

APPENDIX B List of Reference Materials

LIST OF REFERENCE MATERIALS

REPORTS AND ARTICLES

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
1	Abdull Halim Siddiqi	1981	Weather Systems of Oman. "Commercial".
2	Arthur D. Little Int'l	1982	Summary Review of Land Classification Reports and Water Resources Information. Main Report
3	Arthur D. Little Int'l	1982	Summary Review of Land Classification Reports and Water Resources Information. Appendix
4	B. G. Appelgren (Ministry of Agriculture)	1976	A Summary of Water Resources and Agricultural Development Reports in the Sultante of Oman
5	Brain A. P. Gemmell	1979	Hydrometeorological Field Instrument Installations, Flood Observations General Data Collection and Local Staff in Service Training. Oman/77/001
6	Clements F. A.	1980	Oman, the Roborn Land. Longman Group Ltd.
7	Clements F. A.	1982	The Sultante of Oman Today. Apex Publishing.
8	Clements F. A.	1981- 1982	The Sultante of Oman Business Directory. Apex Publishing
9	Durham University	1978	Research & Development Surveys in Northern Oman. Final Report Vol. II Water
10	Development Consultants Ltd.	1977	Protection Bank for Rostaq.
11	Director General of Civil Aviation	1981	Operational Meteorology Blossoming Fast. Concept Omanica P.79 ~ P81
12	DC, Technical Secretariat, D.G. of National Statistics	1975	Statistical Year Book. Fourth Issue
13	DC, Technical Secretariat, D.G. of National Statistics		The Five Year Development Plan 1976 ~ 1980.
14	DC, Technical Secretariat, D.G. of National Statistics		Follow-up Report on the First Five Year Plan

