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MEMORANDUM

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RECEIVED NOV 13 1985 U.S. Nuclear Regulatory Commission Mail Section

TO FILE: American Nuclear Corp., Permit 352

FROM: Jim Finley, Hydrologist JF

DATE: October 29, 1985

SUBJECT: Review of Groundwater Conditions and Hydraulic Data at the American Nuclear Mill Site

Checked by: JGH

A. Introduction

In a memo dated July 5, 1985, Mark Moxley requested a review of groundwater conditions at American Nuclear's Gas Hills mill site. The request came in response to a report submitted May, 1985 by American Nuclear which discussed water levels, water quality, and monitoring changes for the system of wells in operation at the site. Decommissioning of this site is expected to commence within the next year. Also, Tailings Pond 1 has been proposed as a disposal site for the Susquehanna tailings.

B. Discussion

1. Groundwater Assessment

Hydro-Engineering's May - 1985 report is mainly a compilation of data. Water levels and water quality analyses results are tabulated from 1979 to 1984. Graphs of water levels and chemical concentrations for selected wells are plotted. Based on short discussions of these plots a new monitoring plan is presented.

A new review of the data contained in the report was conducted in which both water levels and water quality were analyzed. Water levels for several monitoring wells were plotted against time. Water levels from five wells indicate that the pumpback system has not historically had much of an affect on the flow gradient (Figure 1). With no baseline or pre-1979 data, it is not possible to determine whether or not these down gradient water levels reflect the influence of seepage. Some of the original mathematical modeling of the perched aquifer indicates that water from this aquifer discharges approximately 2000 feet north of the tailings pond. The piezometric map and Figure 1 suggest this is not true, but that a discharge area possibly exists to the north of the Fox wells. Water levels are below the topographic surface in the three Fox wells plotted on Figure 1.

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Certified By Mary C. Hood

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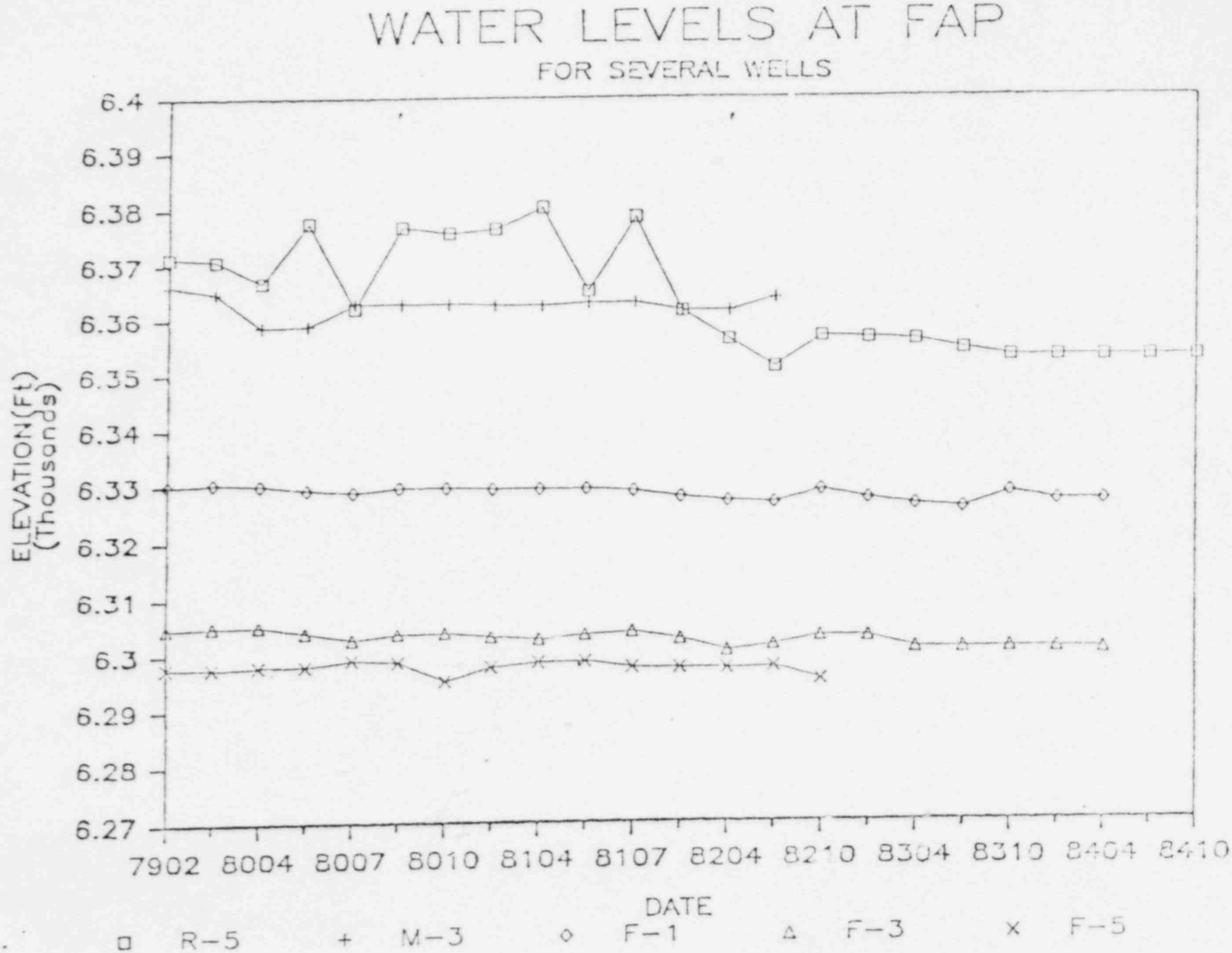
Figure 1



