

**TUNDRA OIL AND GAS LTD.**



**SOURIS HARTNEY UNIT NO. 1**

**PRESSURE MAINTENANCE  
APPLICATION**

**AUGUST, 1999**

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1111 One Lombard Place, Winnipeg, Manitoba R3B 0X4 TEL: (204) 934-5850 FAX: (204) 934-5820

August 3, 1999

Manitoba Energy and Mines  
Petroleum Branch  
1395 Ellice Avenue, Suite 360  
Winnipeg, Manitoba  
R3G 0G3

Attention: **Mr. J. Fox, P.Eng.**  
**Chief Petroleum Engineer**

Dear John,

**RE: Souris Hartney Field**  
**Pressure Maintenance Application**

---

## **INTRODUCTION**

The Souris Hartney Field is located in Township 6, Range 22 WPM (refer to Figure No.1). Oil production is obtained from 5 producing wells. The productive horizon in the Souris Hartney Field is the Upper Virden Pool of the Lodgepole group of formations. Total oil production from the Upper Virden Pool at 99.06.30 was 20 m3/day at a field watercut of 85%. The field has been historically developed with vertical wells on 80 acre spacing. Horizontal drilling was completed in 1993 (2 wells), in 1995 (1 well), and in 1999 (1 grass roots well with a second leg added to an existing horizontal). The purpose of this pressure maintenance application is to install waterflood operations to maximize oil recovery from the Upper Virden Pool.

## **CONCLUSIONS**

1. Pressure surveys conducted during 1997 indicated a decline in original reservoir pressure in the Upper Virden Pool.
2. Based on recent engineering studies in 1998, the Upper Virden Pool at Souris Hartney is considered to be an acceptable reservoir for pressure maintenance operations.
3. Ultimate oil recovery with waterflooding is forecasted at 27.5% of oil-in-place from the Upper Virden Pool.
4. The waterflood program will be staged in the proposed Souris Hartney Unit No.1. Initially, waterflood operations will be installed in Section 17-6-22 by converting 2-17, 6-17, and 10-17-6-22 to injection service. Pending acceptable

waterflood response from offsetting producers, shut-in well 16-17-6-22 may also be converted to injection service. Pressure maintenance operations may also be considered in Section 16-6-22 at a later date (potentially suspended well 6-16-6-22 WPM could be converted to injection service).

## **DISCUSSION**

The supporting documentation for the pressure maintenance application is summarized as follows:

### **UNIT NAME**

Tundra proposes that the official Unit name of the pressure maintenance scheme in the Souris Hartney Field shall be Souris Hartney Unit No.1.

### **OPERATORSHIP**

Tundra Oil and Gas Ltd. will be the operator of record of the proposed Souris Hartney Unit No.1.

### **Unit Wells**

The wells to be included in the Unit are outlined in Table No.2

### **UNIT LANDS**

The Unit will consist of Sections 16 (West 1/2) and 17-6-22 WPM (East 1/2 and portion of West 1/2). The unitization concept will be based on 80 acre tracts (similar to spacing, oriented in a north-south direction). Using this approach, the proposed Unit will consist of 10 tracts. The lands included in the 80 acre tracts are summarized as follows:

#### **Tract No.1**

Lsd's 3-16, and 6-16-6-22 WPM

#### **Tract No.2**

Lsd's 4-16, and 5-16-6-22 WPM

#### **Tract No.3**

Lsd's 11-16, and 14-16-6-22 WPM

#### **Tract No.4**

Lsd's 12-16, and 13-16-6-22 WPM

#### **Tract No.5**

Lsd's 1-17, and 8-17-6-22 WPM

**Tract No.6**

Lsd's 2-17, and 7-17-6-22 WPM

**Tract No.7**

Lsd's 3-17, and 6-17-6-22 WPM

**Tract No.8**

Lsd's 9-17, and 16-17-6-22 WPM

**Tract No.9**

Lsd's 10-17, and 15-17-6-22 WPM

**Tract No.10**

Lsd's 11-17, and 14-17-6-22 WPM

Figure No.4 outlines the lands to be included in the proposed Unit.

**UNITIZED ZONE**

The unitized zone in the proposed Souris Hartney Unit No.1 will be the Upper Virden Pool. Attachment No.2 outlines a representative log cross-section of a Upper Virden Pool well.

**TRACT FACTORS**

The Souris Hartney Unit No.1 will consist of ten 80 acre tracts. The tract factors proposed for the Unit lands are outlined in Table No.10. Production from the last 90 operating days (refer to Table No.7) was used in the determination of tract factors. Since four of the five wells in the proposed Unit are horizontals, the production allocation factors (areas being drained by the horizontals) from the approved production sharing agreements were used in determining the tract factors (refer to Table No.8). The entire methodology to determine the tract factors is outlined in Table No.9.

**WORKING INTEREST OWNERS**

Tundra will be the only working interest owner in the proposed Souris Hartney Unit No.1. As a result, Tundra Oil and Gas Ltd. will have a 100% working interest in the Unit.

**TECHNICAL STUDIES**

The waterflood performance predictions for the Upper Virden Pool in the proposed Souris Hartney Unit No.1 are based on several geological and engineering studies.

Geological work included a review of the available open-hole logs and core data to establish reservoir continuity and to develop an effective oil net pay map. Attachment No.1 outlines the net oil pay map in the Unit area.

Engineering reviews included reserve estimation, historical production assessment, ultimate oil recovery predictions, special core studies (relative permeability study), pressure transient surveys, and reservoir simulation. Reservoir simulation was used to improve the reliability of the production forecasts of the existing field depletion strategy and proposed waterflood operation.

### **HISTORICAL PRODUCTION**

Figure No.2 outlines the production history of the Souris Hartney field. Oil production commenced from the Souris Hartney field in 1962, peaked initially in 1963, and declined until 1993 when two horizontal wells were drilled. A third horizontal well was drilled in 1995, again increasing oil production. Oil production declined thereafter until 1997 when the pumps were put on bottom to improve oil productivity. Since the second quarter of 1997, oil production has continued to decline in the Souris Hartney field. During the first quarter of 1999, one new grass roots horizontal well at 1-17-6-22 WPM was drilled with a second leg being added to an existing horizontal well at 15-17-6-22 WPM. Current oil production is about 20 m3/day (at 99.06.30). Cumulative oil production to 99.06.30 was 189,168 m3. Figure No.6 outlines the primary oil production forecast for the Unit. Attachment No.3 outlines the production histories of the wells in the Souris Hartney field, and the wells to be included in the proposed Unit. Attachment No.3 also outlines the ultimate primary oil recovery predictions of the 5 wells that are currently producing in the field.

### **RESERVES**

The Upper Virden volumetric oil-in-place is estimated at 1,036,153 m3. Table No.3 outlines the volumetric oil-in-place estimates in the Souris Hartney field on an individual LSD basis.

### **RECOVERY PROFILES**

Ultimate primary oil recovery is estimated at 243,011 m3 (refer to Figure No.3 and Table No.4). This represents an ultimate oil recovery of 23.5% of oil-in-place. Table No.4 outlines the recovery profiles of the individual wells in the proposed Unit.



### **WATERFLOOD DEVELOPMENT**

Waterflood predictions were generated with the aid of reservoir simulation. A review of the highlights of the reservoir simulation predictions is presented here-after.

#### **a. Reserves**

The oil-in-place estimate generated by the simulator was 1,145,000 m<sup>3</sup> or 10.5% greater than outlined in Table No.3. A sensitivity run was also made where the lobes in the NW1/4 of Section 17-6-22 and the SE1/4 of Section 16-6-22 were cut-off. This resulted in an oil-in-place estimate of 969,000 m<sup>3</sup> or a decrease of 6.5%, when compared to the approach outlined in Table No.3. The volumetric estimate of oil-in-place of 1,036,153 m<sup>3</sup> presented in Table No.3 agrees favourably with reservoir simulator estimates.

#### **b. Recovery Profiles**

Ultimate primary oil recovery of 280,000 m<sup>3</sup> is forecasted by the reservoir simulator. This represents an ultimate primary oil recovery of 24.5% of oil-in-place (simulator oil-in-place estimate). On a comparative basis, the reservoir simulator prediction, and individual well forecasting plots (outlined in Attachment No.3 and Table No.4) are in close agreement. However, reservoir simulator estimates (oil-in-place and ultimate oil recovery predictions) tend to be optimistic, and the prediction presented in Table No.4 is in the ball park.

#### **c. Waterflood Cases**

Several waterflood cases were investigated to determine the optimum installation of water injection wells. Waterflooding will initially be directed towards Section 17, since the majority of productive acreage is presently in this area of the field. Waterflood recovery predictions were generated by adding 2, 3, 4, and 5 injection wells. Table No.6 outlines that the optimum number of injectors in Section 17 would be four locations when compared to incremental oil recovery. Initially wells 2-17, 6-17, and 10-17-6-22 will be converted to injection service. Pending initial production performance in the areas impacted by injectors 2-17, 6-17, and 10-17-6-22, further expansion of waterflood operations in Section 17 would include converting well 16-17-6-22 to injection operations. Total incremental oil recovery of 58,000 m<sup>3</sup> is forecasted in Section 17 by the reservoir simulator with waterflood operations. Based on the reservoir simulation study, waterflood operations in Section 17 would provide an ultimate Unit recovery of 27.5% of oil-in-place. Further

waterflood expansion in the Unit to Section 16 would be contingent on acceptable performance in the initial area of waterflood operations in Section 17-6-22. A future injector in Section 16 of the Unit would potentially include well 6-16-6-22 WPM.

**d. Waterflood Pattern**

Figure No.5 outlines the waterflood pattern envisioned in Section 17. Basically, a line drive water injection configuration has been determined by the reservoir simulator to be the most effective means of providing pressure support and incremental oil recovery in Section 17.

**e. Future Development**

In addition to the new horizontal at 1-17-6-22 and lateral added to 15-17-6-22 horizontal in the Unit during 1999, further horizontal drilling may be implemented in Year 2000+, pending the initial performance of horizontal 1-17-6-22. A grass roots horizontal could be considered in each of the SE1/4 and NE1/4 of Section 16-6-22 WPM. Drilling of these additional horizontals will be contingent on good performance from 1-17-6-22 horizontal, which traverses the NW1/4 and SW1/4 of Section 16-6-22 WPM (Tracts No.2, No.3, and No.4), and terminates in Tract No.5 (Lsd's 1 and 8-17-6-22).

**UNIT ENLARGEMENT**

Pending future development drilling, the same formula (production during the last 90 operated days plus production allocation factors approved in production sharing agreements) will be used to determine the tract factors for new wells, as has been outlined in Tables No.7, No.8, and No.9 of this pressure maintenance application. Similarly, the tract factors of the existing unitized wellbores will be adjusted as new wells are added.

**WELL CONVERSION PROGRAM**

The workover programs to convert 2-17, 6-17, 10-17-6-22 WPM to injection service are outlined in Attachment No.4. Similarly, the Manitoba EMR application forms to reclassify the aforementioned wells to injection service are included in Attachment No.5.

**FACILITIES**

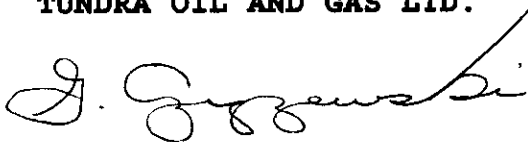
The Souris Hartney Unit No.1 will utilize battery facilities that are located at 12-16-6-22 WPM. The water injection pumps will be located at each wellsite designated for injection operations. Make-up injection water, if required, will be procured that is compatible with produced Upper Virden water. Figure No.7 outlines the location of the facilities, and injection lines in the proposed Unit.

**NOTIFICATION OF MINERAL AND SURFACE RIGHTS OWNERS**

Tundra is in the process of notifying all mineral rights and surface rights owners of the unitization of the Upper Virden Pool in Souris Hartney Unit No.1, and subsequent commencement of waterflood operations. Attachment No.7 outlines the surface and mineral owners in the proposed Unit and adjacent lands.

Respectfully submitted,

**TUNDRA OIL AND GAS LTD.**

A handwritten signature in cursive script, appearing to read 'G. Czyzewski', written in dark ink.

George Czyzewski, P.Eng.  
General Manager

# LIST OF FIGURES

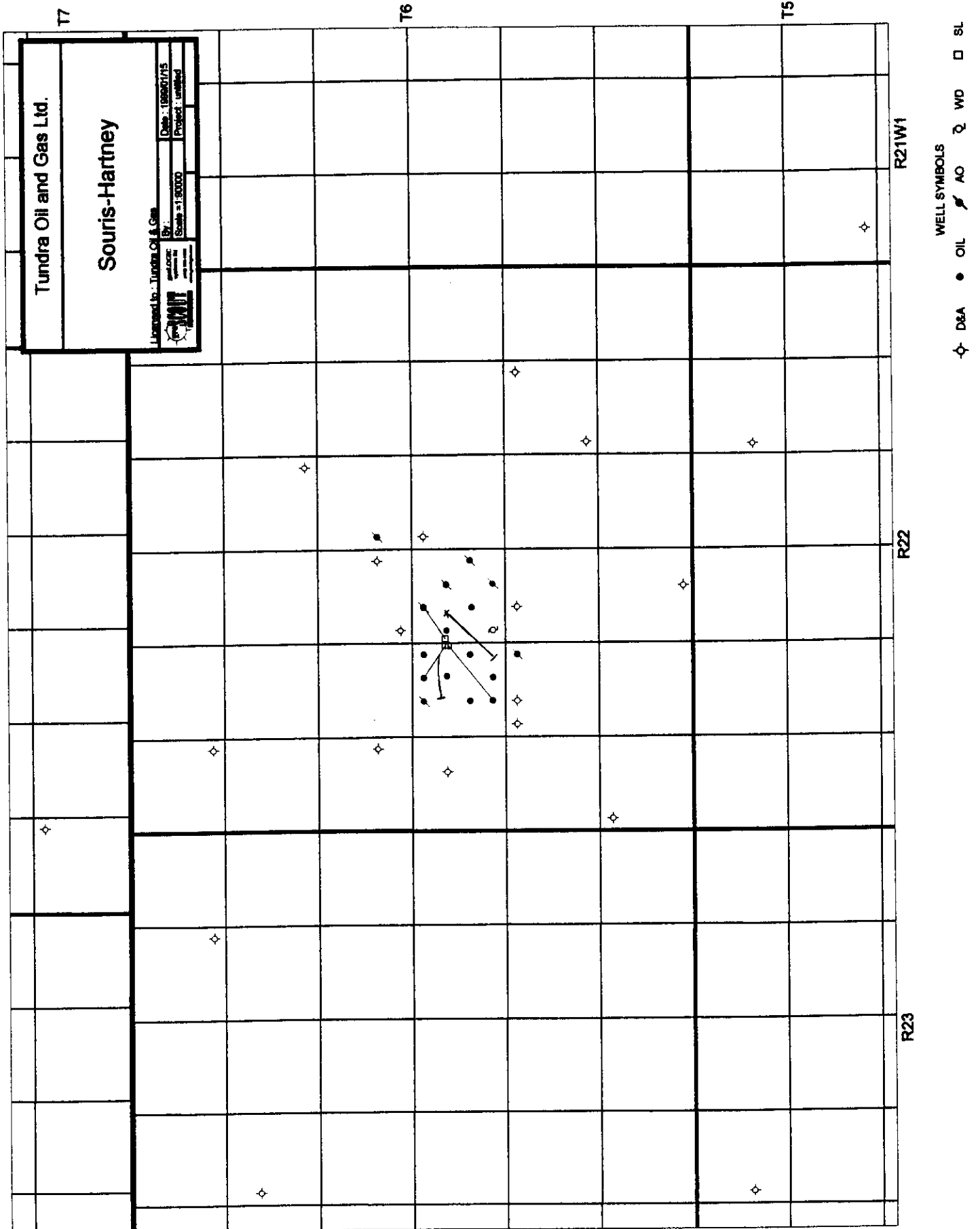
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# FIGURE NO.1

## SOURIS HARTNEY FIELD MAP

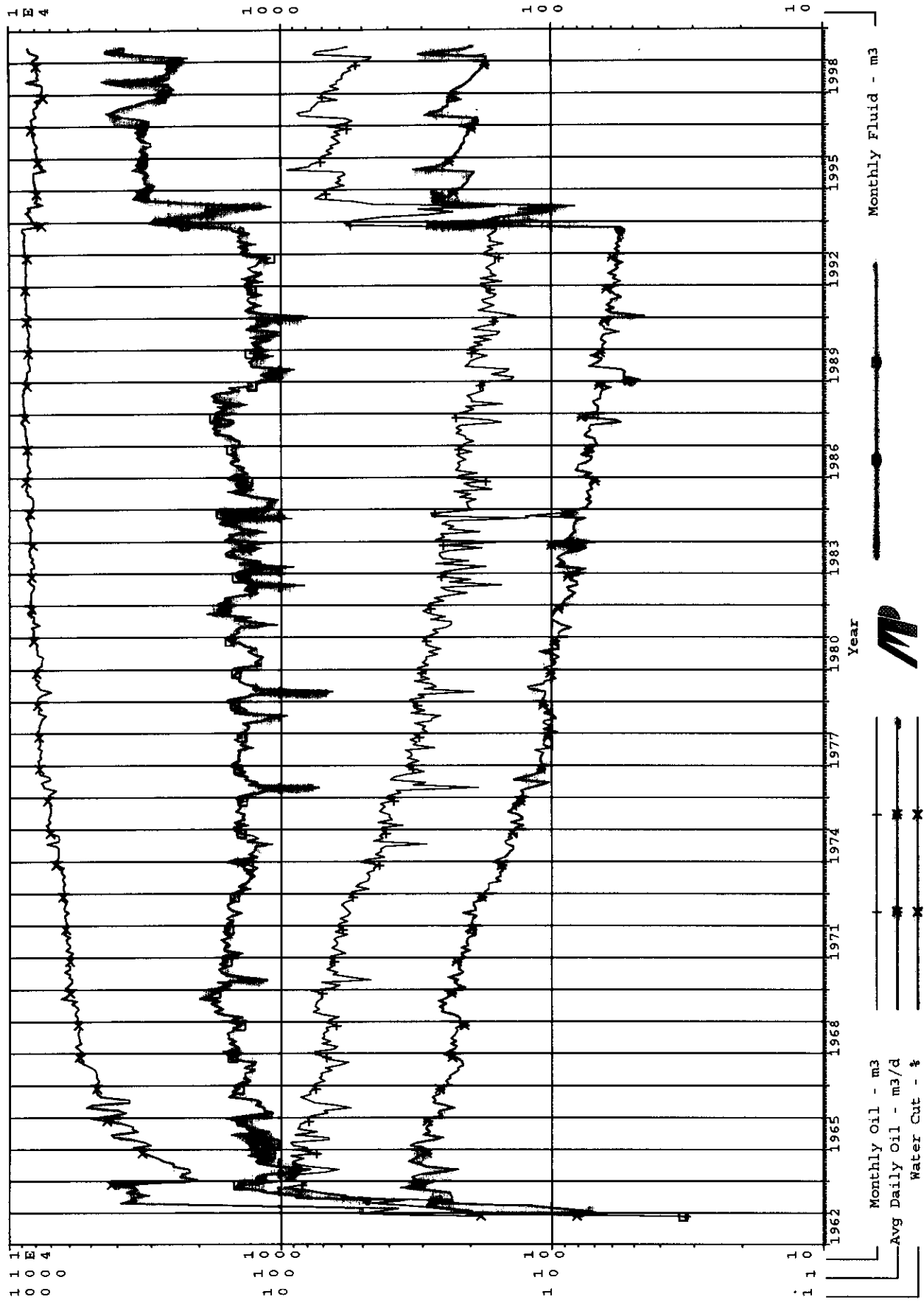


# FIGURE NO. 2

## FIELD PRODUCTION HISTORY

Operator:  
Field:  
Zone:  
Type: Oil  
Group: sourish

Production Cums  
Oil: 189339 m3  
Gas: 0 E6m3  
Water: 524708 m3  
Cond: 0 m3

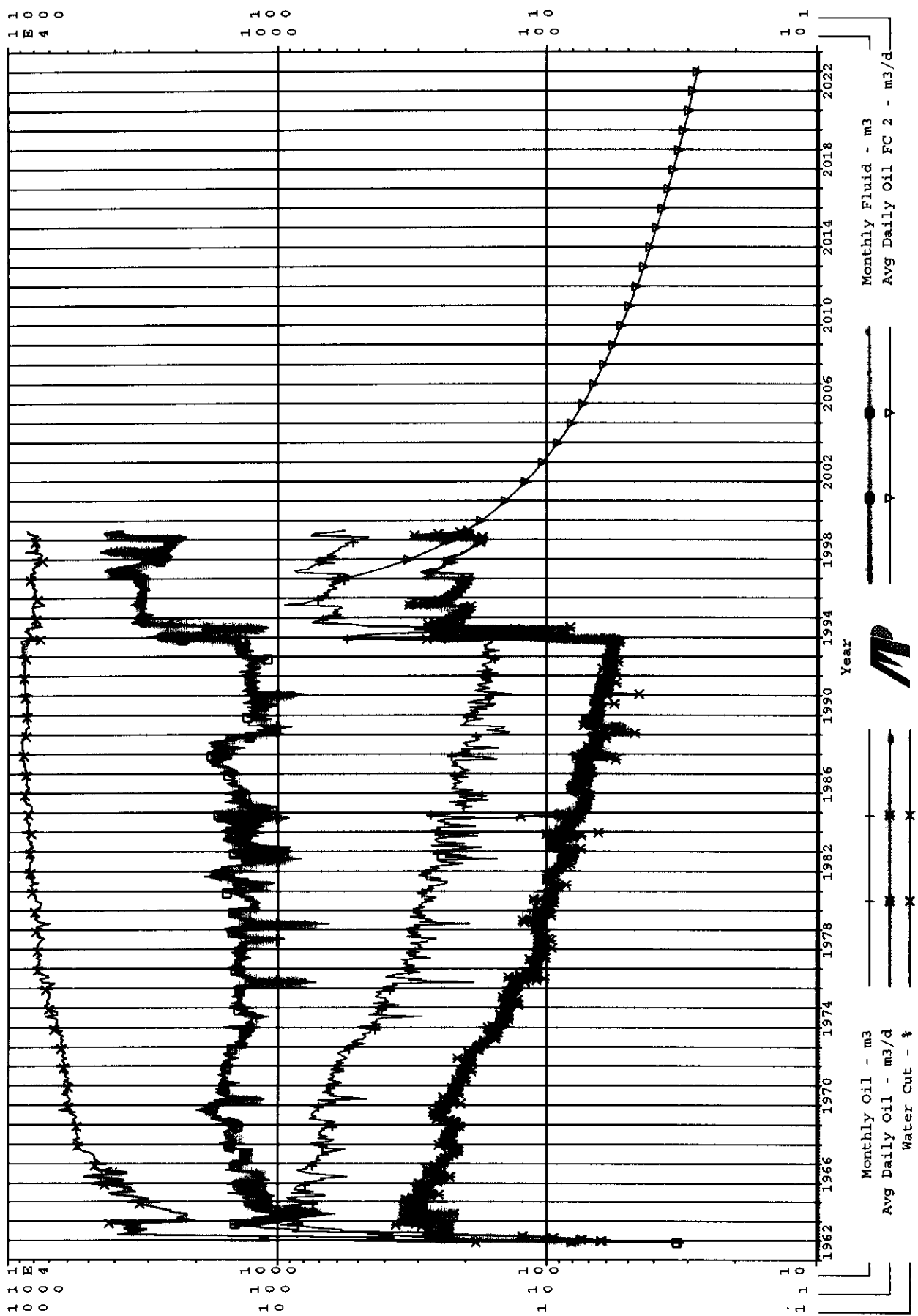


# FIGURE 10.3

## ULTIMATE RECOVERY PREDICTION

Operator: shoilaw Data 11/62-06/99  
 Field: Avg Daily Oil FC 2 (Rate-Time)  
 Zone: qi: 61.6901 m3/d, Dec, 1996  
 Type: Oil qf: 2.74588 m3/d, Mar, 2023  
 Group: sourish di (Har): 44.9798 CTD: 189339 m3  
 RR: 53666.2 m3 Tot: 243005 m3

