RECLAMATION LAKE WATER QUALITY
FOR
HIGHLAND URANIUM OPERATIONS

Charles E. Downs, Ph. D.
Senior Staff Hydrologist

Technical Services Division
Development and Operations Department

May 1984

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT

HIGHLAND RECLAMATION LAKE WATER QUALITY

Exxon Minerals Company's (EMC) Highland Uranium Operations plans to reclaim the open-pit mine from its uranium mining operations by allowing the natural accumulation of water in the reclaimed Pit 3 and 4 area to form a reclamation lake.

The objective of this study is to evaluate the hydrologic characteristics of the lake which will be formed by allowing the surface open-pit mine to fill naturally with water. This was done before; however, in 1983 additional reserves were identified in Pit 4 which were mined causing a change in the size and shape of the planned lake. This study was undertaken to verify the characteristics of the slightly altered lake. We took the opportunity at this time to re-examine the assumptions of the study. We identified an effect of wall sloping not identified in the earlier work.

The earlier study assumed that none of the tailings dam sand aquifer, the principal aquifer feeding the lake, would be covered by wall sloping. This was incorrect and was evaluated in this study.

SUMMARY

1. Backfill cover of the Tailings Dam Sandstone (TDSS) for the 100% sloping cases will result in a negative impact on lake water quality. The 50% sloping case will result in good water qualities when the sloping on the TDSS inflow sides of Pits 3 and 4 is minimized.

2. Sloping 100% of the pit walls causes backfill coverage on the Tailings Dam Sandstone which results in a reduction of 50 to 75% of the inflow from the TDSS aquifer; this results in an order of magnitude increase in lake water radium and total dissolved solid concentrations over those predicted in the EPRCo. study.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT
218C-R1

3. Use of measured permeability values for the TDSS aquifer and minimizing the extent of 50% sloping to include only the least stable areas on the west sides of Pits 3 and 4 will result in good water quality.

4. The analysis indicates that for measured TDSS aquifer permeabilities on the order of 4-5 darcys it is not necessary to divert surface runoff from the Antelope watershed area to achieve good lake water quality.

PREVIOUS STUDY

The initial study to determine the water quality of the proposed Highland pit reclamation lake was conducted by EPRCo. in January of 1983. The report by N. K. Springer and R. J. Mitro, entitled "Surface Mine Reclamation Lake Study for Highland Uranium Operations", made predictions of lake conditions. The water quality predictions were derived using a Lake Simulation Program (LSP) which models the lake as a continuously stirred tank in which all inflows are uniformly mixed before flowing out, and pure water is lost through evaporation.

The EPRCo. study assumed three major conditions, among others. First, it was assumed that there would be no backfill cover over any of the TDSS aquifer inflow or outflow zones. Secondly, the study utilized an overly conservative assumption for the TDSS aquifer permeability of 2 darcys. A third important assumption was that water supply to the lake would be augmented through the inclusion of the runoff from Antelope draw which is a 2,340 acre watershed west of the surface mine. Hence, the EPRCo. study evaluated the water quality in the proposed reclamation lake for the case in which the TDSS inflow was unobstructed and which included diversion inflow from Antelope draw.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT
218C-R1

The EPRCo. study concluded, based on the assumptions for backfill coverage, TDSS aquifer permeability, and runoff augmentation, that the ultimate lake water quality would be approximately 16 pCi/l radium activity and 4,200 ppm TDS.

Predicted lake water quality was judged acceptable if below 30 pCi/l radium-226 activity and 5,000 ppm total dissolved solids (TDS).

THIS STUDY

The methodology employed in evaluating the impacts of reclamation activities and alternatives in this study is identical to that employed by EPRCo. in their previous work. This study utilizes the same Lake Simulation Program model as did EPRCo. Details on the methodology and simulation sensitivities are contained in the EPRCo. report. Further, as in the previous study, lake water quality is considered acceptable if the radium 226 concentration is less than 30 pCi/l and the TDS concentration is less than 5,000 ppm.

This work was divided into three phases addressing the following areas of study:

I. Impact of Sloping

Wyoming DEQ regulations dictate that at least 50% of the lake perimeter be sloped. Pit sloping will result in obstruction of water inflow from the TDSS aquifer. This obstruction will cause negative water quality impacts. Therefore, cases evaluating both 50 and 100% sloping requirements are addressed. It should be recognized, however, that the best water quality is achieved by no pit wall sloping.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT

II. Impact of TDSS Permeability Values

Three permeabilities for the TDSS are used in the evaluation. These were permeability values of 4,000, 4,643, and 5,000 millidarcys (md).

Four cases were studied for each of the three assumed permeabilities. These cases include:

A. 50% pit wall sloping with Antelope diversion inflow.
B. 50% pit wall sloping without Antelope diversion inflow.
C. 100% pit wall sloping with Antelope diversion inflow.
D. 100% pit wall sloping without Antelope diversion inflow.

Unique lake area-volume-elevation relationships exist for these four case studies. Hence, four spline functions were generated to represent the four area-volume-elevation relationships.

The influence of permeability changes are addressed through looking at three permeability values for the TDSS aquifer in conjunction with the different sloping and surface water inflow cases.

III. Impact of Antelope Diversion Inflow

Antelope Draw drains runoff from 2,340 acres west of the reclamation lake. It would be possible to divert this into the lake as recommended in the EPRCo. report. The predicted lake water quality with and without Antelope diversion inflow is evaluated.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT

Impact of Pit Sloping on Lake Water Quality

The process of pit modification will result in varying degrees of backfill coverage of pit inflow and outflow zones. Phase I of this study evaluated the effects of covering the TDSS inflow zones with backfill during this process.

The segments of the pit walls to be sloped in the 50% case are based upon EMC's reclamation pit slope stability study. These locations are shown in Figure 1. Wyoming DEQ regulations require that at least 50% of the pit walls be sloped.

Using data provided by Highland, backfill coverage of ore sand and TDSS inflow and outflow zones was evaluated for the effects of the backfill on reducing permeability and aquifer inflow into and outflow from the proposed reclamation lake. It was noted that in the 100% cases - with and without Antelope diversion inflow - the radium concentration in the lake varied between 63 to 163 pCi/l and TDS varied between 16,020 and 39,120 ppm for the 100% backfill cases, with extensive TDSS obstruction. It was also noted in these cases that the reduction in inflow volumes precluded filling to the outflow elevation. Without outflow, the lake filled to a low level and then stagnated wherein radium and TDS concentrations continually increased as evaporation from the water body concentrated these constituents.

The importance of minimizing the obstruction of TDSS inflow is evidenced by the good water quality which results from a 50% sloping scenario. With and without Antelope inflow, radium and TDS concentrations vary between 9.98 to 13.2 pCi/l and 3,273 to 4,763 ppm, respectively. Ground water inflow in both 50% cases is adequate to sustain the lake elevation above the minimum discharge elevation, thereby preventing stagnation.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT
218C-R1

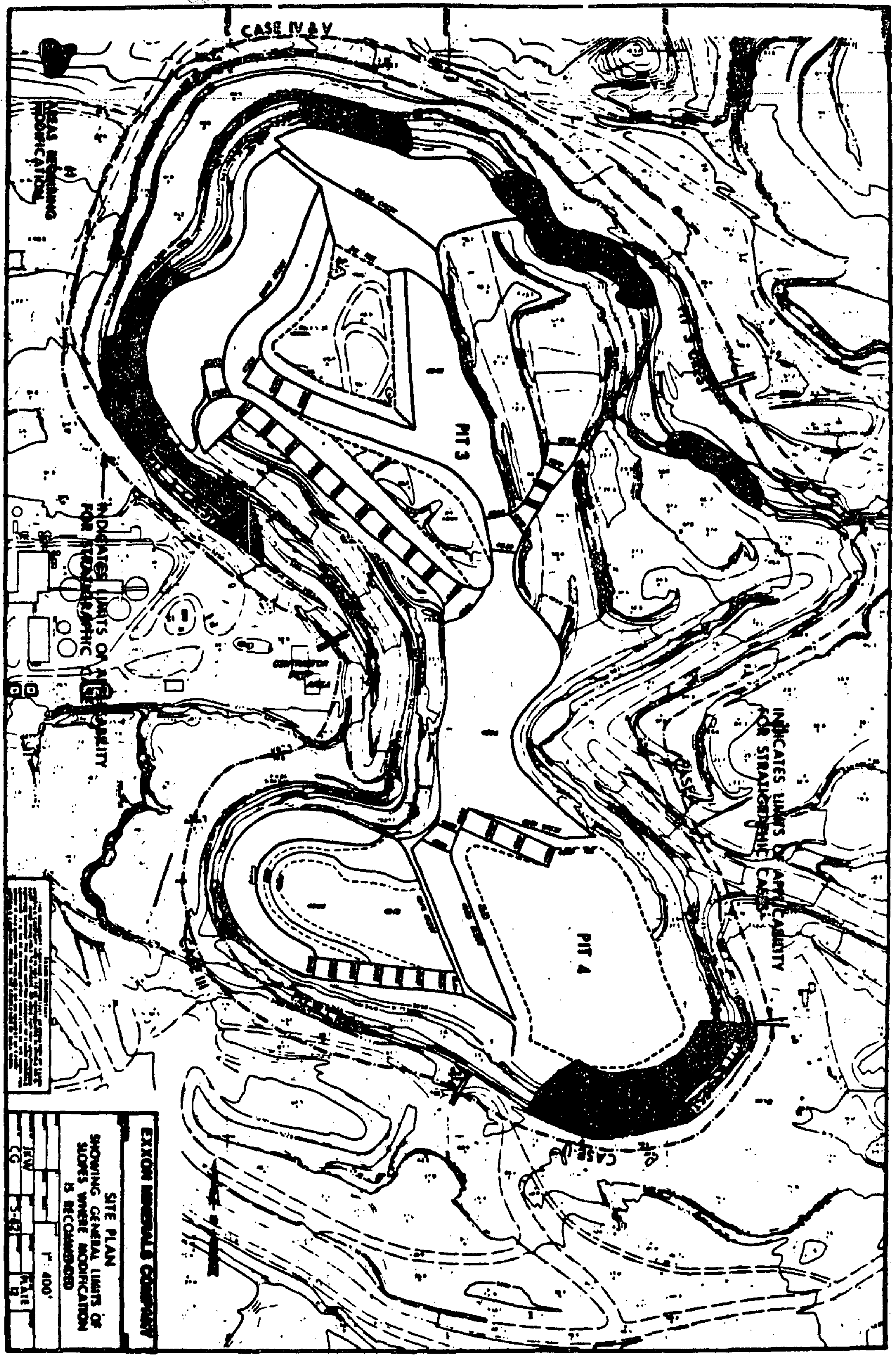

Fig. 1 Pit Lake Site Plan Showing Where Slope Modification Is Recommended

LAND QUALITY DIVISI
RECEIVED JUNE 25, 1
TFN 1 6/242 PERMIT

Impact of Permeability Increase on Lake Water Quality

The EPRCo. study assumed a permeability for the TDSS aquifer of 2,000 millidarcys (md). They recognized in making this assumption that this was an extremely conservative estimate. Therefore, the permeability data were reevaluated for this study in light of the importance of aquifer inflow to water quality.

The average TDSS permeability derived from three draw-down tests and a recovery test is 4,690 md. The average permeability of the tailings dam sands based on laboratory permeability measurements is 4,597 md which gives an average permeability for the TDSS of approximately 4,643 md. In addition, it is observed that these pumping tests were conducted in the TDSS after the system had been dewatered as part of the underground operations. As such, it is felt that these permeability estimates are also conservative.

Permeability values for the TDSS aquifer were measured by field pumping and recovery test and by laboratory core analysis. The results of these drawdown pumping tests and a recovery test as well as laboratory core tests are summarized in Table 1. Analysis of well logs and field tests on well VIII indicated some question as to the actual test sample depth and the aquifer condition. In addition, serious well drilling problems were encountered during construction of the hole which required increased drilling fluids and caused bentonite impregnation of the outside of the core. Therefore, it was felt that the sample was not representative of the true formation hydraulic characteristics and was deleted.

Based on field and laboratory test results as summarized in Table 1, an average permeability of 4,643 md was assumed in analyzing the hydrogeology of the reclamation lake.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT
218C-R1

TABLE 1

Permeability Measurements of the TDSS

Well No.	Field (md)	Lab (md)
VII	7,930	
	7,420 (Recovery)	
XII	2,220	
XXI	1,190	
VIII		372*
XII		2,804
XX		6,343
	F = 4,690 md	L = 4,597 md

Avg. K = 4,643 md

* Deleted because of question of sample depth and hole completion problems.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT

The four cases were evaluated for TDSS permeabilities of 4,000, 4,643, and 5,000 md in order to include a range of sensitivities. It is felt, based on average permeability values and the observed rapid recovery of ground water levels in the TDSS aquifer, that a 4-5 darcy permeability assumption is realistic for the predicted aquifer response characteristics at this site.

