WATER QUALITY SUMMARY

ATHABASCA RIVER

1966 - 1971

by

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SUMMARY

The condition of the Athabasca River over the last five years (1966 - 1971) has generally been satisfactory. Effluent discharge at Hinton has had a significant effect but the river is able to recover.

The river has been considered in three sections for the purpose of recommending new water quality standards.

1. Upstream of Hinton- This provides background levels against which the downstream performance of the river is evaluated.

2. Hinton to Whitecourt- This represents a zone of mixing of effluent from Hinton.

3. Downstream of Whitecourt- In this stretch of water, the river recovers from the effects of pollutant discharge at Hinton.

In recommending the revised limits, the following points have been considered:

1. What is the river used for in this section?

2. What standards could be realistically maintained and controlled?

3. Would these levels have detrimental effects on downstream uses of the river?

4. What are the background levels of the parameters of pollution?

On this basis, the following revisions have been recommended:

1. Minimum dissolved oxygen levels upstream of Hinton be set at 10 mg/l and downstream of Hinton be set at 7 mg/l.

2. Maximum concentration of phenolics between Hinton and Whitecourt be set at 10 p.p.b..

3. Threshold odour number not to exceed 32 between Hinton and Whitecourt, and not to exceed 16 below Whitecourt.

4. Maximum allowable concentration of phosphates be set at 0.4 mg/l on the whole river.

Comparison of these revised standards with "Surface Water Quality Standards" indicates that the Athabasca River is in satisfactory condition.

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INTRODUCTION

This report is concerned with data compliation and evaluation of water quality of the Athabasca River during the last five years (1966 - 1971). This data has been reviewed in relation to existing water quality criteria and water quality standards for the Athabasca River have been prepared.

SAMPLE LOCATION and RIVER STUDY

Figure I indicates the six sampling points on the Athabasca River.

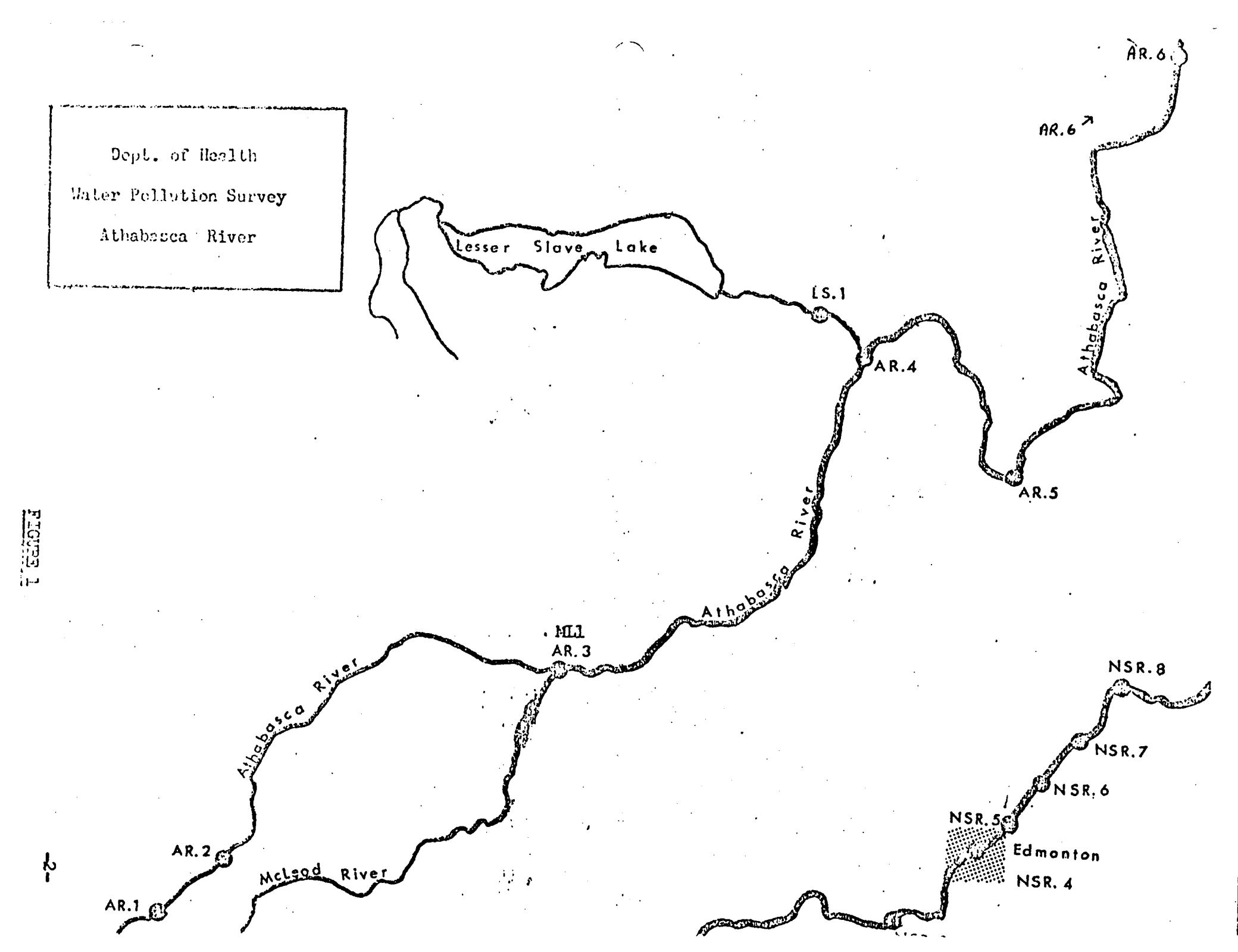
		Miles
AR 1	Above Hinton	0
AR 2	Obed Ferry	22
AR 3	Whitecourt Bridge	117
AR 4	Smith (CPR Bridge)	249
AR 5	Athabasca (N of townsite)	311
AR 6	Fort McMurray (N of townsite at Tar Island)	549

Obed Ferry - This site was not sampled during the surveys of 1968 - 1969 or 1970 - 1971 due to road closure.

Whitecourt Bridge - The samples were taken from the bridge on Highway 43 upstream of the confluence of the McLeod River with the Athabasca River.

Fort McMurray - The samples were taken at Tar Island downstream of the town of Fort McMurray but upstream of the Great Canadian Oil Sands plant site.

The Athabasca River has many tributaries within the area studied, the major ones being the McLeod, Pembina and Lesser


Dept. of Health
Water Pollution Survey
Athabasca River
Lesser Slave Lake
LS.1
AR.4
AR.5
AR.6
AR.6
Athabasca River
Athabasca River
ML1
AR.3
Athabasca River
AR.2
AR.1
McLeod River
NSR.8
NSR.7
NSR.6
NSR.5
Edmonton
NSR.4

Slave. Of these, the latter is the most significant.

The river is used by the people of Alberta for recreational purposes, fishing, water supply and effluent disposal. The major uses and effluent discharges along the Athabasca River are shown on Table I.

ATHABASCA RIVER LOADINGS

The table below (Table II) shows the mean loadings discharged into the Athabasca for the period 1966 - 1971.

TABLE II

MEAN LOADINGS
(lbs/day)

	66/67**	67/68*	68/69	69/70***	70/71*
B.O.D.	59,000	26,800	21,000	21,361	25,100
C.O.D.	261,000	134,700	134,000	138,000	168,000
Total Residue	418,000	339,800	314,000	311,000	326,000
Tannins & Lignins	20,500	5,000	11,000	6,700	9,230
Phosphates		214	266	312	516
Phenols		118	114	55	100
Ammonia N		1,601	1,900	2,500	2,000
Nitrate N		48	830	91	200

* Sum of loading of the two major industries.
** Pulp Mill at Hinton.
*** Sum of loading of three major industries.

DISSOLVED OXYGEN

At no time during the last five years has the Dissolved Oxygen content of the Athabasca River fallen below the minimum acceptable level of 5 mg/l, the single lowest recorded being 7.8 mg/l (February 9, 1967 at Obed). On all of the surveys, samples taken at Obed

TABLE I

ATHABASCA RIVER USERS AND EFFLUENT DISCHARGERS

Type of Discharge and Treatment	Source	Discharged to:
1. Industrial Waste (secondary)	NORTH WESTERN PULP AND POWER LIMITED	Athabasca River
2. Domestic Sewage	HINTON	NWP&P Treatment Facility
3. Domestic Sewage (anaerobic lagoon)	WHITECOURT	Athabasca River
4. Domestic Sewage (raw)	ATHABASCA	Athabasca River
5. Domestic Sewage (anaerobic lagoon)	FORT McMURRAY	Clearwater River
6. Industrial Waste (A.P.I. Separators) (Settling Ponds)	GREAT CANADIAN OIL SANDS LIMITED	Athabasca River

DRINKING WATER USERS

User	Source	Type of Treatment
Hinton	Athabasca River	Complete (through NWP&P)
Whitecourt	McLeod River	Chlorination
Athabasca	Athabasca River	Complete
Fort McMurray	Athabasca River	Complete

showed a drop in Dissolved Oxygen content (with respect to AR 1) as a result of the discharge of biochemically oxygen demanding material into the river at Hinton.

However, with the help of its tributaries' dilution effect and supply of oxygen, the Dissolved Oxygen recovers to near saturation at Fort McMurray.

Plots of median values of DO/River miles for the five surveys show no consistant trend from year to year other than the ability of the river to recover. With the exception of the 1968 - 1969 results, the river recovers gradually after Whitecourt. The exception is a drop from 9.6 mg/l at Smith to 8.8 mg/l (median values) at Athabasca.

