development proposals comprise the majority of EIA conditions imposed under the Act. The General Provisions (1980) of the Act also provide for a building setback of 30 metres above high watermark to allow for public access to the foreshore.

Land and water below the high water mark are the property of the State and are administered by the Ministry for Lands and Mineral Resources through the Department of Lands and Surveys. The Director of Lands has the power to grant foreshore leases, which are usually sought for reclamation purposes, and licenses for dredging. A number of these applications frequently involves reclamation of mangrove or other sensitive areas. Applications are referred to the Director of Town and Country Planning for comments, recommendations and suggested conditions if approved. The Director of Lands also refers the application to the Department of Fisheries for assessment of the resource and to the Native Fisheries Commission for arbitration of compensation. In 1974 the Government set up a procedure to compensate traditional fishing rights owners for the loss of customary fishing rights/resources associated with the granting of foreshore leases and subsequent development, and dredging. This procedure for monetary compensation to traditional owners for loss of natural resource use has set a precedent which now has wider implications for some aspects of environmental management, especially with regard to establishment of protected areas.

Table 19.1 Fiji's environmental laws

Legislation	Outline of Provision	Penalty	Authority Responsible
<u>Land and Resource Use</u>			
Mining Act 1966 (Cap 146)	- Compensation for damage - Restoration of land	Max fine $200 and/or 6 months imprisonment	Director of Mines & Ministry of Land & Mineral Resources
Forest Act 1953 (Cap 150)	Minister may declare Nature Reserves and sylviculture areas in reserved forests and declare native land to be Protected Forest	Max fine $300 and /or 6 months imprisonment	Conservator of Forests & Ministry of Forestry
Town Planning Act 1946 (Cap139)	Minister may order area to be a town planning area: permission of local authority and Director of DTCP required for development. Preservation of historic buildings and objects of historic or scientific interest.	Max fine $100 or 3 months imprisonment $20 per day infringement	Director of Town & Country Planning & Ministry of Housing & Urban Development
Native Land Trust 1940 (Cap 134)	Can lease Native Land (which is not Native Reserve land) with restrictions regarding land use.	Civil Remedies	Native Land Trust Act Board
Land Development Act 1961 (Cap 142)	Land Development Authority promotes and assists the investigation, formation and carrying out of projects for the development, improvement and settlement of the land.		Land Development Authority

Land Conservation and Improvement Act 1953 (Act 141)	Land Conservation Board may make 'Conservation Orders' Contravention of such an order is an offence.	Max fine $200 and/or 6 months imprisonment	Land Conservation Board, Ministry of Primary Industries
Agricultural Landlord Tenant Act 1966	Stipulates 'good husbandry practices' by tenants.		
Conservation and Quarantine			
Birds and Game Protection Act 1923 (Cap 170)	Wounding, killing, selling, holding in captivity or exporting protected birds is an offence.	Max fine $50 or imprisonment max 3 months	Ministry of Primary Industries
National Trust for Fiji Act 1970 (Cap 265)	Power to purchase land. May enter into voluntary agreements to protect the land.		Ministry of Housing & Urban Development
Preservation of objects of Archaeological and Palaeontological interest Act 1978 (Cap 264)	Power to declare and acquire National Monuments'. Preservation of Monuments.	Max fine $200 or 6 months imprisonment	Board of Trustees of Fiji Museum and Ministry of Women and Culture
Plant Quarantine Act 1982; Noxious Weeds, Pests and Disease of Plants Act 1964, (Cap 133)	Quarantine powers including declaration of noxious pests, infested places, removal of pests; prohibited imports		Ministry of Primary Industries
Animal Importations Act (1970)			Ministry of Primary Industries
Marine and Pollution/Conservation			
Marine Spaces Act 1977 (Cap 158A)	Management and conservation of fisheries within Fiji's economic zone (200 mile limit). Licencing of foreign fishing vessels	Maximum fine $100,000	Office of the Prime Minister
Fisheries Act 1941 (Cap 158)	Licence to fish required	Max fine $50 and/or 3 months imprisonment	Ministry of Primary Industries
	Non Fiji registered fishing vessel without Licence.	Max fine $100	
	Use of dynamite.	Max fine 12 months and/or $200 fine	
Fisheries Regulations 1965	Prohibited methods and areas e.g. poison. Protection of turtles, etc.	3 months imprisonment and/or $50 fine	
Continental Shelf Act 1970 (Cap 149)	Oil pollution of 'designated areas' resulting from escape from pipeline or as a result of exploration.	Max fine $3,000	Ministry of Lands and Mineral Resources
Ports Authority of Fiji Regulations 1990	Various offences relating to pollution of port areas.	Max fine $400.	Ports Authority of Fiji
Water Pollution			
Rivers and Streams Act 1882 (Cap 136)	Rivers belong to the Crown and are for enjoyment of public.		