Production Cume  
 Oil: 189339 m3  
 Gas: 0 E6m3  
 Water: 524708 m3  
 Cond: 0 m3



91



**T - TRACT NUMBER**

**Souris-Hartney**

Licensed to: Tundra Oil & Gas

Scale = 1:25000	Project : bolchoona	Date : 18/03/20
-----------------	---------------------	-----------------

Scale = 1:25000

Project: bghchoona

Scale = 1:25000



McGraw-Hill

## WELL SYMBOLS

[illegible]



# FIGURE NO.5

## INITIAL WATERFLOOD AREA

T6

Tundra Oil and Gas

Souris-Hartney

Licensed to: Tundra Oil & Gas  
 By: [Signature]  
 Date: 1999/01/26  
 Scale: 1:25000  
 Project: Lethbridge

WELL SYMBOLS

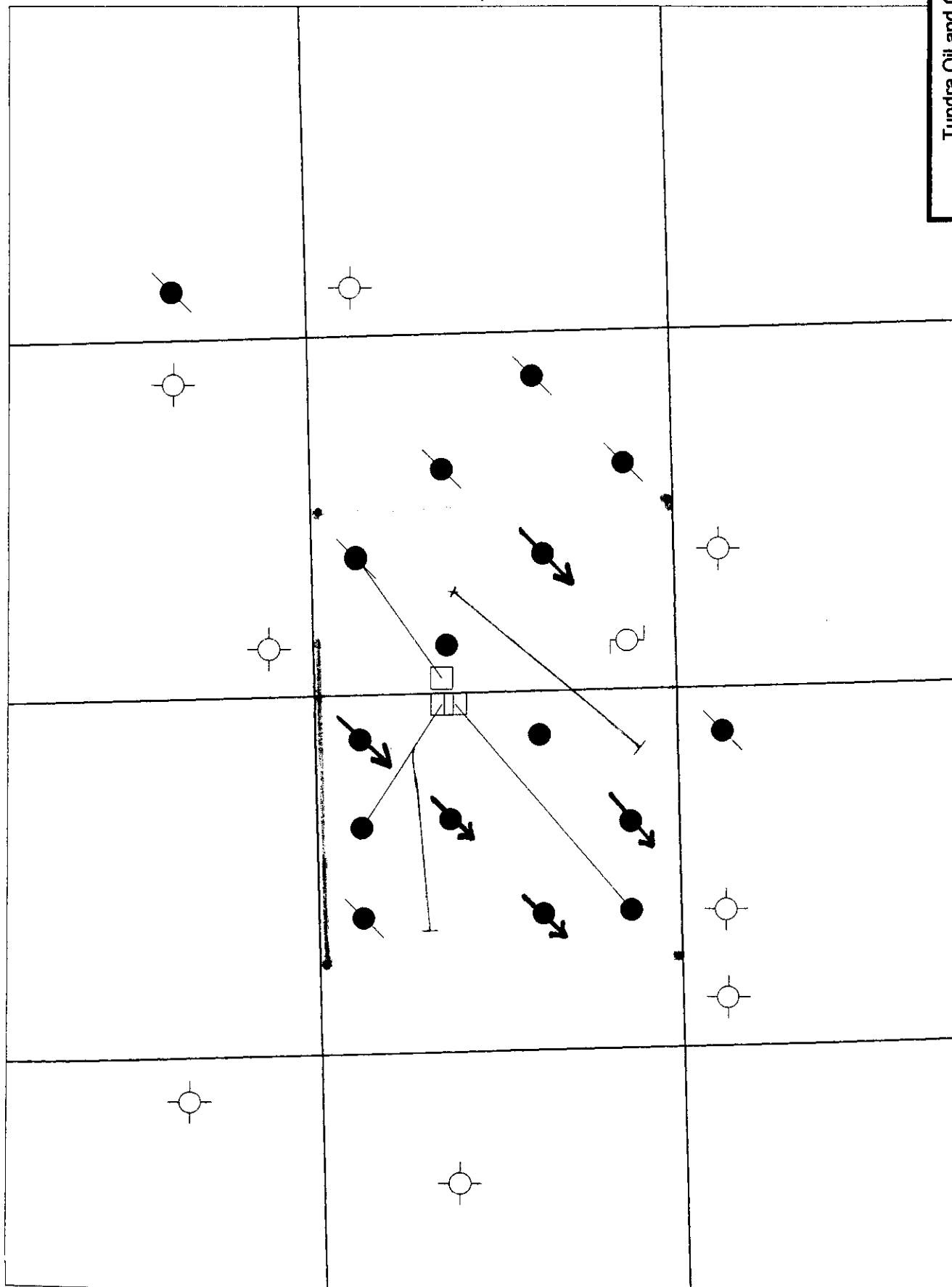
Oil	PTO	LCT	HET	AQZ	GOR	SSR	RDR	ASI
Water	W1	W2	W3	W4	W5	W6	W7	W8
Gas	GA	GB	GC	GD	GE	GF	GG	GH
Other	DA	DB	DC	DD	DE	DF	DG	DH

R22W1

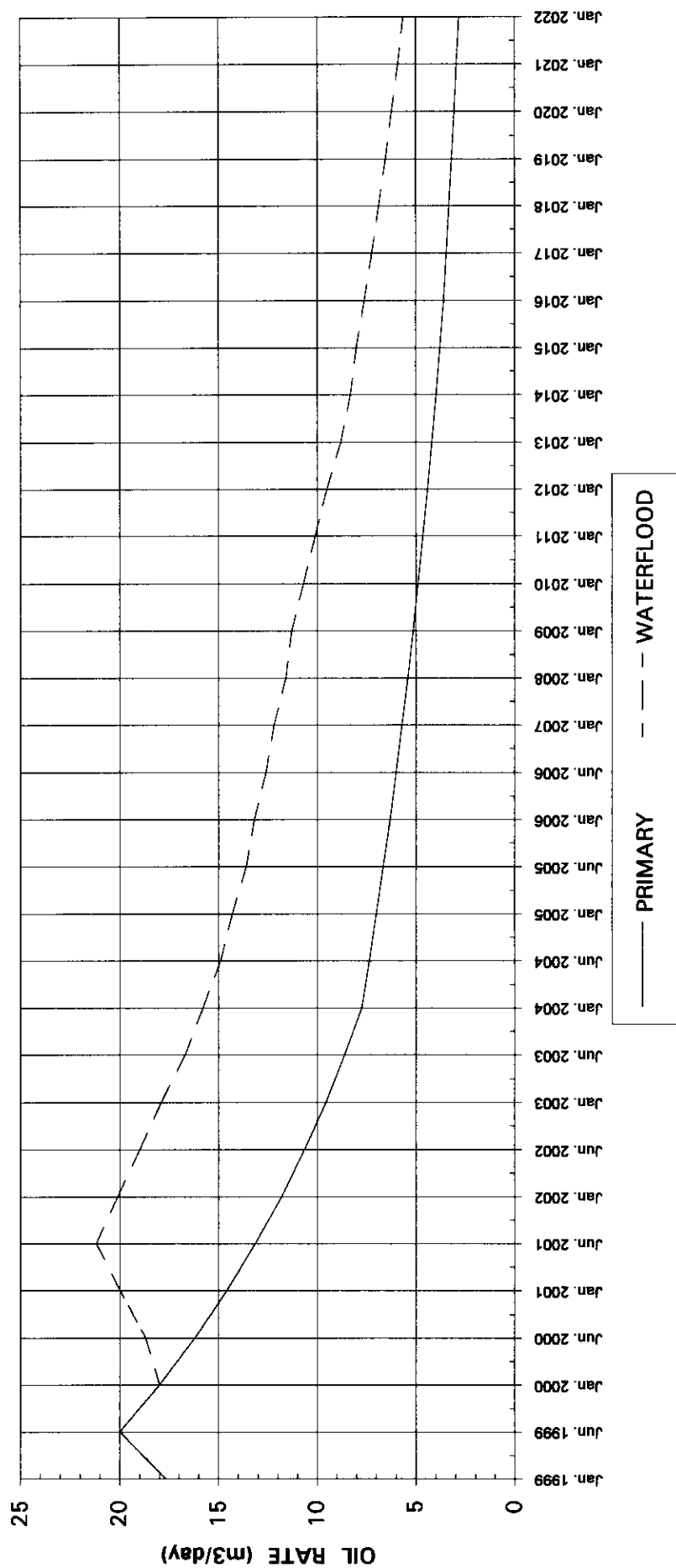
UNIT OUTLINE

INITIAL WATER INJECTORS

FUTURE INJECTORS



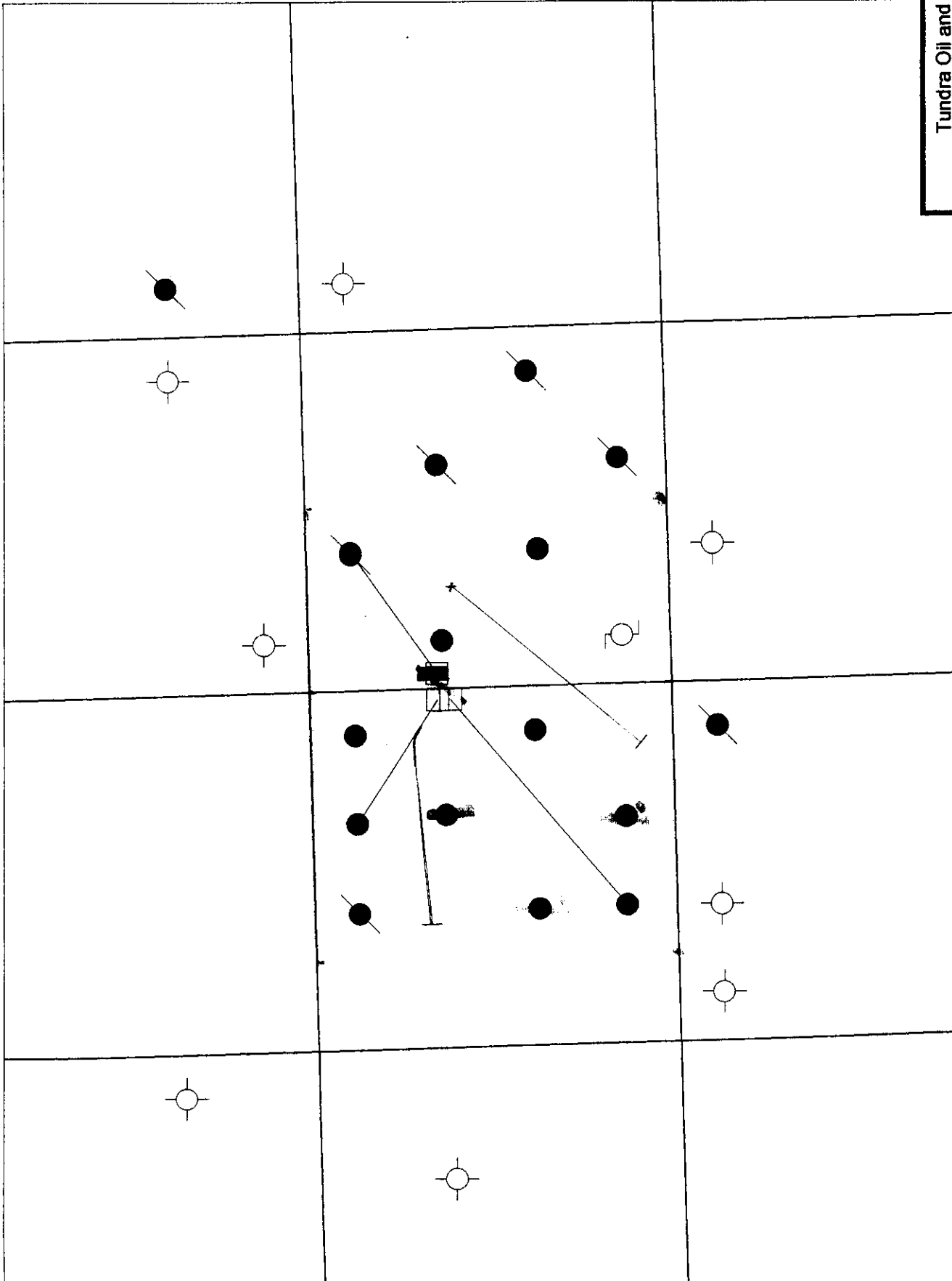
**FIGURE NO.6**  
**SOURIS HARTNEY UNIT NO.1 PRIMARY AND WATERFLOOD OIL FORECASTS**



# FIGURE NO.7

## CENTRAL BATTERY FACILITIES

T6



Tundra Oil and Gas	
Souris-Hartney	
Licensed to: Tundra Oil & Gas Date: 1999/01/28 Project: bpl/bona	By: [Signature] Scale: 1:2500

WELL SYMBOLS

Oil	PTO	LCT	X	NZT	AQZ	GOR	BSI	RDR	ASI
Water	W	W	W	W	W	W	W	W	W
Gas	G	G	G	G	G	G	G	G	G
Steam	S	S	S	S	S	S	S	S	S
Other	O	O	O	O	O	O	O	O	O

R22W1

WATER DISTRIBUTION NETWORK

CENTRAL BATTERY FACILITIES 12-16-6-22

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TABLES

**TABLE NO.1**  
**UPPER VIRDEN POOL FLUID PARAMETERS**

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**UPPER VIRDEN POOL**

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Reservoir Temperature	30 deg. C
Initial Reservoir Pressure (Pi)	6,670 kPa
Current Reservoir Pressure	4,700 kPa
Oil API	32 deg. API
Boi	1.05 Rm <sup>3</sup> /m <sup>3</sup>
Solution GOR	12.5 m <sup>3</sup> /m <sup>3</sup>
Oil Compressibility @ Pi	1.08 E-6 (1/kPa)
Water Compressibility	4.497 E-7 (m <sup>3</sup> /m <sup>3</sup> /kPa)
Oil Viscosity @ Pi	7.6 (mPa.s)
Relative Density @ Pi	0.84 fraction
Water Viscosity @ Pi	1.13 (mPa.s)
Rock Compressibility	3.70 E-7 (1/kPa)

**TABLE NO.2**  
**SOURIS HARTNEY UNIT NO.1**  
**UNIT WELLS**

---

<b>TOTAL UNIT WELLS</b>	<b>STATUS</b>
1-17-6-22 WPM Hz	Producing
2-17-6-22 WPM	Producing
3-17-6-22 WPM Hz	Producing
6-17-6-22 WPM	Shut-in
8-17-6-22 WPM	Abandoned
10-17-6-22 WPM	Shut-in
15-17-6-22 WPM Hz	Producing
16-17-6-22 WPM	Shut-in
4-16-6-22 WPM	Disposal
6-16-6-22 WPM	Suspended
12-16-6-22 WPM	Shut in
14-16-6-22 WPM Hz	Producing
14-16-6-22 WPM	Abandoned
14-17-6-22 WPM	Abandoned

TABLE NO.3

## SOURIS HARTNEY FIELD

## SECTION 16 AND SECTION 17-6-22

## OIL-IN-PLACE ESTIMATES

## BASED ON CORE ANALYSIS AND ADJUSTED SW'S

Section	LSD	Constant	Area (hectare)	Area Factor	Net Pay (metres)	Porosity (fraction)	Sw (fraction)	(1-Sw) (fraction)	Boi (Rm3/m3)	OOIP (m3)	OOIP (STB)
Section 16-6-22	1	10,000	16.19	0.6	1.25	0.10	0.55	0.45	1.06	5,185	32,424
	2	10,000	16.19	1	2.42	0.11	0.55	0.45	1.06	17,335	112,468
	3	10,000	16.19	1	2.66	0.11	0.5	0.5	1.06	22,345	140,552
	4	10,000	16.19	1	3.08	0.11	0.5	0.5	1.06	25,873	162,744
	5	10,000	16.19	1	5.18	0.12	0.45	0.55	1.06	52,217	328,447
	6	10,000	16.19	1	4.25	0.13	0.45	0.55	1.06	47,484	298,672
	7	10,000	16.19	1	4.25	0.13	0.5	0.5	1.06	42,193	265,396
	8	10,000	16.19	1	3.05	0.13	0.55	0.45	1.06	37,971	174,052
	9	10,000	16.19	1	2.79	0.10	0.55	0.45	1.06	33,476	120,617
	10	10,000	16.19	1	4.4	0.11	0.55	0.45	1.06	34,173	214,949
	11	10,000	16.19	1	4.95	0.12	0.45	0.55	1.06	49,899	313,863
	12	10,000	16.19	1	5.44	0.12	0.45	0.55	1.06	54,838	344,933
	13	10,000	16.19	1	3.54	0.11	0.45	0.55	1.06	32,711	205,755
	14	10,000	16.19	1	3.96	0.11	0.5	0.5	1.06	32,359	203,536
	15	10,000	16.19	1	4	0.10	0.55	0.45	1.06	37,492	172,928
	16	10,000	16.19	1	2.79	0.10	0.55	0.45	1.06	33,176	120,617
Section 17-6-22	1	10,000	16.19	1	4.42	0.12	0.45	0.55	1.06	44,556	280,258
	2	10,000	16.19	1	4.15	0.12	0.45	0.55	1.06	41,834	263,138
	3	10,000	16.19	1	3.96	0.12	0.45	0.55	1.06	39,919	251,091
	4	10,000	16.19	1	2.83	0.10	0.5	0.5	1.06	34,612	135,940
	5	10,000	16.19	1	2.78	0.11	0.5	0.5	1.06	33,353	146,892
	6	10,000	16.19	1	4.48	0.12	0.45	0.55	1.06	45,161	284,062
	7	10,000	16.19	1	5.49	0.13	0.45	0.55	1.06	59,954	377,112
	8	10,000	16.19	1	6.1	0.15	0.45	0.55	1.06	75,839	477,030
	9	10,000	16.19	1	5.55	0.13	0.45	0.55	1.06	60,609	381,233
	10	10,000	16.19	1	3.79	0.13	0.45	0.55	1.06	40,752	256,332
	11	10,000	16.19	0.8	2.17	0.10	0.5	0.5	1.06	13,257	83,389
	12	10,000	16.19	0.4	1.22	0.09	0.55	0.45	1.06	3,019	18,987
	13	10,000	16.19	0	0	0	0.45	0.55	1.06	0	0
	14	10,000	16.19	0.8	0.7	0.08	0.55	0.45	1.06	3,002	18,884
	15	10,000	16.19	1	2.18	0.12	0.5	0.5	1.06	19,978	125,661
	16	10,000	16.19	1	3.24	0.12	0.45	0.55	1.06	32,661	205,438
Average/LSD TOTAL											
					3.47	0.11				32,380	203,669
										1,036,153	6,517,399

- not in unit, non-productive

TABLE NO.4

SOURIS HARTNEY FIELD												SHREC\$W.XLS
SECTION 16 AND SECTION 17-6-22												
RECOVERY PROFILES												
BASED ON CORE ANALYSIS DATA WITH ADJUSTED SW'S												
Section 16-6-22	LSD	Well	OOIP (m3)	Cum. Oil (99.06.30) (m3)	Cum. Oil (99.06.30) (STB)	Rec. Factor (99.06.30) (%)	Ultimate Recovery (m3)	Ultimate Recovery (STB)	Ultimate Rec. Factor (%)	Remaining Reserves (m3)	Remaining Reserves (STB)	
CURBURY 514763	1		5,155									
	2	2-16-6-22	17,880	71.6	450.4	0.4	72	450	0.4	0	0	
	3		22,345									
	4	4-16-6-22	25,873	452.7	2,847.5	1.7	453	2,847	1.7	0	0	
	5		52,217									
	6	6-16-6-22	47,484	5,130.4	32,270.2	10.8	5,130	32,270	10.8	0	0	
	7		42,193									
	8	8-16-6-22	27,671	189.1	1,189.4	0.7	189	1,189	0.7	0	0	
	9		19,176									
	10	10-16-6-22	34,173	82.2	517.0	0.2	82	517	0.2	0	0	
	11		49,899									
	12	12-16-6-22	54,838	32,134.1	202,123.5	58.6	32,134	202,123	58.6	0	0	
	13		32,711									
	14	14-16-6-22 V + Hz	32,359	9,114.5	57,330.2	28.2	16,001	100,646	49.4	6,887	43,316	
	15		27,492									
	16		19,176									
Section 17-6-22	1	1-17-6-22 Hz	44,556	936.7	5,891.8	2.1	29,000	182,410	65.1	28,063	176,518	
	2	2-17-6-22	41,834	23,390.2	147,124.4	55.9	24,048	151,280	57.5	858	4,136	
	3	3-17-6-22 Hz	39,919	21,000.3	132,091.9	52.6	34,490	216,942	86.4	13,490	84,850	
	4		21,612									
	5		23,353									
	6	6-17-6-22	45,161	22,293.9	140,228.6	49.4	22,294	140,229	49.4	0	0	
	7		59,954									
	8	8-17-6-22	75,839	32,620.4	205,182.3	43.0	32,620	205,182	43.0	0	0	
	9		60,609									
	10	10-17-6-22	40,752	25,980.7	163,418.6	63.8	25,981	163,420	63.8	0	2	
	11		13,257									
	12		3,019									
	13		0									
	14	14-17-6-22	3,002	133.0	836.6	4.4	133	837	4.4	0	0	
	15	15-17-6-22 Hz	19,978	5,085.2	31,985.9	25.5	9,831	61,837	49.2	4,746	29,851	
	16	16-17-6-22	32,661	10,553.4	66,380.9	32.3	10,553	66,381	32.3	0	0	
Average/LSD			33,424	6,102	38,383		7,839	49,308		1,737	10,925	
TOTAL			1,036,148	189,168	1,189,869	18.3	243,011.5	1,528,542.3	23.5	53,843	338,673	
Section 16												
Average/Lsd			31,915	2,948	18,546		3,379	21,253		430	2,707	
Total			510,642	47,175	296,728	9.2	54,061	340,044	10.6	6,887	43,316	
Section 17												
Average/Lsd			35,034	9,466	59,543		12,597	79,233		3,130	19,690	
Total			525,506	141,994	893,141	27.0	188,950	1,186,498	36.0	46,957	295,357	