The beneficial influence of the Lesser Slave River is shown by an observed increase in D.O. between Athabasca and Fort McMurray for every survey conducted.

Although samples were not taken at Obed during the survey of 1970 - 1971, the median D.O. figures for Hinton and Whitecourt show an oxygen depression downstream of Hinton. The river recovers to near saturation values at Smith and continues to improve at Fort McMurray. The B.O.D. results suggest that during the 1970 - 1971 survey an unusually large amount of B.O.D. material was loaded into the river at Hinton. The generally reduced flow rates for 1970 - 1971 contribute to the poorer quality of the river for this year.

A sample (1970 - 1971) taken two miles below Hinton has a D.O. of 12.1 mg/l. This is higher than above Hinton and indicates either

1. too close to Hinton; stabilization not commenced,
2. faulty result.

BIOCHEMICAL OXYGEN DEMAND

These results mirrored the D.O. results. Values above Hinton were typically 0.4 to 0.7 mg/l and an increase was rated at Obed due to pulp mill discharge. (Maximum increase was 0.5 mg/l to 3.2 mg/l in 1966 - 1967). A stabilization occurs between Obed and Whitecourt after which a further increase in B.O.D. material occurs as a result of discharge of municipal waste at Whitecourt. The effects of this are lessened by the dilution effect of the McLeod River.

The survey for 1970 - 1971 deserves special mention here. The B.O.D. at Whitecourt was particularly high (2.0 mg/l). No sample was obtained at Obed but the B.O.D. and D.O. results indicate a very large loading of B.O.D. material at Hinton that could result in critical conditions between Hinton and Whitecourt. However, the river recovers quickly to result in a B.O.D. of 0.8 mg/l at Smith. This is maintained at Fort McMurray.

So with the possible exception mentioned above, the Athabasca River has been satisfactory, with regard to D.O. and B.O.D. over the last five years (1966 - 1971).

THRESHOLD ODOUR NUMBER (TON)

Surface water quality criteria suggests a maximum Threshold Odour Number of 8.

The pulp mill at Hinton has a drastic effect on the odour of the Athabasca River. Above Hinton, TON values have been minimal and of the wood resin or musty type. The effect of the pulp mill has been such that only once in the last five years has the TON been below 16 at Obed. The effect is still observable at Whitecourt but by Smith the TON's have tended to be at or below the recommended limit of 8.

Values of TON at Tar Island (AR 6) are often above 8.

The data on TON suggests that rigid controls are required with regard to the odour of the effluent at Hinton, Athabasca and Fort McMurray.

PHENOLS

The Surface Water Quality Standards suggest a maximum phenol concentration of 5 p.p.b.. Samples taken a Obed consistantly exceed this value. In all cases, phenol concentrations at Smith have decreased to or within the maximum acceptable limit of 5 p.p.b.. The figures for Obed, however, suggest controls are necessary on effluent phenolic levels at Hinton.

The 1970 - 1971 survey showed generally lower final levels of phenols than in previous years but no general trend over the whole

river length was observed. However, it did appear that phenol concentration at Obed and Whitecourt have decreased over the years.

	Obed	Whitecourt
1966 - 1967	59 p.p.b.	6.3 p.p.b.
1967 - 1968	9 p.p.b.	5.0 p.p.b.
1968 - 1969	no sample	2.0 p.p.b.
1969 - 1970	8 p.p.b.	4.0 p.p.b.
1970 - 1971	no sample	3.0 p.p.b.

In November 1970, a high leading of phenols occurred at Hinton that produced inadmissible levels at all sample points over the next few days. The river did recover to median levels within a month or two but the need for control is illustrated.

PHOSPHATES

There has been general decrease in levels of phosphate over recent years. Typical values now are 0.1 to 0.3 mg/l whereas in 1967 - 1968 typical values were 0.3 to 0.5 mg/l with occasional highs of 0.6 to 1.0 mg/l. Existing controls therefore seem adequate.

NITROGEN (Ammonia and Nitrate)

Levels of nitrogen (ammonia and nitrate) increase as a result of effluent discharge at Hinton. However, they remain at safe levels. Again, there has been improvement in recent years and present controls seem adequate.

TANNINS & LIGNINS

Leadings of tannins and lignins have been reduced in recent years and this is reflected in the general improvement in condition of the river. In this respect, improved treatment facilities at Hinton have also had beneficial effects.

HEAVY METALS

Analysis for heavy metals was introduced in the 1970 - 1971 survey. Samples were taken at AR 1, AR 3 and AR 5 where minimal values of most contaminants were obtained.

BACTERIALOGICAL CONSTITUTENTS

The MPN total coliform, E coli and standard plate counts have been minimal over the past five years.

RECOMMENDED WATER QUALITY STANDARDS - ATHABASCA RIVER

It is convenient to consider the Athabasca River in three stages:

1. Upstream of Hinton- This provides background pollutant levels resulting from natural causes.
2. Hinton to Whitecourt- In this stretch of water critical conditions may exist as a result of effluent discharge at Hinton. This is essentially a mixing zone.
3. Downstream of Whitecourt- This represents the stage during which the river recovers from the effects of effluent discharge at Hinton.

With these divisions and the observed oxygen depression downstream of Hinton in mind, the following standards are recommended for the Athabasca River. (Table III) The table shows only those standards that are revisions of the previously compiled Surface Water Quality Criteria.

TABLE III

	Upstream of Hinton	Hinton to Whitecourt	Downstream of Whitecourt
Dissolved Oxygen	Min^m of 10 mg/l	Min^m of 7 mg/l	Min^m of 7 mg/l
Biochemical Oxygen Demand (BOD_5)	Should not be such that the D.O. becomes less than the above recommendations.		
Phenolics	Max^m of 5 p.p.b.	Max^m of 10 p.p.b.	Max^m of 5 p.p.b.
Tannins & Lignins	Max^m of 1.0 mg/l	Max^m of 1.5 mg/l	Max^m of 1.0 mg/l
Threshold Odour Number	Max^m of 8	Max^m of 32	Max^m of 16
Phosphates	Max^m of 0.4 mg/l	Max^m of 0.4 mg/l	Max^m of 0.4 mg/l

A minimum D.O. of 10 mg/l upstream of Hinton should be sufficient to maintain a D.O. of above 7 mg/l downstream of Hinton. The recommendations with respect to phenolics recognizes the fact that the stretch of water between Hinton and Whitecourt is not used for domestic supply or recreational purposes. The revised standards for this section of the river represent a limit that can be achieved without detrimental effects on river uses downstream of Whitecourt. They also represent standards that can be effectively maintained.

The revised standards for odour recognize the legitimate use of the river by the pulp mill at Hinton. Hence, they represent levels that could be effectively maintained.

The phosphate level at any point of the river seems to be dependent on phosphate concentrations upstream of Hinton. Man-made phosphate pollution seems well controlled and the recommended limits reflect the observed phosphate levels arising from sources upstream of Hinton.

CONCLUSIONS

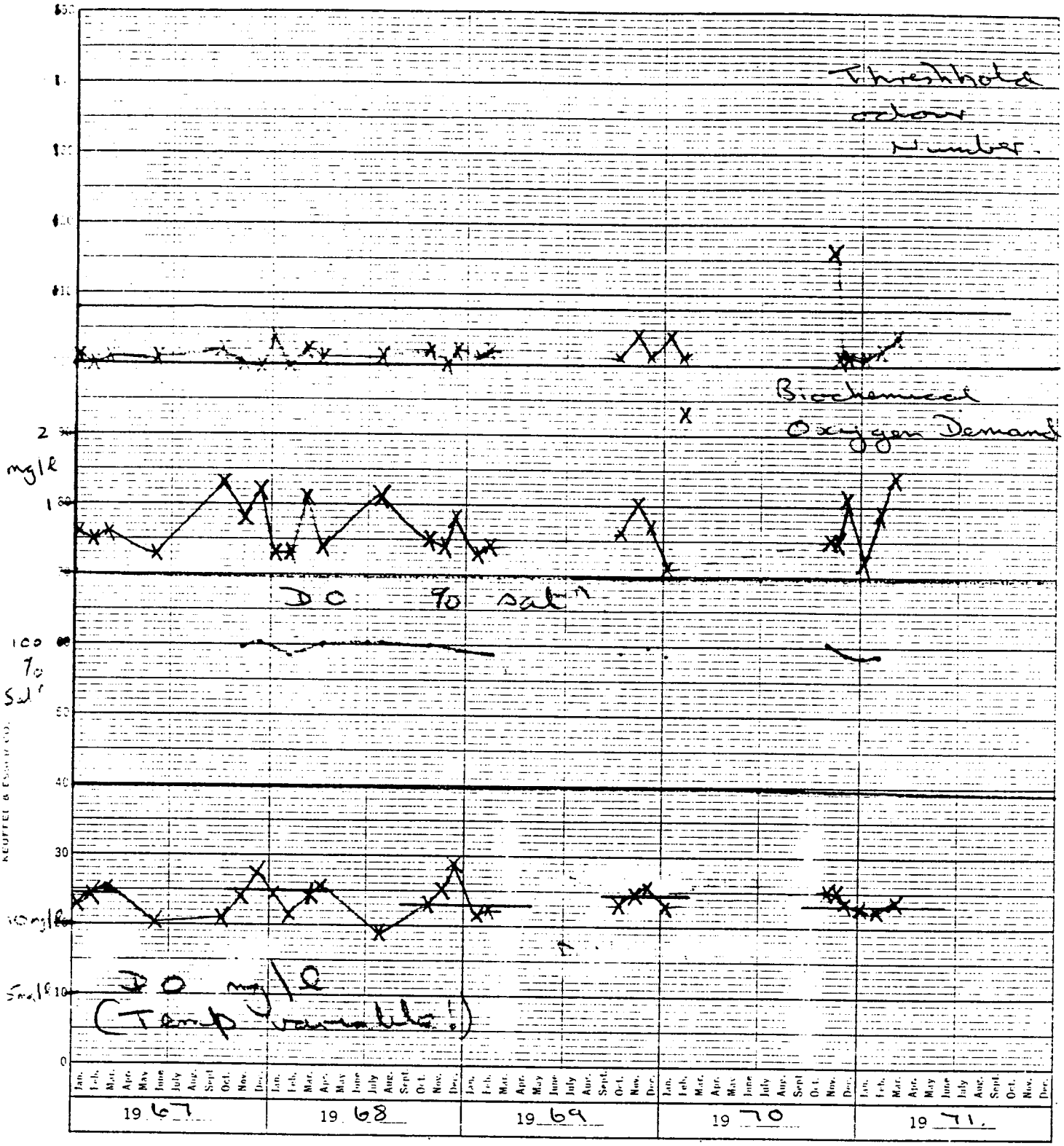
The Athabasca River has generally been in good condition over the past five years. It is possible that critical conditions in terms of D.O. may exist between Obed and Whitecourt but the river assimilates pollutants quite readily and recovers well. Levels of most pollutants are minimal but it would appear that stricter control of effluent levels of Odour and Phenols would be beneficial.