WATER LEVELS AT FAP
FOR SEVERAL WELLS
ELEVATION(Ft)
(Thousands)
6.4
6.39
6.38
6.37
6.36
6.35
6.34
6.33
6.32
6.31
6.3
6.29
6.28
6.27
7902
8004
8007
8010
8104
8107
8204
8210
8304
8310
8404
8410
DATE
R-5
M-3
F-1
F-3
F-5

Periods of active pumping from the recovery wells have been sporadic for all wells (Figure 2). Water levels in the recovery wells have decreased since 1979, which is a combination of pumping and decreased water levels in Tailings Pond 1. R-4 has been pumped the most actively though water remains in all wells but R-5. This is not surprising considering that these wells should be drilled to the top of the clay and pre-mining water levels existed in the perched aquifer. Through time, decreased water levels in these wells should become stable, at which point seepage from the tailings pond will have ceased.

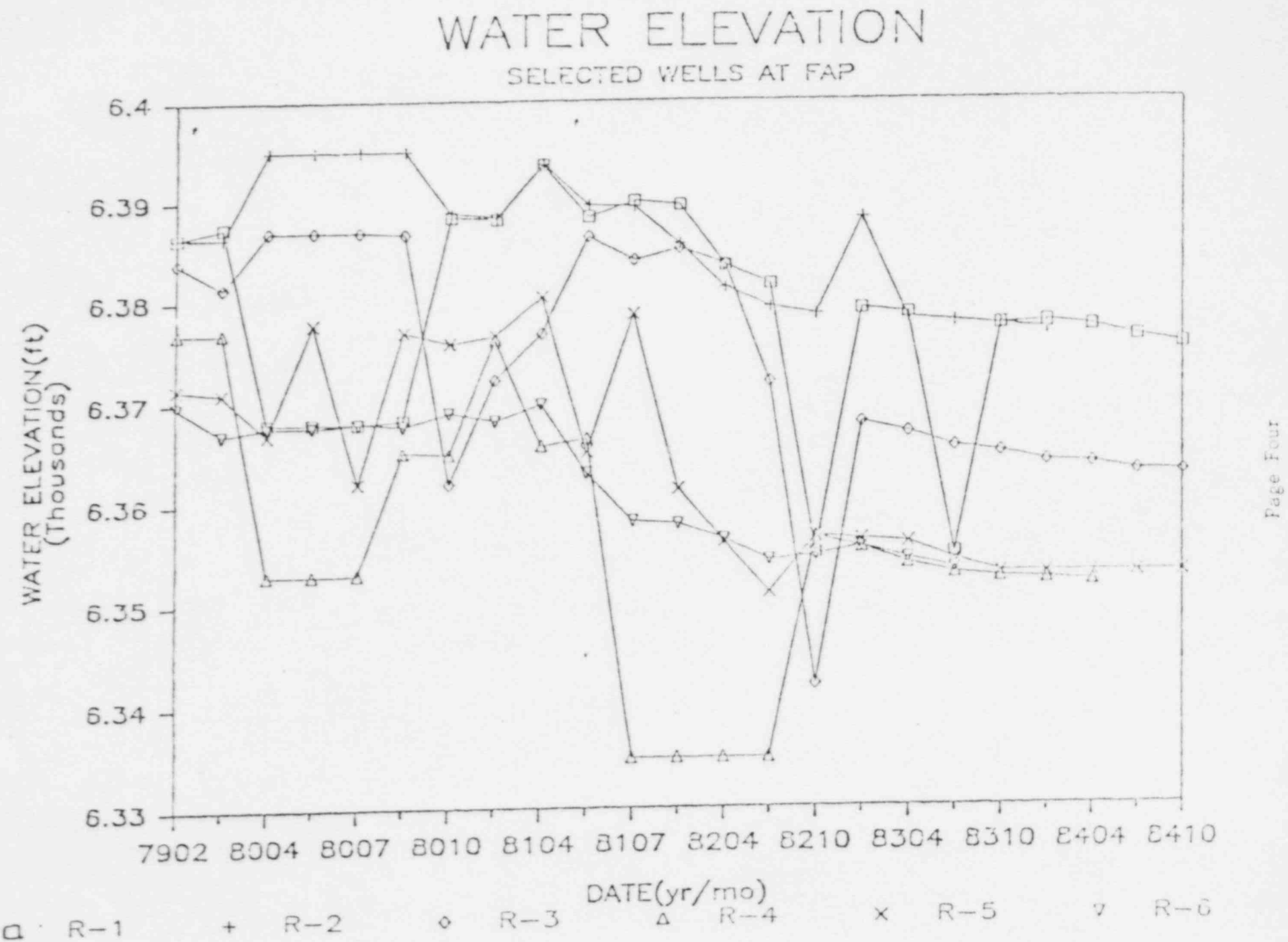
An effective pumpback system is necessary in order to minimize further seepage movement into the perched aquifer. The well system has not worked very reliably to date (Figure 2; see August 6, 1985 memo Niles Andrus to NRC). A rejuvenation of the well system coupled with a more effective evaporative technique (e.g. a mist system) should be considered for any decommissioning of this tailings pond.