**TABLE NO.5****SOURIS HARTNEY UNIT NO.1****PRIMARY AND WATERFLOOD OIL FORECASTS**

Year	Primary Oil Forecast (m3/day)	Cum. Primary Forecast (m3)	Waterflood Oil Forecast (m3/day)	Incremental Oil Forecast (m3/day)	Cum. Waterflood Forecast (m3)
Jan. 1999	17.7		17.7	0	
Jun. 1999	20		20	0	
Jan. 2000	18.0	6,777	18	0	
Jun. 2000	16.2		18.7	2.5	228
Jan. 2001	14.6	12,712	20	5.4	951
Jun. 2001	13.1		21.2	8.1	2,183
Jan. 2002	11.8	17,519	20.1	8.3	3,676
Jun. 2002	10.6		19	8.4	5,196
Jan. 2003	9.6	21,413	17.9	8.3	6,721
Jun. 2003	8.6		16.7	8.1	8,220
Jan. 2004	7.7	24,567	15.8	8.1	9,693
Jun. 2004	7.4		14.9	7.5	11,115
Jan. 2005	7.0	27,256	14.3	7.3	12,470
Jun. 2005	6.6		13.6	7.0	13,771
Jan. 2006	6.3	29,683	13.2	6.9	15,035
Jun. 2006	6.0		12.6	6.6	16,266
Jan. 2007	5.7	31,873	12.2	6.5	17,462
Jan. 2008	5.4	33,900	11.6	6.2	19,779
Jan. 2009	5.1	35,826	11.3	6.2	22,032
Jan. 2010	4.9	37,655	10.7	5.8	24,218
Jan. 2011	4.6	39,393	10.1	5.5	26,276
Jan. 2012	4.4	41,044	9.5	5.1	28,202
Jan. 2013	4.2	42,613	8.8	4.6	29,973
Jan. 2014	4.0	44,103	8.3	4.3	31,604
Jan. 2015	3.8	45,518	8	4.2	33,163
Jan. 2016	3.6	46,863	7.6	4.0	34,666
Jan. 2017	3.4	48,148	7.2	3.8	36,088
Jan. 2018	3.3	49,382	6.9	3.5	37,424
Jan. 2019	3.2	50,566	6.5	3.3	38,675
Jan. 2020	3.1	51,703	6.2	3.1	39,851
Jan. 2021	2.9	52,795	5.9	2.9	40,958
Jan. 2022	2.8	53,843	5.6	2.8	42,000
<b>Note:</b>					
Primary oil forecast based on no further development					
Waterflood forecast based on waterflooding Section 17-6-22 only (injectors 2-17, 6-17, and 10-17-6-22)					

**TABLE NO.6**  
**SOURIS HARTNEY UNIT NO.1**  
**WATERFLOOD RECOVERY PREDICTIONS**

Water Injectors	Reservoir Pressure	Incremental Oil Recovery
6-17 and 10-17-6-22	5,580 kPa	27,000 m3
6-17, 10-17, 16-17-6-22	6,630 kPa	40,000 m3
2-17, 6-17, 10-17-6-22	6,600 kPa	42,000 m3
2-17, 6-17, 10-17, 16-17-6-22	6,610 kPa	55,000 m3
2-17, 6-16, 10-17, 16-17, 16-8-6-22	6,630 kPa	58,000 m3

TABLE NO.7

UNIT OIL PRODUCTION													
LAST 90 OPERATING DAYS													
Well	W.I. in LSD	Mar-99		Apr-99		May-99		Jun-99		Total		Last 90	
		Prod.	Days	Prod.	Days	Prod.	Days	Prod.	Days	Prod.		Days	Days
	(%)	(m3)		(m3)		(m3)		(m3)		(m3)			
14-16-6-22 Hz	100	6.1	1	147.2	29	150.4	30	167.8	30	471.5		90	
1-17-6-22 Hz	100	21	1	302.7	29	213.5	30	168.4	30	705.6		90	
2-17-6-22	100	0	0	12.8	29	13.9	31	17.1	30	43.8		90	
3-17-6-22 Hz	100	45.1	5	211	29	194.6	30	148.7	26	599.4		90	
15-17-6-22 Hz	100	11.1	6	61.2	29	49.3	25	63.4	30	185		90	
Total										2,005.3			

**TABLE NO.8**

[illegible]

TABLE NO.9

METHOD TO DETERMINE UNIT TRACT FACTORS									
Tract Number	Area (80 Acre Tracts)	Well Impacting Drainage Area	Tundra W.I. in Well	Total Operating Days	Total Production	Average Oil Rate per Operating Day	Production Allocation Factor	Tract Factor in Unit	
			(%)		(m3)	(m3/day)	(%)	(%)	
Tract No.1	Lsd's 3 & 6-16-6-22	1-17-6-22 Hz	100	90	705.6	7.84000000	1.8353	0.6457825	
Tract No.2	Lsd's 4 & 5-16-6-22	1-17-6-22 Hz	100	90	705.6	7.84000000	42.9731	15.1208395	
Tract No.3	Lsd's 11 & 14-16-6-22	1-17-6-22 Hz	100	90	705.6	7.84000000	8.1568	2.8701132	
Tract No.3	Lsd's 11 & 14-16-6-22	14-16-6-22 Hz	100	90	471.5	5.23888889	50	11.7563457	
Tract No.4	Lsd's 12 & 13-16-6-22	1-17-6-22 Hz	100	90	705.6	7.84000000	8.186	2.8803878	
Tract No.4	Lsd's 12 & 13-16-6-22	14-16-6-22 Hz	100	90	471.5	5.23888889	50	11.7563457	
Tract No.5	Lsd's 1 & 8-17-6-22	1-17-6-22 Hz	100	90	705.6	7.84000000	38.8488	13.6696321	
Tract No.5	Lsd's 1 & 8-17-6-22	3-17-6-22 Hz	100	90	599.4	6.66000000	25	7.4726974	
Tract No.6	Lsd's 2 & 7-17-6-22	2-17-6-22	100	90	43.8	0.48666667	100	2.1842118	
Tract No.6	Lsd's 2 & 7-17-6-22	3-17-6-22 Hz	100	90	599.4	6.66000000	25	7.4726974	
Tract No.7	Lsd's 3 & 6-17-6-22	3-17-6-22 Hz	100	90	599.4	6.66000000	25	7.4726974	
Tract No.8	Lsd's 9 & 16-17-6-22	3-17-6-22 Hz	100	90	599.4	6.66000000	25	7.4726974	
Tract No.8	Lsd's 9 & 16-17-6-22	15-17-6-22 Hz	100	90	185	2.05555556	24.2764	2.2396320	
Tract No.9	Lsd's 10 & 15-17-6-22	15-17-6-22 Hz	100	90	185	2.05555556	54.3059	5.0100192	
Tract No.10	Lsd's 11 & 14-17-6-22	15-17-6-22 Hz	100	90	185	2.05555556	21.4177	1.9759011	
		Total			2,005.3	22.28111111		100.0000000	

TABLE NO.10						
SOURIS HARTNEY UNIT NO.1						
SUMMARY OF UNIT TRACT FACTORS						
Tract Number	Area (80 Acre Tracts)	Well(s)	Allocated Oil Production (m3/day)	Tract Factor (%)		
Tract No.1	Lsd's 3 & 6-16-6-22	1-17-6-22 Hz	0.1438875	0.64578252		
Tract No.2	Lsd's 4 & 5-16-6-22	1-17-6-22 Hz	3.3690910	15.1208394		
Tract No.3	Lsd's 11 & 14-16-6-22	14-16 & 1-17-6-22 Hz's	3.2589376	14.6264589		
Tract No.4	Lsd's 12 & 13-16-6-22	14-16 & 1-17-6-22 Hz's	3.2612268	14.6367335		
Tract No.5	Lsd's 1 & 8-17-6-22	1-17 & 3-17-6-22 Hz's	4.7107459	21.1423295		
Tract No.6	Lsd's 2 & 7-17-6-22	2-17 Vertical / 3-17-6-22 Hz	2.1516667	9.65690920		
Tract No.7	Lsd's 3 & 6-17-6-22	3-17-6-22 Hz	1.6650000	7.47269735		
Tract No.8	Lsd's 9 & 16-17-6-22	3-17 & 15-17-6-22 Hz	2.1640149	9.71232932		
Tract No.9	Lsd's 10 & 15-17-6-22	15-17-6-22 Hz	1.1162879	5.01001921		
Tract No.10	Lsd's 11 & 14-17-6-22	15-17-6-22 Hz	0.4402527	1.97590111		
TOTAL			22.2811111	100.0000000		

TABLE NO.11  
SOURIS HARTNEY UNIT NO.1  
RESERVE AND RECOVERY FACTOR SUMMARY

	RESERVES (m3)	RESERVES (STB)	RECOVERY FACTORS
UNIT AREA ONLY OOIP	745349		
CUM. PROD (99.06.30)	189,168 m3	1,189,869 STB	18.3 % OOIP 25.3 %
UNIT AREA CUM PROD	188825		
REMAINING PRIMARY	53,843 m3	338,672 STB	5.2% OOIP 7.2 %
UNIT REM. PRIMARY	53843		
TOTAL PRIMARY	243,011 m3	1,528,541 STB	23.5 % OOIP 32.5 %
TOTAL UNIT PRIMARY	242668		
WATERFLOOD	42,000 m3	264,180 STB	4.0 % OOIP 5.6 %
UNIT WF	42000		
TOTAL	285,011 m3	1,792,721 STB	27.5 % OOIP 38.1 %
TOTAL UNIT	284668		

water flood recovery  
 add.  $\frac{381}{600} = 63.5\%$

# LIST OF ATTACHMENTS

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- ATTACHMENT NO.1: UPPER VIRDEN NET OIL PAY MAP
- ATTACHMENT NO.2: UPPER VIRDEN POOL LOG CROSS-SECTION
- ATTACHMENT NO.3: INDIVIDUAL WELL RECOVERY PREDICTIONS
- ATTACHMENT NO.4: COMPLETION PROGRAMS FOR INJECTORS 2-17,  
6-17, 10-17-6-22 WPM
- ATTACHMENT NO.5: APPLICATIONS TO CONVERT 2-17, 6-17, 10-17,  
-6-22 WPM TO WATER INJECTION SERVICE
- ATTACHMENT NO.6: SPECIAL CORE STUDY UPPER VIRDEN POOL
- ATTACHMENT NO.7: SURFACE AND MINERAL OWNERS

ATTACHMENTS

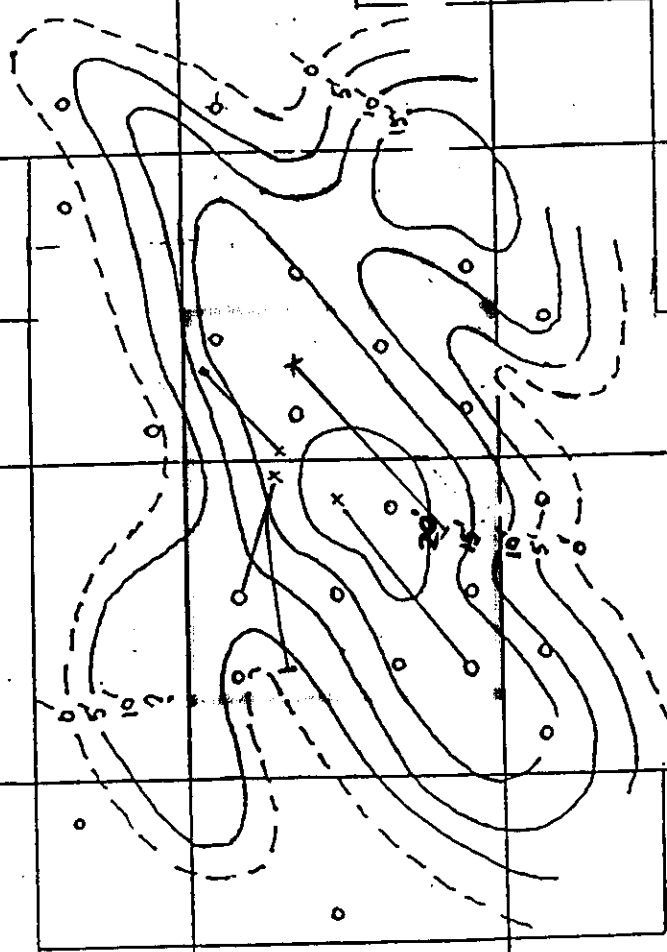


**ATTACHMENT NO.1**  
**SOURIS HARTNEY UNIT NO.1**  
**UPPER VIRDEN NET OIL PAY MAP**

# ATTACHMENT NO.1

## NET OIL PAY MAP

A22201



VIRDED NET POROSITY MAP  
AT 75% SEC; 7%  $\phi$  Lm cutoff

TG

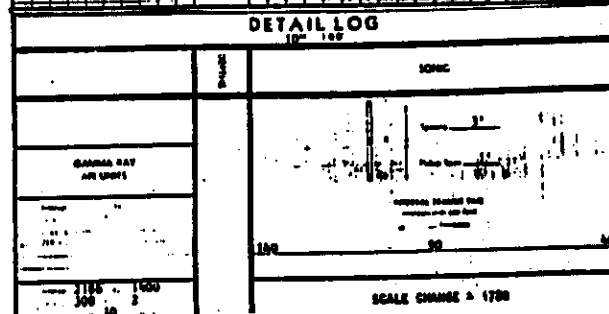
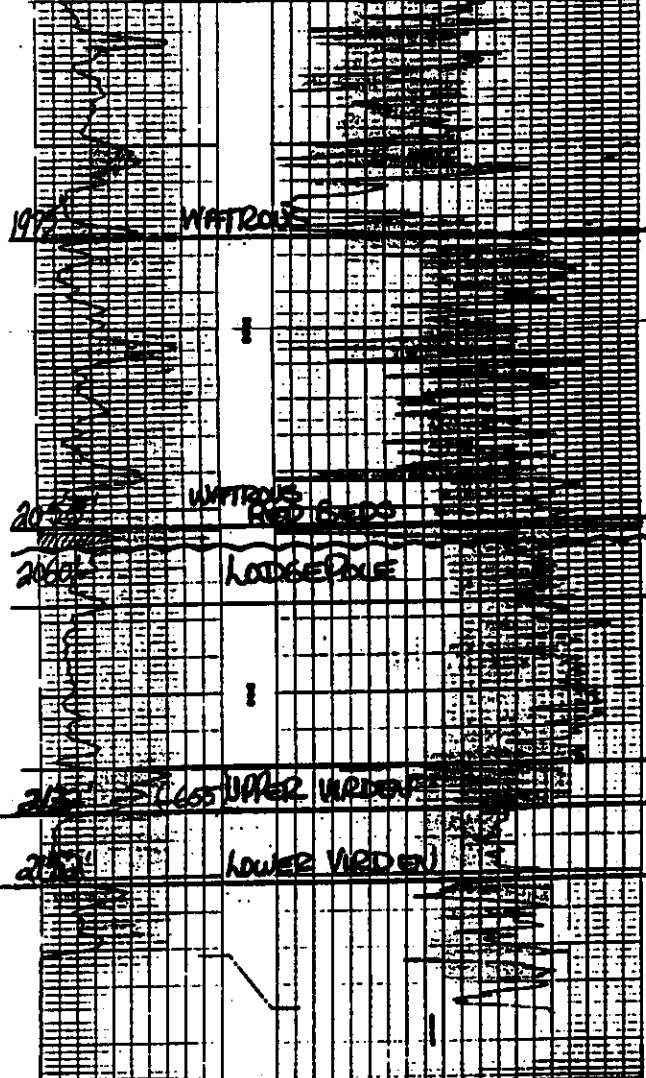
UNIT OUTLINE

**ATTACHMENT NO.2**  
**SOURIS HARTNEY UNIT NO.1**

**UPPER VIRDEN POOL LOG CROSS-SECTION**

PROJECT: TERRACE RECREATION CENTER	
DATE: 8-17-77	BY: [Signature]
LOCATION: [Address]	
DRAWN: [Signature]	
CHECKED: [Signature]	
APPROVED: [Signature]	

**8-17**

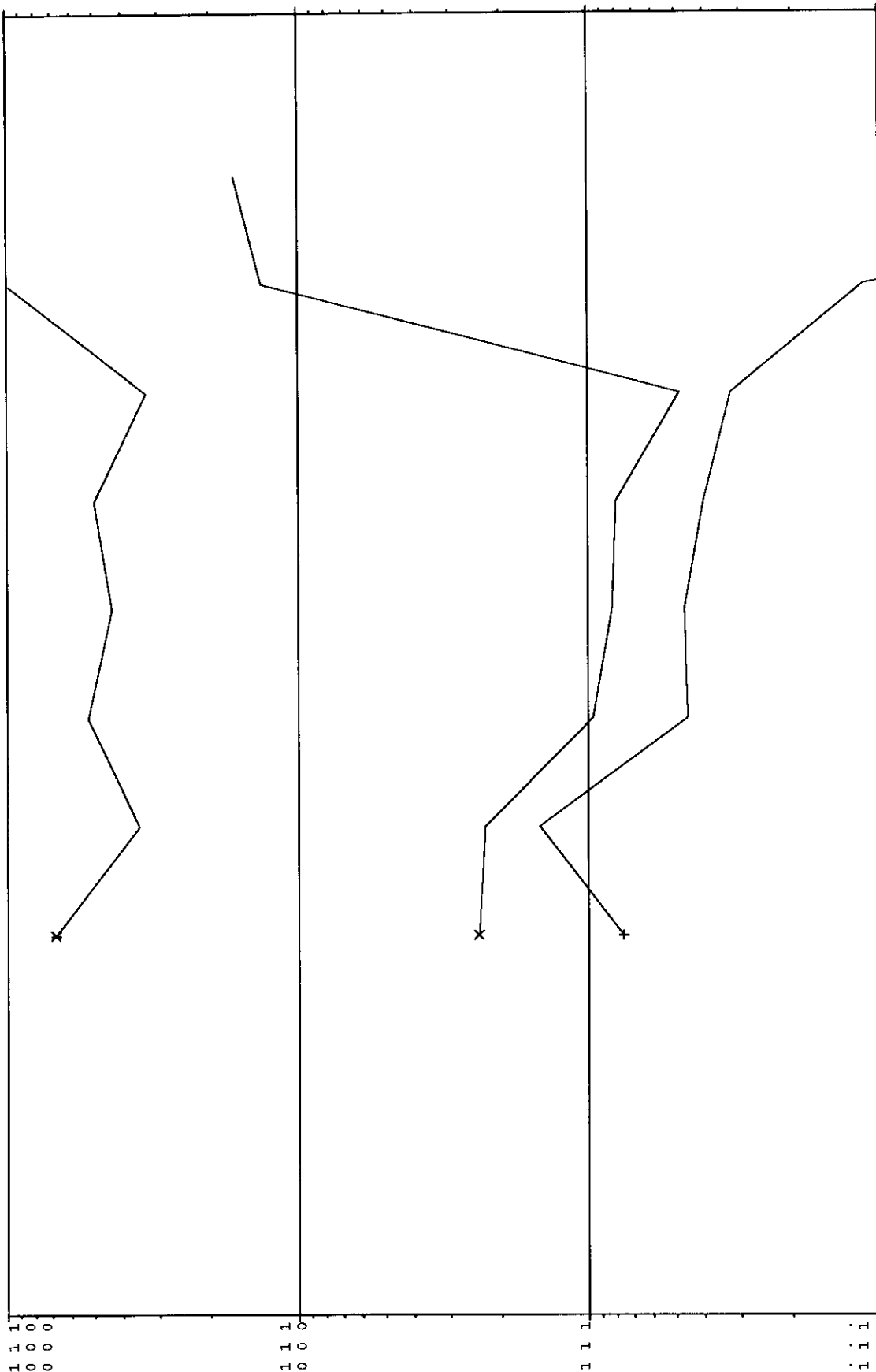


**ATTACHMENT NO.3**  
**SOURIS HARTNEY UNIT NO.1**  
**INDIVIDUAL WELL RECOVERY PREDICTIONS**

00/02-16-006-22W1/0 (Texaco Souris 02-16-06-22W1) Data 04/63-11/63

Production Cums  
 Oil: 71.6001 m3  
 Gas: 0 E6m3  
 Water: 535.6 m3  
 Cond: 0 m3