The more important tributaries of the Athabasca (the McLeod and the Lesser Slave Rivers) have been surveyed regularly and apart from occasional high values of pollutants, they have generally been in good condition.

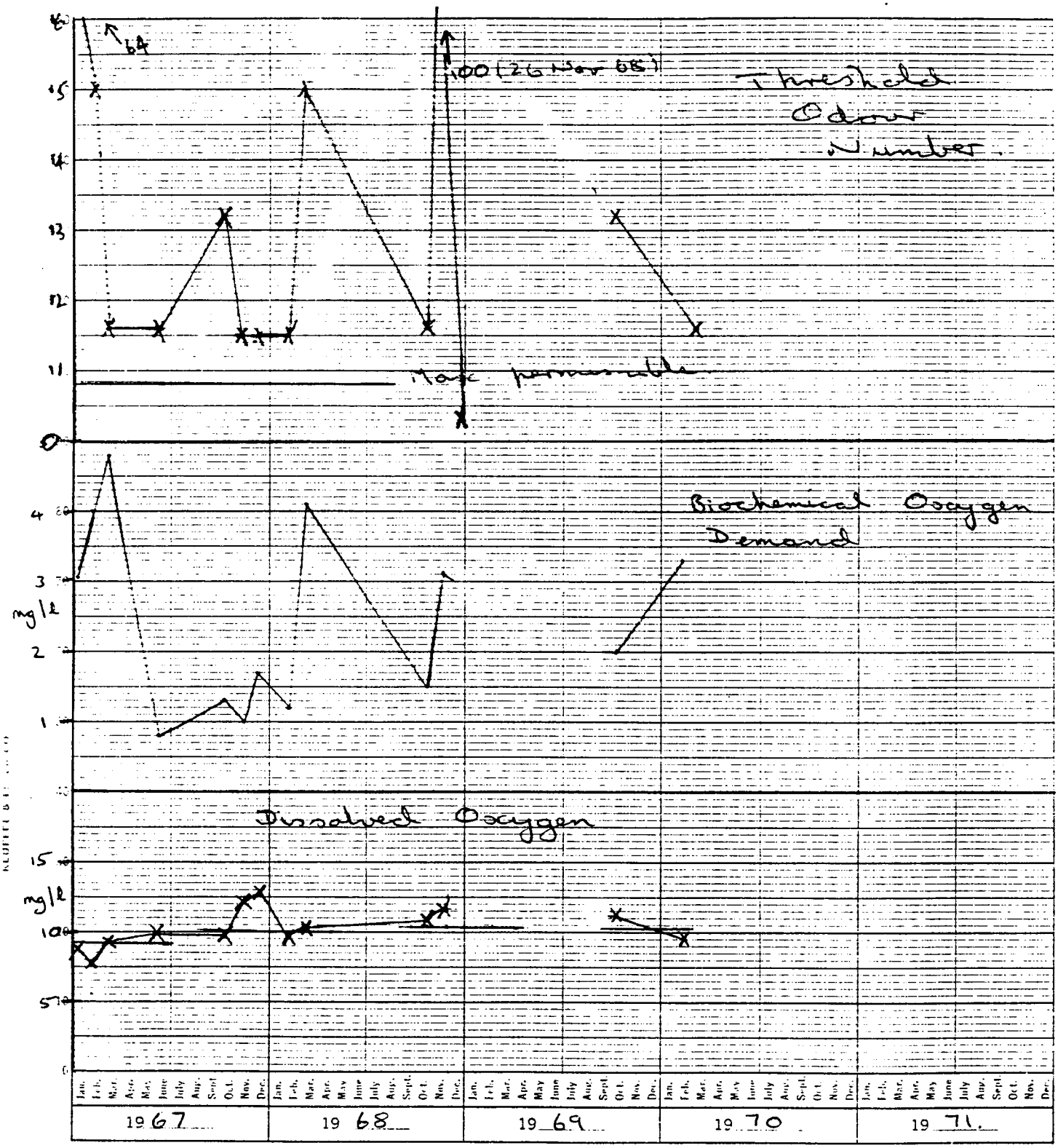
A P P E N D I X

Pollutant Levels at each Sample
Station over the Period 1967 - 1971

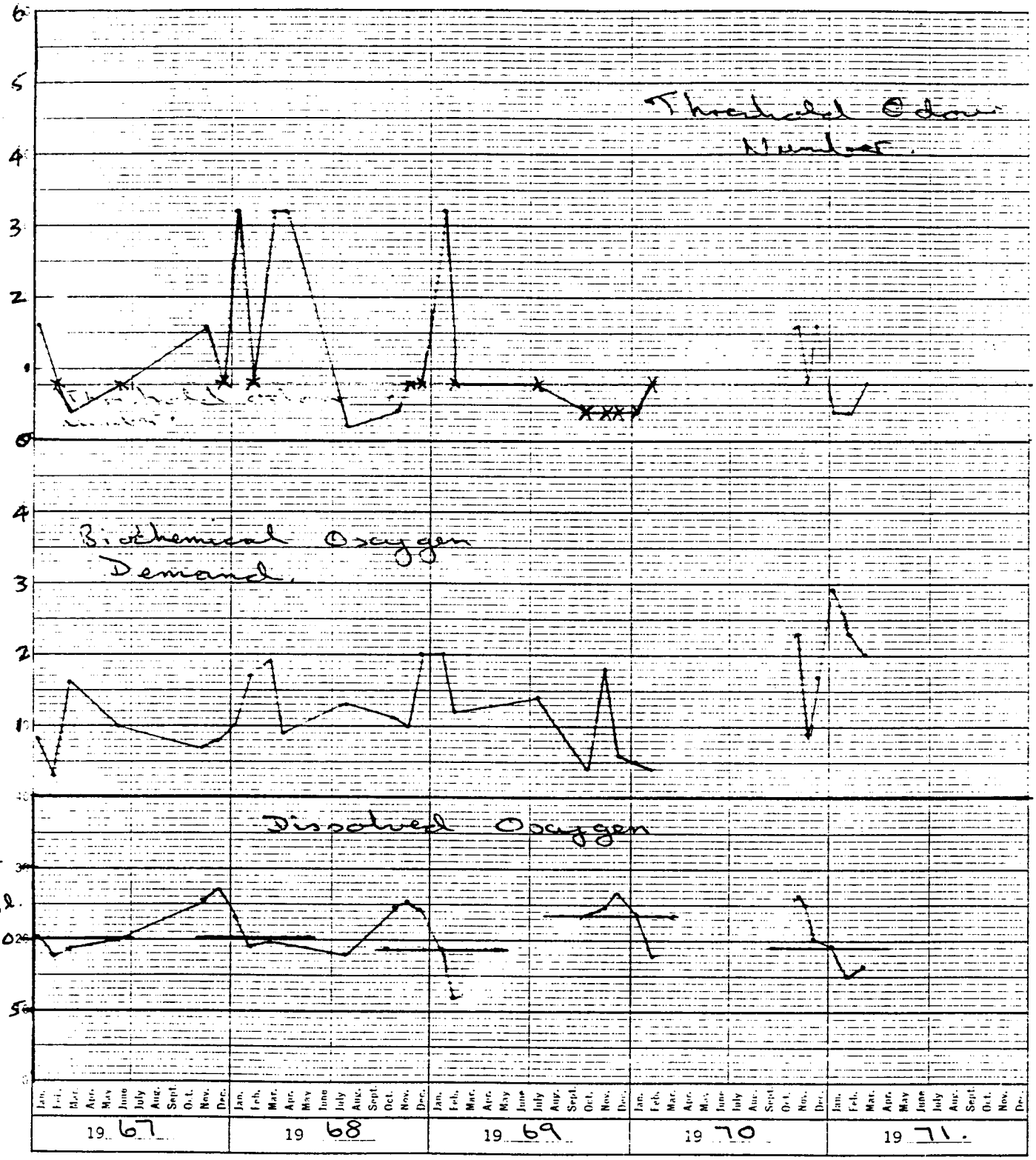
Athabasca River above Hinton.