Table 3 of the May, 1985 report contains the proposed monitoring program. Changes include sampling frequency, the number of wells, and chemical parameters analyzed. A concurrent review was conducted by the NRC, and phone conversations, as well as a review of the NRC draft report, have resulted in the suggested monitoring plan listed in Table 1.

Table 1. Recommended Groundwater Monitoring Program

Frequency	Wells	Parameters
Semi-annually	6, 13, TP1-D2, TP2-2, TP2-3, R6, TP1-1, Fox 4	WL, Temp., pH, TDS, EC, SO4, Cl, As, Se, Mn, NO3, Fe, Al, Unat., Ra226
Semi-annually	Willow Springs	Same as above
Semi-annually	Fox 2, TP2-1, R1, TP1-20, TP1-24, R3	Water level
Annually	6, 13, TP1-D2, TP2-2, TP2-3, R6, TP1-1, Fox 4	Those listed above plus: Pb, Cd, Cr, Na, K, Ca, Mg, HCO3, CO3, NH3, Ba, B, Cu, F, Fe, Mn, Hg, Mo, Ni, NO2, V, Zn, Pb210, Th230, Po210

Figure 2


WATER ELEVATION
SELECTED WELLS AT FAP
WATER ELEVATION(ft)
(Thousands)
6.4
6.39
6.38
6.37
6.36
6.35
6.34
6.33
7902 8004 8007 8010 8104 8107 8204 8210 8304 8310 8404 8410
DATE(yr/mo)
R-1
R-2
R-3
R-4
R-5
R-6

Several water quality parameters were plotted against time for wells in a down gradient direction (Figures 3, 4, 5, and 6). Values of pH rise from two (tailings liquor) to eight as distance down gradient of the tailings is increased (Figure 3). Low pH fluids seeping from the tailings pond are buffered by the natural salt content of the perched aquifer. The rate at which the buffering occurs is controlled by two processes: (1) reaction kinetics; (2) and relative permeability of the aquifer. Reaction kinetics is fixed if the medium is homogeneous. Directional permeability will control rates of flow affecting contact time. Zones of increased permeability (e.g. sand or gravel lenses) will transport low pH water further from the tailings pond. Changes in pH and Eh regulate the relative solubility of major cations and anions, and indirectly the chemistry of toxic trace elements (Johnson, 1985). Values of pH below 6 occur as far down gradient as TP1-1 (Figure 3). It is expected that the zone of low pH will slowly increase in size as the buffering capacity of the aquifer material is exhausted.

Chloride concentrations show no increasing or decreasing trend for any wells through time (Figure 4). Values range between 250 and 575 mg/L for all wells but Fox 2 and TP1-1. This again suggests that the sampling conducted to date reflects not pre-seepage conditions but those already created as a result of seepage. Other constituents plotted reflect the same conditions (Figures 4, 5, and 6). Nitrates at three wells peak in late 1981 then drop to within 10 and 20 mg/L (Figure 5). Sulfates generally increase in a down gradient direction with very high values recorded at Fox 5. Four wells range between 2000 and 7000 mg/L with a rising trend from 1981 to late 1982 (Figure 6). In all cases, Well TP1-1 had the lowest concentration of all parameters which indicates the plume has not moved in this direction. Flow may move in a more westerly direction though data are not available to evaluate this possibility.