Impact of Antelope Diversion Inflow on Lake Water Quality

The previous study by EPRCo. concluded that water supply augmentation by diverting runoff from the Antelope watershed into the reclamation lake would be necessary to achieve good water quality. Cases evaluating the effect of excluding Antelope inflow are included in this study. These effects are accounted for in the 50% and 100% pit sloping cases by comparing expected water quality conditions for the reclamation lake with and without Antelope diversion inflows. As noted above, when backfill coverage of the TDSS aquifer inflow zones precludes adequate ground water inflow, the lake will not adequately fill to achieve outflow and, hence, it stagnates and water quality deterioration occurs through evaporation.

ANALYSIS

Graphical analyses of the predictions of lake water quality for the four cases considered are presented in Figures 1-22. Table 2 summarizes the predicted lake water quality characteristics of the four cases for the TDSS aquifer permeabilities of 4,000, 4,643, and 5,000 md.

It is important to note that the predicted radium concentrations for the scenarios presented are conservatively high in that the adsorption capacity effects of suspended solids in runoff entering the lake are not included in the model. Also, it is noteworthy that within the first 100-200 years, all cases predict approximately the same water quality responses.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6-2 4 2 PERMIT 218C-R1

TABLE 2

Lake Water Quality after 2,000 years for the four cases studied as a function of Tailings Dam Sandstone Aquifer Permeabilities:

Case	TDSS Permeability (md)	Radium 226 (pCi/l)	TDS (ppm)	Elevation (ft.)
50% w/Antelope Diversion	4,000	11.50	3,645	5,126
	4,643	9.98	3,273	5,130
	5,000	9.37	3,122	5,132
50% w/o Antelope Diversion	4,000	16.91	5,843	5,114
	4,643	13.22	4,763	5,119
	5,000	11.91	4,376	5,123
100% w/Antelope Diversion	4,000	63.65	16,020	5,110
	4,643	47.38	12,385	5,112
	5,000	42.00	11,164	5,114
100% w/o Antelope Diversion	4,000	162.56	39,120	5,096
	4,643	155.70	39,134	5,099
	5,000	149.00	37,920	5,101

CED:ms
1589Q
05/14/84

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6.24. PERMIT

Diversion of Antelope inflow only makes a difference between meeting and not achieving water quality targets when TDSS permeability is less than approximately 4,400 md.

Five zones of less stable soil/embankment have been identified in the EMC pit wall stability study. The five pit perimeter areas where slope modification is recommended are delineated in Figure 1.

It is important to note in both of the 50% sloping cases that coverage of the TDSS inflow zone is minimized. This amounts to approximately 30% of the TDSS inflow on the west sides of Pits 3 and 4.

Slope modification in the southeast corner of Pit 4 should likewise be designed to minimize the obstruction to outflow.

<u>50% Sloping Without Antelope Diversion Influence</u>

Figures 2, 3, and 4 illustrate the predicted radium-226, TDS and lake elevation conditions for this case over the 2,000 year projection period.

Radium concentrations are reduced from 16.9 to 11.9 pCi/l (30% decrease) for an increase in permeability from 4,000 to 5,000 md.

TDS concentrations are reduced from 5,843 to 4,376 ppm over the same 25% range of permeability change.

The lake will fill to the 5,114-5123 ft. elevation in approximately 40 years in all cases. The final lake elevation will increase 9 ft. from 5,114 ft. for 4,000 md permeability to 5,123 ft. for a 5,000 md permeability.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT
218C-R1

50% Sloping With Antelope Diversion Inflow

Figures 5, 6, and 7 illustrate the predicted radium-226, TDS and lake elevation conditions for this case over the 2,000 year projection period.

Radium concentrations are reduced from 11.5 to 9.37 pCi/l for a TDSS permeability increase from 4,000 to 5,000 md, respectively. Similarly, TDS concentrations are predicted to decrease from 3,645 to 3,122 ppm over the same range of permeability variation.

The reclamation lake is projected to fill to the 5,126 ft. elevation in approximately 50 years. The lake elevation is projected to rise to 5,130 ft. and 5,132 ft. for the 4,643 md and 5,000 md cases, respectively. Thereafter, the lakes maintain these elevations over the 2,000 year modeling period.

100% Sloping With Antelope Diversion Inflow

Figures 8, 9, and 10 illustrate the predicted radium-226, TDS, and lake elevation responses for this case over the 2,000 year projection period.

The analysis indicates that because of extensive obstruction of the TDSS inflow lake elevation only reaches the 5,112 elevation. Accordingly, the lake stagnates receiving limited inflow and additional dissolved solids from the Antelope inflow.

The influence of increasing permeabilities from 4,000 to 5,000 md is reflected in the predicted decrease in radium and TDSS concentrations from 63-42 pCi/l and 16,000-11,000 ppm. This corresponds to a lake elevation increase of 4 ft. from 5,110 ft. to 5,114 ft. Hence, reaching the minimum outflow elevation is critical to achieving acceptable water quality targets.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6,242 PERMIT
218C-R1

100% Sloping Without Antelope Diversion Inflow

Figures 11, 12, and 13 illustrate the predicted radium, TDS, and lake elevation responses for this case. It is important to note that the lake elevation only reaches 5,100 ft for the 5,000 md case. Because of this, the lake stagnates and water quality constituents are concentrated over time.

The influence of Antelope diversion inflow on predicted lake water quality is directly related to the assumed permeability of the TDSS aquifer. When assumed TDSS aquifer permeability is low (4,000 md), the addition of Antelope inflow contributes to improving water quality through a dilution effect. As assumed TDSS permeabilities increase, the marginal benefit of Antelope diversion inflow to water quality is reduced. This relationship is illustrated in Figures 14 to 19 for the 50% vs 100% sloping cases and in Figures 19 to 22 for the 50% sloping cases.

The comparisons of 50% and 100% wall sloping with and without the Antelope diversion for a permeability of 4,643 md are summarized in Table 3.

CONCLUSIONS

Good water quality conditions can be achieved in the proposed Highland reclamation lake.

The LSP model predicts that the optimal design for the reclamation lake includes 50% sloping with particular attention to minimizing the obstruction of ground water inflow/outflow via the TDSS aquifer. Antelope diversion inflow is of only marginal water quality benefit.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT
218C-RI

TABLE 3

Comparison of the Effect of Antelope Diversion Inflow on Water Quality and Elevation Predictions for the 4,643 md Permeability Case at 2,000 Years:

Case	Parameter	Perm. (md)	Concentrate w/o Antelope	Concentrate w/Antelope	Change
50%	Radium 226	4,643	13.22 pCi/l	9.98 pCi/l	-3.24 pCi/l
50%	TDS	4,643	4,763 ppm	3,273 ppm	-1,490 ppm
50%	Elevation	4,643	5,119 feet	5,130 feet	+11 feet
100%	Radium 226	4,643	155.7 pCi/l	47.38 pCi/l	-108.32 pCi/l
100%	TDS	4,643	39,134 ppm	12,385 ppm	-26,750 ppm
100%	Elevation	4,643	5,099 feet	5,112 feet	+13 feet

CED:ms
1590Q
05/14/84

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24/ PERMIT

ACKNOWLEDGEMENT

This study benefited from the thoughtful input and assistance of N. K. Springer and R. J. Mitro of EPRCo. and H. P. Estey, D. M. Range, and J. F. Wallace of EMC.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT
218C-R1

LAKE WATER QUALITY

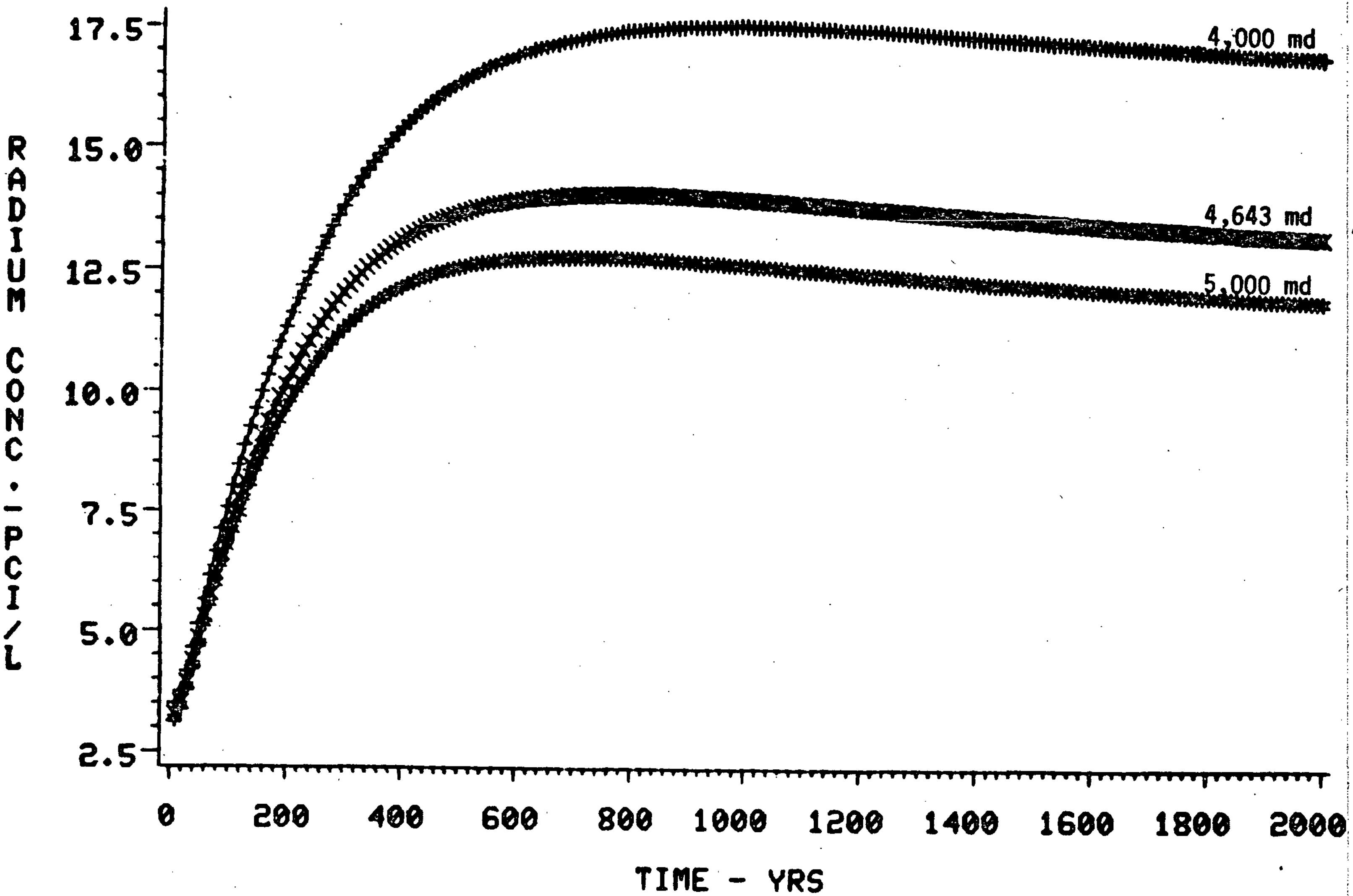

Fig. 2 Radium Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 50% Pit Sloping Without Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6 ;4 PERMIT
218C-R1