Athabasca River at Obed.

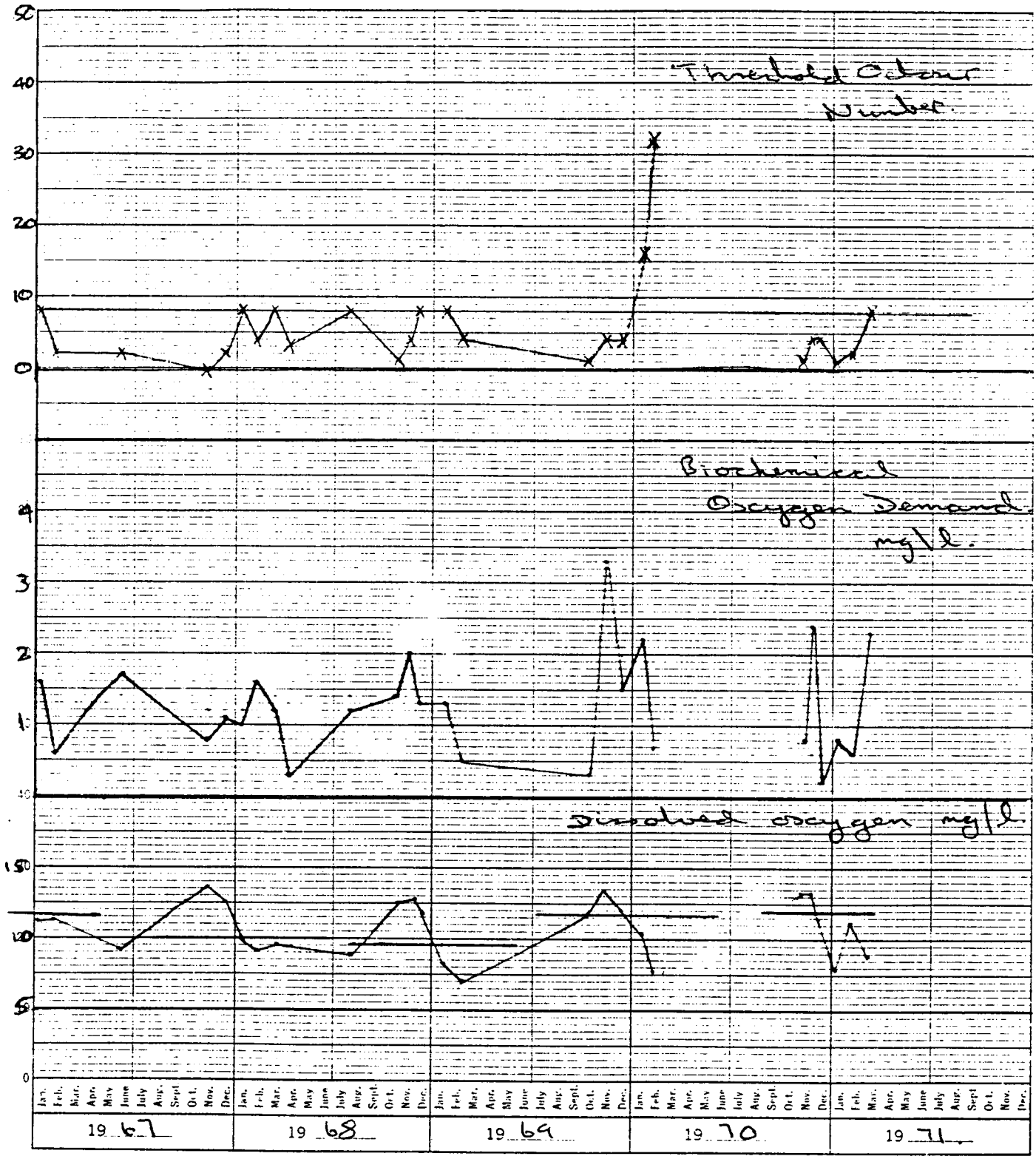


Athabasca River at Whitecourt.

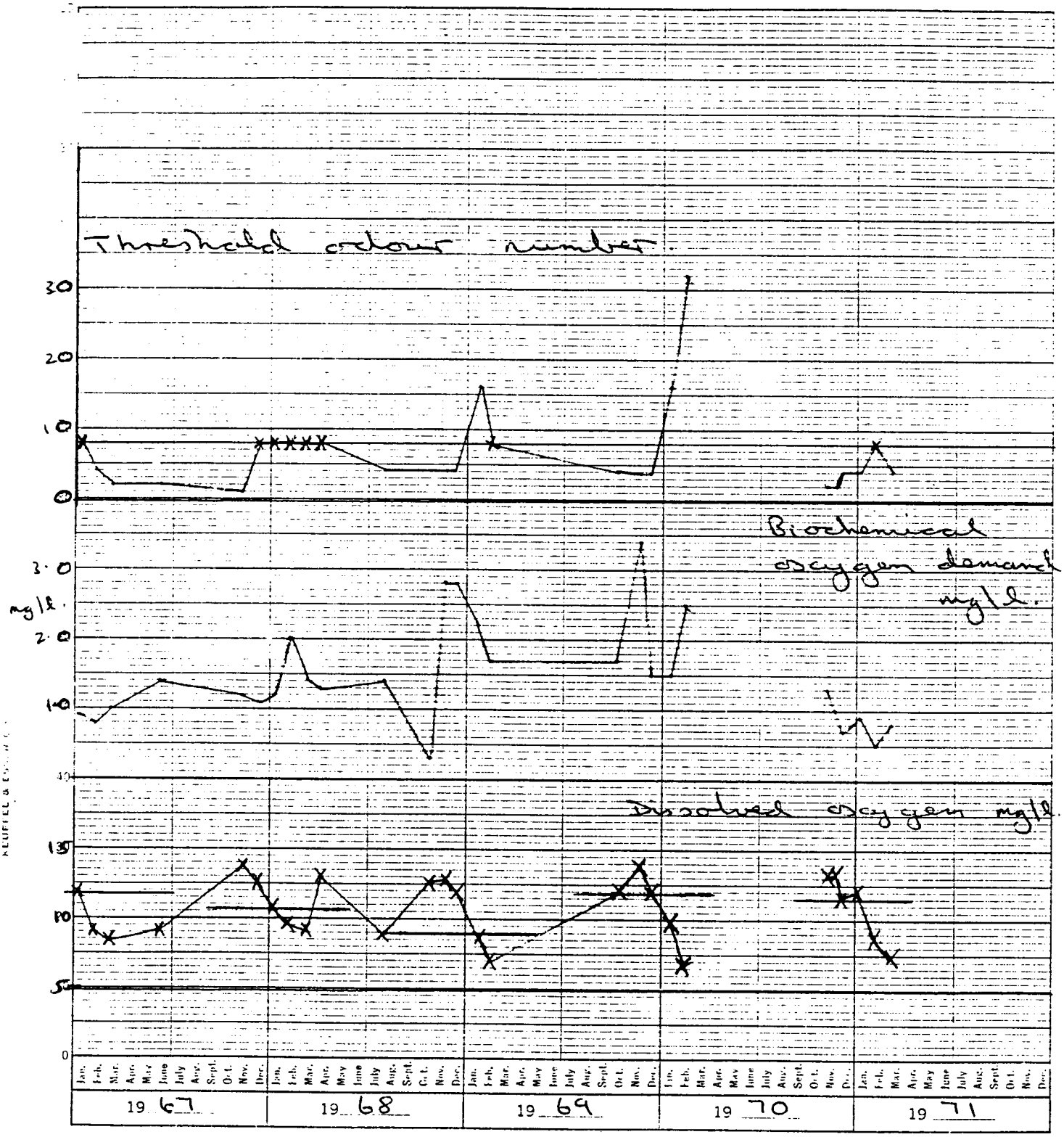


above.