As mentioned in the Moxley memo (July 5, 1985), Tailings Pond No. 1 was identified as a potential repository for the Susquehanna mill tailings. Since that time, the State of Wyoming has officially chosen the proposal as the preferred alternative. Therefore, the following is a brief conceptual evaluation of placing the Susquehanna tailings atop FAP's Tailings Pond No. 1.

Presently, no free water is contained in the tailings pond. Water seeping from the pond is caused by gravity drainage of pore water in excess of the specific retention of the porous medium (McWhorter and Sunada, 1977). Placement of the Susquehanna tailings will create an additional surcharge to the system. This will increase the total overburden stress at all depths. Initially, the increased surcharge is opposed by an equal increase in pore water pressure. Slowly, as a function of the physical properties of the earth materials, the pore water pressure dissipates as water flows from the

Figure 3

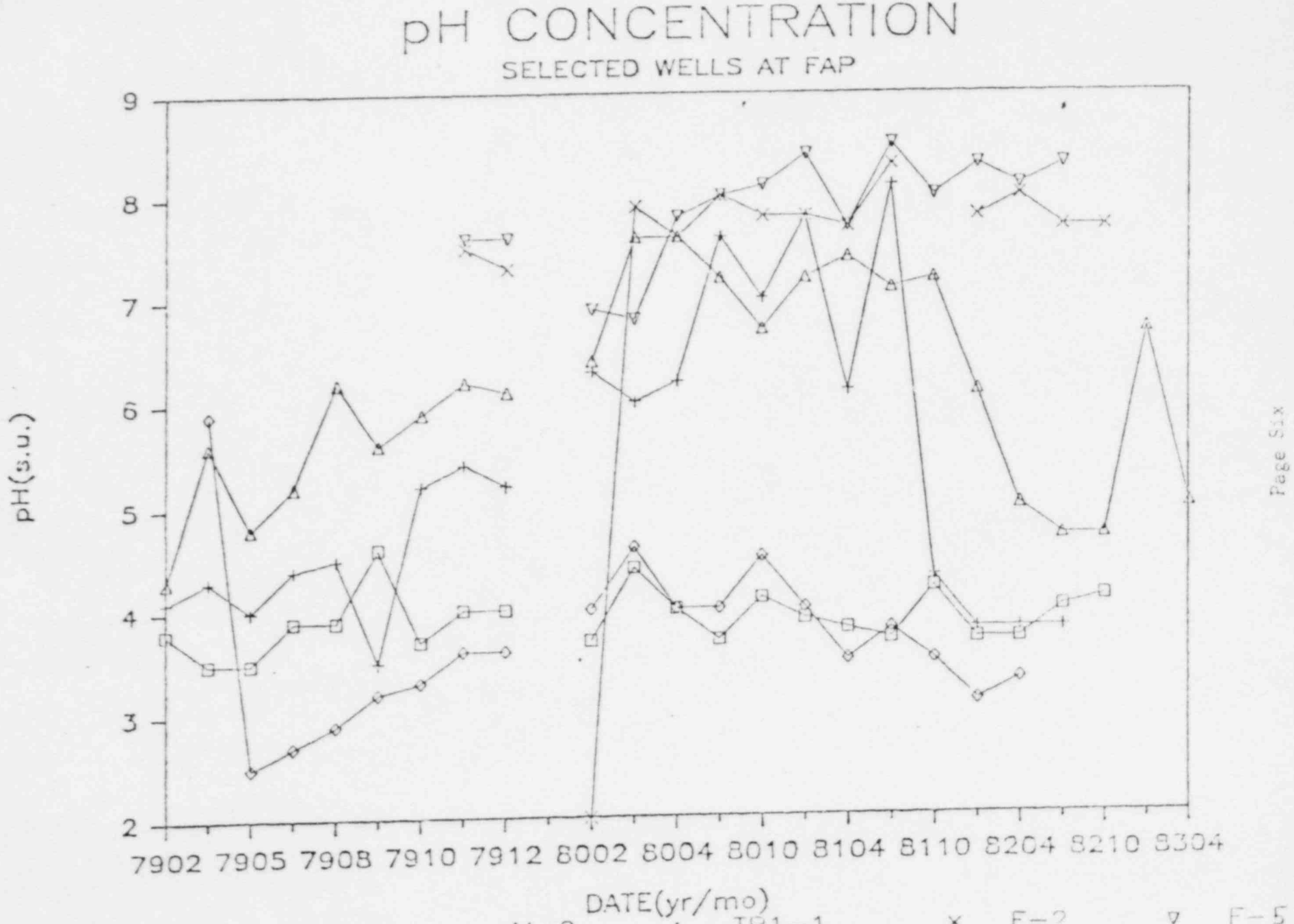

pH CONCENTRATION
SELECTED WELLS AT FAP
pH(s.u.)
9
8
7
6
5
4
3
2
7902 7905 7908 7910 7912 8002 8004 8010 8104 8110 8204 8210 8304
DATE(yr/mo)
TP1-24
M-1
M-2
TP1-1
F-2
F-5