LAKE WATER QUALITY

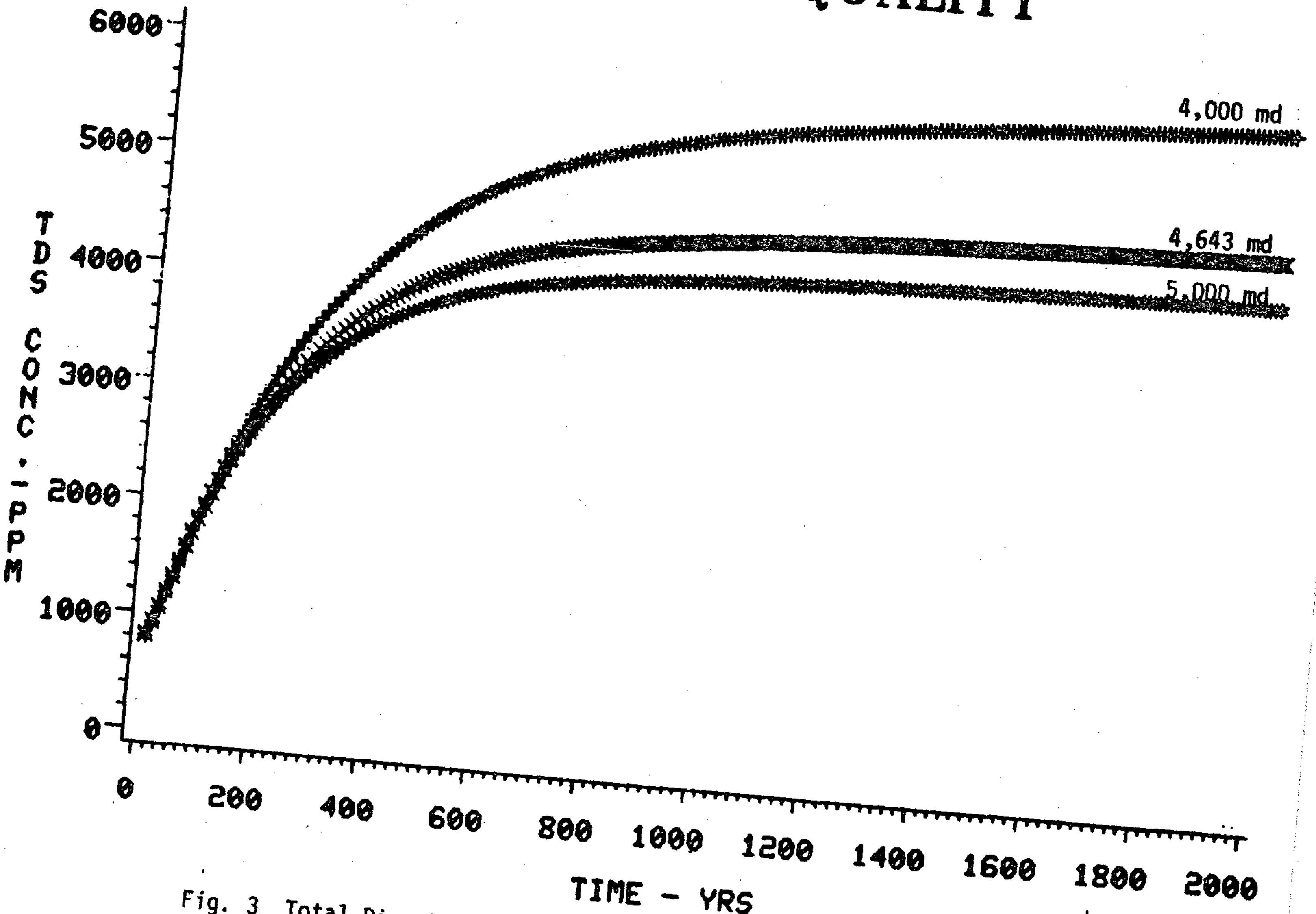

Fig. 3 Total Dissolved Solids Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 50% Pit Sloping Without Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984

LAKE WATER QUALITY

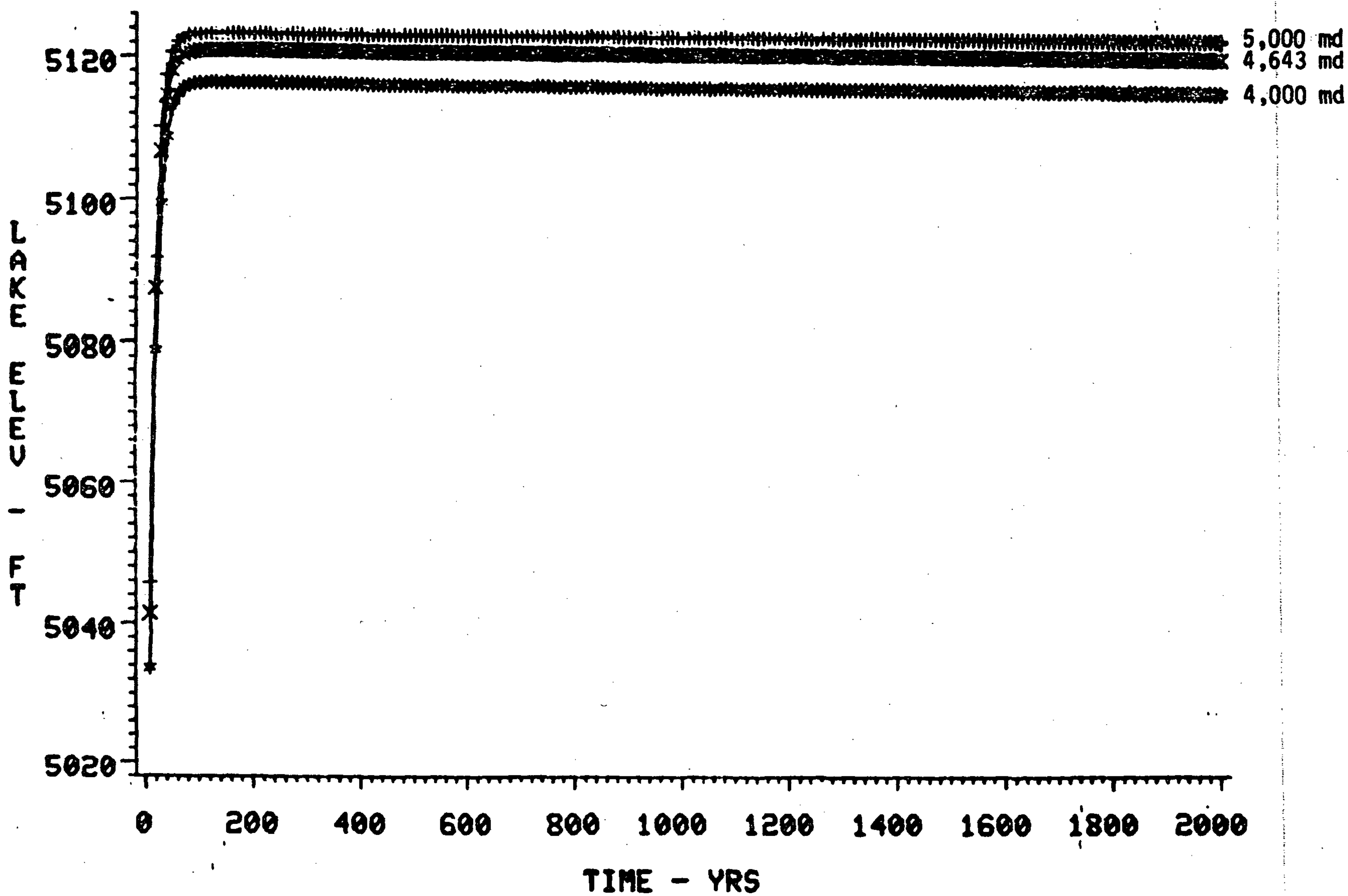

Fig. 4 Lake Filling Rates for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 50% Pit Sloping Without Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT

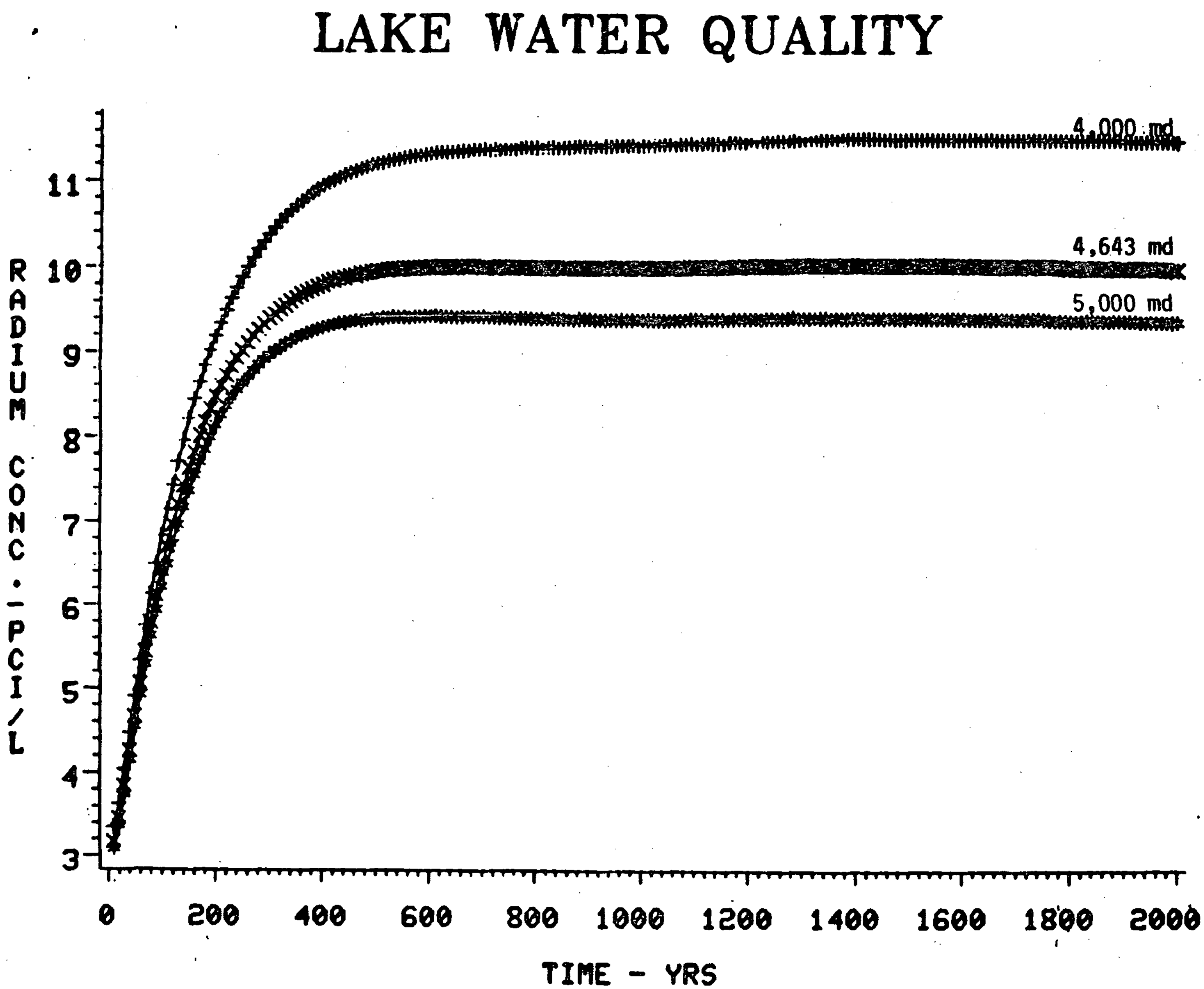

Fig. 5 Radium Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 50% Pit Sloping With Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT

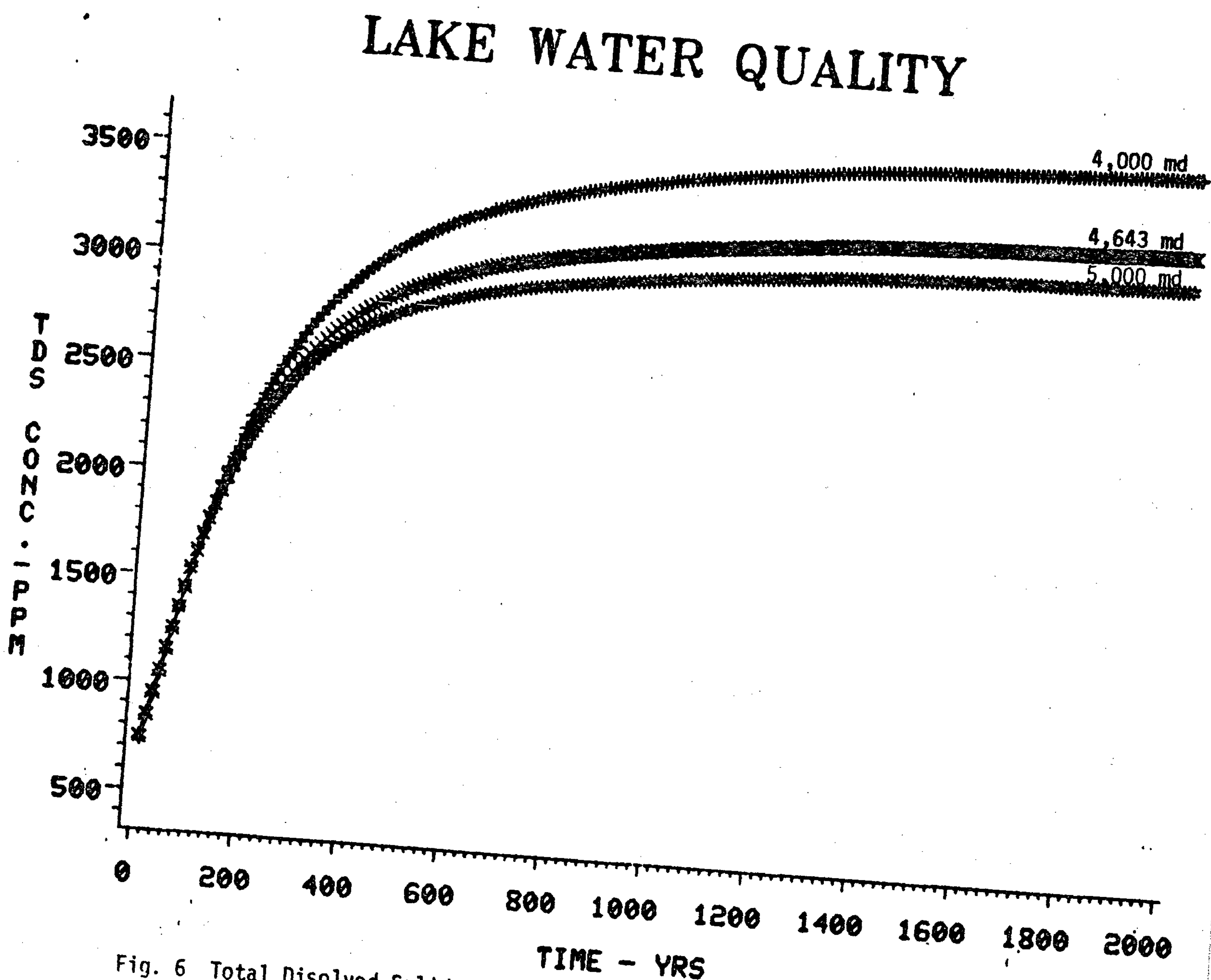

Fig. 6 Total Disolved Solids Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 50% Pit Sloping With Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT

LAKE WATER QUALITY

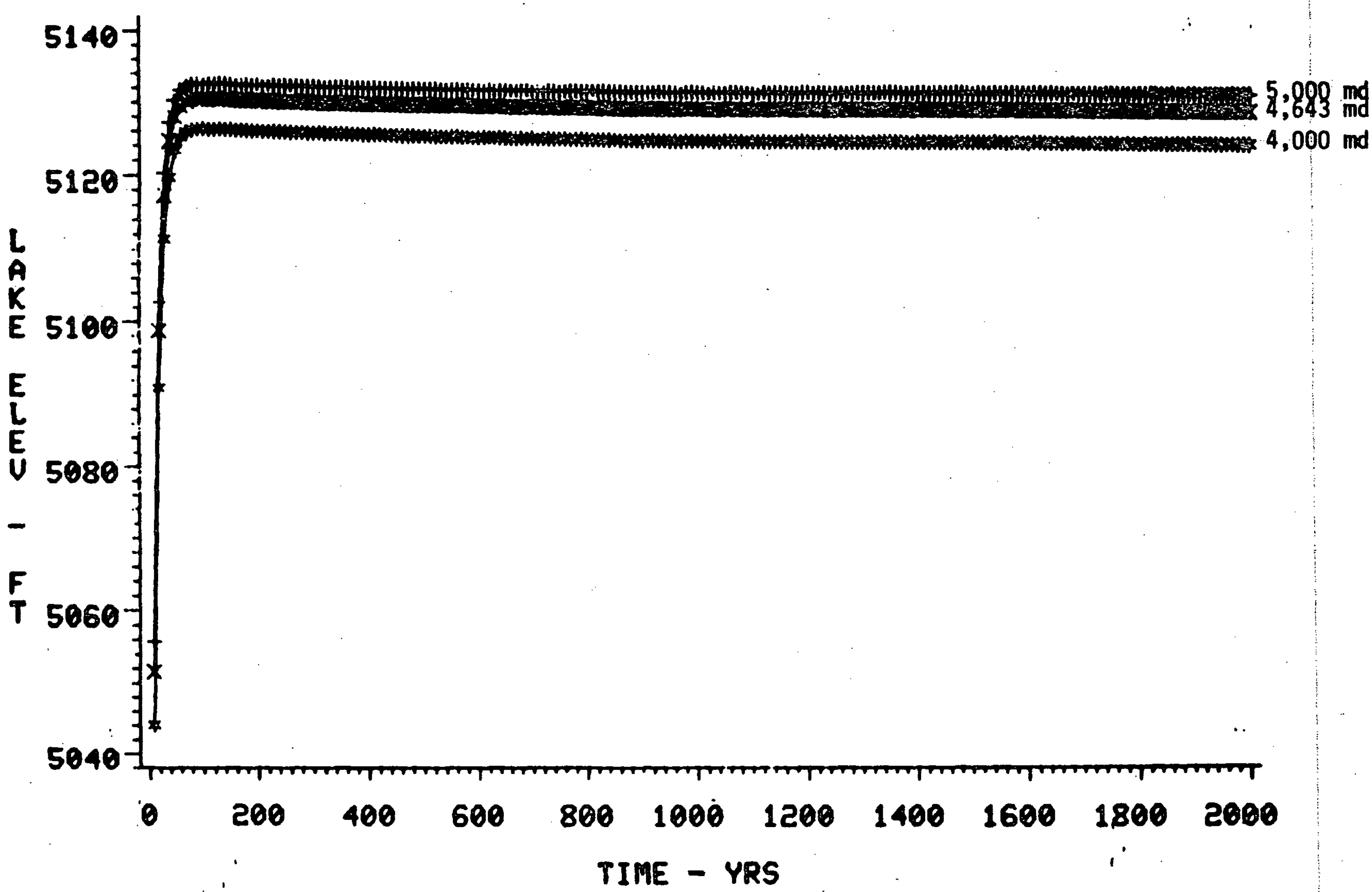

Fig. 7 Lake Filling Rates for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 50% Pit Sloping With Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT
218C-R1

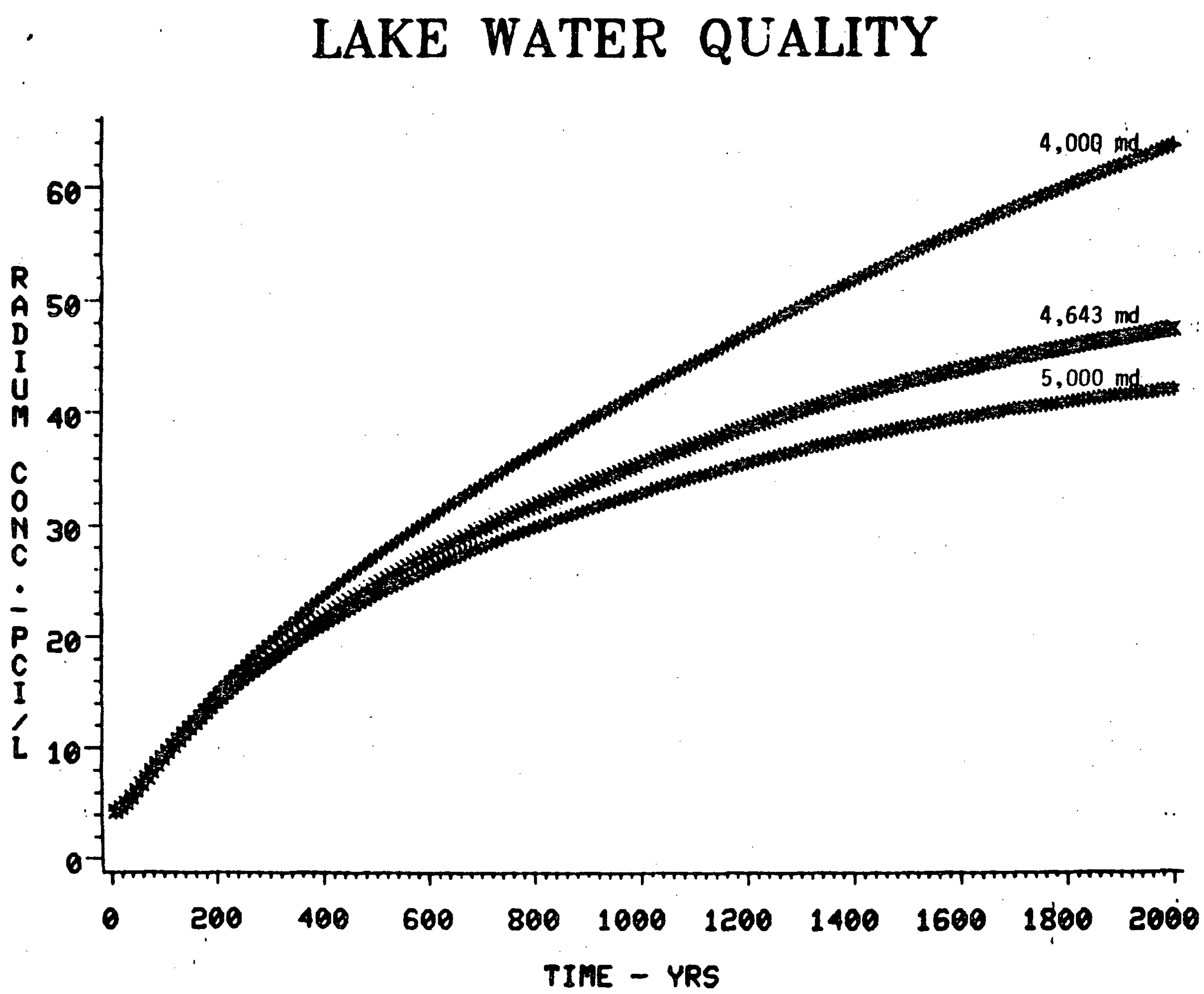

Fig. 8 Radium Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 100% Pit Sloping With Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
PERMIT
218C-R1

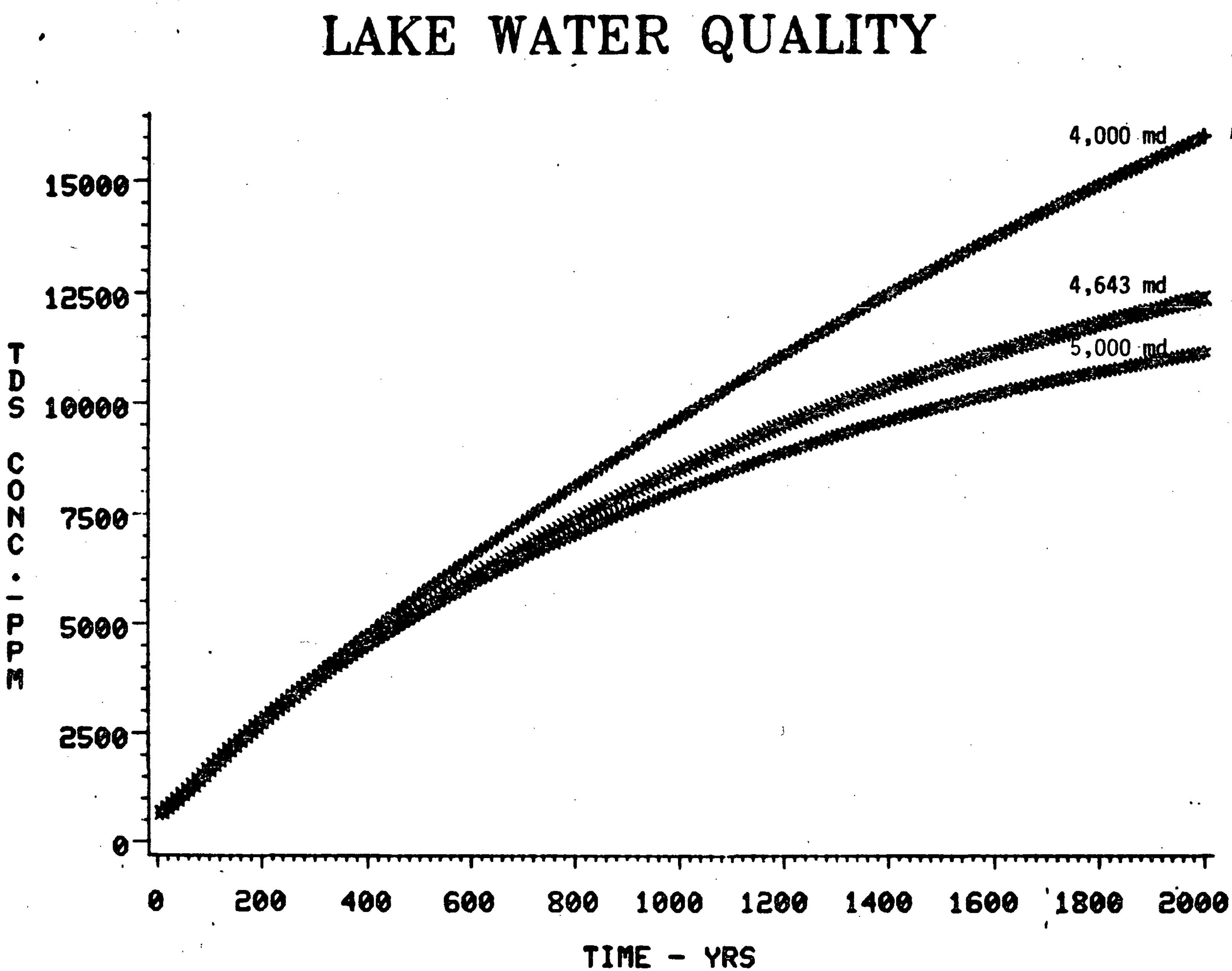

Fig. 9 Total Dissolved Solids Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 100% Pit Sloping With Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
PERMIT