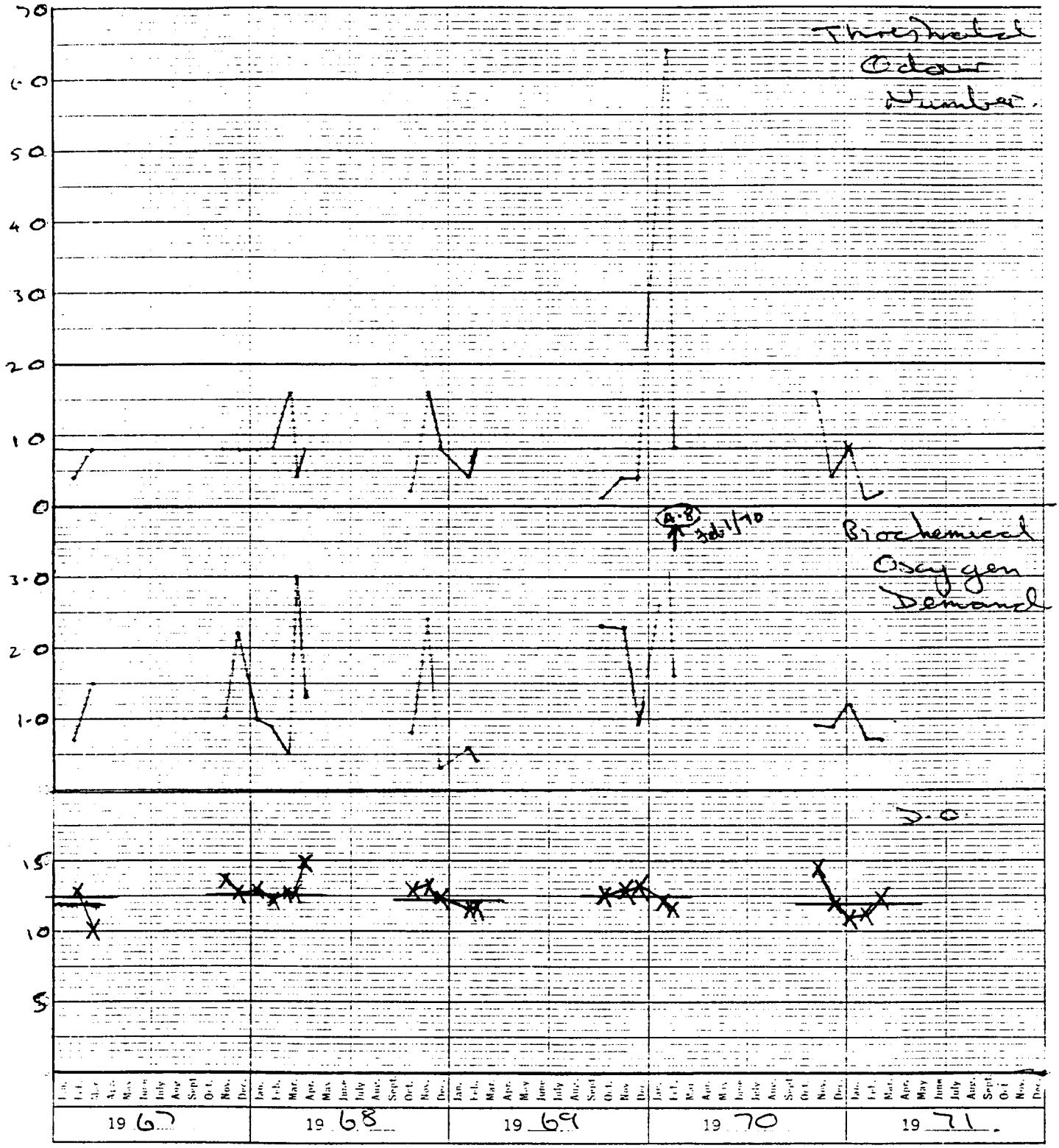
Athabasca River at Smith.



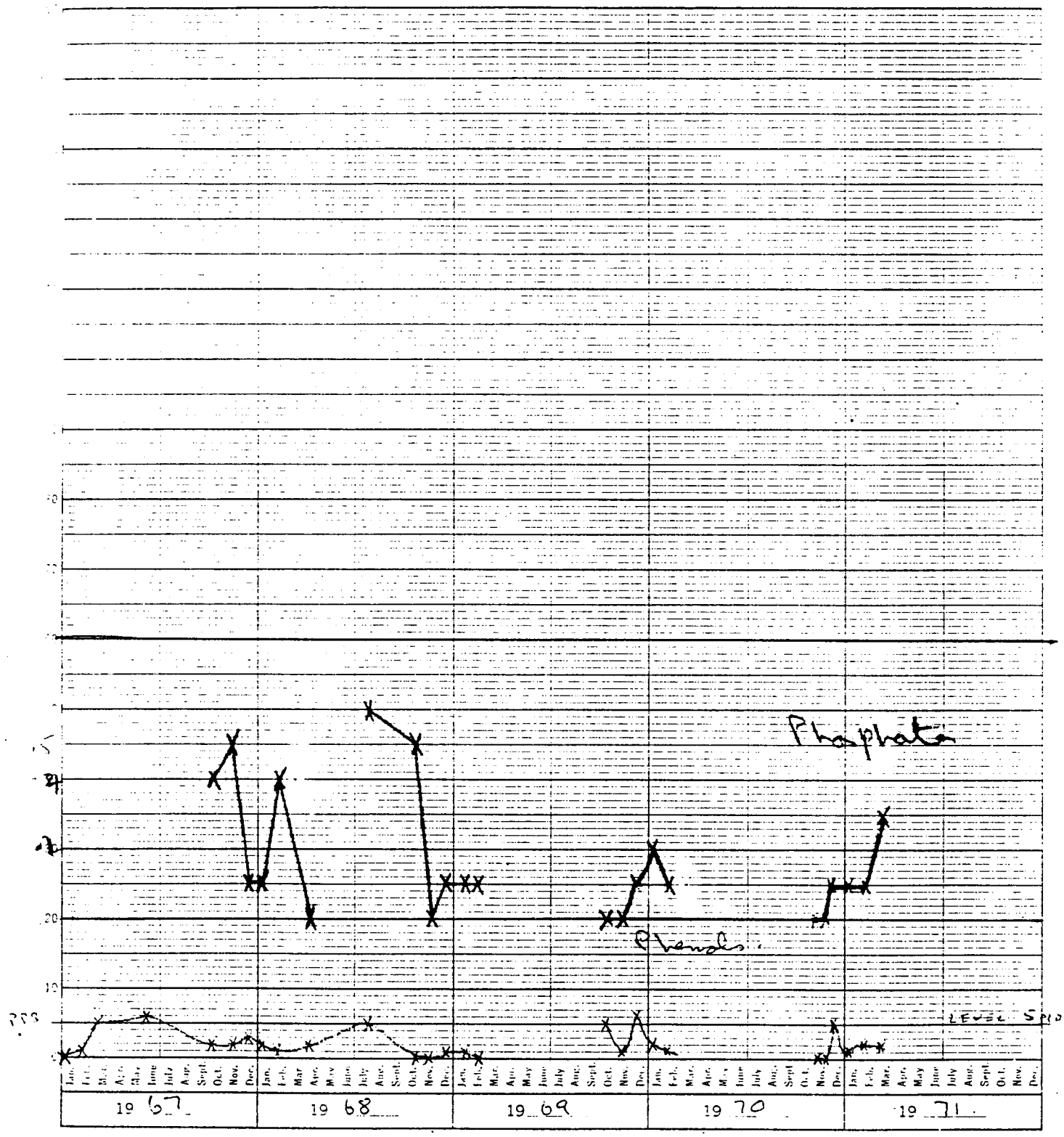
Athabasca River above Athabasca



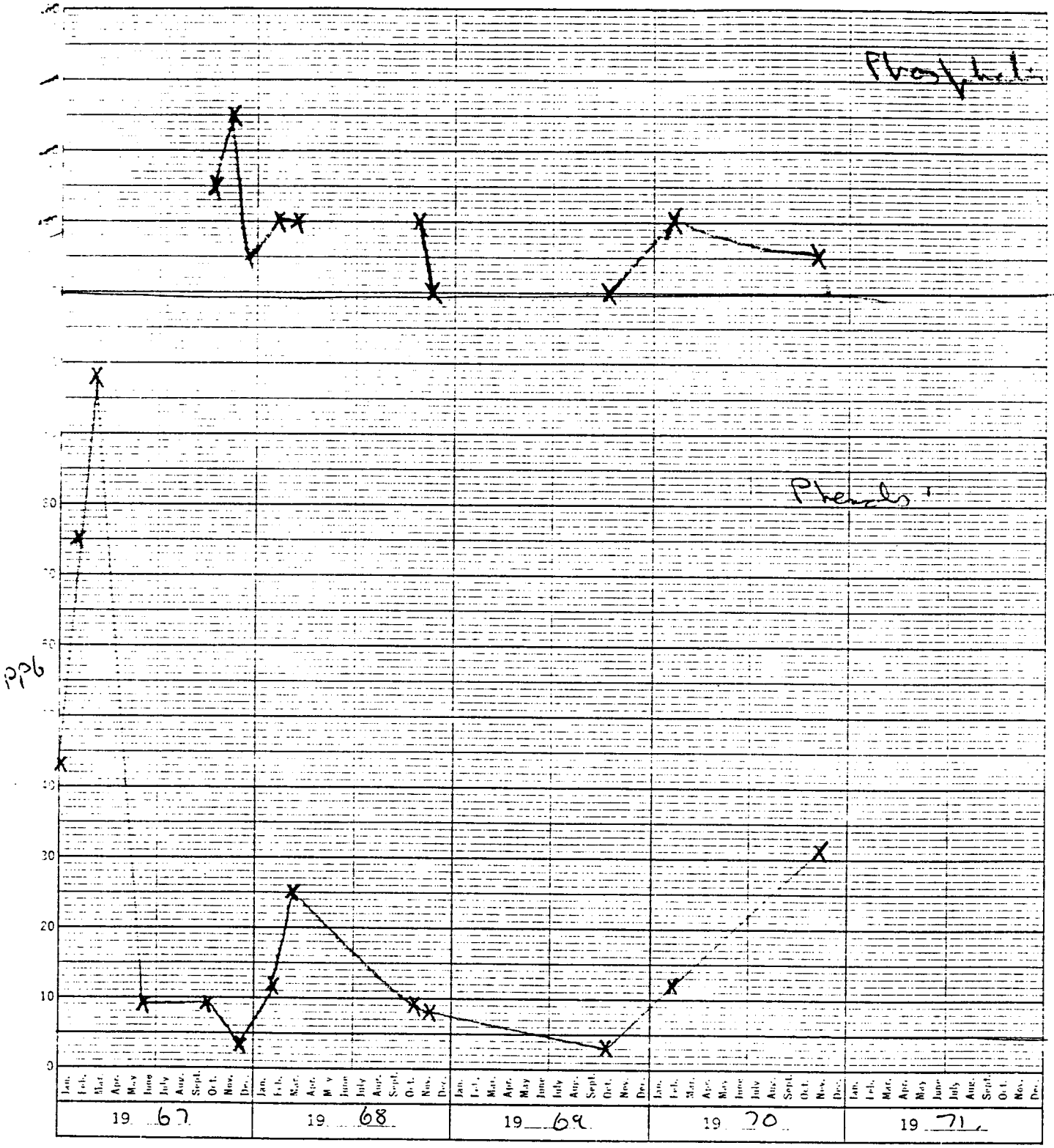
Athabasca River Tar Island.