Figure 4

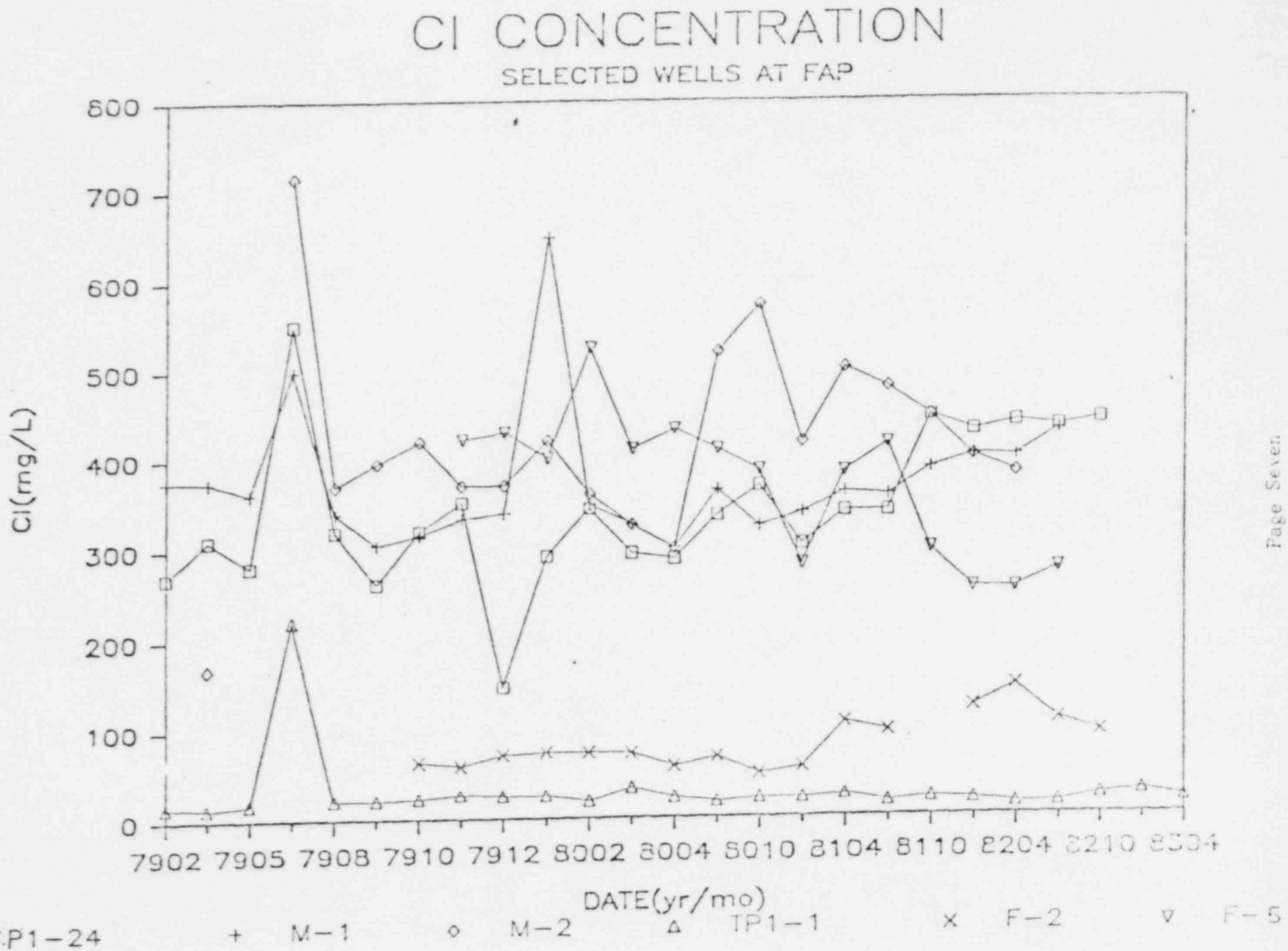

CI CONCENTRATION
SELECTED WELLS AT FAP
CI(mg/L)
800
700
600
500
400
300
200
100
0
7902 7905 7908 7910 7912 8002 8004 8010 8104 8110 8204 8210 8304
DATE(yr/mo)
T.P1-24
M-1
M-2
TP1-1
F-2
F-5