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
15	DC, Technical Secretariat, D.G. of National Statistics	1980	Statistical Year Book. Ninth Issue.
16	Donald Hawley	1980	Oman & its Renaissance. Revised Edition. Stacey International.
17	Donald Hawley	1980	Oman - Revised Edition. Stacey International.
18	Eric C. Barret	1977	Assessment of Rainfall in North Eastern Oman Through Integration of Observations from Conventional and Sattellite Sources
19	FAO	1975- 1976	A Summary of Water Resources and Agricultural Development Reports in the Sultante of Oman. Chapter. Irrigation.
20	FAO	1975- 1976	A Summary of Water Resources and Agricultural Development Reports in the Sultante of Oman. Section: Water Resources Development.
21	FAO	1975	Report on Water Resources Policy Administration and Legislation.
22	FAO	1976	National Standards of Soil and Water Analysis in Oman. Soil and Water Management. OMA/73/010. Field Document No. 1. (FAO).
23	FAO	1976	Development of New Land for Irrigated Agriculture in Oman Soil and Water Management. OMA/73/010. Field Doc. No. 4.
24	FAO (DOWRI, MAF)	1976	The Water Resources of Oman.
25	FAO	1976	Relationship between Conductivity Values and Salt Concentrations in Soils and Waters of Oman. Soil and Water Management. FAO OMA/73/010. Field Document No. 2.
26	FAO (MAF)	1977	Climate of the Jebel Akhdar (SAIO). FAO Project OMA/77/001. Field Doc. 2.
27	FAO (MAF)	1977	Rainfall in Oman (1974 ~76). FAO Project OMA/77/001. Field Document 3.
28	FAO (MAF)	1979	Water Resources of the Batinah. FAO Project OMA/77/001. Field Document No. 10.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
29	FAO (MAF)	1979	Groundwater Resources for Agricultural Development in the Sohar-Saham Districts, Batinah Region. FAO Project OMA/77/001. Field Document 12.
30	FAO	1980	Groundwater Development in the Kamil/Wafi District Sharqiya Region. FAO Project OMA/77/001. Field Document No. 15.
31	FAO (MAF)	1980	Development of Water Resources of Oman for Agriculture. FAO Project OMA/77/001. Field Document No. 14.
32	Gealey, W.K.	1977	Ophiolite Obduction and Geologic Evolution of Oman Mountains and Adjacent Area. Geol. Soc. America Bull V.88. P.118
33	Dr. Hatim El Attar FAO	1977	Development of New Land for Irrigated Agriculture in Oman Soil and Land Classification.
34	H. A. Phon	1976	A Comparison of Land Sat Images and Nimbus Thermal Inertia Mapping of Oman. Jour Res. USGS. V.4 No. 6. Nov. - Dec. 1976 ~ P.661 ~ 665.
35	ILACO (MC)	1974	Water Resources Development Project Northern Oman. Maps (1 ~ 10).
36	ILACO (MC)	1975	Water Resources Development Project Northern Oman. Final Report Vol. I Main Report.
37	ILACO (MC)	1975	Water Resources Development Project Northern Oman. Final Report. Vol. II Annex. A & B.
38	ILACO (MC)	1975	Water Resources Development Project Northern Oman. Final Report. Supporting Doc.
39	JICA	1980	Interim Report on Preliminary Survey of Agricultural Development.
40	JICA	1981	Wadi Al Bassierah Basin Water Resources Development Project. Report on Feasibility Study. Vol. III. Appendix.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
41	JICA (MAF)	1981	Wadi Jizzi Agricultural Development Project - Sohar, North Batina. Interim Report No. 1, Feasibility Study.
42	JICA	1982	Wadi Jizzi Agricultural Development Project. Interim Report No. 2.
43	J.L. Astier (Water Resources Center Oman. FAO/UNDP)	1975	Eastern Batinah and Nizwa - Adam Basin Analysis of the Results of the Geophysical Survey Carried out in February - April 1975.
44	Jordan International	1977	Rostaq Flood Control Project.
45	James Mandaville Jr.	1978	Wild Flowers of Northern Oman. John Bartholomew and Son Ltd.
46	Konteatis	1975	Reconnaissance Survey of Northern Oman Water Resources and Development Prospects.
47	K. W. Glennie	1974	Geology of the Oman Mountains. Part One (Text).
48	K. W. Glennie	1974	Geology of the Oman Mountains. Part Two. Tables & Illustration.
49	K. W. Glennie	1974	Geology of the Oman Mountains. Part Three (Enclosures).
50	MAF	1976	Proposed Frame of the Five Year Agricultural Development Plan - Summary of Highlights.
51	MAF	1977	Water in Oman.
52	MAF		Final Results of the Census of Agriculture (1978 ~ 1979).
53	MAF	1980	Second Five-Year Agricultural Development Plan (1981 ~ 1985)
54	Ministry of Communication	1976	On the Establishment of a National Meteorological Service in the Sultante of Oman. Advisory Report.
55	PAWR	1980	Study of the Jajar Super Group Aquifer in the Capital Area.
56	PAWR	1980	Preliminary Engineering Design for Wadi Al Khawd Recharge Scheme.
57	PAWR	1980	Groundwater Recharge Alternatives for Wadi Al Khawd.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
58	PAWR	1980	Study of the Hajar Super Group Aquifer in the Capital Area
59	PAWR		Five Year Plan (1981 ~ 1985) for Water Resource.
60	P.M. Horn and J.B. Nielsen	1977	Climate of the Batinah. FAO Project OMA/77/001. Field Doc. 4.
61	P. M. Horn		Short Period Rainfall Intensities in Oman. Appendix A to Field Document No. 11. Project OMA/77/001.
62	P. M. Horn & J. B. Nielsen	1978	Runoff Measurements in Oman. FAO Project OMA/77/001. Field Document No. 7.
63	P. M. Horn	1979	Rainfall in Oman (1974 ~ 78). FAO Project OMA/77/001. Field Document 11.
64	Phon, et, al.	1974	Thermal - Interim Mapping from Satellite Discrimination of Geologic Units in Oman. V.2 No. 2 MAR - APR 1974, P. 147 ~ 158.
65	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water Resources Survey in North-East Oman. Interim Report. Annex. A - F.
66	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report.
67	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report. Annex. A.
68	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report. Annex B. Geophysical Survey.
69	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report. Annex. C. Hydrogeology
70	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report. Annex D.
71	Renardet Sauti ICE, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report. Annex E. Pedology
72	Renardet Sauti Ice, Consulting Engineers (MC)	1975	Water and Resources Survey in Northeast Oman. Interim Report. Annex F. Agriculture.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
73	IRI Research Institute	1978	Draft of Preliminary Report - Shoar - Saham Well Drilling and Pump Installation Study.
74	Sir Alexander Gibb and Partners (Directorate General of Finance)	1975	Water Resources Survey of Northern Oman. Investment Networks.
76	Sir Alexander Gibb and Partners (Directorate General of Finance)	1976	Water Resources Survey of Northern Oman. Final Report Vol. I. Main Report.
77	Sir Alexander Gibb and Partners (Directorate General of Finance)	1976	Water Resources Survey of Northern Oman. Final Report Vol. II Appx. A Rainfall & Meteorology.
78	Sir Alexander Gibb and Partners (Directorate General of Finance)	1976	Water Resources Survey of Northern Oman. Final Report Vol. III Appx. B Surface Water Flow.
79	Sir Alexander Gibb and	1976	Water Resources Survey of Northern Oman. Final Report Vol. IV Appx. C. Geology & Hydrogeology
80	Sir Alexander Gibb and Partners (Directorate General of Finance)	1976	Water Resources Survey of Northern Oman. Final Report Vol. V Appx. D. Survey of Water Use in Villages.
81	Sir Alexander Gibb and Partners (Directorate General of Finance)	1976	Water Resources Survey of Northern Oman. Final Report Vol. VI Appx. E. Water Chemistry & Isotope Studies
82	Sir M. MacDonald & Partners Consulting Services	1977	Power and Urban Water Development Program 1977 ~ 1995. Phase 1 Water Development Program through 1980 Capital Area. Draft Final Report
83	Sir M. MacDonald & Partners Consulting Services	1977	Power and Urban Water Development Program 1977 ~ 1995. Phase 2 Water Development Program Investi- gation
84	Sir M. MacDonald & Partners Consulting Services	1978	Power and Urban Water Supply Study - Phase 2 Water Supplies to Sohar - Water Resources Evaluation. Pre- liminary Evaluation.
85	Sir M. MacDonald & Partners Consulting Services	1978	Power and Urban Water Supply Study Phase II Interim. Water Development Program Capital Area. Vol. 2. Appendices.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
86	Sir M. MacDonald & Partners Consulting Services	1979	Power and Urban Water Supply Study - Phase II. Water Development Program Capital Area. Interim Report No. 2. Vol. 1. Report.
87	Sir M. MacDonald & Partners Consulting Services	1979	Power and Urban Water Supply Study - Phase II. Water Development Program Capital Area. Interim Report No. 2. Vol. 2 Appendices.
88	Sir M. MacDonald & Partners Consulting Services	1980	Capital Area Wellfield Refurbishing - Al Khawd Wellfield. Interim Report.
89	Sauti Ice	1978	City of Rustaq - Project for Defence Against Wadi Far Floods. Preliminary Drawings, Drawing Nos. 1 to 7.
90	Sauti Ice	1978	City of Rustaq - Project for Defence against Wadi Far Floods. Preliminary Report.
91	Sauti Ice	1978	City of Rustaq - Cost Estimate of the Variation Defence against Wadi Far Floods.
92	Sauti Ice	1978	Report on the Possible First-stage Works for the Protection of the Rustaq Oasis from Flooding of the Wadi Far.
93	Sauti Ice	1979	City of Rustaq - Project for Defence against Wadi Far Floods. Final Design Drawing Nos. 1 to 7.
94	Sauti Ice	1979	City of Rustaq - Project for Defence against Wadi Far Floods.
95	Sauti Ice	1979	City of Rustaq - Project for Defence against Wadi Far Floods.
96	Sauti Ice	1979	City of Rustaq - Project for Defence against Wadi Far Floods. Schedule of Rates and Prices
97	Sauti Ice	1979	City of Rustaq - Project for Defence against Wadi Far Floods. Final Design Specifications.
98	Sauti Ice	1979	City of Rustaq - Project for Defence against Wadi Far Floods. Final Design Report
99	Scott Wilson Kilpatric & Partners	1973	Report on Water Supply Investigation Northern Oman.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
100	Scott Wilson Kilpatric & Partners	1977	Rostaq Flood Protection & Reclamation -- Proposal for Design Consultancy.
101	Tetra-Tech International Inc.	1977	Channel Geometry and Wadi Flows -- Batinah Coast
102	Tetra-Tech International Inc.	1977	Demonstration of Rockfill Flood-retarding Structures
103	Tetra-Tech International Inc.	1977	Satellite Imagery Interpretation and a Brief Tectonic History of Oman.
104	Tetra-Tech International Inc.	1978	Groundwater Salinity Survey of the Southeast Batinah Coastal Plain.
105	Tetra-Tech International Inc.	1980	Evaluation of Alternative Groundwater Development Schemes for the Wadi Samail Aquifer.
106	Turner Wright and Partners (MAF, MPM)	1977	Report on Three-Year Plan for Development of Irrigation
107	Turner Wright and Partners (MAF, MPM)	1977	Report on Three-Year Plan for Development of Irrigation.
108	USA Corps of Engineers	1978	Report on Water Resources Study for Government of Oman Phase I.
109	U.S. Army Corps of Engineers, Middle East Division (MAF)	1979	Report on Water Resources Study, Phase II, and Technical Proposal for Construction of Water Recharge Projects.
110	University of Durham	1975	Land Systems of the Batinah. University of Durham Report No. 5.
111	University of Durham	1975	Physiographic Regions, an Outline of the Durham Project Area. University of Durham General Statement No. 2.
112	University of Durham	1975	Oman Report No. 21 B - Wells on the Batinah.
113	White, R.S. & Ross. D.A.	1979	Tectonics of the Western Gulf of Oman. Jour. Geophy. Res. V. 84 No. B7.
114	WRE		Rainfall in Oman 1977.
115	WRE	1978	Flood Hydrology of Northern Oman.