Operator:  
 Field: 10  
 Zone: 53A  
 Type: Unknown  
 Group: sourish



1963  
 Year

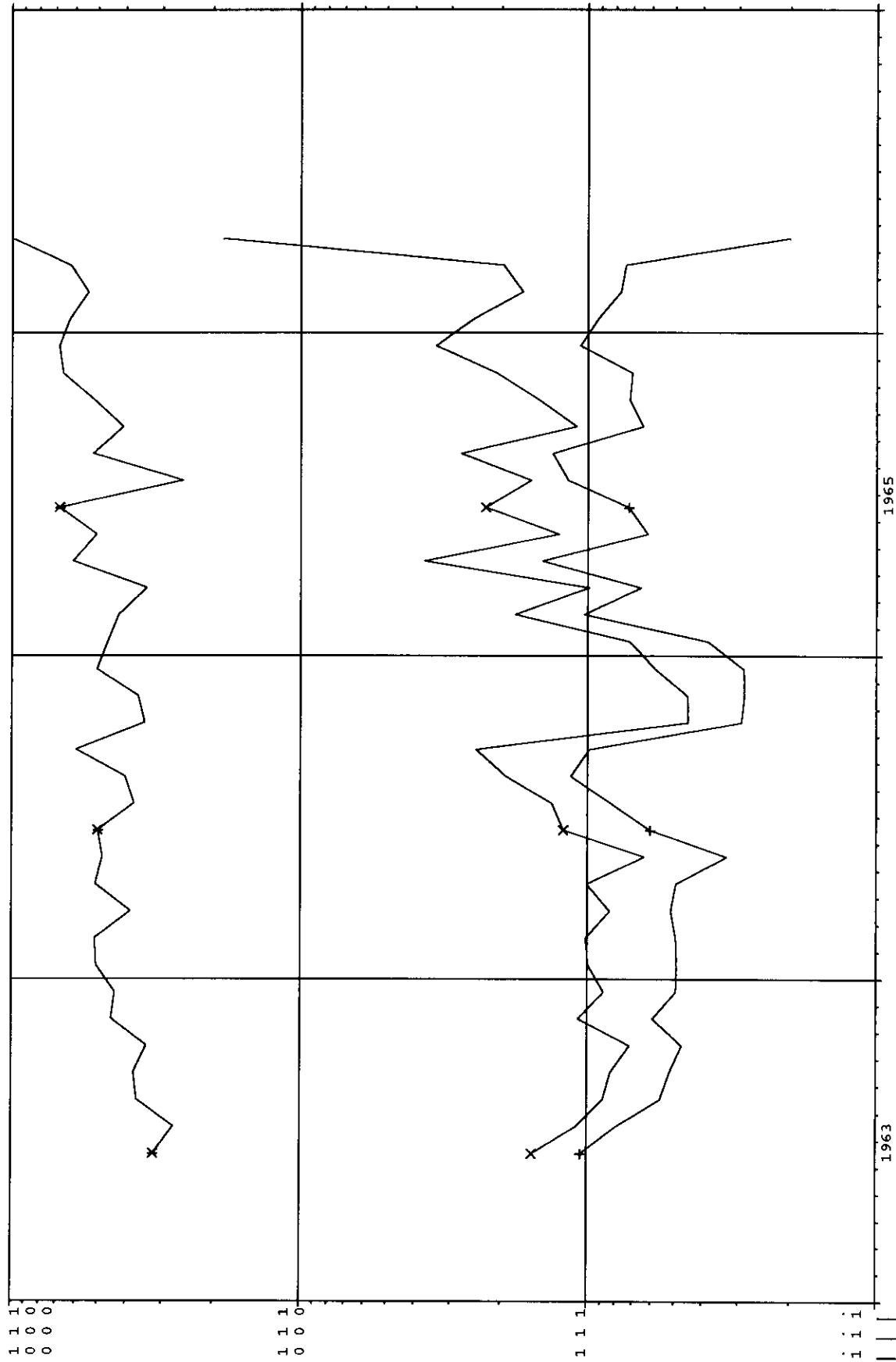


Avg Daily Oil - m3/d  
 Water Cut - %  
 Avg Daily Fluid - m3/d

00/04-16-006-22W1/0 (Tundra Souris Hartney SWD 04-16-06-22W1) Data 06/63-04/66

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: sourish

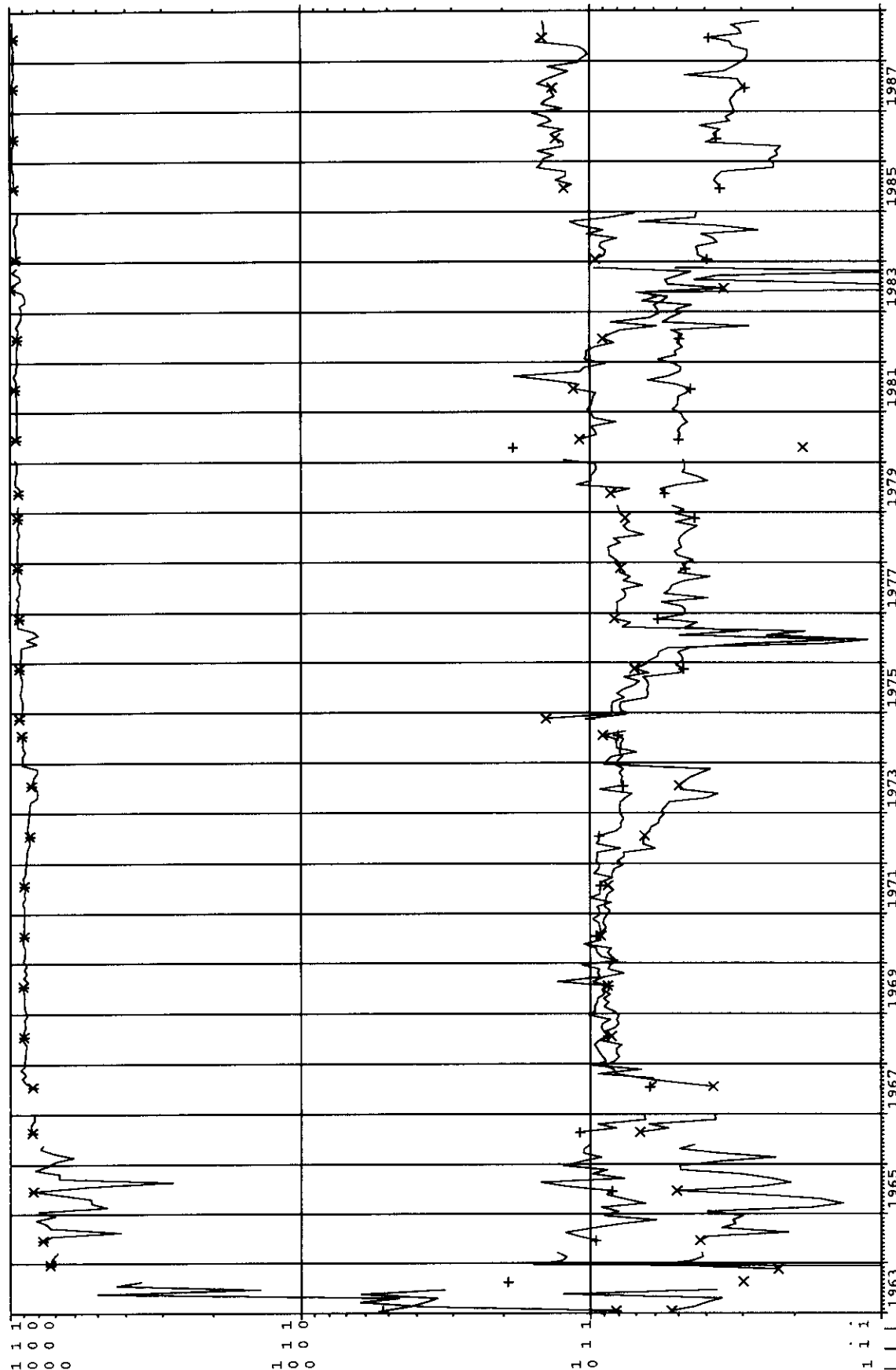
Production Cums  
Oil: 452.704 m3  
Gas: 0 E6m3  
Water: 492.7 m3  
Cond: 0 m3



00/06-16-006-22W1/0 (Tundra Souris Hartney 06-16-06-22W1) Data 01/63-10/88

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: Sourish

Production Cums  
Oil: 5130.4 m3  
Gas: 0 E6m3  
Water: 56227.5 m3  
Cond: 0 m3



Avg Daily Oil - m3/d  
Water Cut - %  
Avg Daily Fluid - m3/d

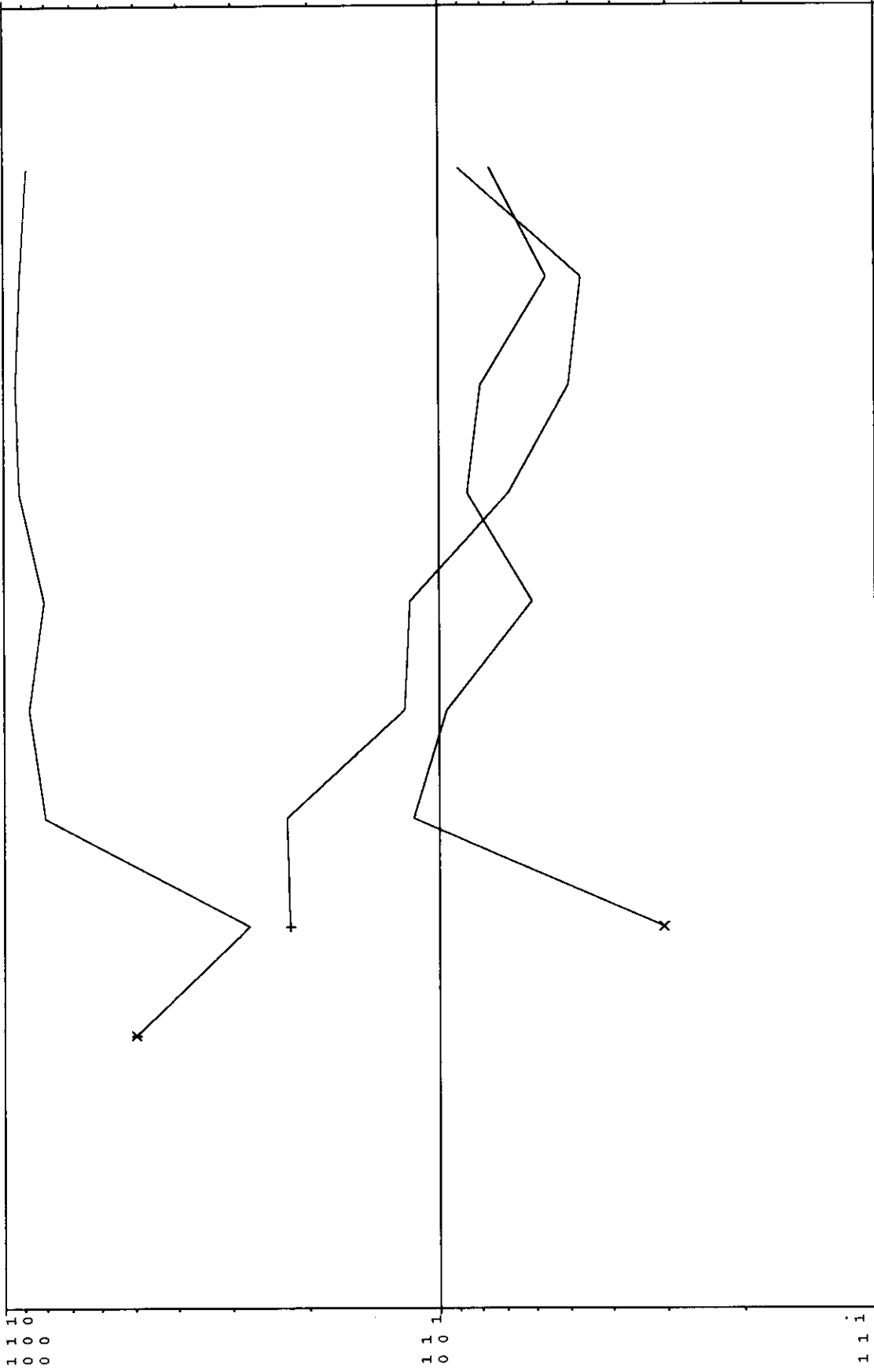




00/08-16-006-22W1/0 (Texaco Souris 08-16-06-22W1) Data 03/63-11/63

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: sourish

Production Cums  
Oil: 189.101 m3  
Gas: 0 E6m3  
Water: 1163.4 m3  
Cond: 0 m3



1963  
Year



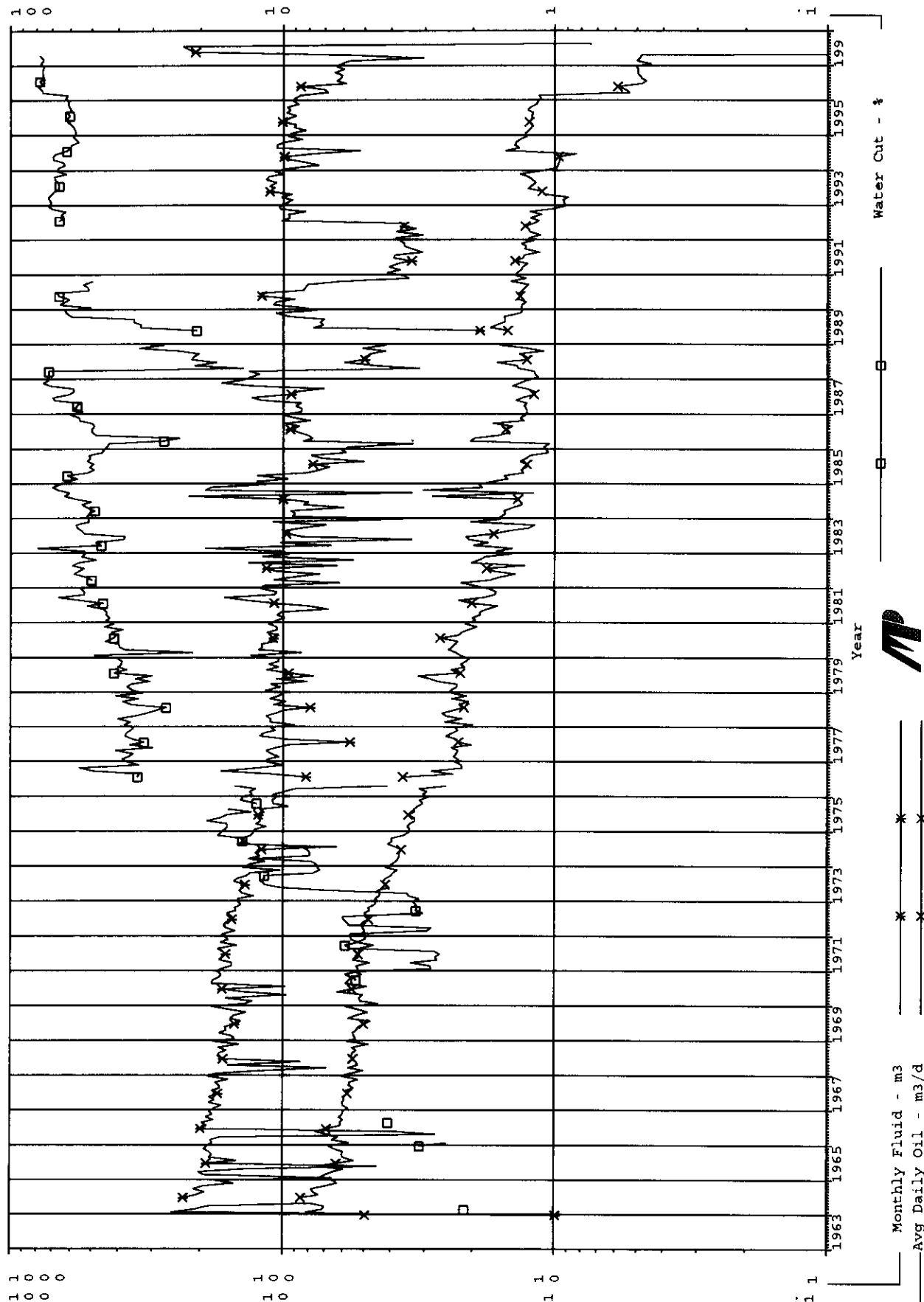
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\_\_\_\_\_ \* \_\_\_\_\_  
\_\_\_\_\_ \* \_\_\_\_\_

Avg Daily Oil - m3/d  
Water Cut - %  
Avg Daily Fluid - m3/d

Data 01/63-08/97

Group: sourish

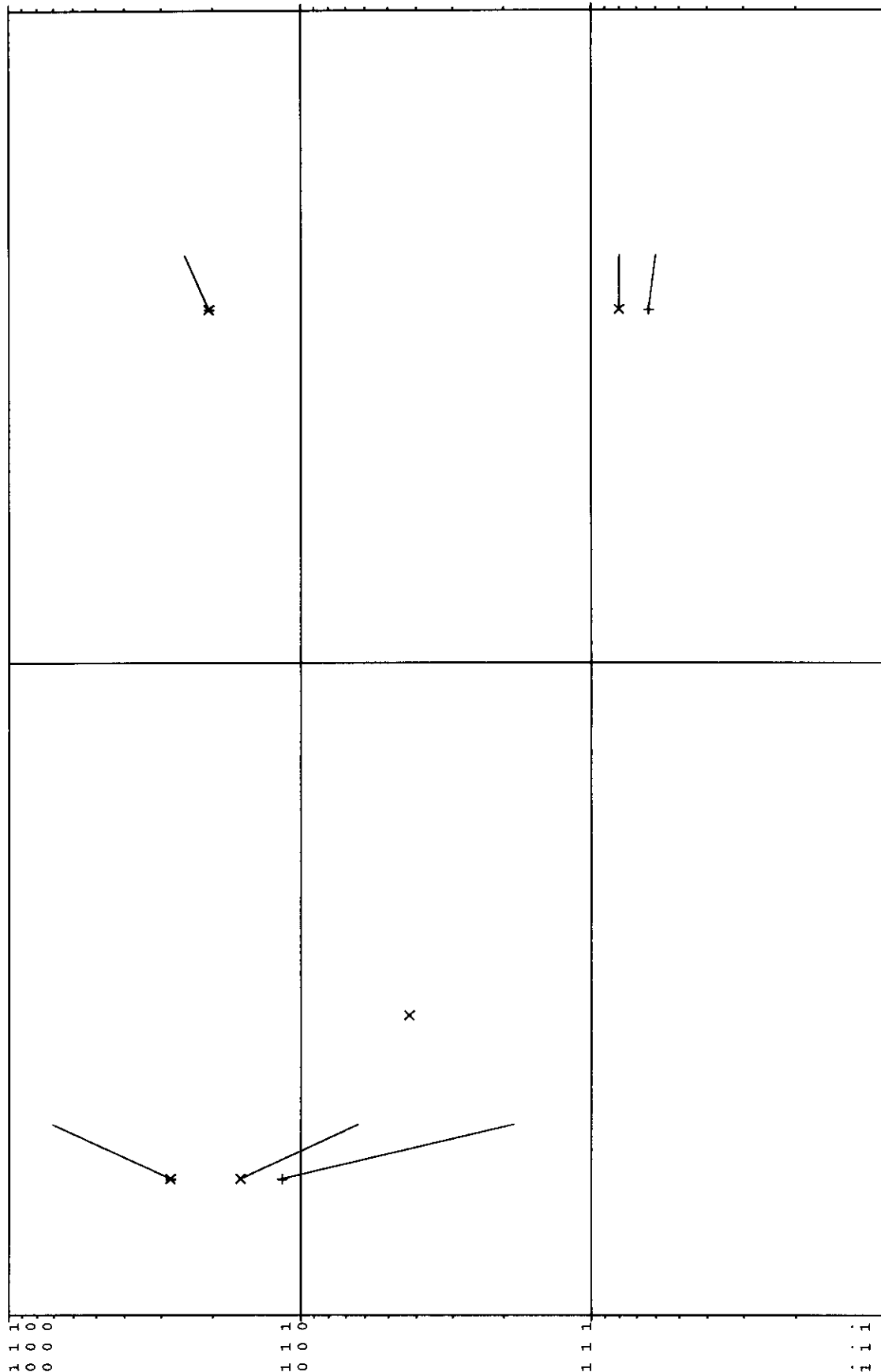
Cond: 0 m3



00/14-16-006-22W1/0 (Texaco Souris 14-16-06-22W1) Data 03/63-08/64

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: sourish

Production Cums  
Oil: 60.5002 m3  
Gas: 0 E6m3  
Water: 102.1 m3  
Cond: 0 m3



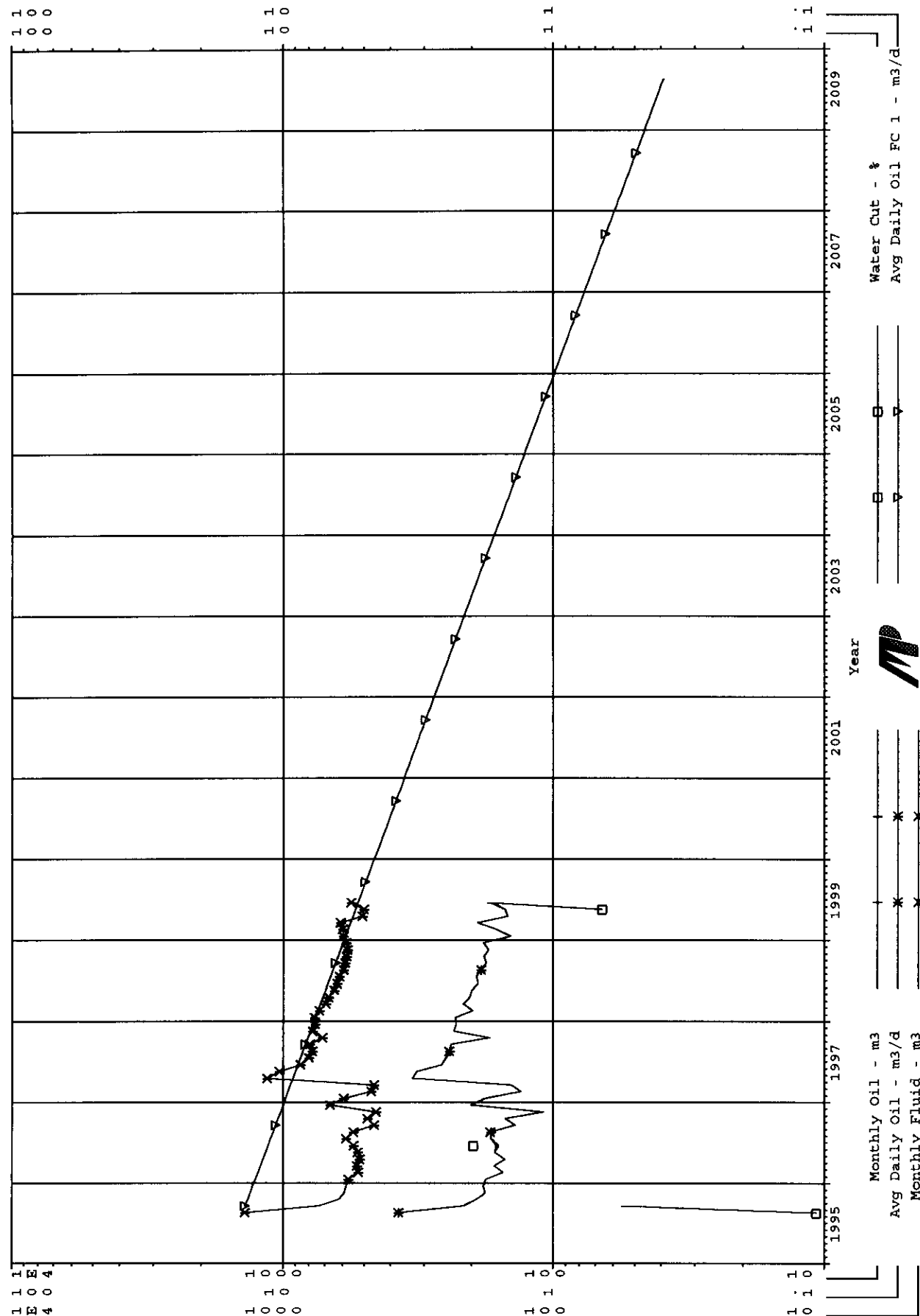
Year



1963

Avg Daily Oil - m3/d  
Water Cut - %  
Avg Daily Fluid - m3/d





00/02-17-006-22W1/0 (Tundra Souris Hartney 02-17-06-22W1) Data 09/63-06/99

Operator:

Field: 10

Zone: 53A

Type: Unknown

Group: SOURIS

Avg Daily Oil FC 1 (Rate-Time)

qi: 1.62527 m3/d, Mar, 1984

qf: 0.297948 m3/d, Aug, 2004

di(Exp): 7.94248 CTD: 23390.2 m3

RR: 657.535 m3 Tot: 24047.7 m3

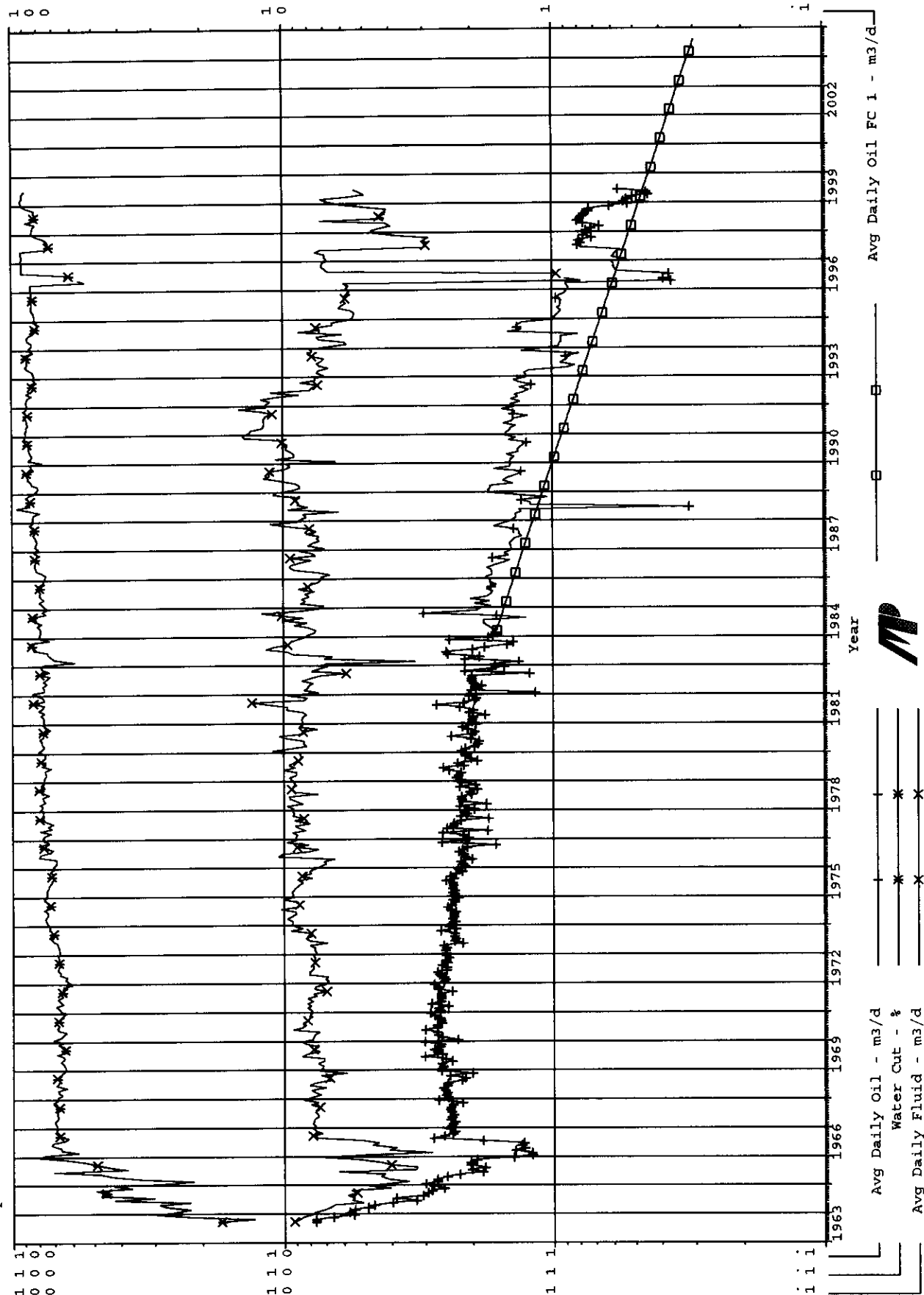
Production Cume

Oil: 23390.2 m3

Gas: 0 E6m3

Water: 73883.7 m3

Cond: 0 m3

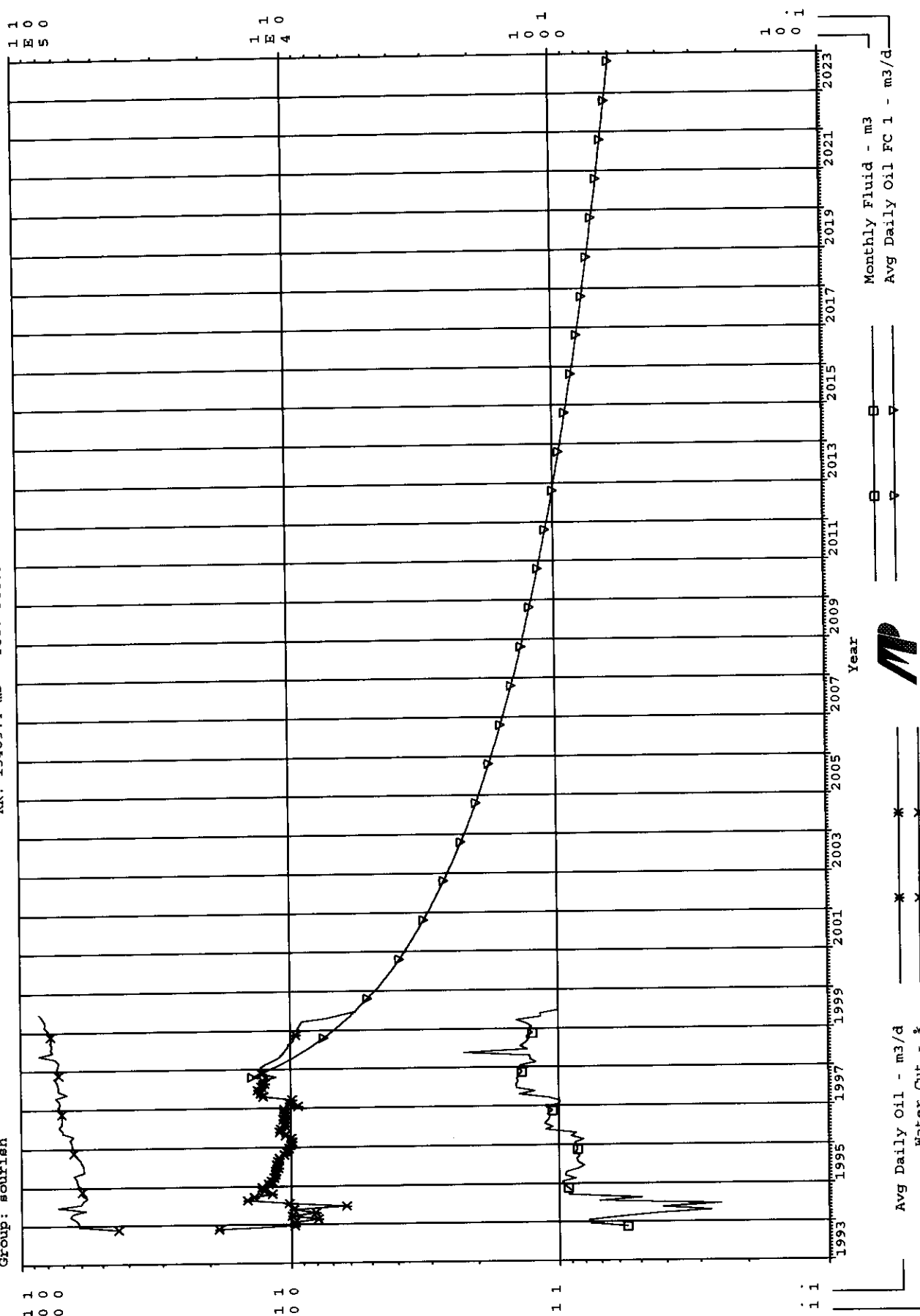


00/03-17-006-22W1/0 (Tundra Souris Hartney HZNTL 03B-17-06-22W1) Data 11/93-06/99

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: Sourish

Avg Daily Oil FC 1 (Rate-Time)  
qi: 14.9442 m3/d, Oct, 1997  
qf: 0.556885 m3/d, Oct, 2025  
di (Har): 47.9153 CTD: 21000.3 m3  
RR: 13489.4 m3 Tot: 34489.7 m3

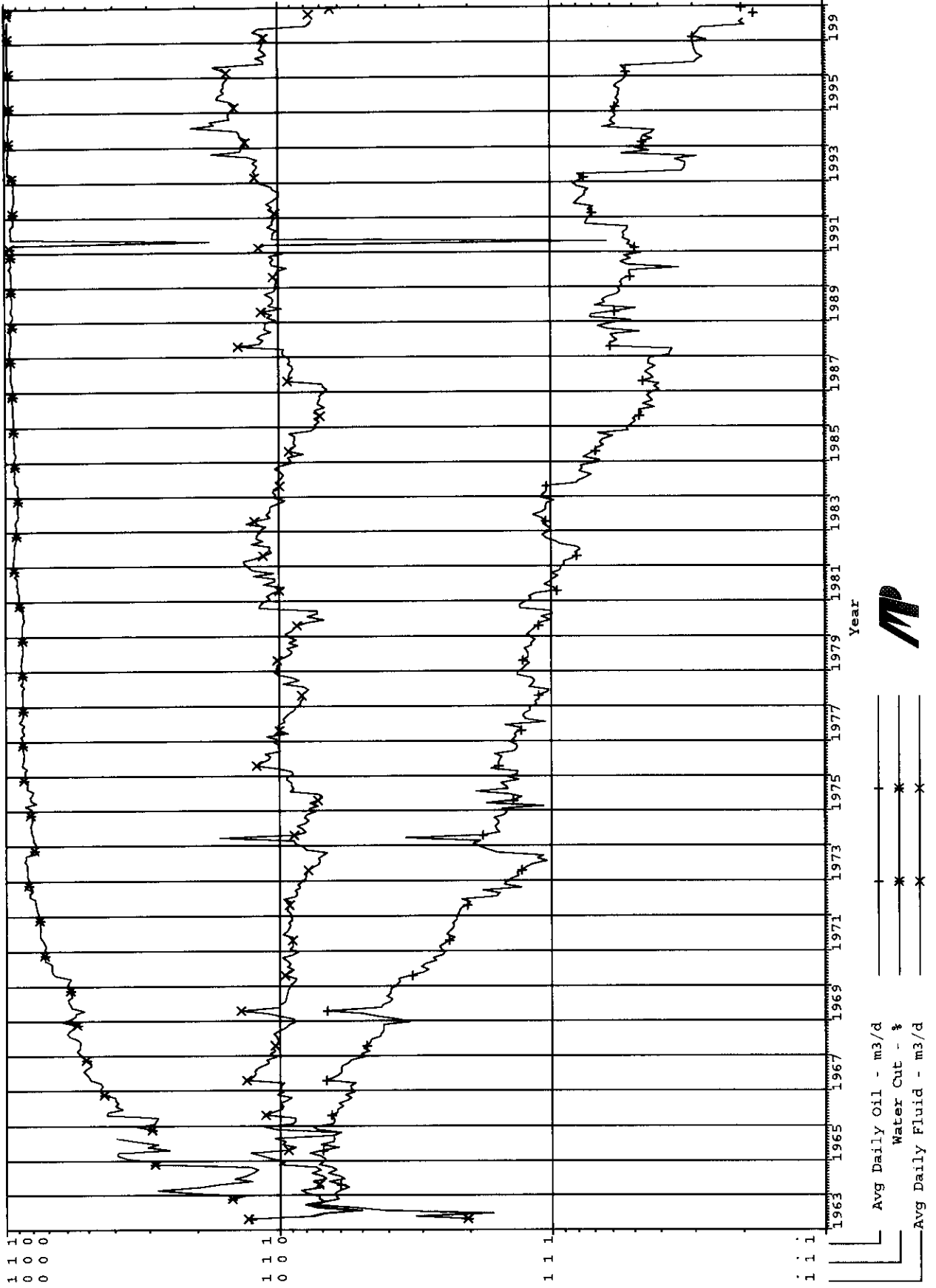
Production Cums  
Oil: 21000.3 m3  
Gas: 0 E6m3  
Water: 50191.2 m3  
Cond: 0 m3



00/06-17-006-22W1/0 (Tundra Souris Hartney 06-17-06-22W1) Data 04/83-12/97

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: sourish

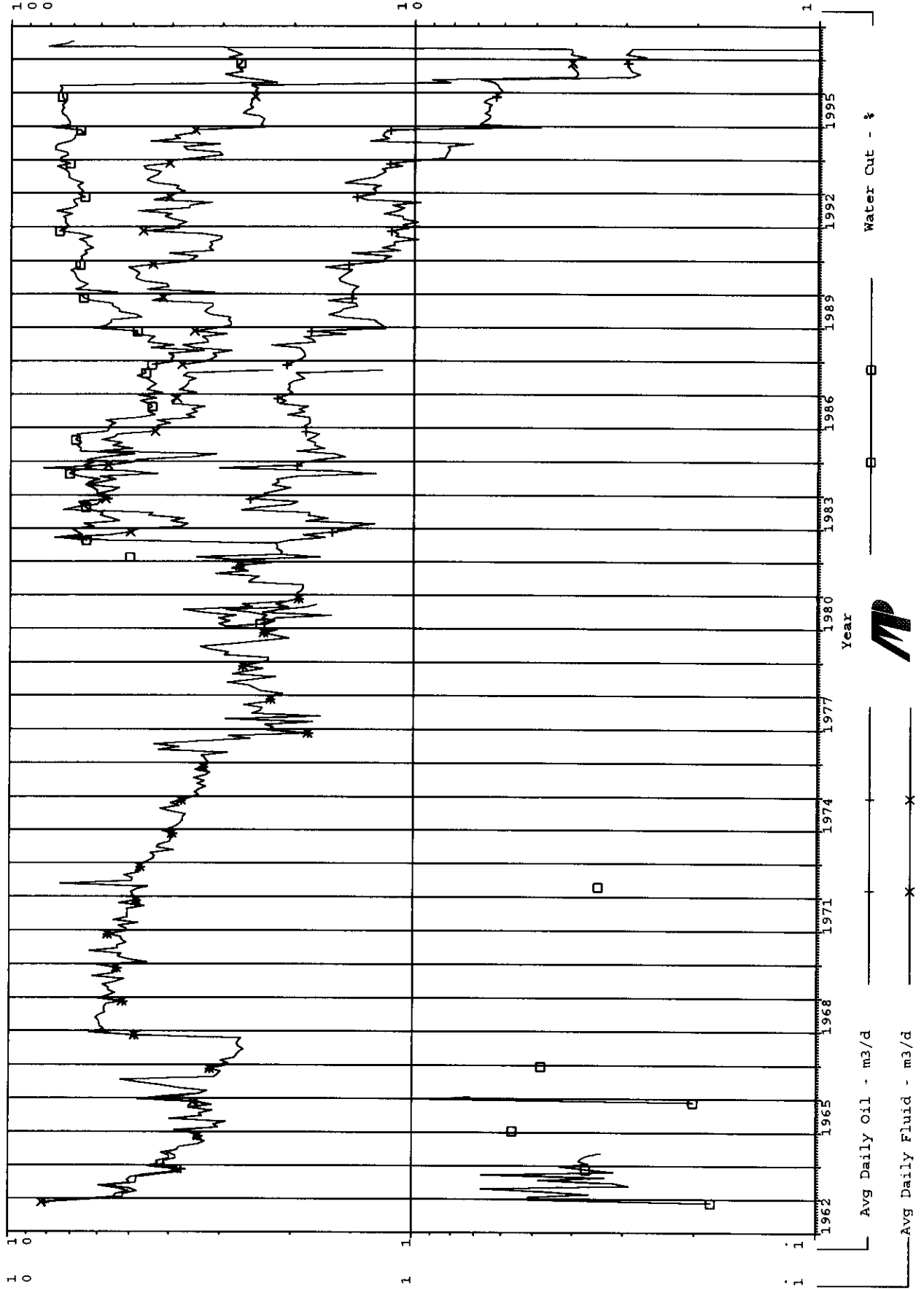
Production Cums  
Oil: 22293.9 m3  
Gas: 0 E6m3  
Water: 95991.5 m3  
Cond: 0 m3



00/08-17-006-22W1/0 (Tundra Souris Hartney 08-17-06-22W1) Data 11/62-07/97

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: sourish

Production Cums  
Oil: 32620.4 m3  
Gas: 0 E6m3  
Water: 12315.1 m3  
Cond: 0 m3

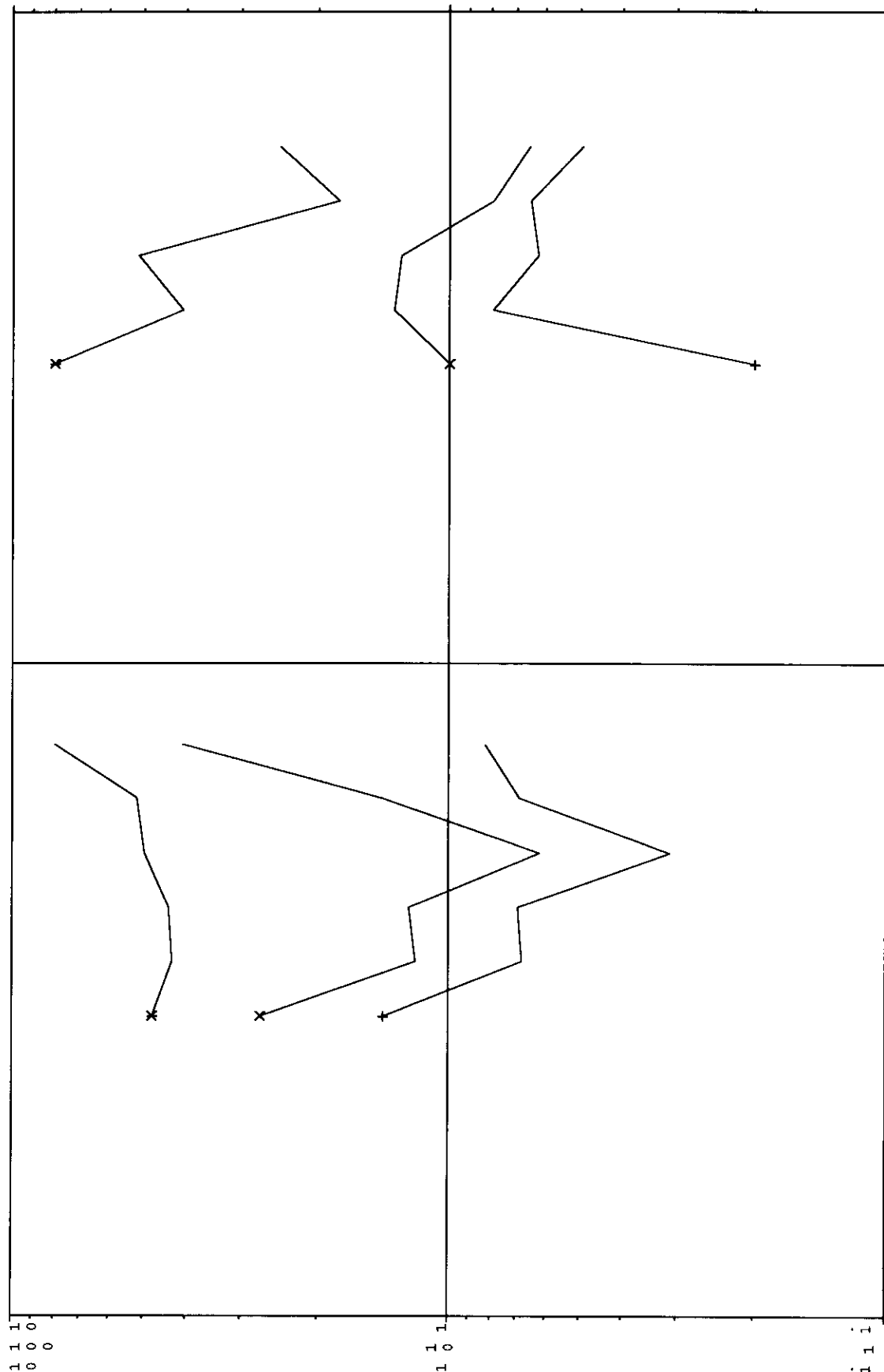




00/14-17-006-22W1/0 (Texaco Souris 14-17-06-22W1) Data 06/63-10/64

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: sourish

Production Cums  
Oil: 133.001 m3  
Gas: 0 E6m3  
Water: 115.598 m3  
Cond: 0 m3



Year

Avg Daily Oil - m3/d  
Water Cut - %  
Avg Daily Fluid - m3/d

1963



00/15-17-006-22W1/0 (Tundra Souris Hartney HZNTL 15C-17-06-22W1) Data 11/93-06/99

Operator:

Field: 10

Zone: 53A

Type: Unknown

Group: SOURIS

Avg Daily Oil FC 1 (Rate-Time)

qi: 2.68267 m3/d, Nov, 1995

qf: 0.299255 m3/d, Sep, 2015

di(Exp): 10.4276 CTD: 5085.2 m3

RR: 4746.04 m3 Tot: 9831.24 m3

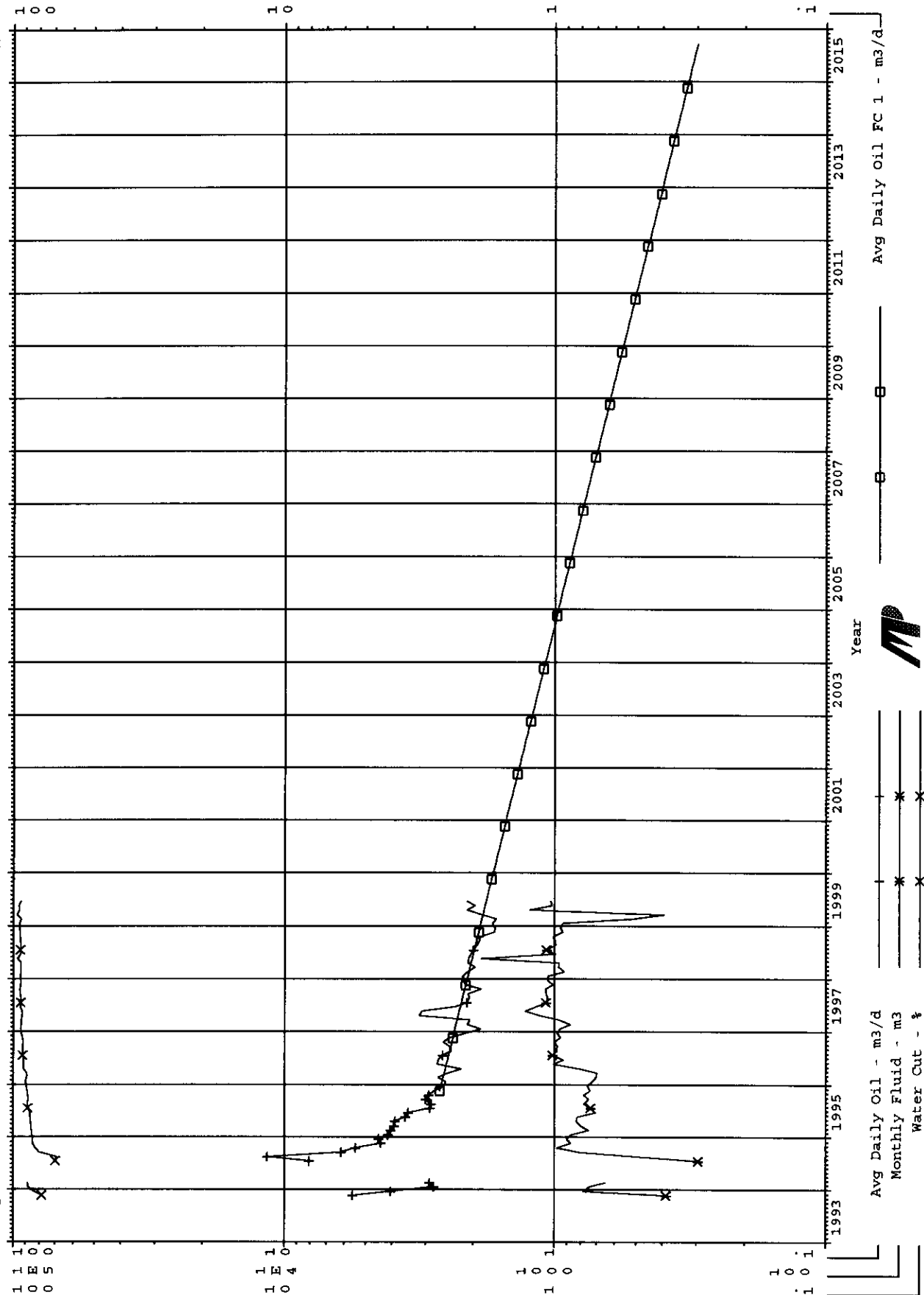
Production Cums

Oil: 5085.2 m3

Gas: 0 E6m3

Water: 52475 m3

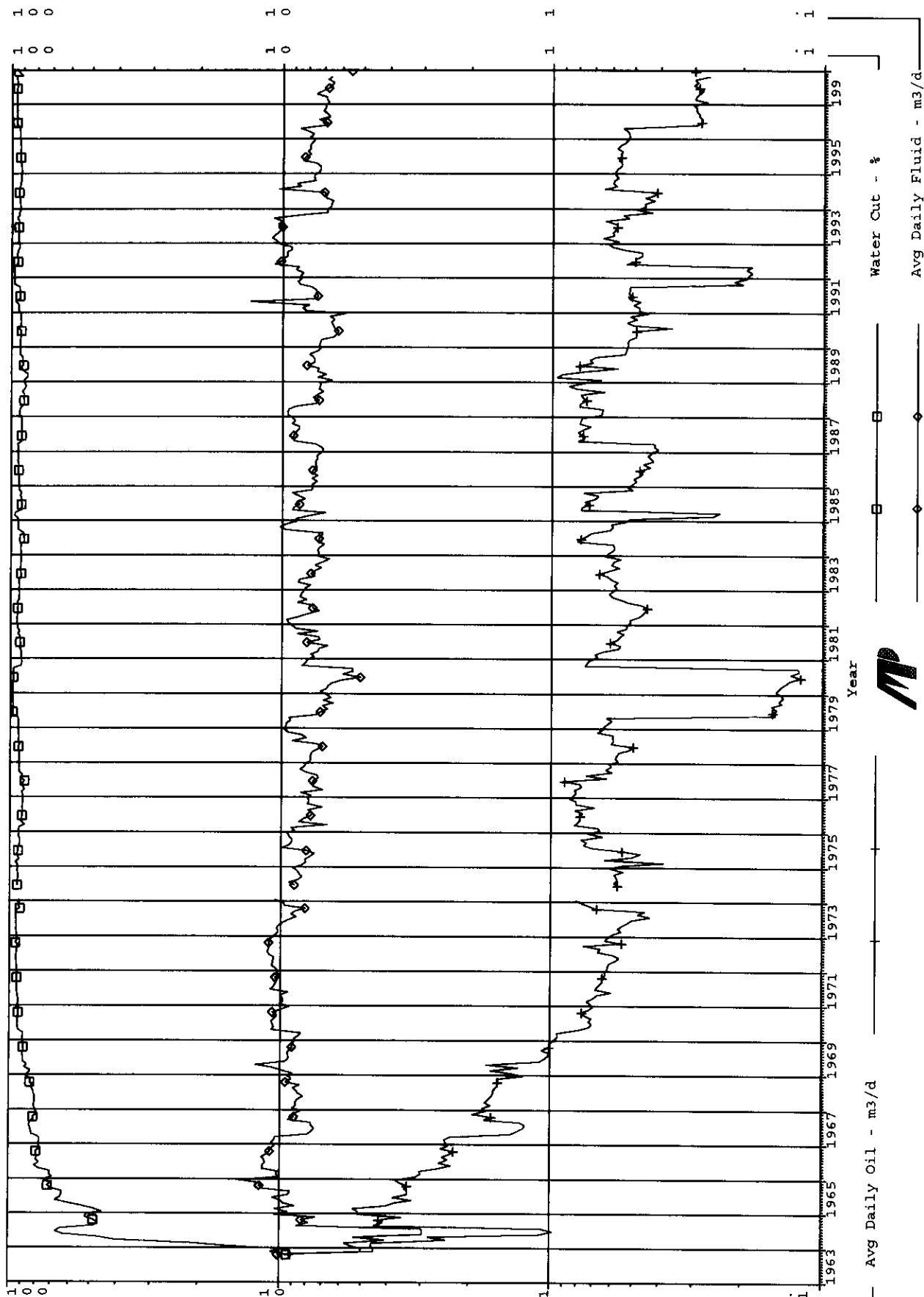
Cond: 0 m3



00/16-17-006-22W1/0 (Tundra Souris Hartney 16-17-06-22W1) Data 10/63-12/97

Operator:  
Field: 10  
Zone: 53A  
Type: Unknown  
Group: Sourish

Production Cums  
Oil: 10553.4 m3  
Gas: 0 E6m3  
Water: 86703.2 m3  
Cond: 0 m3



**ATTACHMENT NO.4  
SOURIS HARTNEY UNIT NO.1  
COMPLETION PROGRAMS  
FOR INJECTORS 2-17, 6-17, AND 10-17-6-22 WPM**

## **CONVERSION PROGRAM**

### **TUNDRA SOURIS HARTNEY 2-17-6-22 W1**

**OBJECTIVE:** The 2-17-6-22 well was drilled in 1963 and completed open hole in the Lodgepole formation, Virden member. The well is currently producing 5.43 m3 total fluid with a water cut of 89.6% giving daily oil of .57 m3 and daily water of 4.87 m3. It is proposed to convert the well to a water injection well to provide pressure maintenance to the offsetting horizontal Wells. **Proposed injection interval is 654.1 - 658.98 mKB.**

The following well information was obtained from well files From Tundra and the Gov't office, Energy and Mines. Waskada.

#### **WELL DETAILS:**

**ELEVATIONS:** K.B. 451.71 M  
G.L. 448.67 M  
P.B.T.D. 657.15 m (2156 ft) hydromite plug placed 66/07/10  
T.D. 662.94 m (2175 ft) Driller  
663.55 m (2177 ft) Logger

#### **CASING DETAILS:**

**SURFACE:** 177.8 mm, 29.76 kg/m, J-55 ST&C, landed at 100.58 m.  
Cemented with 160 sks cement. Good 20 sks cement returns.

**PRODUCTION:** 67 JTS, 114.3 mm, 14.14 kg/m, J-55 ST&C, landed at 654.1 m.  
Cemented with 130 sks cement. No returns.

**LOGS:** GR - Sonic - Caliper

**CORES:** None

**Perforations:** OH 654.1 - 662.64 mKB. (hydromite plug 657.15 - 662.64)  
Perf'd 655.3 - 657.15 mKB.

**Tubing and rod details:**

1 - 60.3 NUE tail jt	LTV 31-84 20-150-RWAC-10
1 - psn	61 - 16 mm sc
66 - 60.3 NUE	23 - 19 mm sc
1 - 60.3 EUE	
1-2', 1-4', 2-6' pups	

**Well History:**

63/08/29	Completion
64/02/24	Pump change
64/10/16	Hot oil job
66/06/10	Hot oil, Pulled equipment, Dumped Hydromite plug 657.15 – 662.64 Acid job 2000 gal non-aqueous acid (took several days to squeeze) Acid job 250 gallons Hcl ¼ bpm at 900 psi.
67/11/07	Pump change
68/09/17	Hot oil job
69/06/23	Hot oil job, Pulled pump, Acid job 125 gal HV, 500 gal Hcl
~ ~	No record of events from 1969 - 1992
92/11/26	Broken rod, pump change, Pump seized in tubing.
96/07/05	Hot oil job, Pump change, broken rod.

## **Program:**

1. Notify the local Department of Energy and Mines office at 673-2472 to inform them of the conversion.
2. Move in service rig complete with pump and tank and rig up. Review program with all rig crew members and ensure all applicable OH&S and E&M regulations are followed. Install and test rig anchors.
3. Pressure test tubing with produced water to 7000 kPa.
4. Pull out of hole and lay down pump and rods. (hot water if necessary to clean tubing and rods)
5. Install and pressure test BOP'S. Note wellhead is Gulfco model. Determine best method to remove and replace with CR type wellhead with slips, pack-off, etc.
6. If pressure test successful. Tag plug back to check for fill and circulate well over to clean salt water.
7. To confirm PBTD, strap out of hole laying down tubing. Lay aside and mark suspect tubing and tail joint. Tally in with a 114.3 mm casing scraper on 60.3 mm work string and run in to 650 m. Pull out of hole with scraper. Install a 114.3 mm packer and run in to 650 m. Set packer and test casing to 3.5 mPa. Take feed rate into open hole section with clean salt water. Maximum 5 mPa.
8. Pull out of hole with packer. Make up 3 7/8 drag bit and run in to PBTD. Rig in power swivel and drill out 1.83 m of hydromite plug from 657.15 to 658.98 mKB. Circulate hole clean. Conduct a feedrate with clean salt water, acidize with 1.0 m3 15% HCL if necessary. Max. 5 mPa.
9. Pull out of hole and lay down tubing and bit.
10. Tally, visually inspect and run in the hole with the following:
  - 1-14.3 mm impreglon or TK99 coated AD-1 tension packer
  - 1-impreglon coated ball seat nipple
  - ~ 645 m - 60.3 mm internally coated TK-99 tubing
  - 1- teflon impregnated cross-over
  - 1- 14 MPa stainless ball valve
11. Land packer at approximately 650.0 mKB.
12. Reverse circulate the annulus over to fresh water containing .5 % packer/wellbore inhibitor. (40 l CRW0132 in 8.0 m3 fresh water)
13. Set packer in 5000 daN tension. Set slips, pack off wellhead.
14. Pressure test annulus to 3500 kPa. Top off with diesel to prevent freezing.
15. Rig out and release service rig.

prepared by:

**Jed Sanderson**

**Area Technologist**

**99/07/20**

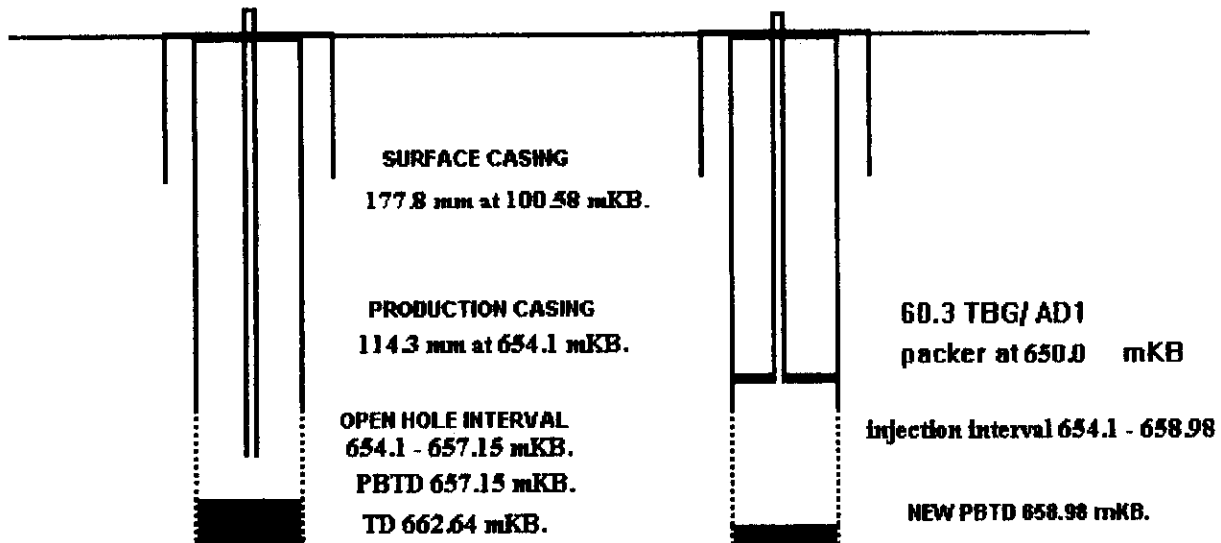
**WELLBORE SCHEMATIC**

**EXISTING / PROPOSED**

**Tundra Souris Hartney**  
**2-17-6-22 WIW**

**FOR SALT WATER INJECTION**

**KB 451.71**  
**GE 448.67**





**TUNDRA**  
OIL AND GAS LTD.

**CONVERSION PROGRAM**

**TUNDRA SOURIS HARTNEY 6-17-6-22 W1**

**OBJECTIVE:** The 6-17-6-22 well was drilled in 1963 and completed open hole in the Lodgepole formation, Virden member. The well is currently shut in. Past production tests showed producing rates of 6.1 m3 total fluid with a water cut of 97% giving daily oil of .2 m3 and daily water of 5.9 m3. It is proposed to convert the well to a water injection well to provide pressure maintenance to the offsetting horizontal wells.  
**Proposed injection interval is 649.83 - 655.32 mKB.**

The following well information was obtained from well files  
From Tundra and the Gov't office, Energy and Mines. Waskada.

**WELL DETAILS:**

**ELEVATIONS:** K.B. 450.8 M  
G.L. 447.2 M  
P.B.T.D. 661.42 m (2170 ft)  
T.D. 661.42 m (2170 ft) Driller  
662.03 m (2172 ft) Logger

**CASING DETAILS:**

**SURFACE:** 219.1 mm, 35.72 kg/m, J-55 ST&C, landed at 98.01 m.  
Cemented with 200 sks cement.

**PRODUCTION:** 114.3 mm, 14.14 kg/m, J-55 ST&C, landed at 649.83 m.  
Cemented with 155 sks cement. No returns.

**LOGS:** GR - Sonic - Caliper - DIL

**CORES:** None

**Perforations:** OH 649.83 - 661.42 mKB.

<b>Tubing and rod string:</b>	1 - 60.3 mm pup	2.46	45 - 16 plain
	1 -psn	.34	40 - 16 scraped
	68 - 60.3 tubing	646.04	2-4', 2-6' ponies
	KB - TH	2.74	

Tubing landed at 651.58

**Well History:**

63/03/19	Completion
63/05/23	Pump change
64/08/05	Hot oil job, pump change
67/08/22	Hot oil, pump change
69/06/17	pump change
73/10/23	hot oil, pump change
75/06/24	hot oil, pump change, gyped up bottom joint
78/09/27	hot oil, pump change, bottom joint gyped, versene job
79/01/19	broken rod, hot oil, pump change
80/09/22	pump change, gyp
80/09/29	versene job
82/07/21	hot oil, pump change, tail joint plugged
82/07/27	versene job
87/03/12	pump change, tail joint full of gyp
87/03/20	versene job
94/11/15	pump change, change top joint

## **PROGRAM:**

1. Notify the local Department of Energy and Mines office at 673-2472 to inform them of the conversion.
2. Move in service rig complete with pump and tank and rig up. Review program with all rig crew members and ensure all applicable OH&S and E&M regulations are followed. Install and test rig anchors.
3. Pressure test tubing with produced water to 7000 kPa.
4. Pull out of hole and lay down pump and rods. (hot water if necessary to clean tubing and rods)
5. Install and pressure test BOP'S. Note wellhead is Norris model. Determine best method to change out wellhead to CR type with slips, pack off, etc.
6. If pressure test successful. Tag plug back to check for fill and circulate well over to clean salt water.
7. To confirm PBTD, strap out of the hole laying down tubing. Mark and lay out suspect tubing and tail joint.
8. Tally in with a 114.3 mm casing scraper on 60.3 mm work string and run in to 645 mKB. Pull out of hole with scraper.
9. Install a 114.3 mm AD1 work packer and run in to 645 m. Set packer and test casing to 3.5 mPa. Conduct A feed rate with clean salt water. Maximum 5 mPa. Pull out of hole with tubing and packer.
10. Run in with 3 ¾ bit on 60.3 mm tubing and circulate clean to PBTD. Pull out of hole with tubing.
11. Run in open ended. Rig in cement unit with 1.0 m<sup>3</sup> Class G 0-1-0 cement. Circulate cement to bottom of tubing and balance plug.
12. Pull up above cement top. Squeeze cement into formation to achieve a 5 mPa. squeeze. Run in to 650 mKB and backwash clean. Pull up above cement and let cement set up overnight.
13. Run in with tubing and tag cement plug. Pull out of hole and install a 3 7/8 drag bit. Drill out cement to 655.32. Pressure test drilled out interval. Pull out tubing and bit.
14. Rig in wireline unit. Run in with a gauge ring to PBTD. Make up a 86 mm Expendable Carrier gun with 32 gram charges, 13 SPM at 90 deg. phasing. Perforate 651.7 m to 655.2 mKB. ( 3.5 m perfs) Rig out wireline unit.
15. Run in with tubing and land .5 m off bottom. Acidize with 1 m<sup>3</sup> 15% HCL. Conduct a feed rate with clean salt water. Maximum 5 mPa. Lay out work string.

16. Tally, visually inspect and run in the hole with the following:
  - 1-14.3 mm impreglon or TK99 coated AD-1 tension packer
  - 1-impreglon coated ball seat nipple
  - ~ 645 m - 60.3 mm internally coated TK-99 tubing
  - 1- teflon impregnated cross-over
  - 1- 14 MPa stainless ball valve
17. Land packer at approximately 645.0 mKB.
18. Reverse circulate the annulus over to fresh water containing .5 % packer / wellbore inhibitor.  
(40 l CRW0132 in 8.0 m3 fresh water)
19. Set packer in 5000 daN tension. Install slips and pack off wellhead.
20. Pressure test annulus to 3500 kPa. Top off with diesel to prevent freezing.
21. Rig out and release service rig.

prepared by:

**Jed Sanderson**

**Area Technologist**

**99/07/20**

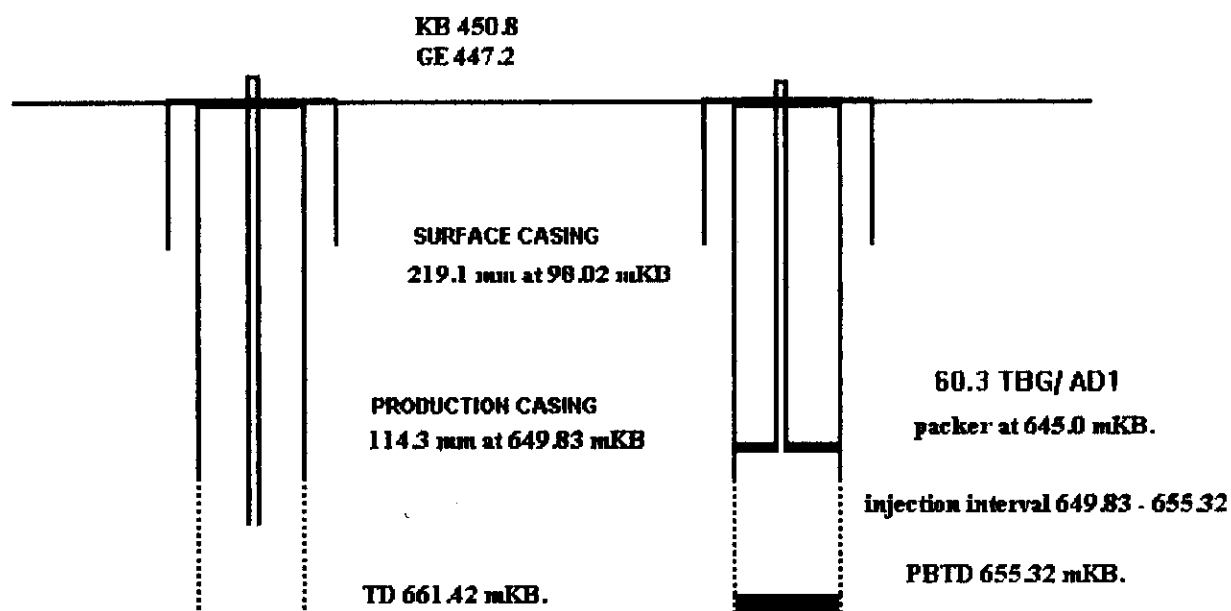
**WELLBORE SCHEMATIC**

**EXISTING / PROPOSED**

**Tundra Souris Hartney**

**6-17-6-22 WIW**

**FOR SALT WATER INJECTION**



**TUNDRA**  
OIL AND GAS LTD.

**CONVERSION PROGRAM**

**TUNDRA SOURIS HARTNEY 10-17-6-22 W1**

**OBJECTIVE:** The 10-17-6-22 well was drilled in 1963 and completed open hole in the Lodgepole formation, Virden member. The well is currently shut in. Past production tests showed producing rates of 5.7 m3 total fluid with a water cut of 93% giving daily oil of .4 m3 and daily water of 5.3 m3. It is proposed to convert the well to a water injection well to provide pressure maintenance to the offsetting horizontal wells.  
**Proposed injection interval is 650.87 - 653.98 mKB.**

The following well information was obtained from well files From Tundra and the Gov't office, Energy and Mines. Waskada.