LAKE WATER QUALITY

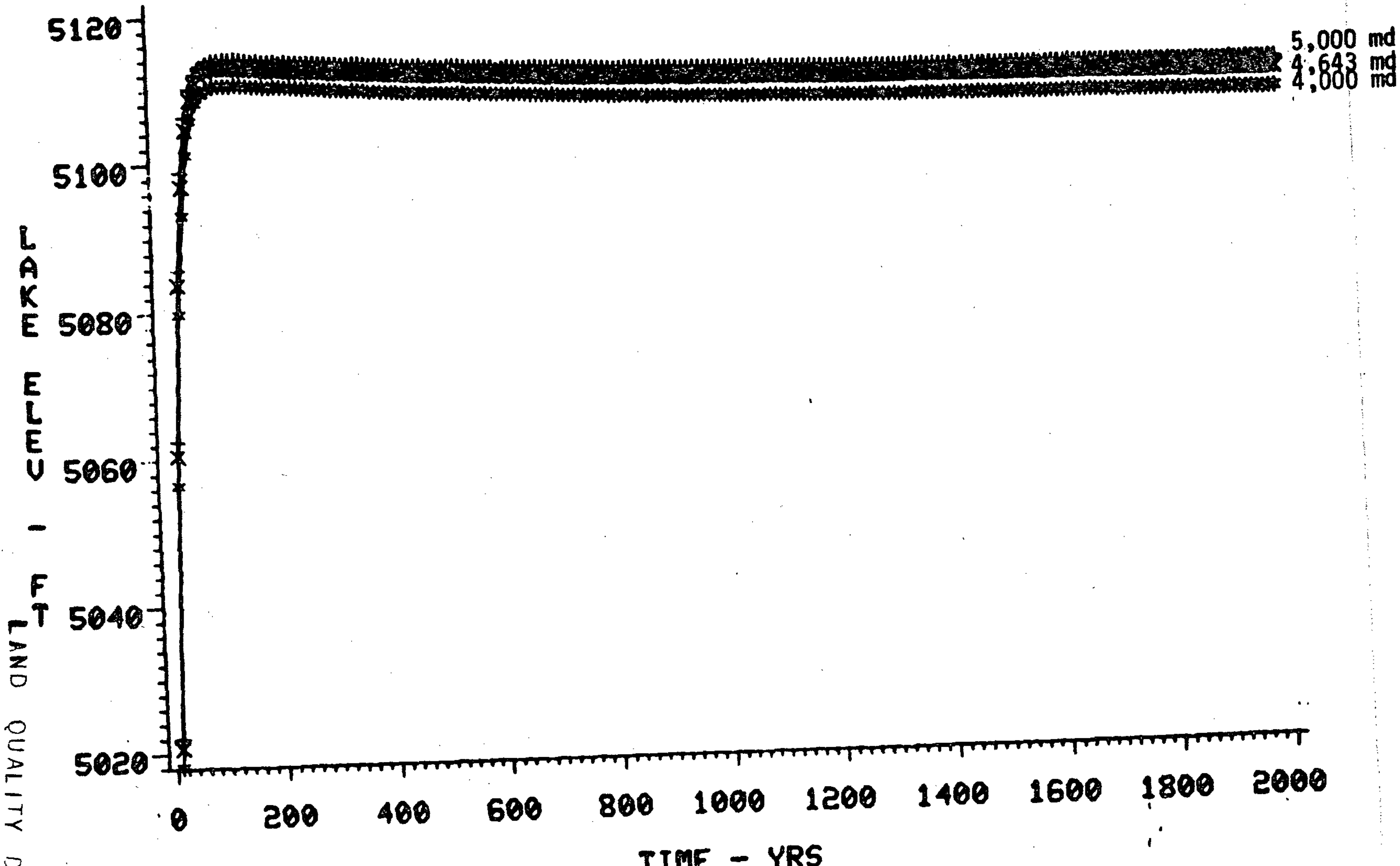

Fig. 10 Lake Filling Rates for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 100% Pit Sloping With Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
PERMIT

LAKE WATER QUALITY

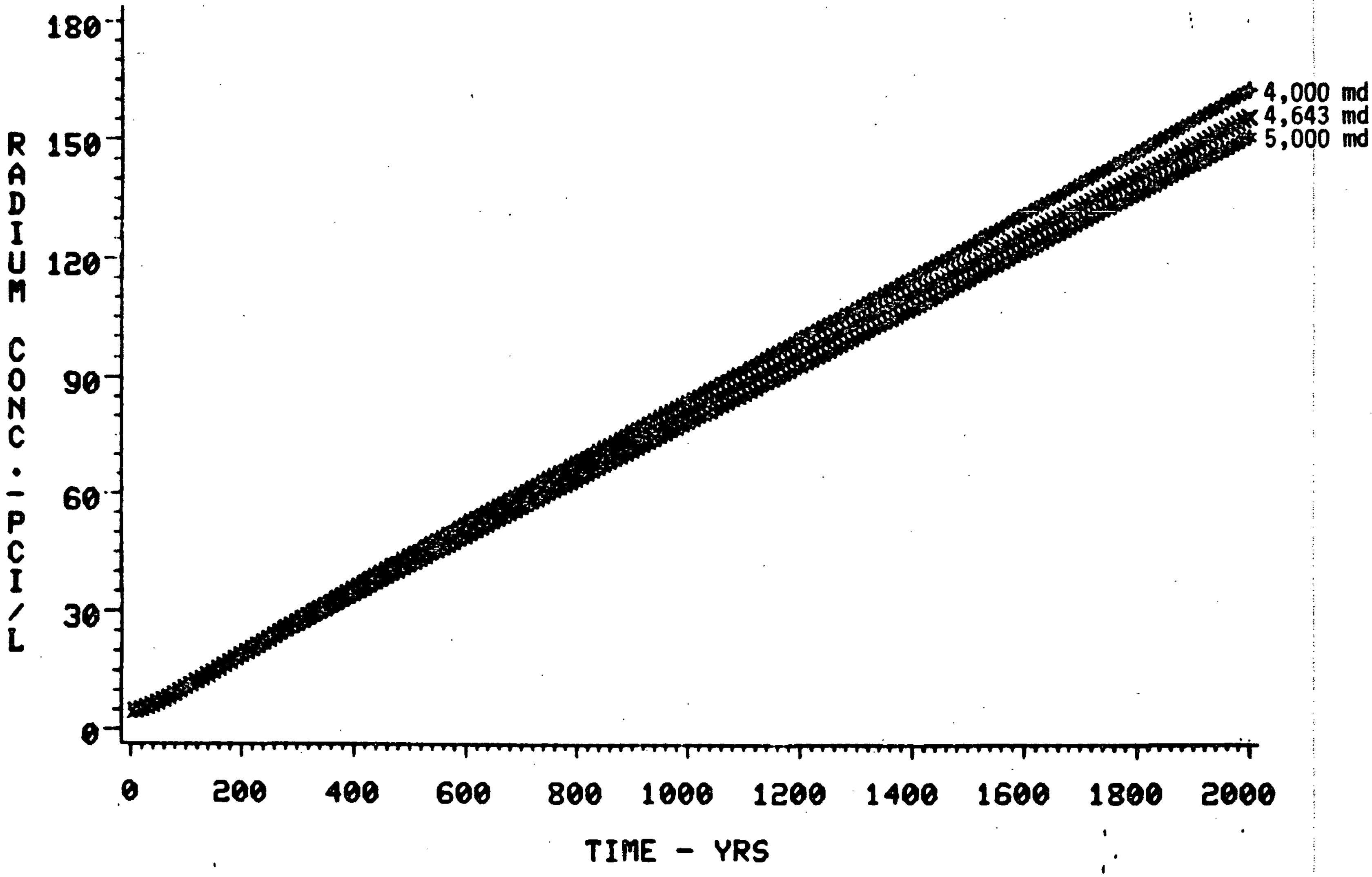

Fig. 11 Radium Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 100% Pit Sloping Without Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6 .4 PERMIT

LAKE WATER QUALITY

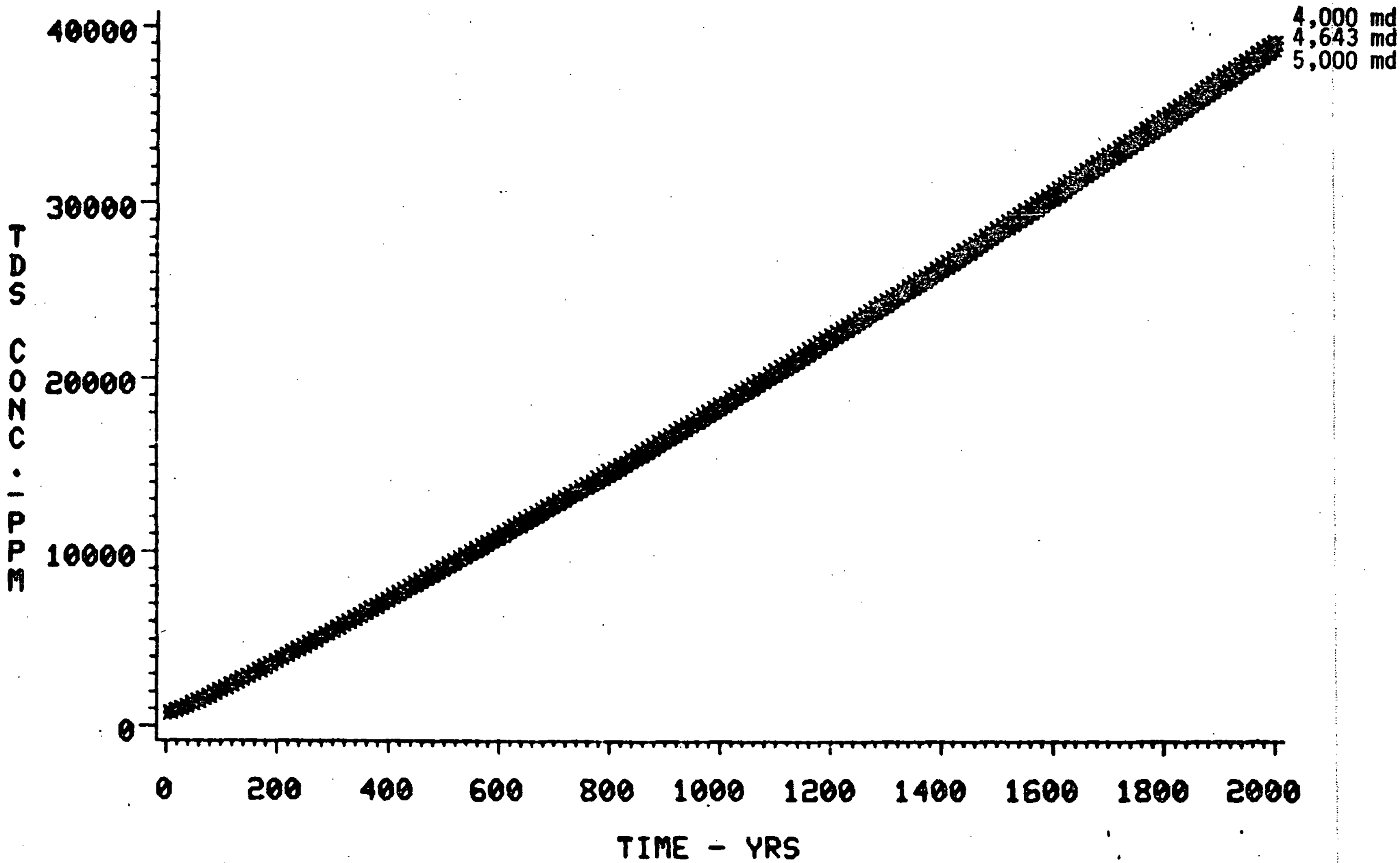

Fig. 12 Total Dissolved Solids Concentrations for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 100% Pit Sloping Without Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6 2/4 PERMIT