<u>No.</u>	<u>Author</u>	<u>Year</u>	<u>Title and Others</u>
116	WRE	1979	Water Resources Assessment and Appraisal
117	WRE	1979	Water Resources of the Batinah.

MAPS

<u>No.</u>	<u>Title</u>	<u>Scale</u>	<u>Year</u>	<u>Source</u>
118	Geological Map of the Arabian Peninsula	1: 2,000,000	1963	USGS & ARAMCO
119	Tactical Pilotage Chart	1: 500,000	1973	Defence Min.U.K.
120	Oman & United Arab Emirates (relief)	1: 100,000	1963	Defence Min.U.K.
121	Joint Operations Graphic-Ground	1: 250,000	1980	Defence Min.U.K.
122	Orthophoto Map (Batinah Coast)	1: 10,000	1982	MAF,OMAN
123	Location of Bench Mark	1: 100,000	-	PDO
124	Soil map (Southeast Batinah & Interior)		1975	GIBB
125	Soil map (Southeast Batinah Coast)		1975	GIBB
126	Soil map (Northwest Batinah Coast)		1975	ILACO
127	Soil map (Batinah General)		1975	Durham Univ.
128	Soil map (Wadi Bani Kharus)		1975	GIBB
129	Soil map (Oman General)		1981	FAO

AERIAL PHOTOGRAPHS

<u>No.</u>	<u>Scale</u>	<u>Year</u>	<u>Source</u>
130	1:60,000	1968	MOD
131	1:30,000	1981	MAF
132	1:40,000	1981	JICA
133	1:20,000	1980	MPW
134	1:10,000	1981	MAF

APPENDIX C Location of Observation Network

- 1. List of Agro-meteorological Station**
- 2. List of Rain Gauge**
- 3. List of Wadi Gauge**
- 4. List of Observation Well**
- 5. List of Water Use Survey Site**

(1) List of Agro-Meteorological Station

Location	Code Number	Altitude (m.a.s.l)	UTM-Grid	Starting Date of Observation
Al-Muladdah	MF1	18	40QEB248577	July 30, 1983
Al-Rustaq	MF2	340	40QEA430905	July 25, 1983

Observation Items of Al-Muladdah Agro-Meteorological Station

Observation Items	Sensors
Wind Speed	Propeller Type Wind Transmitter
Wind Direction	- Do -
Solar Radiation	Pyranometer
Net Radiation	Net Radiometer
Soil Heat Flux (5, 15, 45, 90 cm Deep)	Heat Flowmeter
Soil Temperature (5, 15, 30, 60, 120 cm Deep)	Platinum Resistance Thermometer
Dry and Wet Bulb Temperature (50, 270 cm High)	- Do -
Rainfall	Tipping Bucket Type Transmitter Standard Rain Gauge
Evaporation	Type-A Pan

Observation Items of Al-Rustaq Agro-Meteorological Station

- | | |
|-----------------------------|---------------------|
| 1. Wind speed and direction | 5. Soil temperature |
| 2. Solar radiation | 6. Evaporation |
| 3. Net Radiation | 7. Air temperature |
| 4. Soil heat flux | 8. Humidity |
| | 9. Rainfall |

Note: The data of soil heat flow and temperature are spoiled due to unsuitability of site. It is to start full observation after the shift of the station.