**WELL DETAILS:**

**ELEVATIONS:** K.B. 451.41 M  
G.L. 448.18 M  
P.B.T.D. 653.8 m (2145 ft)  
T.D. 665.7 m (2184 ft) Driller  
665.7 m (2184 ft) Logger

**CASING DETAILS:**

**SURFACE:** 219.1 mm, 35.72 kg/m, J-55 ST&C, landed at 99.51 m.  
Cemented with 210 sks cement. 40 sks returns.

**PRODUCTION:** 67 JTS, 114.3 mm, 14.14 kg/m, J-55 ST&C, landed at 650.87 m.  
Cemented with 150 sks cement. No returns.

**LOGS:** GR - Sonic - Caliper - DIL

**CORES:** 647.4 - 665.7

**Perforations:** 155.6 mm (6 1/8)OH from 650.87 - 653.95 mKB.

**Tubing and rod string:** 1 - 60.3 tail joint 9.55 pump 20-150-RWAC-8  
1 - psn .33 41 - 16 mm plain  
68 - 60.3 tubing 639.14 41 - 16 mm steel sc  
KB - TH 2.13 2-2', 1-4', 1-8' ponies  
Tubing landed at 651.15

**Well History:**

63/03/07 Completion  
Dump bailed 5 sacks neat cement 665.7 - 662.64  
Ran hydromite plug 653.49 - 658.06  
Tagged PBTD 653.8  
Swabbed with packer  
63/03/10 Ran Pump and rods  
  
63/04 Pump change (wax)  
  
67/08/23 hot oil / pump change  
  
67/09/08 broken rod  
  
67/11/04 acid job  
  
68/11/02 hot oil / pump change  
  
68/11/13 hot oil / pump change  
  
68/11/19 turn psn / pc  
  
69/03/19 acid / paran job  
  
70/09/19 hot oil / pump change  
  
73/11/20 broken rod / hot oil / pump change  
  
75/06/24 broken rod / hot oil / pump change  
  
78/07/07 pump change  
  
79/06/04 broken rod / pump change  
  
79/07/30 hot oil / pump change  
  
81/05/07 hot oil / pump change  
  
87/03/12 hot oil / pump change / circ clean  
  
87/03/20 pump change (backed off pull rod)  
  
88/08/06 hot oil / pump change  
  
89/02/08 tubing leak (top joint) / pump change  
  
89/09/18 broken rod / pump change

**Program:**

1. Notify the local Department of Energy and Mines office at 673-2472 to inform them of the conversion.
2. Move in service rig complete with pump and tank and rig up. Review program with all rig crew members and ensure all applicable OH&S and E&M regulations are followed. Install and test rig anchors.
3. Pressure test tubing with produced water to 7000 kPa.
4. Pull out of hole and lay down pump and rods. (hot water if necessary to clean tubing and rods)
5. Install and pressure test BOP'S. Note wellhead is Norris model. Determine best method to remove wellhead and install CR type wellhead with slips, packoff, etc.
6. If pressure test successful, tag plug back to check for fill and circulate clean.
7. To confirm PBTD, strap out of hole laying down tubing. Mark and lay out suspect tubing and tail joint.
8. Strap in with a 114.3 mm casing scraper on a 60.3 mm work string and run in to 645 mKB.  
Pull out of hole with scraper.
9. Install a 114.3 mm AD1 work packer and run in to 645 m. Set packer and test casing to 3.5 mPa.  
If test successful, conduct a feed rate with clean salt water. Maximum 5 mPa. Unset packer, pull out of hole with packer.
10. Run in tubing and 3 ¾ bit to PBTD. Note depth. If fill encountered, circulate wellbore clean.  
If casing test was good and feed rate less than 3.5 mPa. Conduct a second feedrate. (Acidize if necessary)
11. Pull out of hole and lay down tubing and bit.
12. Tally, visually inspect and run in the hole with the following:
  - 1-114.3 mm impreglon or TK99 coated AD-1 tension packer
  - 1-impreglon coated ball seat nipple
  - ~ 645 m - 60.3 mm internally coated TK-99 tubing
  - teflon impregnated cross-over
  - 14 MPa stainless ball valve
13. Land packer at approximately 645.0 mKB.
14. Reverse circulate the annulus over to fresh water containing .5 % packer / wellbore inhibitor.  
(40 l CRW0132 in 8.0 m3 fresh water)
15. Set packer in 5000 daN tension. Install slips and pack off. Pressure test annulus to 3500 kPa.  
Top off with diesel to prevent freezing.
16. Rig out and release service rig.

prepared by:

**Jed Sanderson**

**Area Technologist**

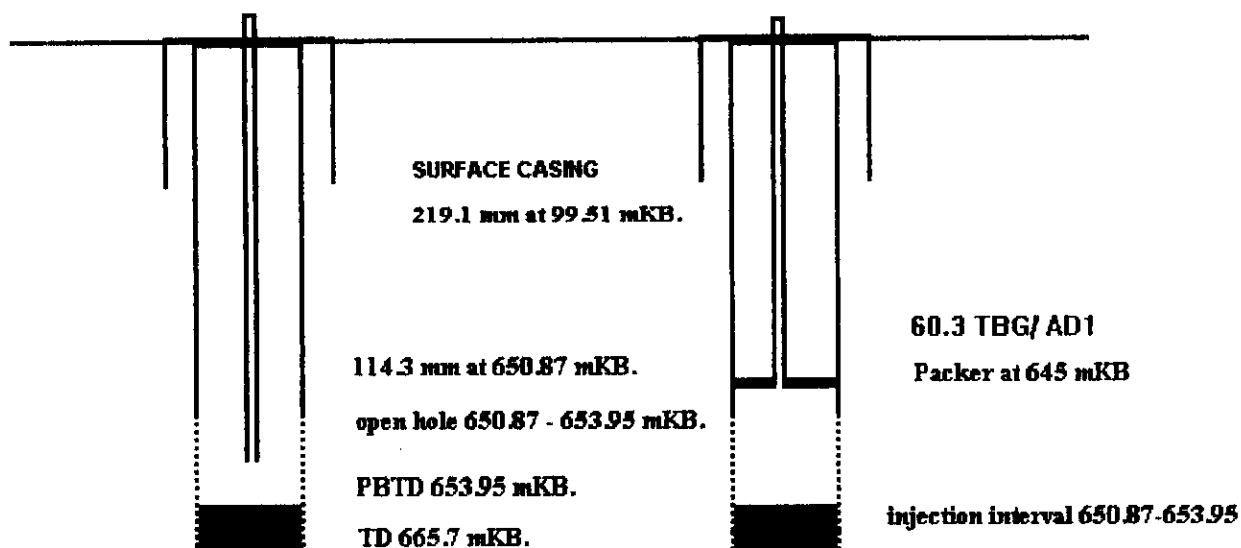


Tundra Souris Hartney

10-17-6-22 WIW

FOR SALT WATER INJECTION

KB 451.41  
GE 448.18



**ATTACHMENT NO.5**  
**SOURIS HARTNEY UNIT NO.1**  
**APPLICATIONS TO CONVERT**  
**2-17, 6-17, AND 10-17-6-22 WPM TO WATER INJECTION SERVICE**



# Manitoba

Energy and Mines

Petroleum

## APPLICATION FOR APPROVAL OF WELL OPERATIONS

In compliance with Section 47 of the Drilling and Production Regulation, application is hereby made for approval of the following operations:

### PROPOSED WELL OPERATIONS (please check):

Suspend \_\_\_\_\_ Recomplete in another zone \_\_\_\_\_ Deepen \_\_\_\_\_ Remove Casing \_\_\_\_\_ Abandon \_\_\_\_\_

Convert to: Salt Water Disposal \_\_\_\_\_ Water Injection X

Other: \_\_\_\_\_

Well name TUNDRA SOURIS HARTNEY 2-17-6-22 Licence No. 1892

Name of Licensee Tundra Oil and Gas Ltd.

Address of Licensee Box 1960, Virden, Manitoba ROM 2CO

Company Representative Jed Sanderson (204) 748-3095 (204) 748-1007  
(telephone) (fax)

### GENERAL WELL INFORMATION

	Size (mm)	Weight (kg/m)	Depth (m)	Cemented to surface (yes or no)
Surface Casing:	<u>177.8</u>	<u>29.76</u>	<u>100.58</u>	<u>Yes</u>
Production Casing:	<u>114.3</u>	<u>14.14</u>	<u>654.1</u>	<u>No</u>
Total Depth:	<u>662.94</u> m		Plugback Total Depth <u>657.15</u> m	
Perforations:	<u>655.3-657.15</u> m		Openhole Interval <u>654.1-657.15</u> m	

### CURRENT WELL STATUS (please check)

Capable of Oil Production X Salt Water Disposal \_\_\_\_\_ Water Injection \_\_\_\_\_ Other \_\_\_\_\_

Suspended \_\_\_\_\_ Expiry Date \_\_\_\_\_ Shut-in \_\_\_\_\_ Date Well Shut-in \_\_\_\_\_

	YY	MM	DD		YY	MM	DD	
Final Production Rate: Oil:			<u>0.57</u>	m3/day	Date of Last Production Test:	<u>99</u>	<u>05</u>	<u>29</u>
Water:			<u>4.87</u>	m3/day		YY	MM	DD

Reason for Proposed Operations: Well is required for pressure maintenance.

Planned Commencement Date: 99 / 09 / 01

YY MM DD

Program of Proposed Operations:

(Complete below and attach detailed program):

Pull equipment. Drill out plug to 658.98 m KB. Acidize well. Run coated injection string with coated packer. Displace annulus to inhibited fresh water. Set packer at 650 m KB. Test annulus to 3.5 mPa.  
Place well on injection.

99-07-20

(Date)

Jed Sanderson  
Signature of applicant)

For assistance in completing this form, contact Dan Surzyshyn, 204-945-8102 or Paulette Seymour, 204-945-6575.

For Department Use Only

# Manitoba

## Energy and Mines

## Petroleum

# APPLICATION FOR APPROVAL OF WELL OPERATIONS

In compliance with Section 47 of the Drilling and Production Regulation, application is hereby made for approval of the following operations:

**PROPOSED WELL OPERATIONS (please check):**

Suspend \_\_\_\_\_ Recomplete in another zone \_\_\_\_\_ Deepen \_\_\_\_\_ Remove Casing \_\_\_\_\_ Abandon \_\_\_\_\_

Convert to:      Salt Water Disposal      \_\_\_\_\_      Water Injection      **X**

Other: \_\_\_\_\_

Well name TUNDRA SOURIS HARTNEY 6-17-6-22 Licence No. 1882

Name of Licensee Tundra Oil and Gas Ltd.

Address of Licensee      Box 1960, Virden, Manitoba      ROM 2CO

Company Representative Jed Sanderson (204) 748-3095 (204) 748-1007  
(telephone) (fax)

## GENERAL WELL INFORMATION

	Size (mm)	Weight (kg/m)	Depth (m)	Cemented to surface (yes or no)
Surface Casing:	<u>219.1</u>	<u>35.72</u>	<u>98.01</u>	<u>Yes</u>
Production Casing:	<u>114.3</u>	<u>14.14</u>	<u>649.83</u>	<u>No</u>

Total Depth:	<u>661.42</u>	m	Plugback Total Depth	<u>661.42</u>	m
Perforations:	<u>          </u>	m	<u>          </u>	m	Openhole Interval    649.83 – 661.42    m

**CURRENT WELL STATUS (please check)**

Capable of Oil Production	<b>X</b>	Salt Water Disposal	Water Injection	Other
---------------------------	----------	---------------------	-----------------	-------

Suspended	Expiry Date	Shut-in	X	Date Well Shut-in	9/2/12
-----------	-------------	---------	---	-------------------	--------

		YY	MM	DD			YY	MM	DD
Final Production Rate:	Oil:			0.2	m3/day	Date of Last Production Test:			
	Water:			5.9	m3/day		YY	MM	DD


Reason for Proposed Operations: Well is required for pressure maintenance.

Planned Commencement Date: 99 / 09 / 01  
YY MM DD

**Program of Proposed Operations:**  
(Complete below and attach detailed program):

Pull downhole equipment. Cement squeeze openhole interval. Drill out 649.83 – 655.32 m. Perforate 651.7 – 665.32 m. Acidize well. Run coated injection packer and coated tubing. Displace annulus to inhibited fresh water. Set packer at 645 m KB. Test annulus to 3.5 mPa. Place well on injection.

99-07-20  
(Date)

  
(Signature of applicant)

*For assistance in completing this form, contact Dan Surzyshyn, 204-945-8102 or Paulette Seymour, 204-945-6575.*

For Department Use Only



# Manitoba

Energy and Mines

Petroleum

## APPLICATION FOR APPROVAL OF WELL OPERATIONS

In compliance with Section 47 of the Drilling and Production Regulation, application is hereby made for approval of the following operations:

### PROPOSED WELL OPERATIONS (please check):

Suspend \_\_\_\_\_ Recomplete in another zone \_\_\_\_\_ Deepen \_\_\_\_\_ Remove Casing \_\_\_\_\_ Abandon \_\_\_\_\_

Convert to: Salt Water Disposal \_\_\_\_\_ Water Injection X

Other: \_\_\_\_\_

Well name TUNDRA SOURIS HARTNEY 10-17-6-22 Licence No. 1877

Name of Licensee Tundra Oil and Gas Ltd.

Address of Licensee Box 1960, Virden, Manitoba ROM 2C0

Company Representative Jed Sanderson (204) 748-3095 (204) 748-1007  
(telephone) (fax)

### GENERAL WELL INFORMATION

	Size (mm)	Weight (kg/m)	Depth (m)	Cemented to surface (yes or no)
Surface Casing:	<u>219.1</u>	<u>35.72</u>	<u>99.51</u>	<u>Yes</u>
Production Casing:	<u>114.3</u>	<u>14.14</u>	<u>650.87</u>	<u>No</u>
Total Depth:	<u>665.7</u> m		Plugback Total Depth <u>653.8</u> m	
Perforations:			m _____ m	Openhole Interval <u>650.87-653.95</u> m

### CURRENT WELL STATUS (please check)

Capable of Oil Production X Salt Water Disposal \_\_\_\_\_ Water Injection \_\_\_\_\_ Other \_\_\_\_\_

Suspended \_\_\_\_\_ Expiry Date \_\_\_\_\_ Shut-in X Date Well Shut-in 97 12

	YY	MM	DD		YY	MM	DD
Final Production Rate: Oil:			<u>0.4</u>	m3/day	Date of Last Production Test:		
Water:			<u>5.3</u>	m3/day			

Reason for Proposed Operations: Well is required for pressure maintenance.

Planned Commencement Date: 99 / 09 / 01

YY MM DD

Program of Proposed Operations:  
(Complete below and attach detailed program):

Pull equipment. Acidize well. Run coated packer and injection string. Displace annulus to inhibited fresh water. Set packer at 645 m KB. Test annulus to 3.5 Mpa. Place well on injection.

99-07-20  
(Date)

Jed Sanderson  
(Signature of applicant)

For assistance in completing this form, contact Dan Surzyshyn, 204-945-8102 or Paulette Seymour, 204-945-6575.

For Department Use Only

**ATTACHMENT NO.6**  
**SOURIS HARTNEY UNIT NO.1**  
**SPECIAL CORE STUDY UPPER VIRDEN POOL**

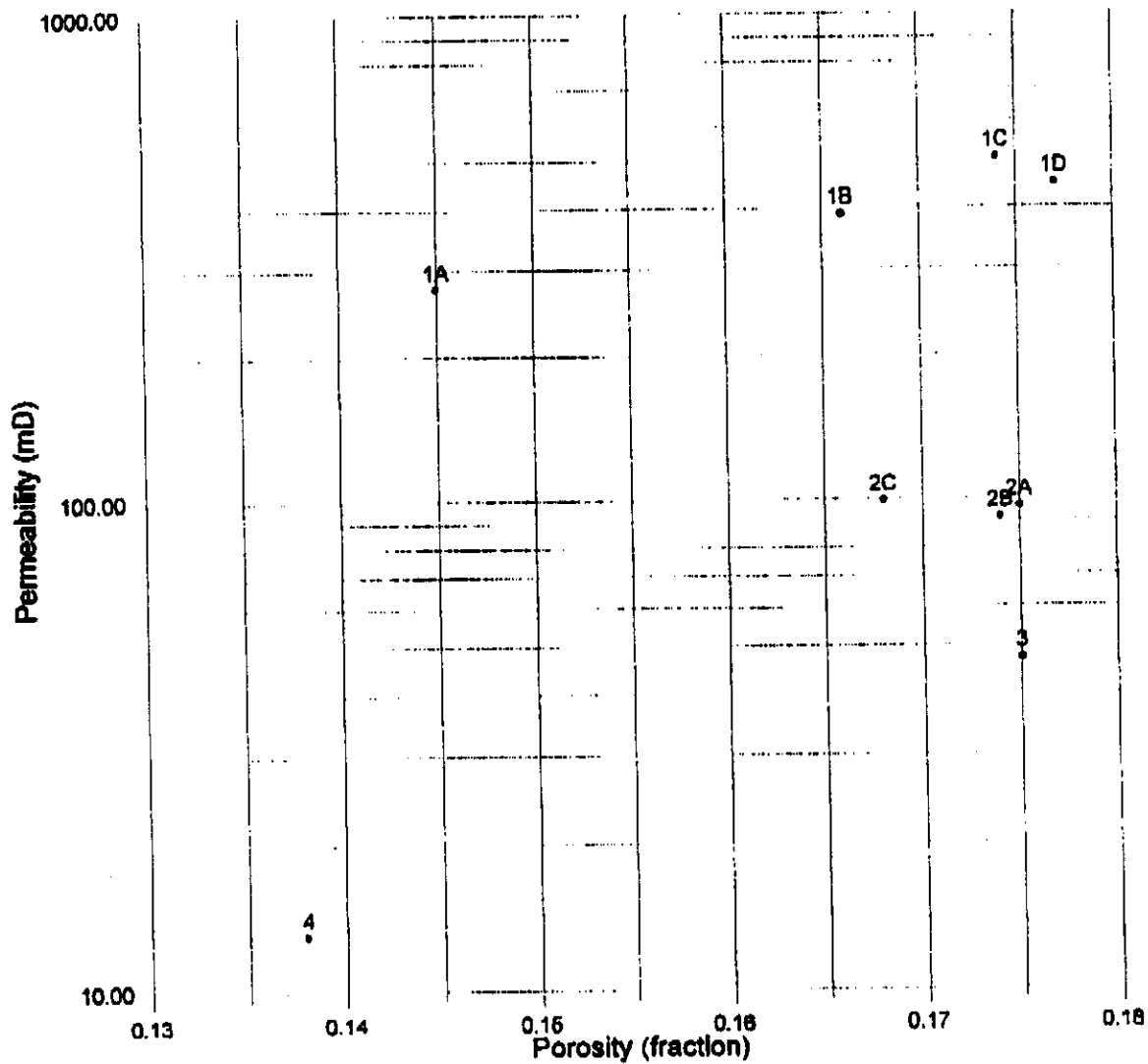
**TABLE 1**  
**TUNDRA SOURIS**  
**FRACTURE FLUID STUDY**  
**ROUTINE CORE ANALYSIS**

Sample No.	Depth (m)	Permeability (mD)	Porosity (fraction)	Grain Density (kg/m <sup>3</sup> )	Comments
WELL 6-17-6-22 W1M					
1A	653.06	275.18	0.145	2740	ls, i, ppv, sv
1B	653.07	389.70	0.166	2720	ls, i, ppv
1C	653.09	505.31	0.174	2720	ls, i, ppv
1D	653.10	446.76	0.177	2720	ls, i, ppv
WELL 10-17-6-22W1M					
2A	652.75	96.57	0.175	2720	ls, i, ppv, sv
2B	652.77	91.66	0.174	2720	ls, i, ppv
2C	652.78	99.40	0.168	2730	ls, i, ppv, sv
WELL 8-17-6-22W1M					
3	652.16	47.00	0.175	2710	ls, i, ppv
4	651.54	13.04	0.138	2750	ls, i, ppv, dol

98012

Hycal

**FIGURE 1B**  
**TUNDRA SOURIS**  
**FRACTURE FLUID STUDY**  
**ROUTINE CORE ANALYSIS**



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**TABLE 1**  
**TUNDRA - SOURIS HARTNEY**  
**RELATIVE PERMEABILITY STUDY**  
**ROUTINE CORE ANALYSIS**

Sample No.	Depth (m)	Permeability (mD)	Porosity (fraction)	Grain Density (kg/m <sup>3</sup> )	Comments
1A	2142.03	275.18	0.145	2740	ls, i, ppv, sv
1B	2142.08	389.70	0.166	2720	ls, i, ppv
1C	2142.12	505.31	0.174	2720	ls, i, ppv
1D	2142.17	446.76	0.177	2720	ls, i, ppv
2A	2141.03	96.57	0.175	2720	ls, i, ppv, sv
2B	2141.07	91.66	0.174	2720	ls, i, ppv
2C	2141.12	99.40	0.168	2730	ls, i, ppv, sv
3	2139.07	47.00	0.175	2710	ls, i, ppv
4	2137.04	13.04	0.138	2750	ls, i, ppv, dol

**TABLE 2**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER - OIL RELATIVE PERMEABILITY**  
**CORE AND TEST PARAMETERS**

Core Stack Number	1
Stack Configuration (from inlet)	2A, 2B, 2C
Depth (m)	652
Field Name	SOURIS
Well Location	10-17-6-22 W1M
Stack Length (cm)	19.59
Diameter (cm)	3.77
Effective Flow Area (cm <sup>2</sup> )	11.16
Bulk Volume (cm <sup>3</sup> )	218.68
Porosity (fraction)	0.173
Pore Volume (cm <sup>3</sup> )	34.70
Test Temperature (°C)	30
Initial Water Saturation (fraction)	0.473
Oil Viscosity @ 30 °C (mPa·s)	7.61
Water Viscosity @ 30 °C (mPa·s)	1.13
Water Displacement Rate (cc/hr)	20
Backpressure (kPag)	0
Net Overburden Pressure (kPag)	1030

**TABLE 3**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER - OIL RELATIVE PERMEABILITY**  
**SATURATION AND PERMEABILITY SUMMARY**

Test Phase	Sg	So	Sw	Permeability (mD)	Relative Permeability
Absolute Liquid Permeability	0.000	0.000	1.000	68	1.000
Initial Oil Permeability (@ Swi)	<del>0.000</del>	<del>0.527</del>	0.473	<del>90</del>	0.735
Final Water Permeability (@ Sor )	0.000	0.211	0.789	43	0.632
Waterflood Recovery, fraction of pore volume:					0.316
Waterflood Recovery, fraction of oil in place:					0.600