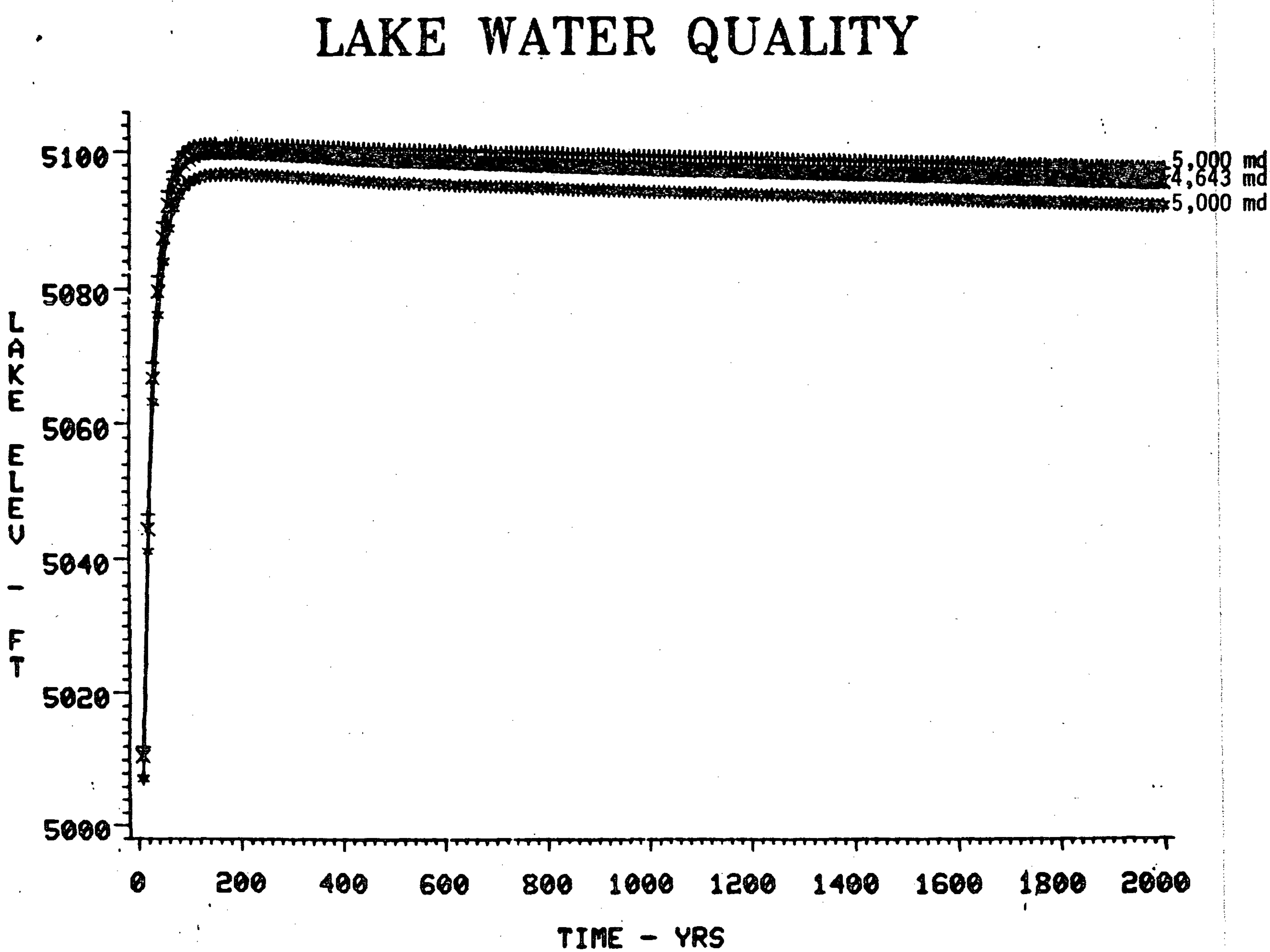

Fig. 13 Lake Filling Rates for TDSS Permeabilities of 4,000, 4,643, and 5,000 md and 100% Pit Sloping Without Antelope Diversion Inflow.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT

LAKE WATER QUALITY

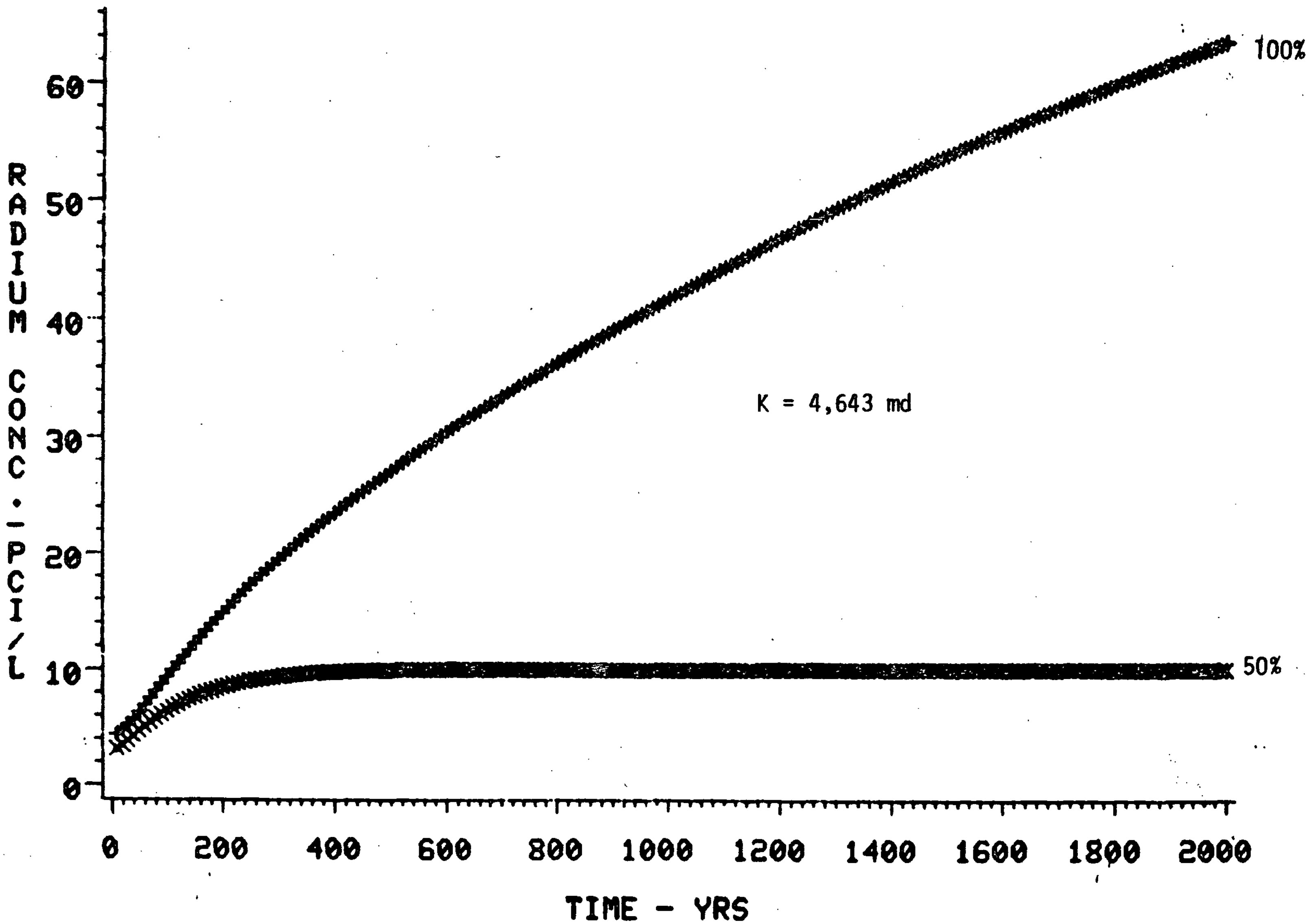

Fig. 14 Comparison of Radium Concentrations for 50% vs 100% Pit Sloping Cases
With Antelope Diversion Inflow and TDSS Permeability of 4,643 md.

LAND QUALITY DIVISION
RECEIVED JUN 25, 1984
TFN 1 6/24 PERMIT

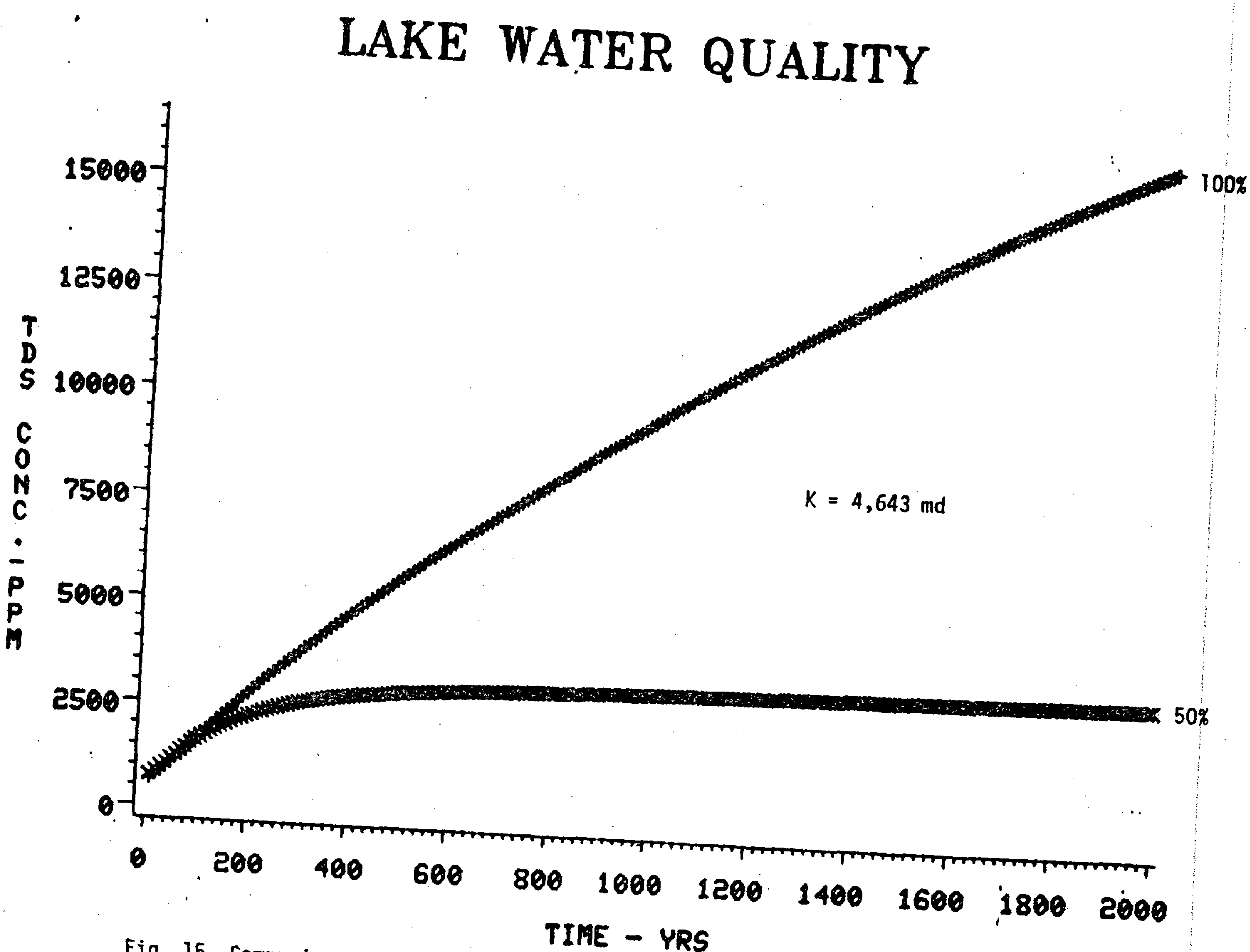

Fig. 15 Comparison of TDSS Concentrations for 50% vs 100% Pit Sloping Cases <u>With</u> Antelope Diversion Inflow and TDSS Permeability of 4,643 md.

LAND QUALITY DIVISION
RECEIVED JUNE 26, 1984
PERMIT

LAKE WATER QUALITY

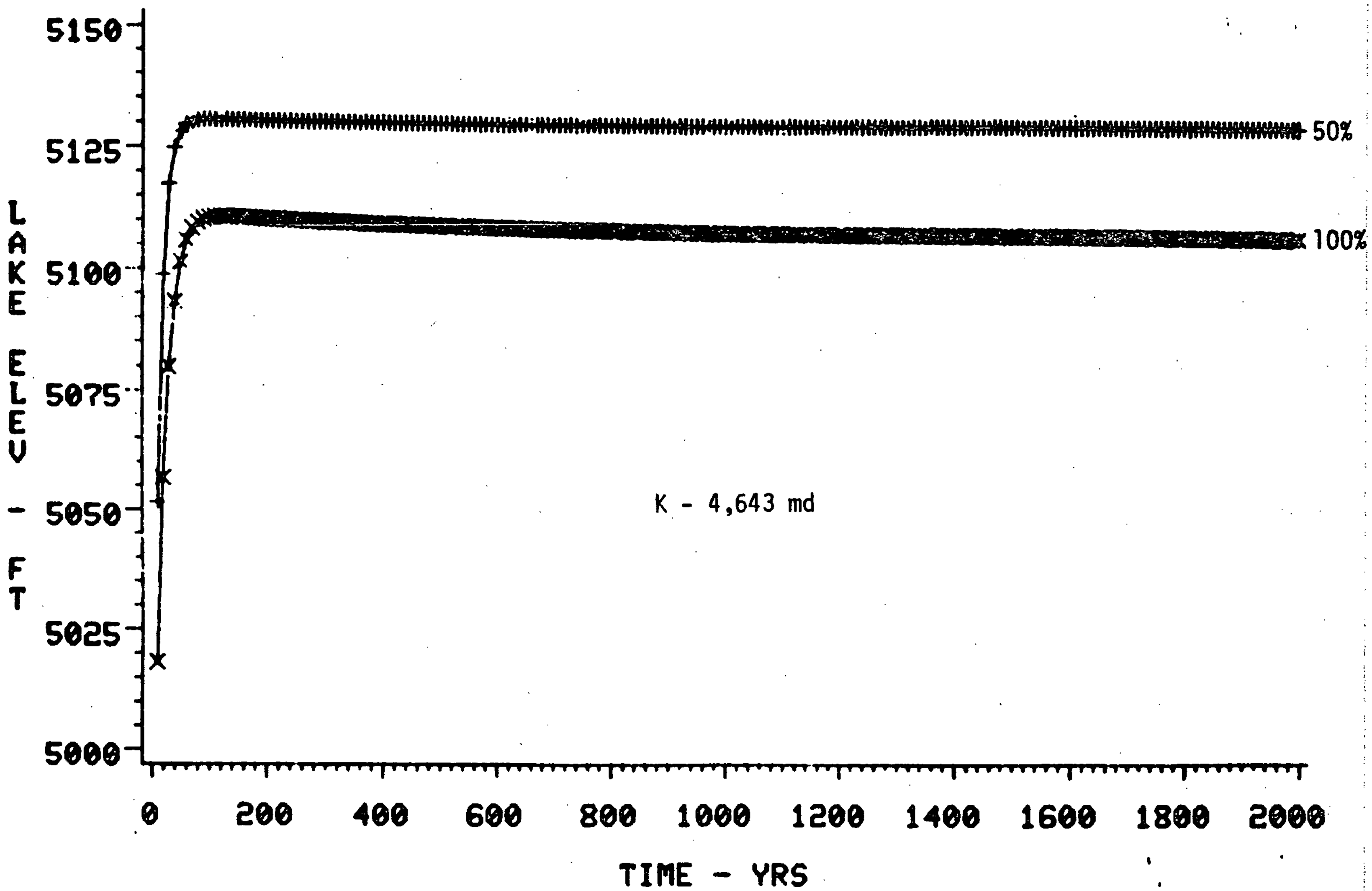

Fig. 16 Comparison of Lake Filling Rates for 50% vs 100% Pit Sloping Cases <u>With</u> Antelope Diversion Inflow and TDSS Permeability of 4,643 md.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24? PERMIT 218C-R1