(2) List of Rain Gauge

Wadi Basin	Code Number	Location	Altitude (m.a.s.l.)	UTM Grid	Starting Date of Observation	Remarks
W. Ahin	RA1	Saham	10	40R DB 880 697	Jun. 7, 1983	Automatic Recorder
	RA2	Al-Hail	300	40R DB 558 598	Jul. 3, 1983	"
	RA3	Haibi	500	40Q DB 543 449	Jul. 3, 1983	"
	RA4	Al-Qufais	570	40Q DB 441 493	Jul. 3, 1983	"
	RA5	Al-Wuqban	750	40Q DB 391 390	Aug. 10, 1983	"
	RA6	Doharat	160	40R DB 620 730	Dec. 13, 1984	"
W. Bani Ghafir	RG1	Al-Suwaig	10	40Q EB 440 367	Jul. 7, 1983	"
	RG2	Al-'Araq	120	40Q EB 374 180	May 31, 1983	"
	RG3	Al-Houqain	220	40Q EB 346 043	May 31, 1983	"
	RG4	Daba'	660	40Q EA 117 927	May 31, 1983	"
	RG5	Yiga'	590	40Q EA 195 860	May 31, 1983	"
W. Al-Fara'	RF1	Al-Amq	700	40Q EA 336 759	May 26, 1983	"
	RF2	Madruj	1,000	40Q EA 298 710	May 26, 1983	"
	RF3	Al-Zammah	670	40Q EA 423 679	Jun. 8, 1983	"
	RF4	Sih Janna	140	40Q EB 530 050	Jun. 7, 1983	"
	RF5	Al-Rustaq	340	40Q EA 432 858	Dec. 13, 1984	"
W. Bani Kharus	RK1	Khatum	180	40Q EA 698 970	Jun. 5, 1983	"
	RK2	Al-Awabi	480	40Q EA 562 788	Jun. 2, 1983	"
	RK3	Al-Hijir	710	40Q EA 516 659	May 30, 1983	"
	RK4	Al-Muhassanah	870	40Q EA 652 637	May 30, 1983	"
	RK5	Al-Ghubrah	610	40Q EA 720 710	Jun. 5, 1983	"
	RK6	Al-Khadrah	1,090	40Q EA 773 590	Jun. 5, 1983	"
	RK7	Abu-Abali	25	40Q EB 719 252	May 31, 1985	"
W. Al-Ma'awil	RM1	Barka'	30	40Q EB 897 156	May 16, 1983	"
	RM2	Sih Khatum	70	40Q EB 769 112	Jun. 8, 1983	"
	RM3	Afi	170	40Q EA 823 925	Jun. 5, 1983	"
	RM4	Ard Al-Mahbil	370	40Q EA 784 848	May 15, 1983	"

(3) List of Wadi Gauge

Wadi Basin	Location		Code number	*1) Type	Height (m)	*2) Equip-ment	Catch-ment Area (km ²)	Starting date of Observa-tion
	Site Name	UTM-Grid						
W. Ahin	Al-Hail	40R DB 560-597	WA1	S	12	L	768.3	Mar. 14, 1984
	Saham	40R DB 858-760	WA2(A)	S	6	L	842.2	Dec. 26, 1983
	Saham	40R DB 856-764	WA2(B)	S	6	L	222.8	Jan. 20, 1984
W. Banj Ghafir	Al-Hougain	40Q EB 345-044	WG1	C	12	L & F	591.1	Sep. 7, 1983
	Al-Suwaig	40Q EB 414-370	WG2	S	6	L	951.9	Nov. 21, 1983
W. Al-Fara'	Al-Mazahit	40Q EA 458-954	WF1	C	12	L & F	698.2	Sep. 11, 1983
	Al-Tarif	40Q EB 626-279	WF2	S	6	L	1014.5	Nov. 21, 1983
	Al-Musana'ah	40Q EB 660-273	WF3	S	6	L	93.8	Jan. 7, 1984
	Al-Tabaqah	40Q EA 315-856	WF4	S	13	L	165.3	Jan. 22, 1984
	Fara'	40Q EA 498-789	WF5	S	10	L	170.2	Jan. 22, 1984
W. Bani Kharus	Al-Abiyad	40Q EA 928-676	WK1	C	12	L & F	750.6	Jan. 19, 1984
	Abu-Abali	40Q EB 729-259	WK2	S	6	L	1292.3	Jan. 21, 1984
	Al-Awabi	40Q EA 540-760	WK3	S	10	L	253.6	Jan. 22, 1984
	Al-Ghubrah	40Q EA 706-792	WK4	S	10	L	201.5	Jan. 22, 1984
W. Al-Ma'awil	Barka'	40Q EB 840-222	WM1	S	6	L	1029.8	Dec. 21, 1983
	Afi	40Q EA 849-850	WM2	S	8	L	319.1	Jan. 4, 1984