Figure 5

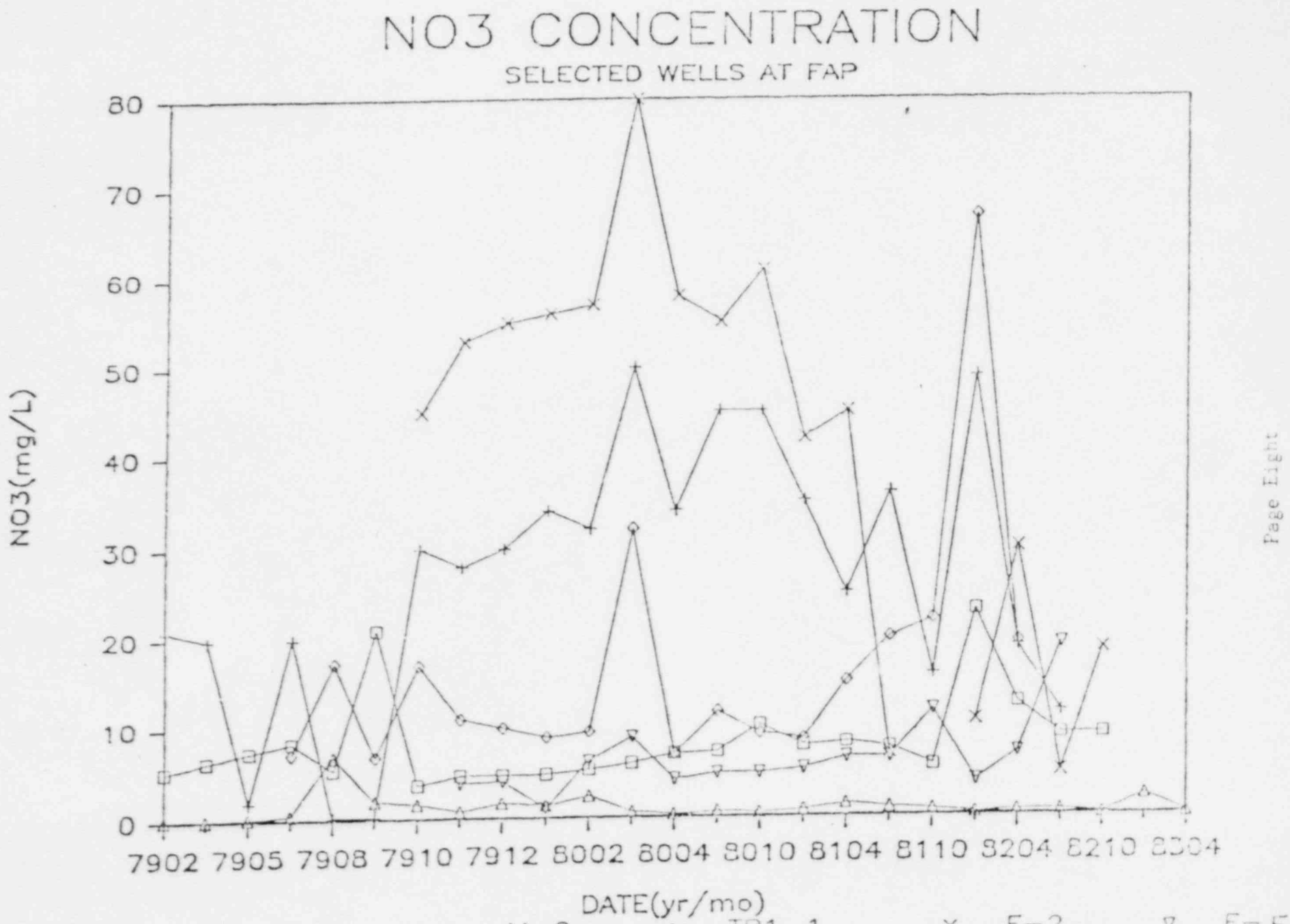
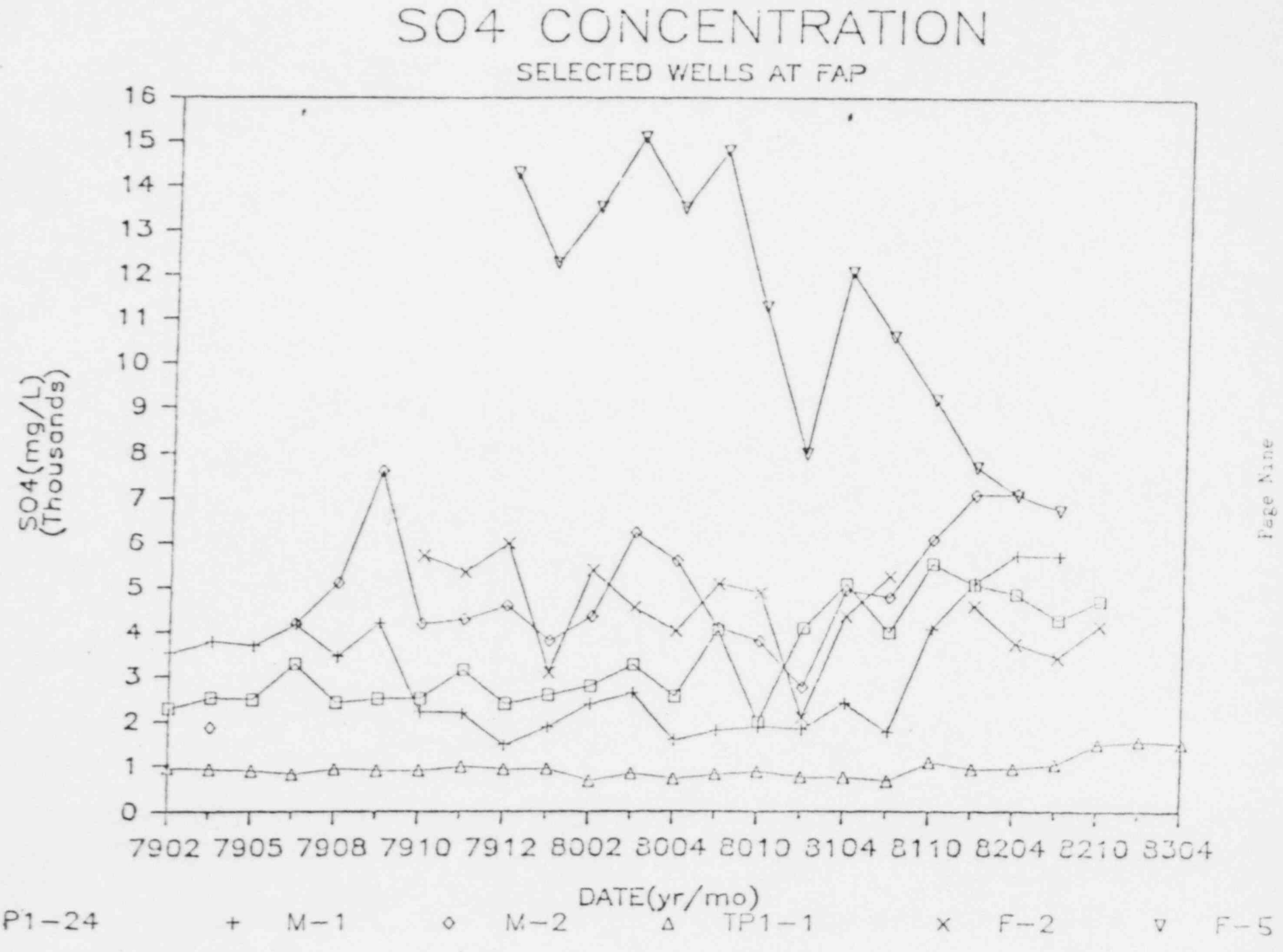