LAKE WATER QUALITY

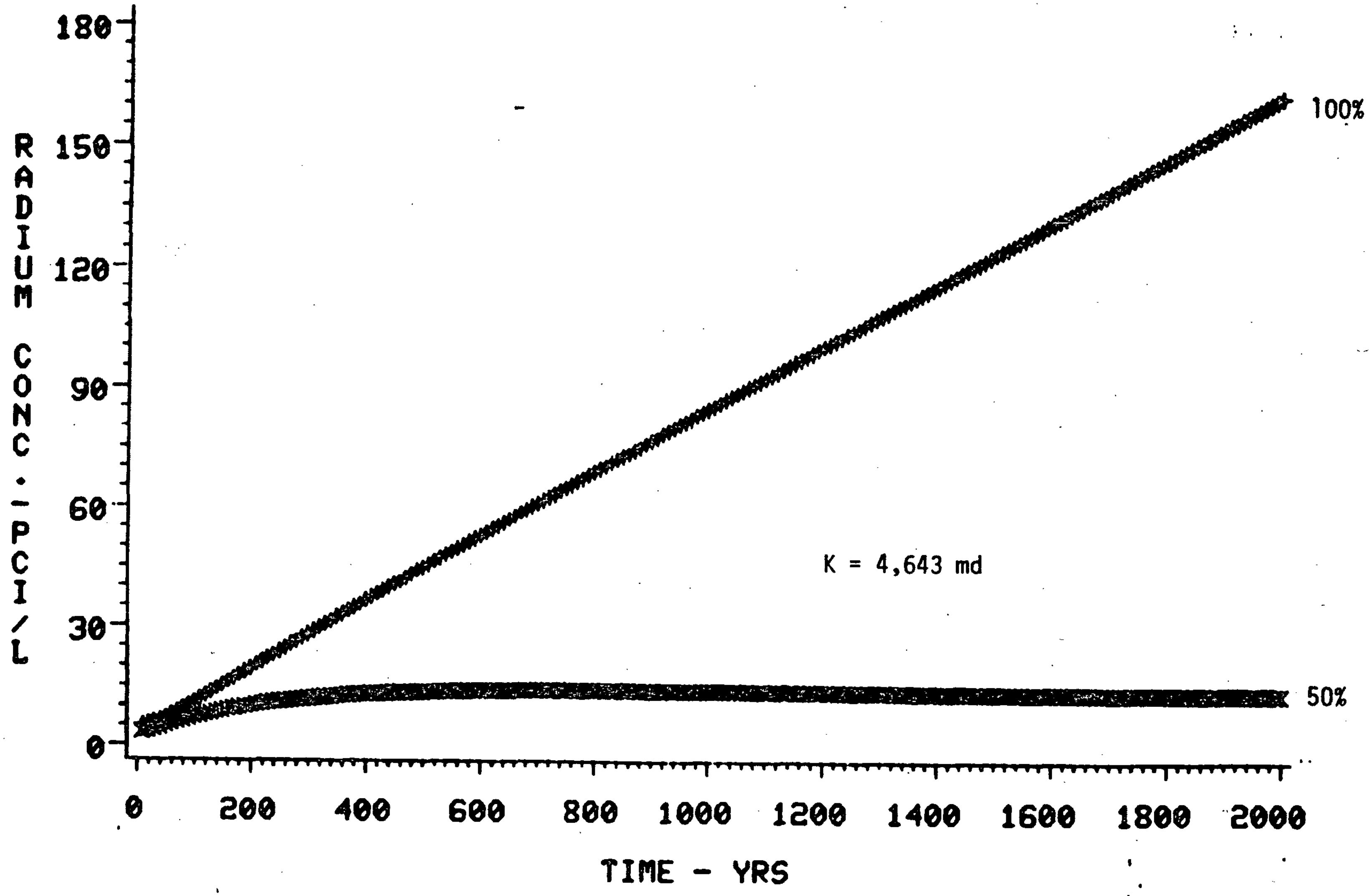

Fig 17 Comparison of Radium Concentrations for 50% vs 100% Pit Sloping Cases Without Antelope Diversion Inflow and TDSS Permeability of 4,643 md.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT
218C-R1

LAKE WATER QUALITY

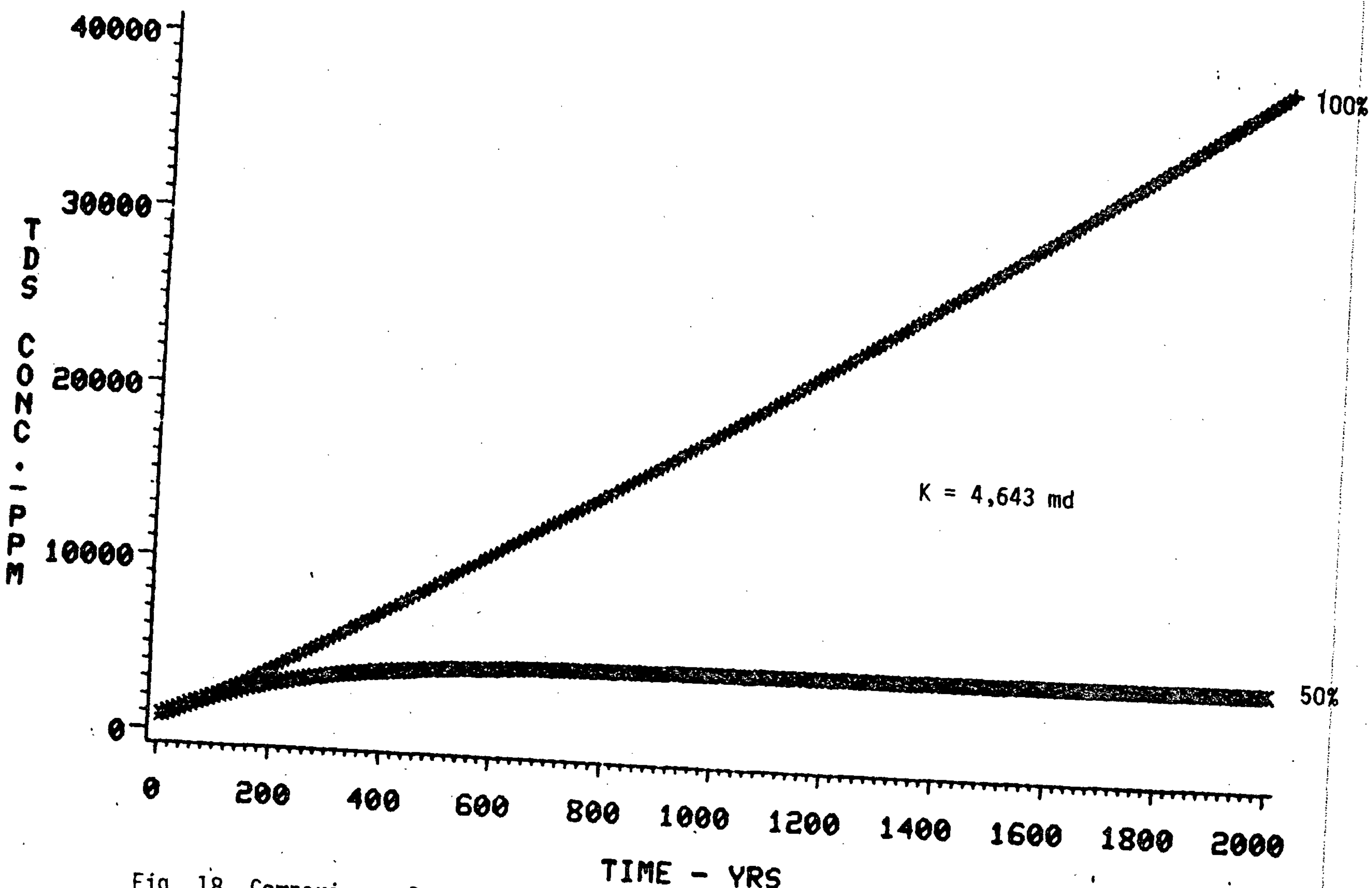

Fig. 18 Comparison of TDSS Concentrations for 50% vs 100% Pit Sloping Cases <u>Without</u> Antelope Diversion Inflow and TDSS Permeability of 4,643 md.

RECEIVED JUNE 25, 1984
PERMIT
TFN 1 6/242
218C-RI

LAKE WATER QUALITY

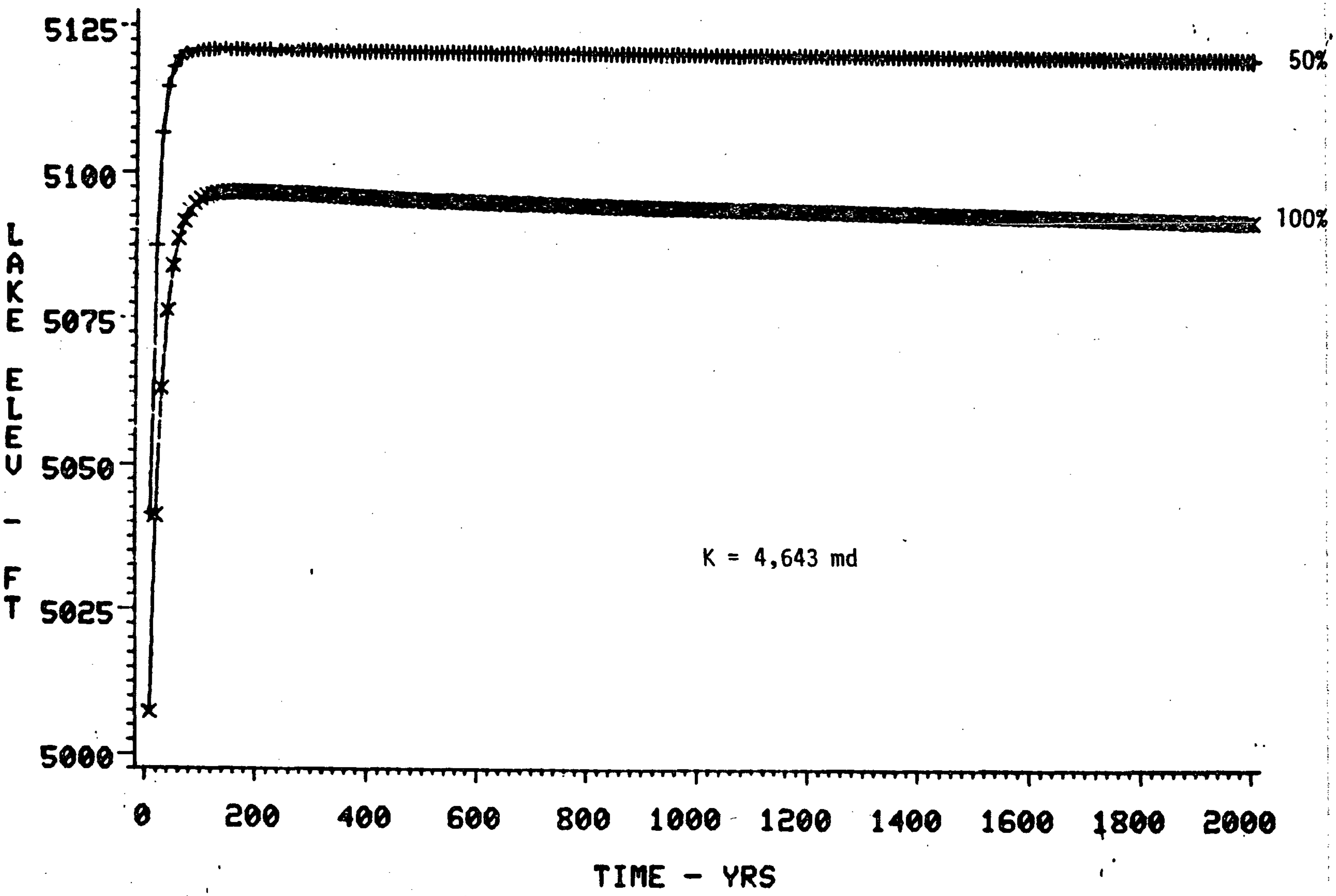

Fig. 19 Comparison of Lake Filling Rates for 50% vs 100% Pit Sloping Cases <u>Without</u> Antelope Diversion Inflow and TDSS Permeability of 4,643 md.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/242 PERMIT 218C-R1