*1) Type : C: Concrete tower type
S: Steel pipe type

*2) Equipment: L: Water level recorder
F: Radio flow meter

(4) List of Observation Well (1/2)

No.	Well Code	Basin	UTM Grid	Casing Diameter	Total Depth (m)	Screen Depth (m)	Present Depth (m)	Remarks
1.	BA1	W. Ahin	40R DB 836 792	10"	100	3.75-99.15	100	Recorder Since Jan. 17, 1984
2.	EA5	"	40R DB 812 762	9 5/8"	175	32-57.5 133.6-146.2	70	Record Since Jan. 23, 1984
3.	WS124	"	40R DB 837 737	14 3/4"	60	36-48	54.5	
4.	OA3	"	40R DB 685 758	4"	100	57-88	89	
5.	EA3	"	40R DB 766 820	9 5/8"	175	34.6-64.4 89.4-102.2	90	
6.	EA4	"	40R DB 790 838		130	85-98 46-72	18.5	
7.	JT20A	W.B. Ghafir	40Q EB 361 128		50	15.05-49.55	50	
8.	JT19	"	40Q EB 360 113	9 5/8"	140.0	118.0-140.0	-	Recorder Since 1976
9.	JT21	"	40Q EB 372 157	"	144.0	24.5-49.0	76.3	
10.	JT22	"	40Q EB 373 221	"	142.0	116.0-128.0	78.9	Recorder Since Dec. 5, 1983
11.	ADG25	"	40Q EB 436 338	"	35.7	26.8-34.4	-	Recorder Since 1976
12.	ADW19	"	40Q EB 390 300	10"	40.0	28.0-39.0	40	
13.	ADG26	"	40Q EB 488 326	9 5/8"	46.0	21.3-29.8 38.7-44.8	21.9	
14.	BG1	W. Fara'	40Q EB 512 257	10"	50	19.85-48.46	50	Record Since Dec. 31, 1983
15.	BG2	"	40Q EB 464 143	"	90	64.98-87.91	90	Drilled in 1983
16.	BF1	"	40Q EB 675 275	10"	100	7.47-96.62	100	Recorder Since Jan. 30, 1984
17.	BNET	"	40Q EB 575 247	10"	23	15.00-20.75	23	Drilled in 1984
18.	JT13	"	40Q EB 620 179	9 5/8"	70.0	35.0-46.0 59.0-70.0	67.0	
19.	JT14	"	40Q EB 602 122	9 5/8"	70.0	47.2-70.0	62.1	
20.	JT15	"	40Q EB 570 198	"	101.0	43.0-54.0 66.0-78.0	91.6	Recorder Since Jan. 30, 1983
21.	JT16	"	40Q EB 542 131	"	140.0	69.0-81.0 92.0-104.0	122.2	
22.	JT17	"	40Q EB 511 088	"	144.0	70.0-81.6 94.2-107.1	100	Recorder Since Jan. 30, 1984
23.	ADG20	"	40Q EB 616 269	"	47.2	27.4-43.0	43.6	
24.	JT24	W.B. Kharus	40Q EB 742 122	9 5/8"	143.0	86.0-97.0 130.0-141.0	140	

(4) List of Observation Well (2/2)

No.	Well Code	Basin	UTM Grid	Casing Doameter	Total Depth (m)	Screen Depth (m)	Present Depth (m)	Remarks
25.	JT57	W.B. Kharus	40Q EB 719 202	9 5/8"	72.0	23.6-45.5 60.5-72.0	68.7	
26.	JT58	"	40Q EB 730 278	"	70.0	13.0-63.0	50.0	
27.	JT67	"	40Q EB 688 131	"	70.4	34.7-44.9 57.2-70.4	63.7	Recorder Since Jan. 30, 1984
28.	JT68	"	40Q EB 691 078	"	140.0	116.6-140.0	100	
29.	JT69	"	40Q EB 726 258	"	72.0	20.0-70.0	-	Recorder Since 1976
30.	ADG24	"	40Q EB 687 248	"	49.0	14.0-31.4	35.6	
31.	DW3	"	40Q EB 729 238	4"	300.0	9.1-300.0	180	
32.	DW4	"	40Q EB 782 216	"	300.0	9.1-300.0	100	
33.	ADG23	"	40Q EB 786 211	9 5/8"	39.0	21.0-35.7	39	Recorder Since Dec. 21, 1983
34.	JT10	"	40Q EB 781 141	"	71.0	22.6-32.9 59.5-70.1		Recorder Since Dec. 21, 1983
35.	JT11	"	40Q EB 757 080	"	140.0	71.0-82.0 128.0-140.0		
36.	JT12	"	40Q EB 730 023	"	140.0	43.5-55.1 91.3-103.6	118.7	Recorder Since Dec. 20, 1983
37.	HD23	"	40Q EB 750 180	-	25.0	-	25.8	Hand dug
38.	BM1	W. Ma'awil	40Q EB 887 221	10"	100	4.80-96.15	100	Recorder Since Dec. 28, 1983
39.	BM3	"	40Q EB 843 169	10"	50	21.15-49.90	50	Drilled in 1983
40.	JT5	"	40Q EB 894 114	9 5/8"	70.1	22.9-34.5 58.8-69.5	66.89	
41.	JT7	"	40Q EA 860 988	"	140.0	117.1-139.6	100	
42.	JT9	"	40Q EA 779 853	"	42.0	-	-	Recorder Since 1976
43.	JT52	"	40Q EB 935 102	"	144.0	63.0-74.0 119.0-130.0	100	Recorder Since Jan. 4, 1984
44.	JT56	"	40Q EB 933 021	10"	157.0	70.0-87.0 100.0-112.0	120	Recorder Since Jan. 3, 1984
45.	ADG17	"	40Q EB 890 176	"	34.7	11.6-31.1	30.6	Recorder Since Jan. 5, 1984
46.	ADW7	"	40Q EB 903 149	10"	157.0	70.0-87.0 100.0-112.0	120	
47.	ADW5	"	40Q EA 827 914	10"	33.0	17.0-27.0	7.0	
48.	BM2	"	40Q EB 840 055	9 5/8"	90	78.43-88.50	90	Drilled in 1983
49.	JT6	"	40Q EB 881 052	"	70.1	23.2-33.8 60.4-70.1	70	