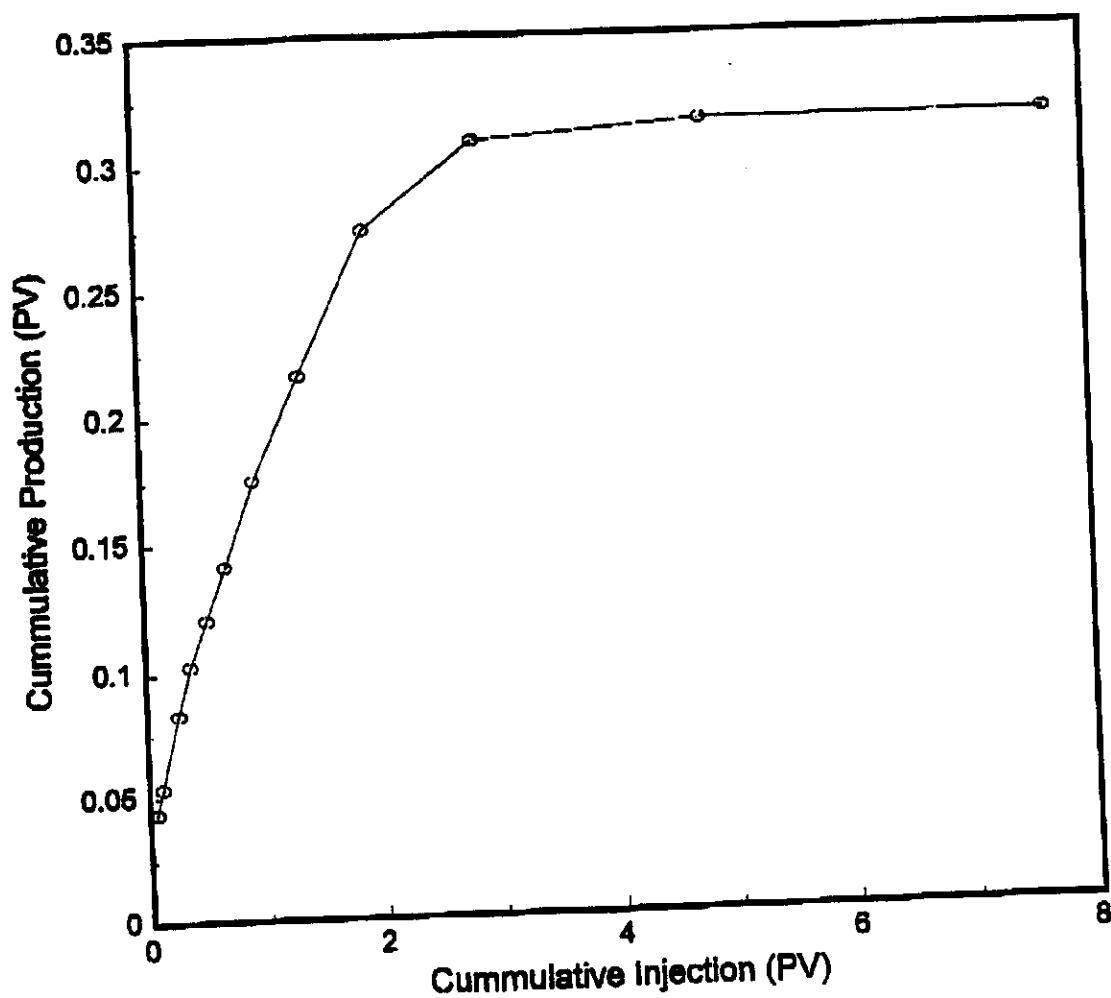
**TABLE 4**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER-OIL RELATIVE PERMEABILITY**  
**DIFFERENTIAL PRESSURE & PRODUCTION**

Cummulative Injection (PV)	Cummulative Production (PV)	Pressure (MPa)
0.058	0.044	0.04068
0.115	0.054	0.03447
0.259	0.083	0.02965
0.375	0.103	0.02792
0.519	0.121	0.02689
0.692	0.141	0.02646
0.951	0.175	0.02620
1.354	0.216	0.02606
1.931	0.274	0.02599
2.882	0.308	0.02599
4.813	0.315	0.02593
7.695	0.316	0.02586

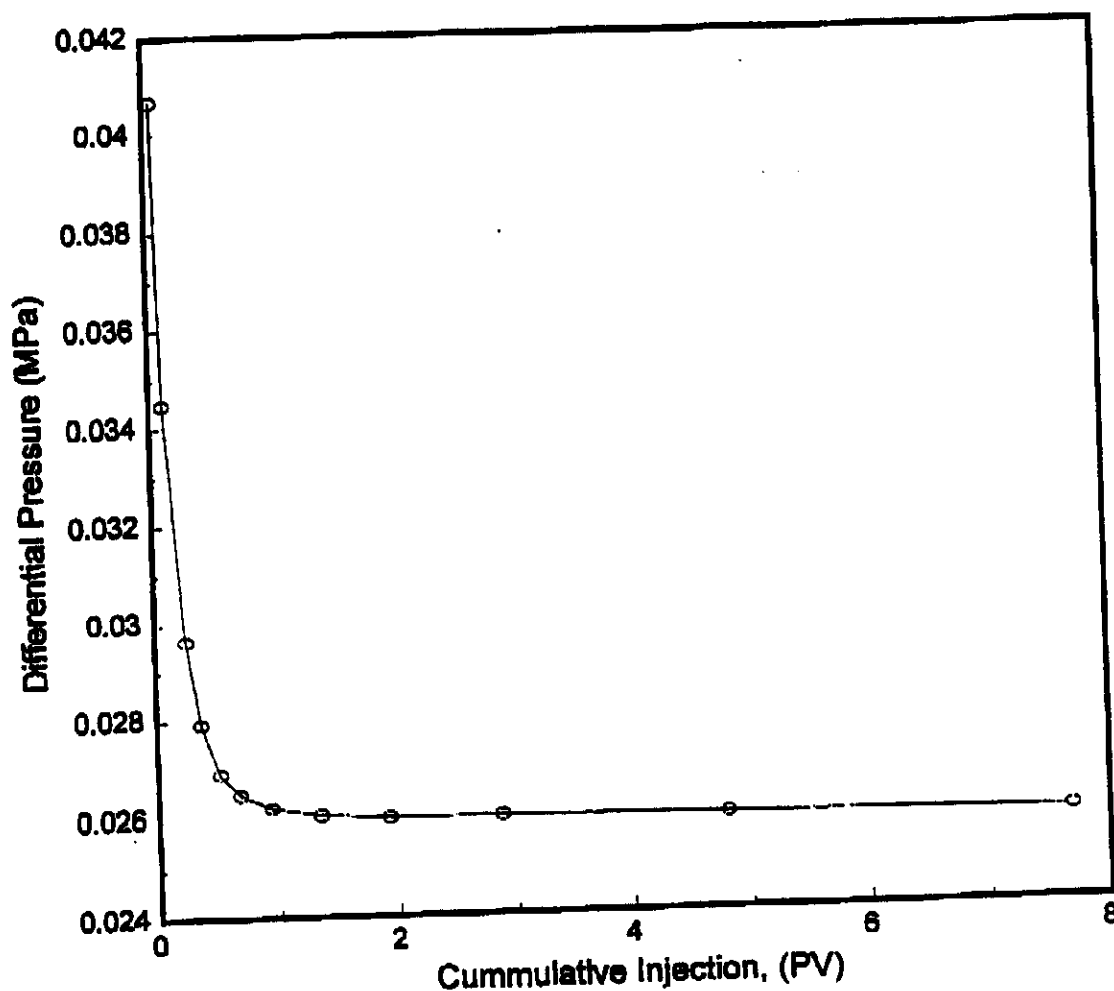
**TABLE 5**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER-OIL RELATIVE PERMEABILITY**  
**RELATIVE PERMEABILITY DATA**

Water Saturation (fraction)	Relative Permeability	
	K <sub>rw</sub>	K <sub>ro</sub>
0.473	0.00000	0.7353
0.489	0.02091	0.6660
0.505	0.04601	0.6001
0.520	0.07298	0.5375
0.536	0.10130	0.4782
0.552	0.13050	0.4223
0.568	0.16060	0.3698
0.584	0.19140	0.3206
0.599	0.22290	0.2749
0.615	0.25480	0.2325
0.631	0.28730	0.1936
0.647	0.32020	0.1582
0.663	0.35360	0.1262
0.678	0.38730	0.0977
0.694	0.42140	0.0728
0.710	0.45580	0.0514
0.726	0.49050	0.0336
0.742	0.52560	0.0195
0.757	0.56090	0.0091
0.773	0.59650	0.0026
0.789	0.63240	0.0000

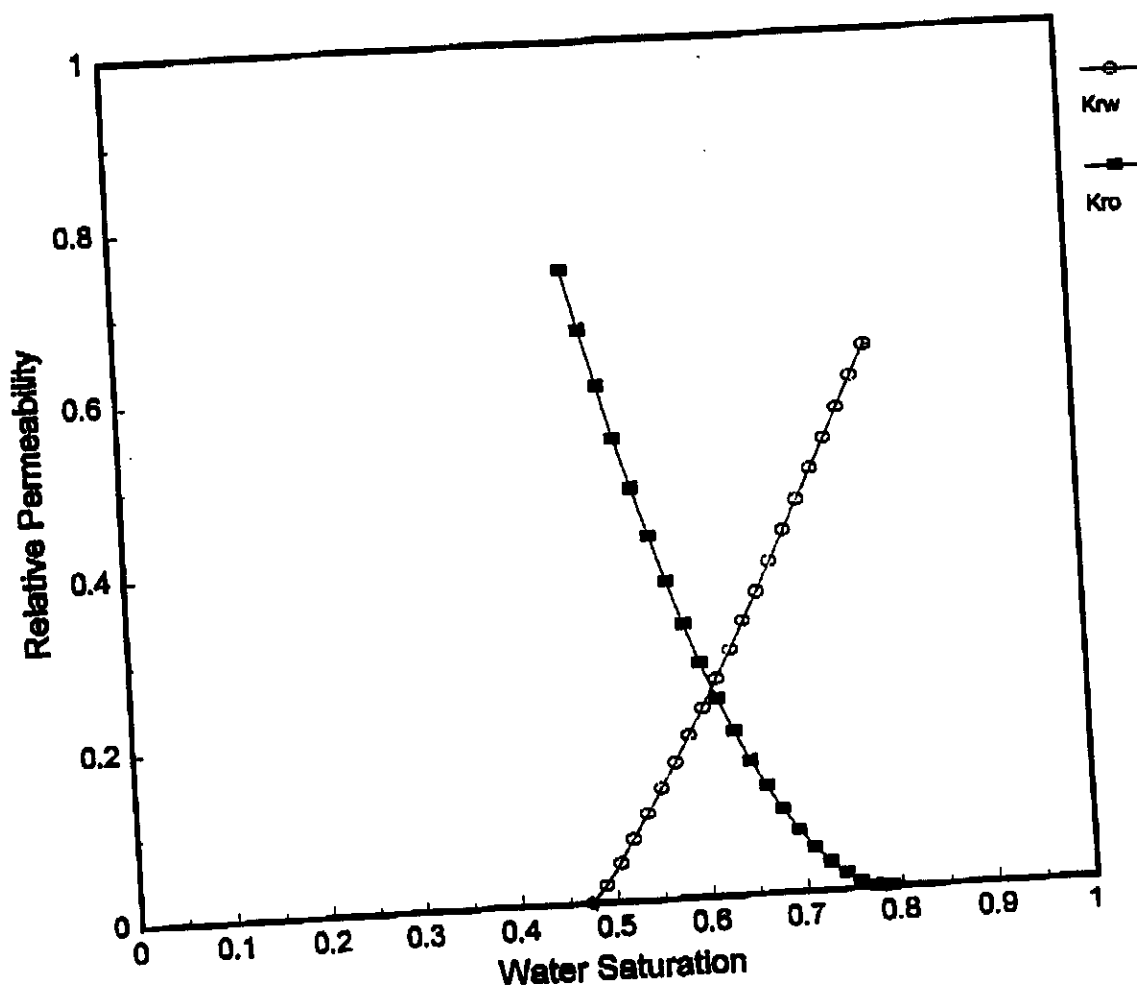
**FIGURE 2**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER-OIL RELATIVE PERMEABILITY**  
**CUMMULATIVE PRODUCTION PROFILE**



**FIGURE 3**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER-OIL RELATIVE PERMEABILITY**  
**DIFFERENTIAL PRESSURE PROFILE**

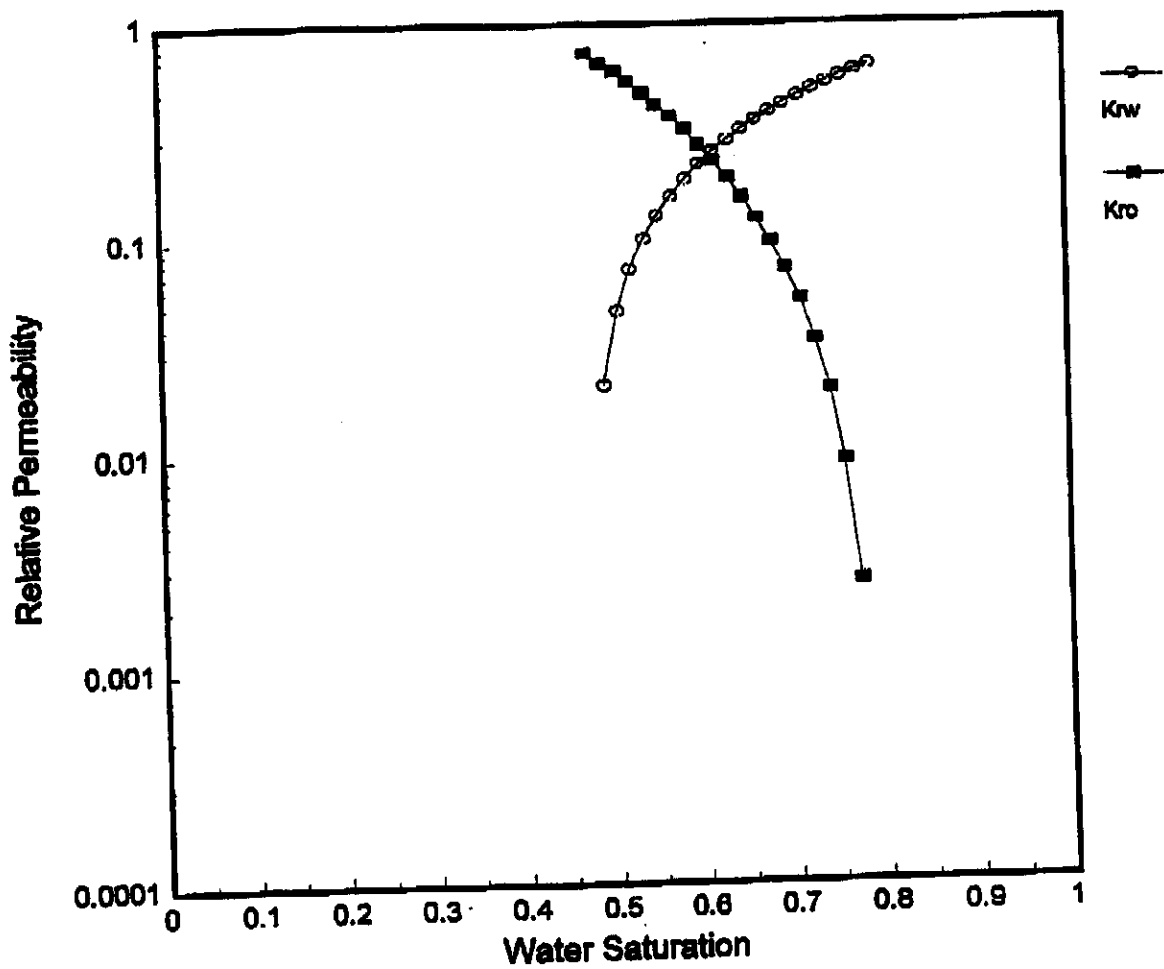


**FIGURE 4**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER-OIL RELATIVE PERMEABILITY**  
**RELATIVE PERMEABILITY PROFILE**





**FIGURE 5**  
**TUNDRA - SOURIS**  
**RELATIVE PERMEABILITY STUDY**  
**CORE STACK #1 - WATER-OIL RELATIVE PERMEABILITY**  
**RELATIVE PERMEABILITY PROFILE**



**ATTACHMENT NO.7**  
**SOURIS HARTNEY UNIT NO.1**  
**SURFACE AND MINERAL OWNERS**

SURFACE (SW-20) 44868 IRENE ADELINE HUNT	SURFACE (SE-20) 44868 IRENE ADELINE HUNT	SURFACE (SW-21) 1466413 MAGUIRE FARMS LTD.	SURFACE (SE-21) 1466422 MAGUIRE FARMS LTD.
MINERAL (SW-20) 33818 CAN PERM TOR GEN TRUST 50% ✓ (SW-20) 195840 FLORENCE J. CARTER 50% ✓	MINERAL (SE-20) 32021 CANADA PERM. TRUST COMPANY 50% ✓ (EXC 208.7 N OF 208.7E) (SE-20) 34912 CANADA PERM. TRUST COMPANY 50% ✓ (EXC 208.7 N OF 208.7E)	MINERAL (SW-21) 432555 CANADA PERM. TRUST COMPANY 50% ✓ (SW-21) 33664 CAN. PERM. TORONTO GEN. TRUST 50% ✓	MINERAL (SE-21) 43225 CANADA PERM. TRUST ✓
SURFACE (NW-17) 1582458 C.R. SOMERVILLE COMP.	SURFACE (NE-17) 35004 C.R. SOMERVILLE COMPANY	SURFACE (NW-16) 172202 SCOTT MALCOLM HUNT ✓	SURFACE (NE-16) 183494 WILLIAM JOHN HUNT
MINERAL (NW-17) 1582458 C.R. SOMERVILLE COMP.	MINERAL (NE-17) 1534146 K.M. ALLAN HOLDINGS	MINERAL (NW-16) 195602 GIBSON OILS LTD.	MINERAL (NE-16) 1426248 KEITH M. MORDEN 50% ✓ (NE-16) 33236 CAN. PERM. TOR. GEN. TRUST 50% ✓
SURFACE (SW-17) 176267 WILLIAM JOHN HUNT ✓	SURFACE (SE-17) 1562459 C.R. SOMERVILLE COMPANY	SURFACE (SW-16) 172201 NEIL THOMAS HUNT ✓	SURFACE (SE-16) MARK LESLIE HUNT
MINERAL (SW-17) 1534146 K.M. ALLAN HOLDINGS	MINERAL (SE-17) 1582459 C.R. SOMERVILLE COMPANY	MINERAL (SW-16) 195602 GIBSON OILS LTD. ✓	MINERAL (SE-16) 1426248 KEITH M. MORDEN 50% ✓ (SE-16) 32036 CAN. PERM. TRUST COMP. 50% ✓
SECTION 17-6-22		SECTION 16-6-22	
SURFACE (NW-8) 171442 WILLIAM ADELINE HUNT	SURFACE (NE-8) 171441 WILLIAM ADELINE HUNT	SURFACE (NW-9) 1652342 NICHOLAS and LAUREEN GENIK	SURFACE (NE-9) 1652342 LAURA L. CHABAN
MINERAL (NW-8) 42903/42904 LLOYD K. MCBURNEY 50% ✓ (NW-8) 171441 WILLIAM ADELINE HUNT 50% ✓	MINERAL (NE-8) 42903/42904 LLOYD K. MCBURNEY 50% ✓ (NE-8) 171441 WILLIAM ADELINE HUNT 50% ✓	MINERAL (NW-9) 1605464 DONALD H. ROSLING 66.2/3% ✓ (NW-9) 1622378 DONALD H. ROSLING 33.1/3% ✓	MINERAL (NE-9) 34172 CANADIAN FINA OIL LIMITED 50% ✓ (NE-9) 27812 TORONTO GENERAL TRUST CORP. 25% ✓ (NE-9) 184417 CANADA PERMANENT TRUST 25% ✓

SOURIS-HARTNEY PROPOSED UNIT

TWP 6 RGE 22 WPM: SEC(S) 16, 17

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**SOURIS HARTNEY PROPOSED UNIT**

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**TWP 6 RGE 22 WPM: SEC(S) 16, 27****SURFACE/MINERAL LANDOWNER NAMES/ADDRESSES**

**CANADA PERMANENT TRUST** (NE-9)(NW-10)(SE-20)(SE-21)(SE-16)  
c/o Montreal Trust Company  
7th Floor, 530 Eighth Avenue S.W. Calgary, Alberta T2P 3S8

**CANADA PERMANENT TORONTO GENERAL TRUST COMPANY**  
c/o Montreal Trust Company (SW-20)(SW-21)(NE-16)  
7th Floor, 530 Eighth Avenue S.W. Calgary, Alberta T2P 3S8

**CANADIAN FINA OIL LIMITED** (NE-9)(NW-10)  
c/o Petro-Canada  
150 – 6<sup>th</sup> Avenue SW Calgary, AB T2P 3E3

**CARTER, Florence J.** (SW-20)  
1705 – 277 Wellington Crescent Winnipeg, MB R3M 3V7

**CHABAN, Laura Lorraine** (NE-9)  
General Delivery Yorkton, SK S3N 3Z4

**C.R. SOMERVILLE COMPANY LIMITED**  
c/o K. Schulz, PA (NW-17)(NE-17)(SE-17)  
1279 Liberty Street Winnipeg, MB R3S 1A5

**GENIK, Nicholas D. and Laureen G.** (NW-9)  
General Delivery Elgin, MB R0K 0T0

**GIBSON OILS** (NW-16)(SW-16)  
P.O. Box 245 Hartney, MB R0M 0X0

**HUNT, Irene Adeline** (SW-20)(SE-20)  
General Delivery Hartney, MB R0M 0X0

**HUNT, Mark** (SE-16)  
Box 64 Hartney, MB R0M 0X0

**HUNT, Neil Thomas** (SW-16)  
General Delivery Cameron, MB

**HUNT, Scott Malcolm** (NW-16)  
General Delivery Cameron, MB

**HUNT, William John** (SW-17)(NE-16)(NW-15)  
General Delivery Hartney, MB R0M 0X0

**HUNT, William and Adeline** (NE-8)(NW-8)  
General Delivery Cameron, Manitoba

**K.M. ALLAN HOLDINGS** (SW-17)(NE-17)  
c/o Mrs. Martha  
305, 699 - 28 St West, Prince Albert, SK S6V 6K5

**MAGUIRE FARMS LTD.** (SW-21)(SE-21)  
Box 132 Elgin, MB R0K 0T0

**MCBURNEY, Lloyd K.** (NW-8)  
General Delivery, Hartney, MB R0M 0X0

**MORDEN, Keith M.** (NE-16)(SE-16)  
P.O. Box 5 Hartney, MB R0M 0X0

**ROSLING, Donald H.** (NW-9)  
General Delivery Nelson, BC

**TORONTO GENERAL TRUST CORPORATION**  
c/o Montreal Trust Company (NE-9)  
7th Floor, 530 Eighth Avenue S.W. Calgary, Alberta T2P 3S8