LAKE WATER QUALITY

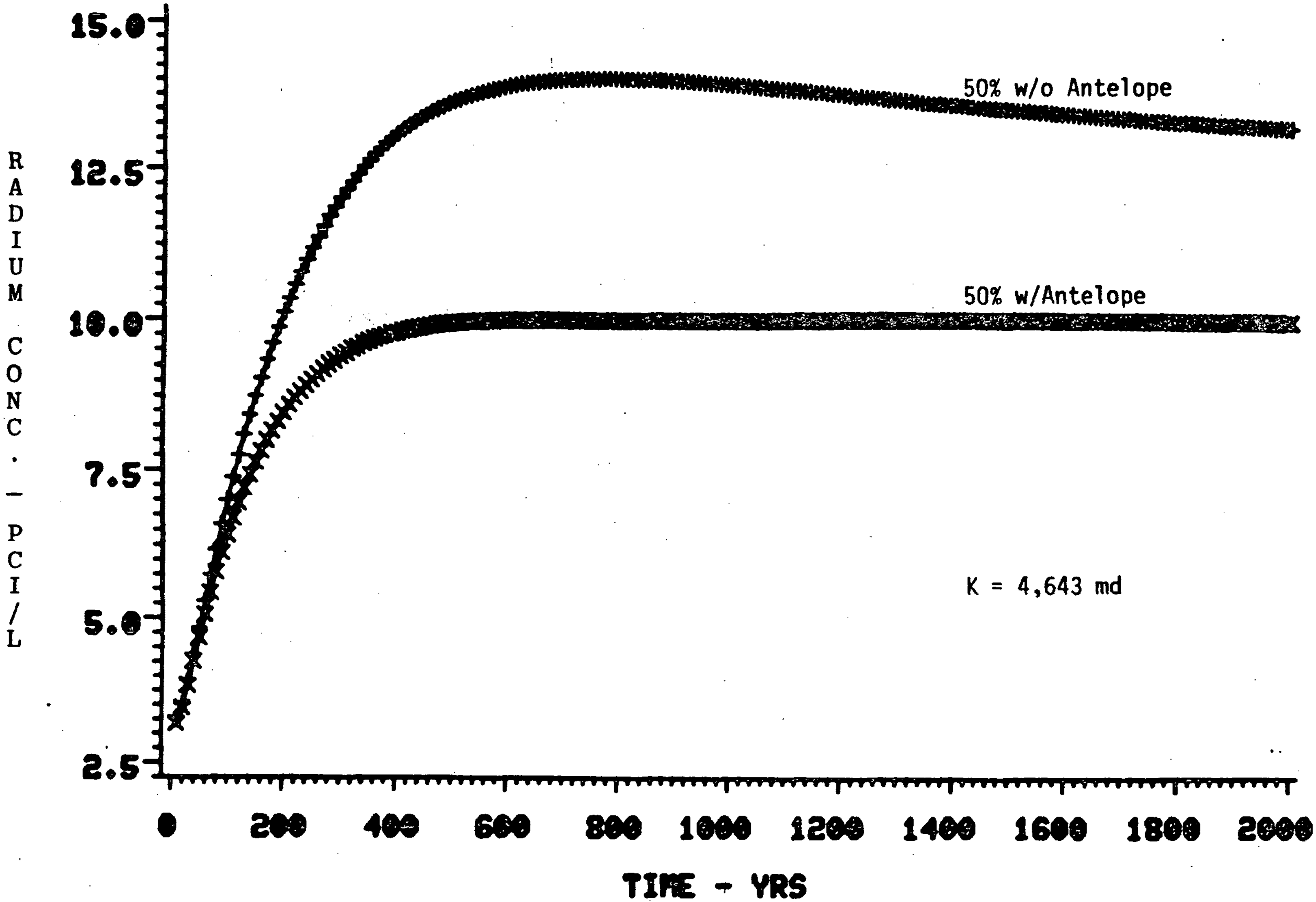

Fig. 20 Comparison of the Impact of Antelope Diversion Inflow on Radium Concentrations for the 50% Sloping Cases.

LAND QUALITY DIVISION
RECEIVED JUNE 26, 1984
TFN 1 6/24
PERMIT 218C-R1

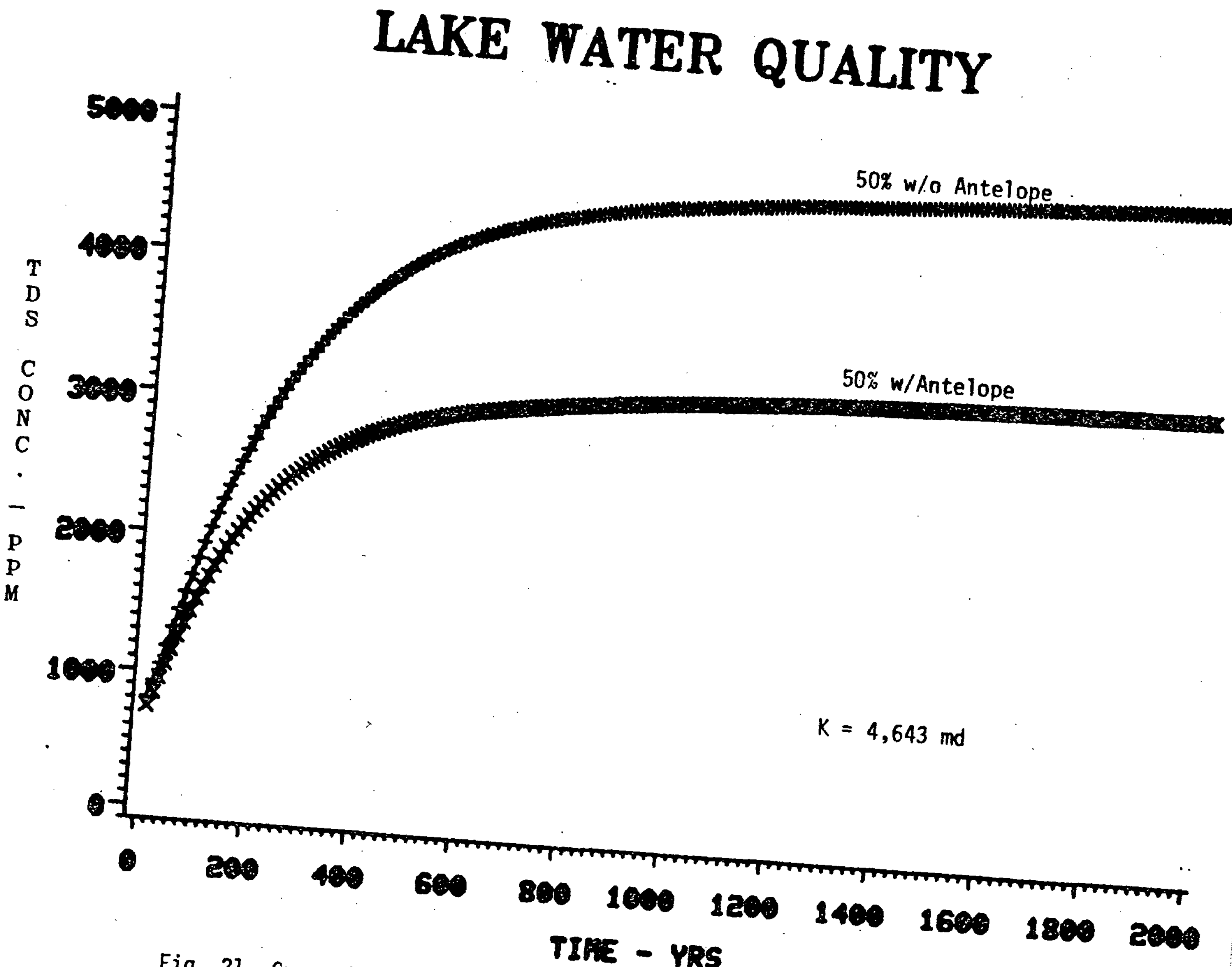

Fig. 21 Comparison of the Impact of Antelope Diversion Inflow on TDS Concentrations for the 50% Sloping Cases.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT 218C-RI

LAKE WATER QUALITY

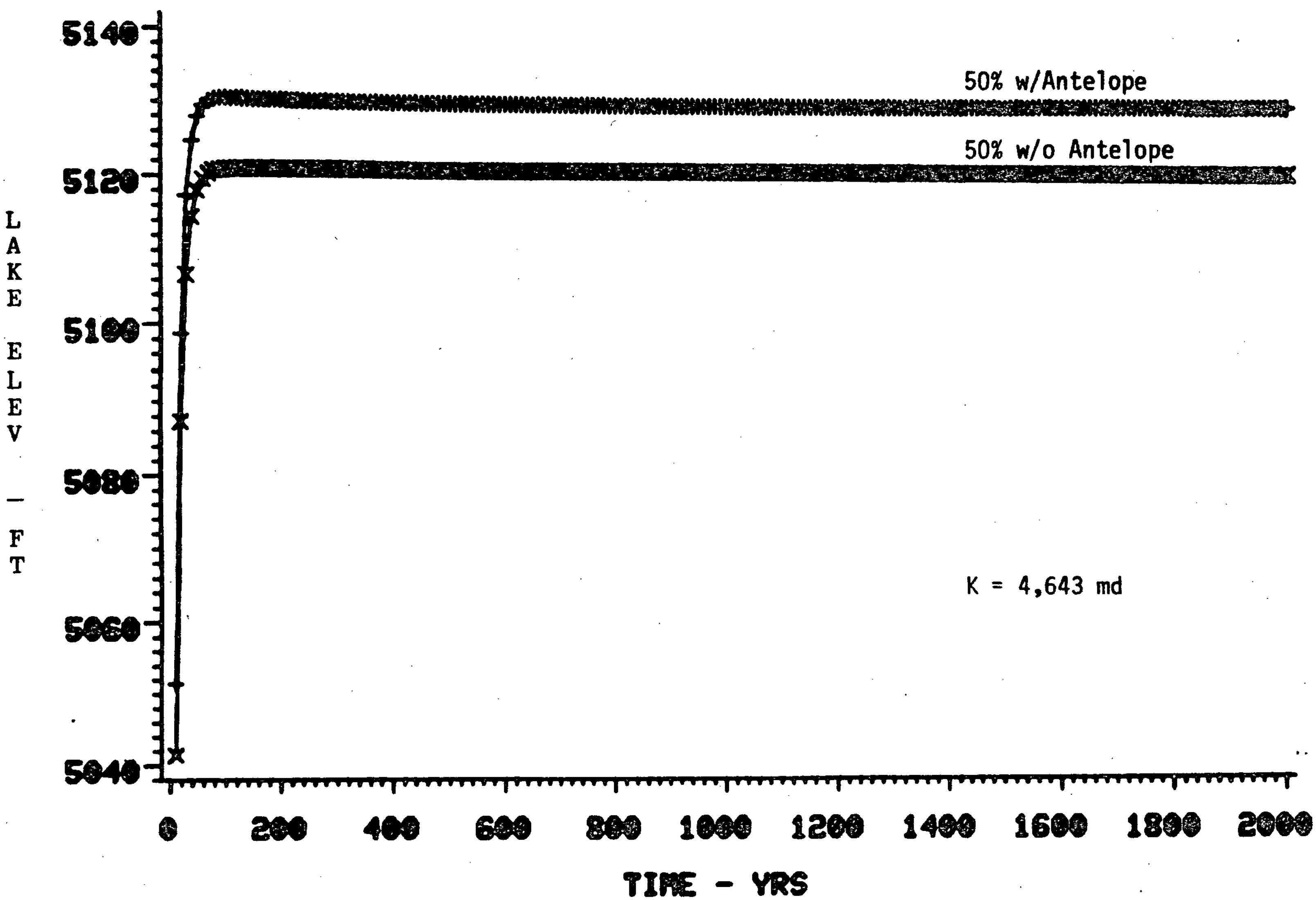

Figure 22 Comparison of the Impact of Antelope Diversion Inflow on Lake Filling Rates for the 50% Sloping Cases.

LAND QUALITY DIVISION
RECEIVED JUNE 25, 1984
TFN 1 6/24 PERMIT