(5) List of Water Use Survey Site

A. List of Falaj Staff Gauge

Staff Gauge No.	Name of Staff Gauge	Name of Falaj	Wadi Basin	Remarks
SB-1	Al-Bilad	Al-Bilad	Wadi Bani Ghagir	
SM-1	Rustaq (I)	Al-Maisar	Wadi Al Fara'	
ST-1	Rustaq (II)	Abu-Taleb	Wadi Al Fara'	
SK-1	Nakhal	Al-Gharid	Wadi Al Fara'	Hot Spring
SH-1	Hazam	Al-Hazam	Wadi Bani Kharus	
SA-1 SA-2	Awabi	Al-Awabi	Wadi Bani Kharus	2 Staff gauge for main and branch canal

B. List of Production Wells with Cumulative Flow Meter

No.	Name of Station	Flow Meter No.	Name of Place	Name of Farm Owner	Remarks
1.	Saham (I)	2536	Khishisah, Saham	Mohammed Houashil Rashid	Near Estuary Center of Musana'ah
2.	Saham (II)	2547	Khishidah, Saham	Rashid Abdullah Mohammed Al-Stabi	
3.	Suwaik (I)	2537	Afraadh, Suwaik	Naser Mohammed	
4.	Suwaik (II)	2548	Suwaik	Mohammad Salim Salih Al Ajmi	Removed the meter on July 8, 1986
5.	Suwaik (III)	2535	Suwaik	Mohammad Salim Salih Al Ajmi	
6.	Manfash	2546	Manfash, Suwaik	Saif Rashid Mohammed	
7.	Musana'ah (I)	2538	Musana'ah	Darwish Khamis Falad	Close to Police Stn. Center of Musana'ah
8.	Musana'ah (II)	2519	Tarif, Musana'ah	Ibrahim Ahamed	
9.	Musana'ah (III)	2539	Tarif, Musana'ah	Khalid Khamis	Near Tarif Mosque 500M inside from Route No.1 Close to Route No.1
10.	Muladdah	2534	Muladdah, Musana'ah	Khamis Ali Al-Baloushi	
11.	Abu-Abali (I)	2545	Abu-Abali, Musana'ah	Juma Salim Khamis	
12.	Abu-Abali (II)	2550	Abu-Abali, Musana'ah	Musaba Hilal Salim	Removed the meter on July 8, 1986
13.	Billah (I)	2549	Billah, Barka	Abdullah Rashid Al-Musharraf	Near School
14.	Billah (II)	2544	Billah, Barka	Abdullah Rashid Al-Musharraf	
15.	Uqdah	2532	Uqda, Barka	Ali Abdulla Haman	Near Owner's House Close to Wadi Al-Ma'awi
16.	Lashko (I)	1075	Uqda, Barka	Nasser Lashko	
17.	Lashko (II)	2551	Uqda, Barka	Naseer Lashko	- Do -
18.	Barka (I)	2541	Barka	Abdulla Hamed Al Amrey	Close to Route No.1
19.	Barka (II)	2543	Jahalsh, Barka	Abdulla Hamed Al Amrey	
20.	Barka (III)	2540	Jahalsh, Barka	Abdulla Hamed Al Amrey	Removed the matter on July 8, 1986

APPENDIX D Project Work Items

Survey Programme of the Project

(June 1985)

OBJECTIVES	ITEMS	1982			1983			1984			1985		
		J	F	M	J	F	M	J	F	M	J	F	M
1 To set up optimum meteorological and hydrological observation networks	Construction and installation												
	(1) Meteorological observation station												
	(2) Rain gauges												
	(3) Wagi gauges												
2 To carry out the observation	(4) Well gauges and observation wells												
	<u>Observation and Survey</u>												
	(5) Meteorological observation												
	(6) Hydrological observation												
	(7) Hydrogeological observation												
	(8) Geoelectric sounding												
3 To analyze the current hydrologic balance in the project area	(9) Geological geomorphological survey												
	(10) Levelling survey												
	(11) Water and land use survey												
	<u>Data Processing and Analysis</u>												
	(12) Remote sensing analysis												
4 To transfer technology to the counterparts	(13) Data processing and analysis of the current hydrologic balance												
	(14) The knowledge of hydro-meteorologic observation and maintenance												
	(15) The system of a computerized data-logging												
	(16) Basic education for observation staffs												
Reporting	Inception Report	▲			▲			▲	III			▲	IV
	Progress Report	▲			▲			▲	II			▲	II
	Interim Report	▲			▲			▲	I			▲	I
	Draft Final Report												▲
	Final Report												▲

Note: — w — Design and Tender, — Construction, installation, observation and survey, with the Project, — Observation (partial), — Observation without the Project

Work Items during the Project (1/2)