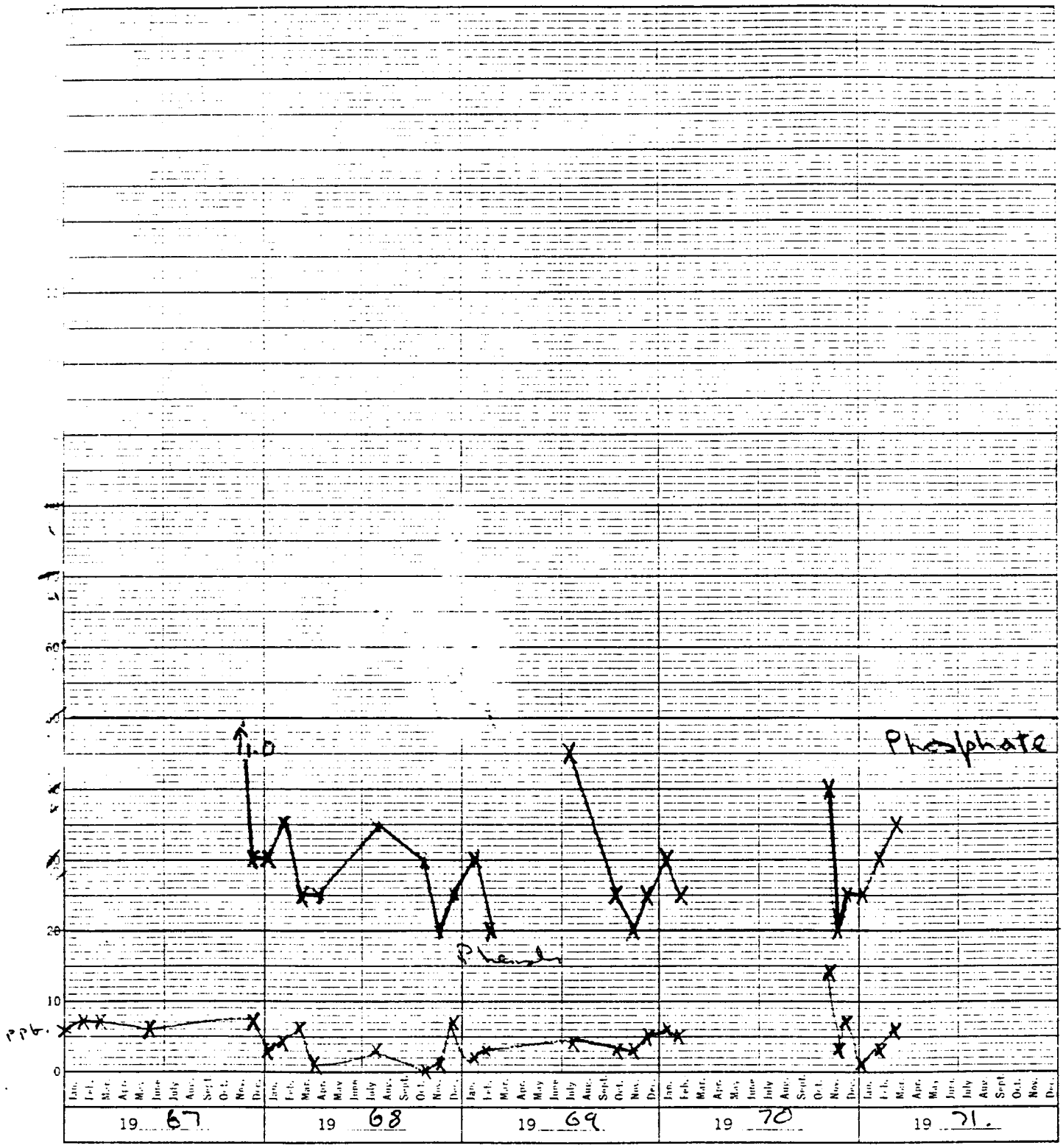
Athabasca River Above Hinton.