Irrigation Act 1973 1973 (Cap 144A)	Offence to pollute water in Irrigation Works.	Max fine $200 or 6 months imprisonment	Commissioner for Irrigation and Ministry Primary Industries
Drainage Act 1961	Offence to interfere with public drainage work i.e. work for the purpose of draining land or miligating flooding or erosion	Max fine $200 or 6 months imprisonment	Appropriate Drainage Board and Ministry of Primary Industries
Water Supply Act 1955 (Cap 144)	Offence to pollute water if:- - in waterworks i.e., sluice pipe, pump etc. used for water supply or in declared catchment area.	Max fine $100	Commissioner of Water; PS - Ministry of Primary Industries
Mining Regulations (Cap 146 S - 3)	Offence to pollute Water in race pipe dam or reservoir in respect to which a special site right has been granted to holder of mining lease.	Max fine $100	Director of Mines & Ministry of Lands and Mineral Resources
Pollution Generally			
Pesticides Act 1971 (Cap 157)	Registration of pesticides	Fine $200 and $10 per day for *infringement*	Registrar of Pesticides & Ministry of Primary Industries
Traffic Regulations 1974 (Cap 176 - S-50)	Offence to drive vehicle from which smoke etc. is emitted likely to cause injury, nuisance or annoyance to any person	Max fine $100 or imprisonment max 3 months.	Ministry of Infrastructure and Public Utilities
Public Health Act 1955 (Cap 111)	Board may cause inquiries to be made. Person authorised in writing may enter premises Power to inspect water and sewerage works.		Central Board of Health (Ministry of Health)
	Various powers to abate nuisances:- Inspection of district to ascertain nuisances.		Local authorities or Central Board of Health (Ministry of Health)
	Section 56 (e) : any accumulation or deposit of any material situated which is offensive to the public or injurious to health may be summarily abated.	Fine $20 or $4 per day in default	
Penal Code 1945 (Cap 17)	Various: e.g. common nuisance:- i.e. causing common injury, danger or annoyance so as to interfere with the public (must be substantial and *unreasonable)*	Imprisonment 1 year	Director of Public Prosecutions (Ministry of Justice)
	Dealing with poisonous substances in negligent manner	6 months imprisonment or $200 fine	

Source: Manuel (1990; unpublished. mss) with additions by NEMP

19.2 LAWS OF LAND AND RESOURCE USE

The principal legislation in this category are the Forests Act of 1953 and Land Conservation and Improvement Act of 1953, and the Mining Act of 1966.

While there are loopholes in both the Forests and Land Conservation and Improvement Act , it is generally considered that both have ample legislative power to control many of the problems readily evidenced in the forestry and agricultural sectors. That they have not been used to this effect is clearly through lack of application by the ministries responsible.

As with all environmental legislation, its effectiveness ultimately depends on political resolve, which in this sector is to implement proper watershed management programmes. To date this resolve has been lacking, in spite of many reviews and studies on the subject.

A notable, positive move has been the recent revival of the Land Conservation Board after many years of inactivity. Although the Board has wide powers, its job is difficult as it will have to combat many years of farmer and institutional indifference to sound agricultural practice. If it pursues its mandate vigorously it will have to make difficult decisions which will clash with other national and ministerial objectives. Notable amongst these will be the expanding ginger industry, which to a major extent is based on unsustainable farming practices.

One of the most disappointing lack of uses of appropriate legislation is that by the NLTB whose leases require the lessee ' to farm and manage the land in such a way as to preserve its fertility...' The NLTB as custodian of the land for future generations needs to ensure practice of sound agricultural management on its leases. The NLTB can be seen to be abrogating its responsibility if lessees are allowed to drain a lease of all its natural productivity and soil resources, before abandoning it and moving on to another new lease, as is reported to be almost commonplace in the ginger industry.

19.3 LAWS OF THE MARINE ENVIRONMENT

Fiji's marine environment is better served by laws and regulations than any other sector. The most recent to be passed, the Ports Authority of Fiji Regulations 1990, may help to clean up some of the blatant acts of pollution in Fiji's ports.

Of all the conservation laws, the fisheries regulations are the most conspicuously enforced. Clamp-downs on the sale of undersized produce and prosecution of users of dynamite, for example, are regularly reported. Nonetheless although Fisheries Department personnel believe these efforts should be greatly increased, they lack the necessary resources.

Some of the stiffest penalties are to be found in fisheries associated legislation (Table 19.1). It is of interest to note that whilst a foreign fishing vessel fishing without a license in Fiji waters may be fined $100,000 (large though it may seem it is small by comparison to the potential profits of some of the modern fishing boats), a foreign company running a polluting industry in Fiji, may with difficulty be prosecuted under the Public Health Act and fined a maximum of $20.

19.4 LAWS OF CONSERVATION AND QUARANTINE

Traditionally, legislation worldwide to protect wildlife relied on listing the species to be protected while the remainder enjoyed no protection. Such

付属資料—10．　全国土地利用図

付属資料－１０．全国土地利用図