	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	Remarks
I. Basic Survey					
- Collection of existing data and information	+				
- Field reconnaissance	+				
- Data acquisition and planning work	+				
II. Field Survey					
1. Installation of a hydrologic observation network					
- Agro-meteorological station	+	+			
- rain gauge	+	+			
- Wadi gauge	+	+			
- Groundwater gauge		+			
- Staff gauge	+	+			Falaj.
- Cumulative flow meter	+	+			
2. Observation of hydrologic components					
(1) Meteorology/Hydrology					
- Observation			+	+	
- Data compilation			+	+	
- Flood survey				+	Flood marks
- Ground survey		+			Wadi cross sections
(2) Hydrogeology					
- Observation			+	+	
- Water quality analysis		+	+		
- Sampling		+	+		
- Pumping test		+	+		
- Electrical prospecting	+	+			
- Geomorphological map		+		+	
- Hydrogeologic map				+	
- Data compilation			+	+	Including existing observation walls
(3) Water/land use					
- Survey/observation		+	+	+	

Work Items during the Project (2/2)

	1982/ 1983	1983/ 1984	1984/ 1985	1985/ 1986	Remarks
- Water use		+	+	+	
- Water quality		+	+	+	
- Water management				+	
- Existing land use	+	+		+	
3. Data processing and data analysis					
(1) Estimation of hydrologi- cal water balance					
(i) Remote sensing					
- Land covers	+				LANDSAT
- Periodic variation in vegetation		+			"
- Lineament reading				+	"
- Precipitation dist- ribution analysis			+	+	NOAA
- Soil moisture Analysis			+	+	"
(ii) Hydrological analysis			+	+	
(iii) Groundwater analysis			+	+	
(2) Water resources development potential				+	
4. Technical transfer					
- Observation/maintenance		+	+	+	
- Data collection		+	+	+	
- Basic knowledge			+	+	
- Year book				+	
- Training in Japan	+ (2)	+ (1)	+ (2)		

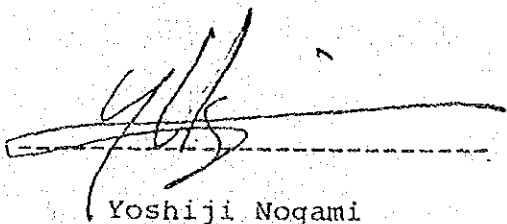
APPENDIX E Scope of Work

MINUTES OF DISCUSSION
BETWEEN THE JAPANESE PRELIMINARY SURVEY TEAM
AND THE OMANI GOVERNMENT AUTHORITIES
CONCERNED ON THE SCOPE OF WORK
FOR THE HYDROLOGIC OBSERVATION PROJECT
IN THE BATINAH COAST AREA OF SULTANATE OF OMAN

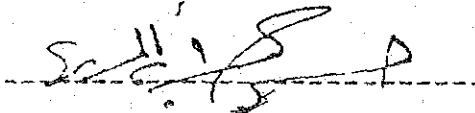
The Japanese Preliminary survey team under the aegis of the Japan International Cooperation Agency (hereinafter referred to as JICA) headed by Mr. Yoshiji Nogami visited Sultanate of Oman in November/December 1981 for the purpose of working out the details of the Hydrologic Observation Project (hereinafter referred to as " Project ") with a view of integrated water resources development in the Batinah Coast Region of Sultanate of Oman.

As a result of a series of careful discussions, the Japanese Team and the Omani authorities concerned agreed to recommend to the respective Governments the implementation of the Project in accordance with the scope of the work attached hereto.

2nd December 1981, in Muscat



Yoshiji Nogami
Leader of Japanese Preliminary
Survey Team



Hasan Abdulla Al Murazza
Undersecretary of Ministry
of Agriculture and Fisheries



SCOPE OF WORK
FOR HYDROLOGIC OBSERVATION PROJECT
IN THE BATINAH COAST OF SULTANATE OF OMAN

1. In response to the request of the Government of Sultanate of Oman, the Government of Japan has decided to conduct Planning and implementation of Hydrologic Observation Project (hereinafter referred to as " the Project ") with a view of integrated water resource development in the Batinah Coast Region of Sultanate of Oman in accordance with laws and regulations in force in Japan without prejudice to Omani laws and in close co-operation with the Government of Sultanate of Oman.

2. The Project will be implemented in line with the Framework of Hydrologic Observation Project (hereinafter referred to as " the Framework ") given in Annex 1 and the schedule shown in Annex 2.

3. In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary measures through the Japan International Co-operation Agency (hereinafter referred to as " JICA ") the official Agency responsible for the implementation of the Technical Co-operation Programmes of the Government of Japan, to despatch at its own expense the Japanese Survey Team to carry out the Project as provided for in this Scope of Work.

4. (i) In accordance with the laws and regulations in force in Japan, the Government of Japan will take necessary

measures through JICA to provide at its own expense such machinery, equipment and other materials necessary for the implementation of the Project.

(iii) The details of the articles referred to in (i) above will be communicated to the Government of Sultanate of Oman following the completion of the basic study as envisaged in the Framework given in Annex 1.

(iv) Hydrologic observation equipment and instruments installed during the course of the Project will become the property of the Government of Sultanate of Oman upon completion of the Project.

5. In order to ensure the smooth operation of the Project, the Government of Japan, in accordance with the laws and regulations in force in Japan, will take necessary measures through JICA, to make available services of Japanese experts to supervise the installation of such instruments.