NO3 CONCENTRATION
SELECTED WELLS AT FAP
NO3(mg/L)
80
70
60
50
40
30
20
10
0
7902 7905 7908 7910 7912 8002 8004 8010 8104 8110 8204 8210 8304
DATE(yr/mo)
TP1-24
M-1
M-2
TP1-1
F-2
F-5

Figure 6


SO4 CONCENTRATION
SELECTED WELLS AT FAP
SO4(mg/L)
(Thousands)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
7902 7905 7908 7910 7912 8002 8004 8010 8104 8110 8204 8210 8304
DATE(yr/mo)
TP1-24
M-1
M-2
TP1-1
F-2
F-5

area of increased pressure to lower pressure zones (i.e. away from the pond). As a result of this increased flow of water, an additional surge of seepage water (low pH tailings liquor) will flush into the system. If American Nuclear upgrades their pumpback system, a fair proportion of this surcharge induced excess seepage can be intercepted and fed into an evaporation system.

2. Diversion Design for Surface Water Drainages

Currently, Willow Springs has been rerouted in a PMF channel around Tailings Pond No. 2. Some aggradation has developed where the head of the diversion grades into the native channel. This is attributed to natural adjustments of the system following channel reconstruction. The downstream extent of the diversion is a culvert which underflows Ore Road. During the field inspection of the site (see Finley memo, August 26, 1985), it was observed that a very large scour hole has developed below the outlet point of the culvert. At present, approximately 20 feet of elevation separates the downstream channel below the culvert and the upstream channel above the culvert. This represents a highly unstable section of the Willow Springs channel and could have severely adverse affects on the long term effectiveness of the in-place Willow Springs diversion. American Nuclear will need to address this in their decommissioning plan.