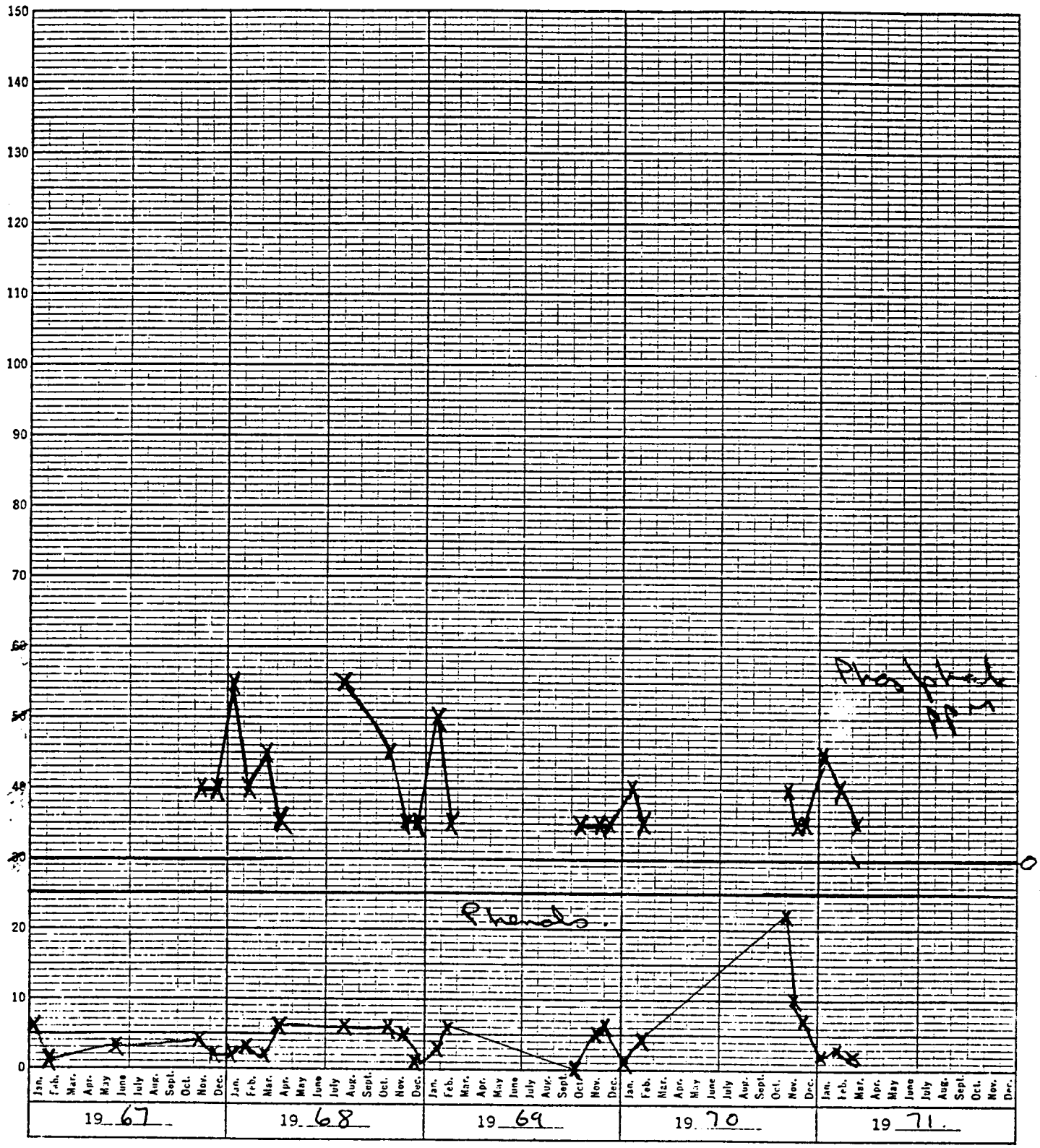
Athabasca River Chem



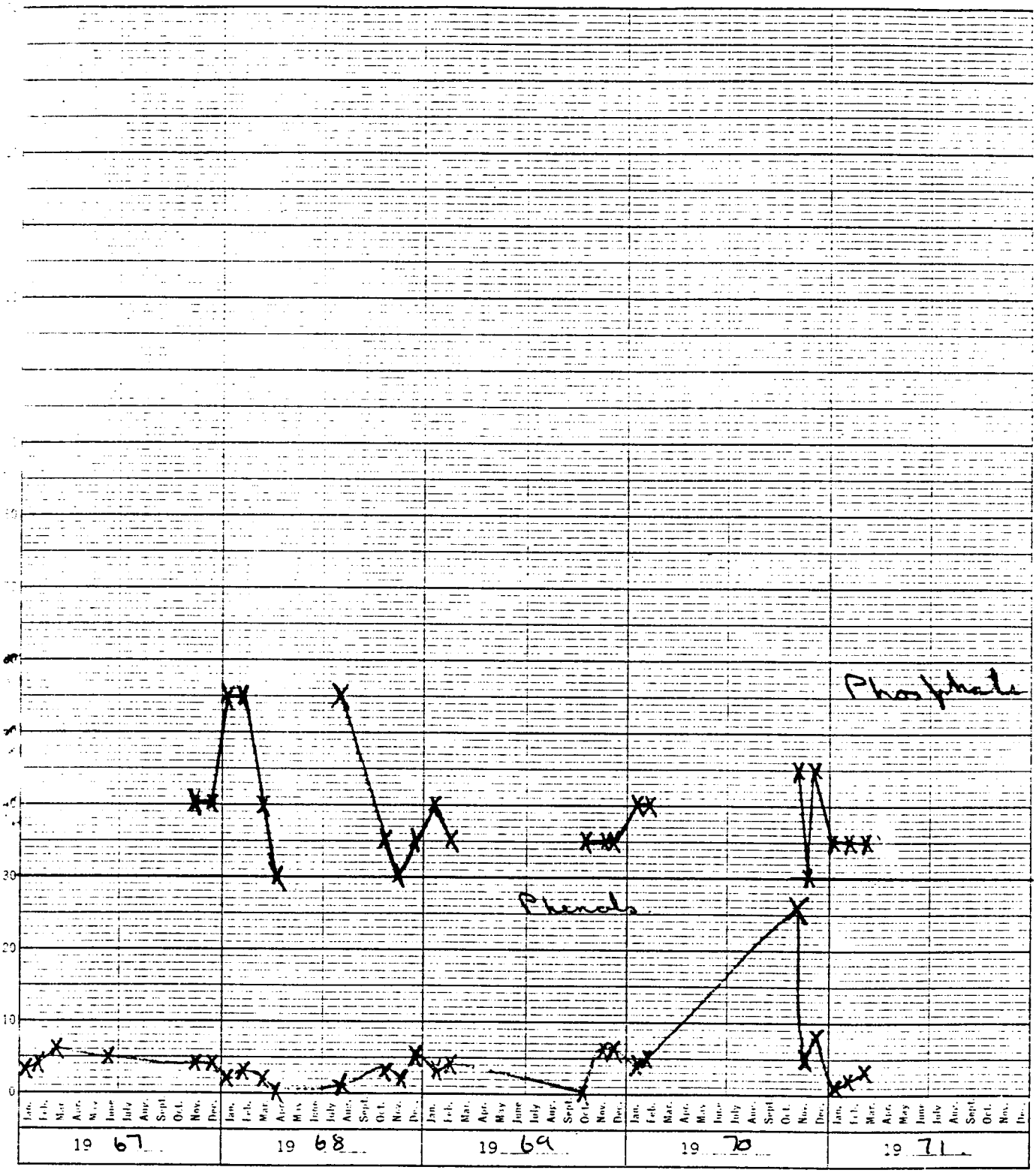
Athabasca River Whitecourt



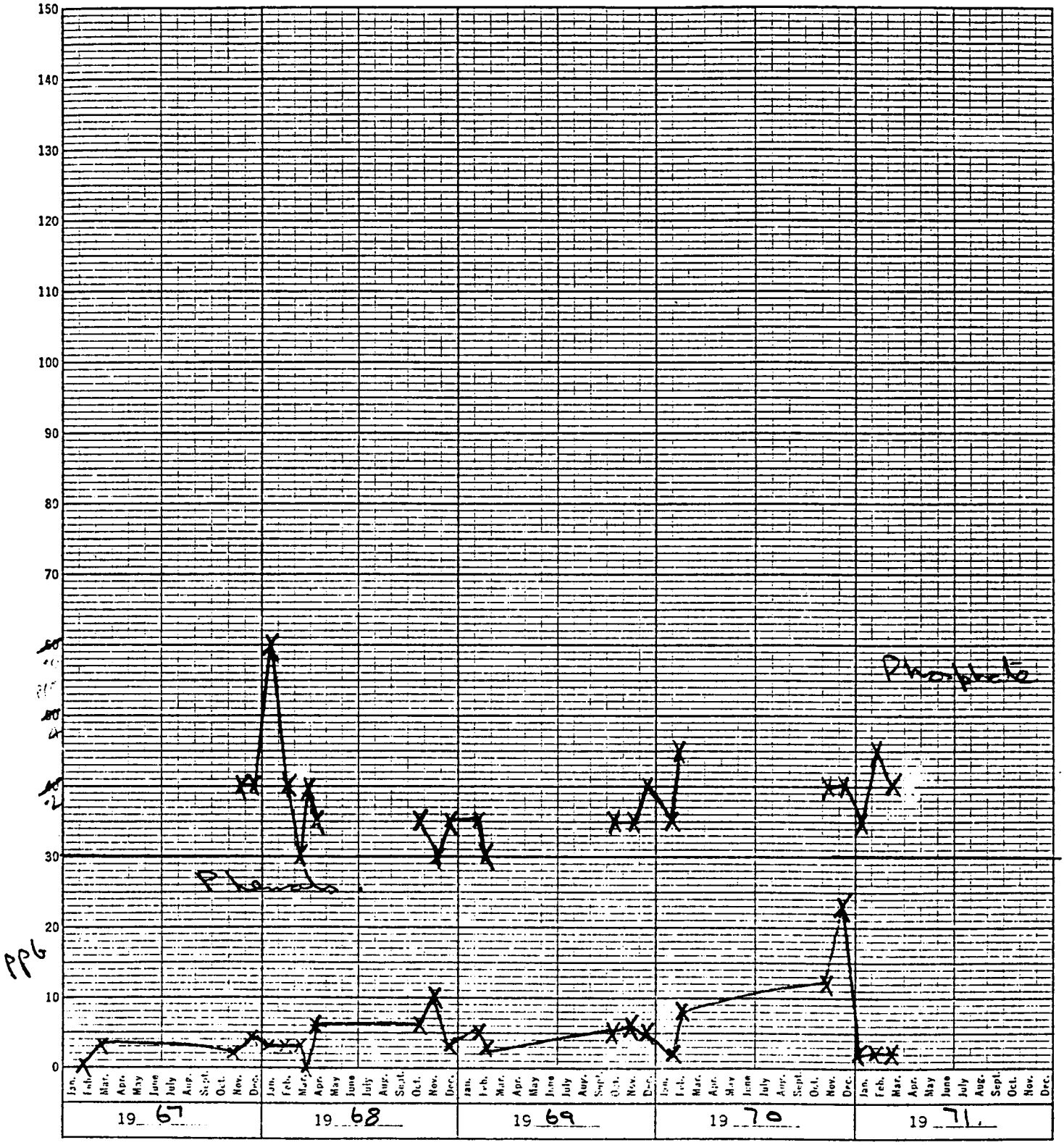
Athabasca River above Smith.



Athabasca River above Athabasca



Athabasca River Tar Island.