6. The Government of Sultanate of Oman will take necessary measures to secure at its own expense necessary services of Omani counterpart personnel and assistant personnel for the project for the duration of the

Project. The Government of Japan on its part, in accordance with the laws and regulations in force in Japan, will take necessary measures through JICA to accept these counterparts in order to transfer necessary technology to these personnel within the framework of JICA's annual training schemes.

7. The Government of Sultanate of Oman will;

- (i) ensure the safety of the study team
- (ii) exempt customs duties, internal taxes and any charges, imposed in Sultanate of Oman on the articles referred to in Paragraph 4 above.
- (iii) ensure prompt customs clearance on the articles referred to in Para. 4 above.
- (iv) provide the Japanese Survey Team with relevant available data, information and materials for the purpose of the implementation of the Project.
- (v) provide the Japanese Survey Team with suitably equipped office accommodation.
- (vi) provide the Japanese Survey Team necessary transportation for the purpose of the Project within Sultanate of Oman.
- (vii) provide miscellaneous minor local cost expenditures, small instruments, tools and any other materials necessary for the implementation of the Project other than those provided through JICA.

under Para. 4 and Para. 5 above.

- (viii) allow the Japanese Survey Team to borrow to use in Japan any such data, maps, records and samples as necessary for the implementation of the Project.
- (ix) carry out bona-fide maintenance of all the survey equipment and instruments and survey installations.
- (x) make necessary arrangements for the permission of the authorities concerned for the team to conduct the survey in the project area.

8. There will be mutual consultations between the two Governments on any major issues arising from, or in connection with this Scope of Work.

9. The duration of the Project will be from JFY 1981 through 1984

10. The Ministry of Agriculture and Fisheries of Sultanate of Oman will bear the responsibility of administration and coordination of the Project on behalf of the Government of Sultanate of Oman.

Annex I
Framework
for Hydrologic Observation Project
in the Batinah Coast Region
of Sultanate of Oman

1. Objectives

The purpose of the Hydrologic Observation Project (hereinafter referred to as " the Project ") is to set up the optimum hydrologic observation network and carry out hydrologic and hydrogeological surveys, with a view of integrated water resource development in the Batinah Coast Region of Sultanate of Oman. On the basis of the said surveys, the hydrological analysis will be carried out to ascertain the salient features and characteristics of hydrological water balance in the said region.

2. Project area

The following stretches of wadis were slated as the project area;

- (1) W. AHIN
- (2) W. BANI GHAFTR
- (3) W. FARAA
- (4) W. KHARUS
- (5) W. MAAWIL

3. Contents of the Project

The Project is composed of three stages; i.e. Basic survey, Field survey and Data Processing Stage. The details of each stage are shown below.

3-1 Basic Survey

The main purpose of this survey is to formulate the basic plans of the project. Some of the items included are as follows;

- 1) Collection of existing data and information necessary for the implementation of the Project such as,
 - a. hydrological conditions
 - b. topographical maps and aerial photos
 - c. geology & hydrogeology
 - d. water quality and ground water conditions
 - e. meteorological records
 - f. others
- 2) Field reconnaissance to ascertain the conditions and informations
 - a. topography and geology
 - b. hydrogeology and surface soil
 - c. ground water well & observation wells in existence
 - d. hydrologic observation station

- 3) Data acquisition and planning work
 - a. brief electric prospecting
 - b. hydrologic observation network
 - c. drilling method
 - d. physical prospecting method
 - e. instruments needed for the project

3-2 Field Survey

This stage is composed of two types of series; i.e. Field Survey I for setting up the hydrologic observation network, and Field Survey II for executing the drilling work and investigations related with hydrogeological conditions.

The contents of each field survey are as follows.

- 1) Field survey I
 - a. Installation of hydrologic observation network
 - o rain-gauge
 - o run-off gauge
 - o evaporation pan
 - o ground water gauge
 - o water level gauge
 - o others
 - b. Observation of hydrologic components
 - o observational work for each measurements will be carried out during survey period

- c. Testing on water quality and present water use
 - o salinity, temperature, ion density
 - o compositions of ground water
 - o consumption of water use

2) Field survey II

- a. drilling works for construction of observation wells and testing wells
- b. electrical logging and pumping test
- c. testing of ground water quality
- d. electrical prospecting

3-3 Data processing and data analysis

The data obtained during surveys will be analysed synthetically and some of the hydrological conditions and hydrogeological features will be made apparent. Such work will be utilized to estimate the hydrological water balance and water resource development potential of each Wadi Basin.


4. Reports

JICA will prepare and submit the following reports in English to the Government of Sultanate of Oman in accordance with the tentative schedule in annex 2.

1. Inception Report
 - o 20 copies
 - o at the beginning of each field survey
2. Progress Report
 - o 20 copies
 - o at the end of each field survey
3. Interim Report
 - o 20 copies
 - o within the three months after basic study and implementation study (Phase I)
4. Draft Final Report
 - o 20 copies
 - o within three months after implementation study (Phase II)
5. Final Report
 - o 50 copies
 - o within 2 months after receipt of comments by the Government of Sultanate of Oman.

ANNEX -2 Tentative schedule.
 For Hydrologic Observation Project in The British Coast Area
 of Northern Oman

Time flow	1981			1982			1983			1984					
	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Surveys															
Preliminary survey (3/4 mission)															
Basic survey															
planning and preparatory work in Japan															
sorting of equipments et. al															
Field survey															
field survey-1 installation observation															
field survey-2 drilling et. al observation															
Data processing															
Reports															
I.C.R. Inception															
P.R. Progress															
I.T.R. Interim															
D.F.R. Draft final															
F.R. Final															

Field Work 
 Home work 