Designs also exist to divert what is known as Campsite Draw. The channel is diverted above Tailings Pond No. 2 into the head of the Willow Springs diversion. The procedures used to design the diversion are accepted techniques. Two potential problems exist and will require some discussion in any decommissioning plan submitted. Firstly, the angle at which Campsite Draw discharge enters Willow Springs is almost directly opposite the direction of flow in the main channel. Should the PMP event strike the area, it is likely that both watersheds will flow at PMF conditions. No analyses exist which consider this likelihood. The affects of this event occurring are probably severe and should be considered. Another problem with the Campsite Draw design is that the discharge point lies above a road which accesses other areas of the mine site. Should a PMF event discharge into this area, it is likely to create a large area of ponded water and destroy the road. Modeling conducted during the design phase of this diversion did not address this physical constraint. American Nuclear will need to consider these problems in their decommissioning submittal.

C. Conclusions

Seepage from Tailings Pond 1 continues at this time. Water levels in down gradient wells provide an indication of the progression and extent of seepage mound flow. The driving force of the system is gravity with the direction of flow to the north northwest. American Nuclear installed a

six well pumpback system as a means of intercepting seepage flow. Plots of water level against time indicate that the operation of the pumpback system has been periodic at best. Historically, the majority of seepage has migrated from the northwest portion of the pond; this being the area with the least amount of pumping. Even when the pumpback system operated the gradient of flow was not altered appreciably. The pumpback system was apparently not designed very well and has not been maintained effectively in the past.

Previous analyses conclude that water moving through the perched aquifer discharges at the surface approximately 2000 feet north of Tailings Pond No. 1. At present, this discharge area has never been exactly delineated. In-house analyses suggest that the surface discharge point (if any) exists even further north, i.e. beyond the Fox wells. Since no water level data exists before 1979, it is not possible to determine pre-tailings disposal water levels in the perched aquifer. Water level plots suggest that the influence of tailings seepage has not begun to dissipate, though water levels should decrease as gravity driven seepage slows down.

Disposal of the Susquehanna tailings at the Tailings Pond No. 1 site is the State of Wyoming's preferred alternative. Actual placement will increase the amount of tailings liquour introduced into the system. This secondary flushing will increase water levels in down gradient wells as the system equilibrates to the new conditions. Renovation of the pumpback system should help to minimize the amount of additional water entering the perched aquifer.

Water quality of the perched aquifer has been degraded as a result of seepage induced contamination. Buffering of the low pH solution occurs soon after fluids enter the aquifer material. Trace elements have precipitated near the tailings pond and contamination of down gradient water is mainly from increased salt concentrations. Conditions at present represent the effects of continued tailings seepage. Chemical equilibration is well advanced and major changes have already occurred. An important objective is to continue monitoring the plume and locating the point of discharge in order to mitigate possible adverse affects in the discharge area.

Surface water diversions, both in-place and proposed, require further considerations. A potentially severe erosion problem exists near the downstream end of the Willow Springs diversion. Two problems are evident in reviewing the Campsite Draw diversion. Flow from the Campsite Draw diversion at the confluence with Willow Springs is directly opposite to the mainstream flows. In addition, a road currently in place was not included in a total system analysis. It is not clear what affects on channel stability the two above mentioned items will have and further investigation is suggested.

D. Recommendations

American Nuclear's forthcoming decommissioning plan should consider the following:

1. Renovation/upgrading of the pumpback system below Tailings Pond No. 1. This is imperative if the Susquehanna tailings are disposed of at this site.

2. Construction of a lined evaporation pond outfitted with equipment to enhance evaporation. Pumpback well operation is suggested during the summer months.

3. A more detailed investigation into the discharge area of the perched aquifer is necessary. Attempting to treat the water in-place is not suggested, but knowing where it discharges is very important.

4. Wells to be monitored, frequency of sampling, and parameters are listed in Table 1 of this document. This table is also endorsed by the NRC.

5. Surface water diversions should include additional discussion of three items:

a) Control of the 20 foot headcut at the downstream end of the Willow Springs diversion.

b) Affects of PMF flows from the Campsite Draw diversion entering the Willow Springs diversion in a nearly opposite direction.

c) Affects of the road currently located at the downstream end of the Campsite Draw diversion.

JF/kv
cc: District II
Susan Hogg
Bill Kearney

References

Johnson, K., 1985, Use of geochemical modeling in the interpretation of water quality and overburden chemical analysis, Proceedings of the American Society for Surface Mining and Reclamation, Denver, CO, October 8-10, 1985, p. 404-412.

McWhorter, D.B., and D.K. Sunada, 1977, Ground-Water Hydrology and Hydraulics, Water Resources Publications, Littleton, CO, 290 p.