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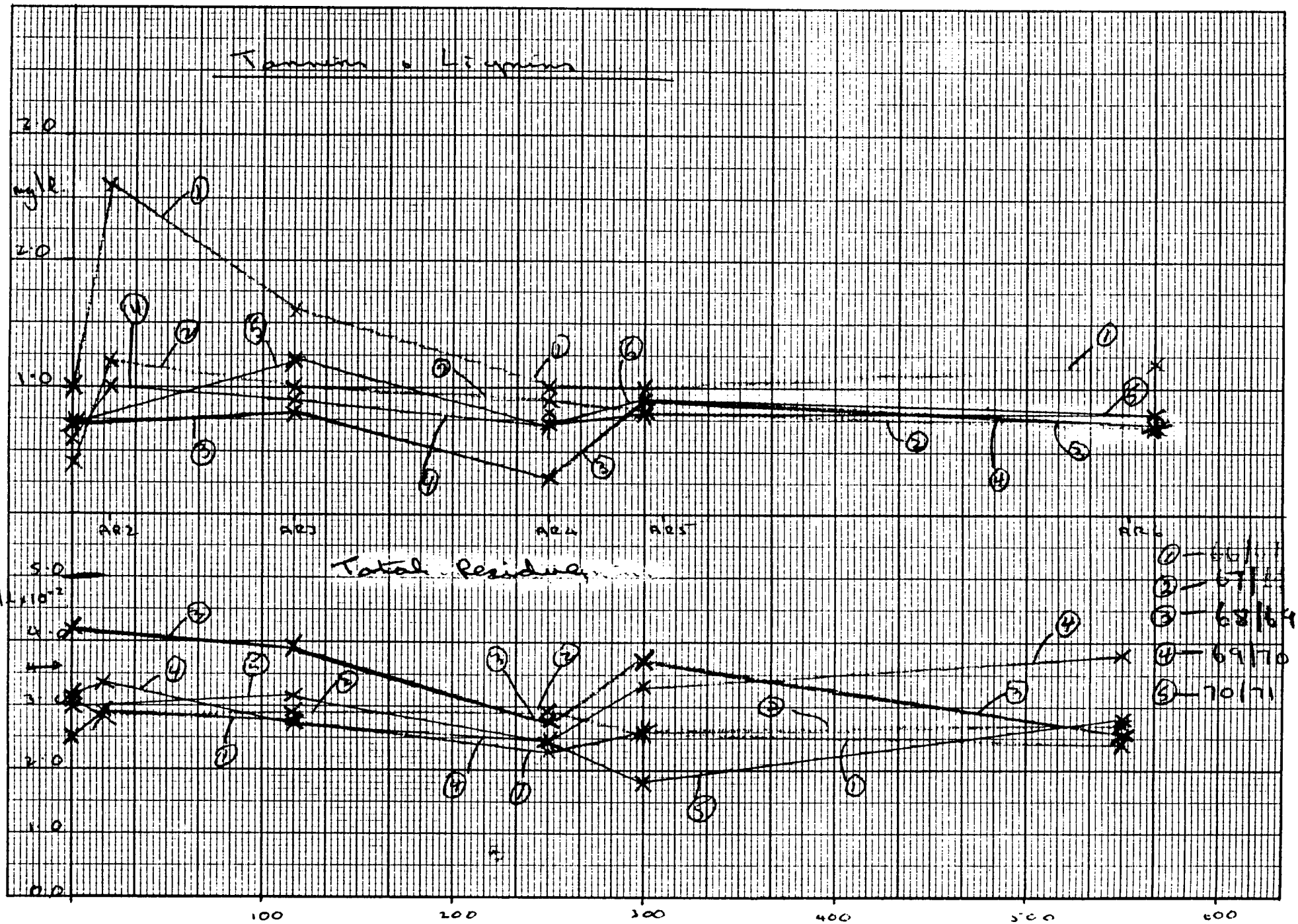
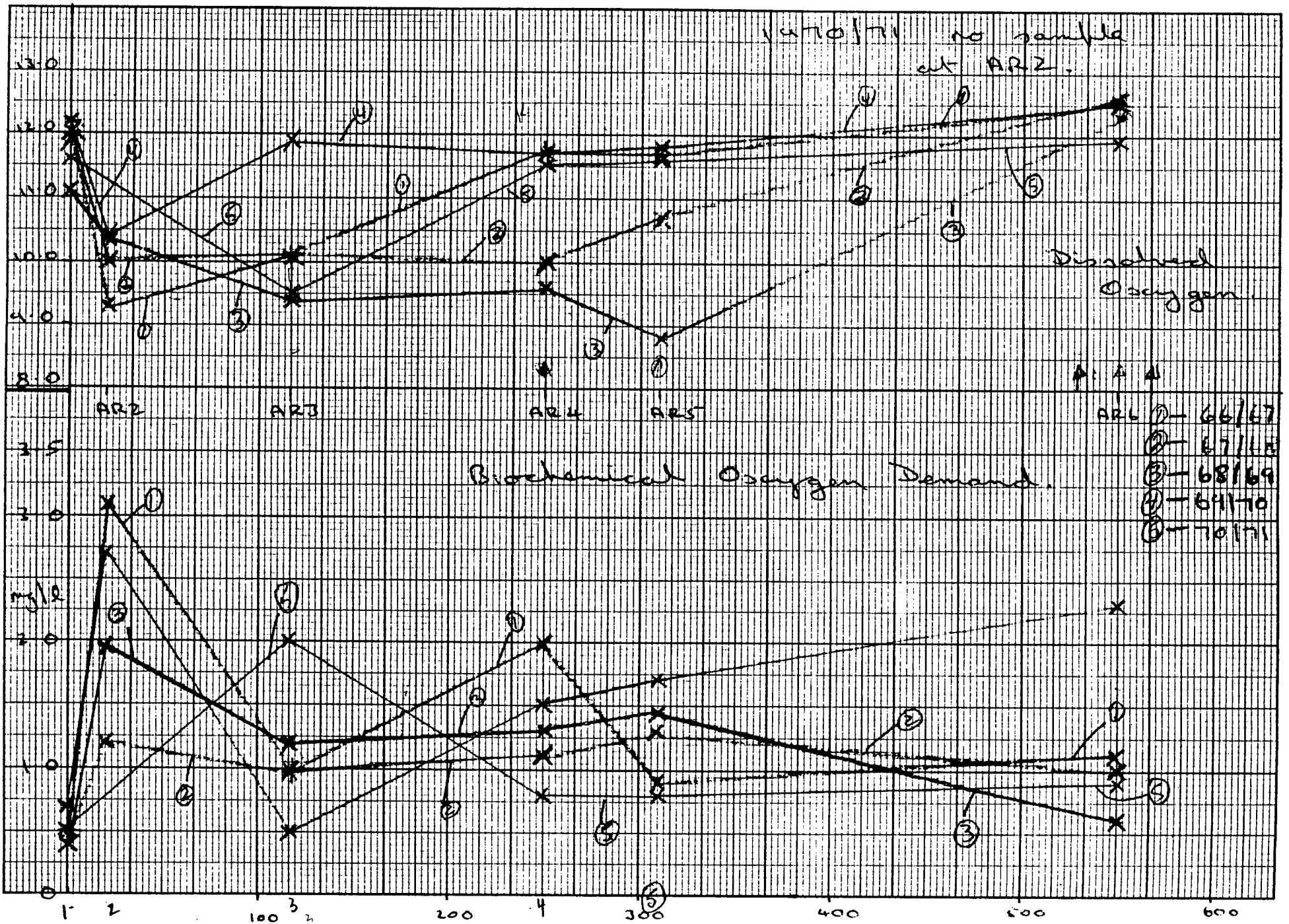
River Profiles of Median Values of Various Pollutants for the Five Surveys, 1966 - 1971





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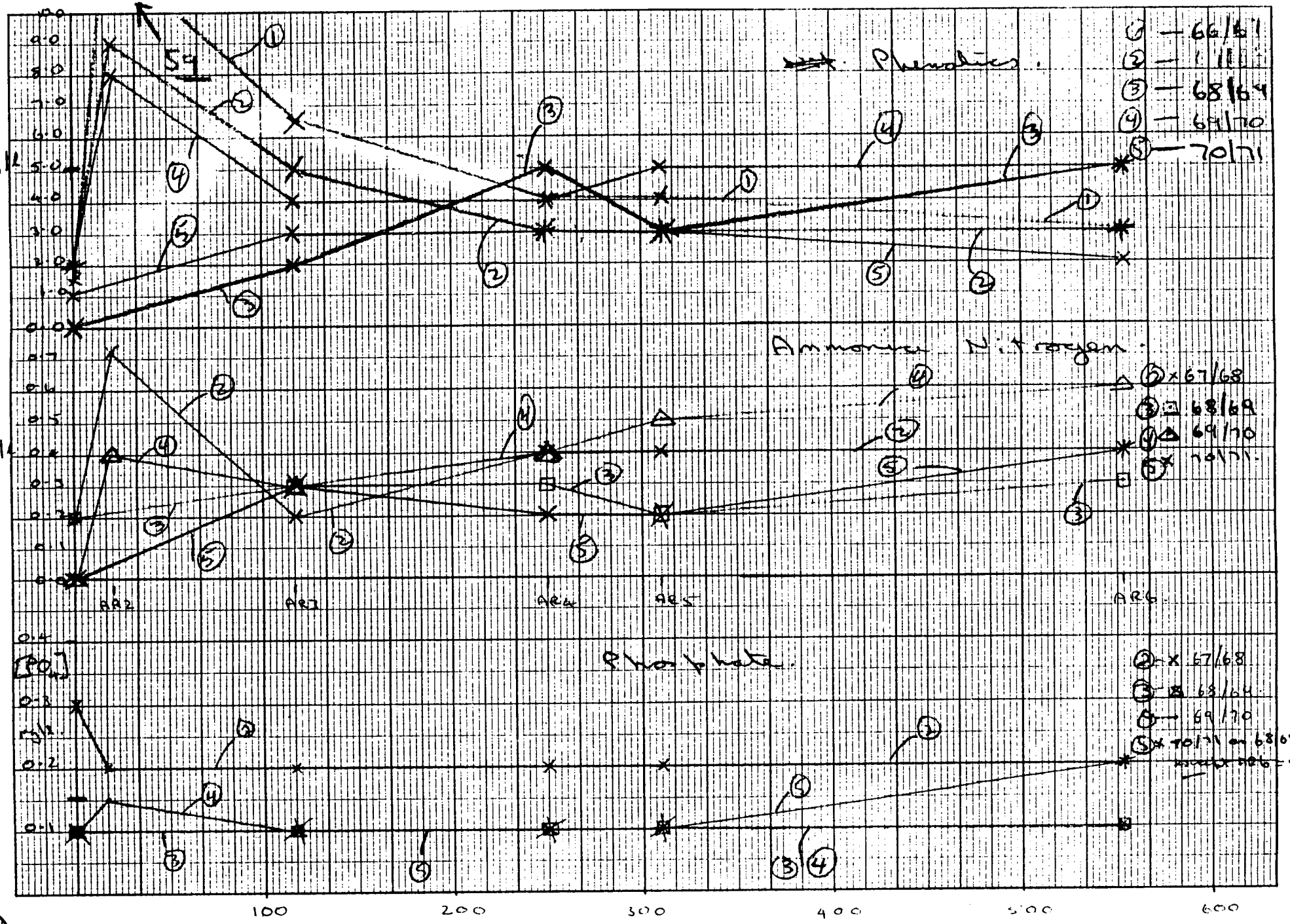
Phenolics.
① — 66/67
② — 67/68
③ — 68/69
④ — 69/70
⑤ — 70/71
µg/l
Ammonia Nitrogen.
② × 67/68
③ ⊡ 68/69
④ △ 69/70
⑤ × 70/71
mg/l
AR2
AR3
AR4
AR5
AR6
Phosphate.
[PO4]
mg/l
② × 67/68
③ ⊠ 68/69
④ — 69/70
⑤ × 70/71 on 68/69
100
200
300
400
500
600

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