CHAPTER IV
ALTERNATIVES FOR GROUNDWATER MANAGEMENT IN IDAHO

Application of the Appropriation Doctrine to Groundwater in Idaho

The appropriation doctrine was designed for the allocation of a perpetual but fluctuating flow of water among competing users. The system is reasonably applicable to surface water and serves as the basis for water rights in a number of western states. In some of these states, including Idaho, the doctrine has been applied to groundwater.

The important aspects of the Idaho Code with respect to groundwater are as follows:

> Section 42-226. "It is hereby declared that the traditional policy of the state of Idaho, requiring the water resources of this state to be devoted to beneficial use in reasonable amounts through appropriation, is affirmed with respect to the groundwater resources of this state as said term is hereinafter defined; and, while the doctrine of 'first in time is first in right' is recognized, a reasonable exercise of this right shall not block full economic development of underground water resources, but early appropriators of underground water shall be protected in the maintenance of reasonable groundwater pumping levels as may be established by the Director of the Department of Water Administration as herein provided. All groundwater in this state are declared to be the property of the state, whose duty it shall be to supervise their appropriation and allotment to those diverting the same for beneficial use. All rights to the use of groundwater in this state, however, acquired before the effective date of this act are hereby in all respects validated and confirmed."
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> Section 42-233a. "'Critical groundwater area' is defined as any groundwater basin, or designated part thereof, not having sufficient groundwater to provide a reasonably safe supply for irrigation of cultivated lands, or other uses in the basin at the then current rates of withdrawal, or rates of withdrawal projected by consideration of valid and outstanding applications and permits, as may be determined and designated, from time to time, by the Director of the Department of Water Administration.

Upon the designation of a 'critical groundwater area' it shall be the duty of the Director of the Department of Water Administration to conduct a public hearing in the area concerned to apprise the public of such designation and the reasons therefore. Notice of the hearing shall be published in two (2) consecutive weekly issues of a newspaper of general circulation in the area immediately prior to the date set for hearing.

In the event an area has been designated as a 'critical groundwater area' and the Director of the Department of Water Administration desires to remove such designation or modify the boundaries thereof, he shall likewise conduct a public hearing follow-similar publication of notice prior to taking such action.

In the event the application for permit is made with respect to an area that has not been designated as critical groundwater area the Director of the Department of Water Administration shall forthwith issue a permit in accordance with the provisions of section 42-203 and section 42-204 provided said application otherwise meets the requirements of such sections.

In the event the application for permit is made in an area which has been designated as a critical groundwater area, if the Director of the Department of Water Administration from the investigation made by him on said application as herein provided, or from the investigation made by him in determining the area to be critical, or from other information that has come officially to his attention, has reason to believe that there is insufficient water available subject to appropriation at the location of the proposed well described in the application, the Director of the Department of Water Administration may forthwith deny said application; provided, however, that if groundwater at such location is available in a lesser amount than that applied for the Director of the Department of Water Administration may issue a permit for the use of such water to the extent that such water is available for such appropriation."

Section 42-237a-g. g. "To supervise and control the exercise and administration of all rights hereafter acquired to the use of groundwaters and in the exercise of this power he may by summary order, prohibit or limit the withdrawal of water from any well during any period that he determines that water to fill any water right in said well is not there available. To assist the Director of the Department

> of Water Administration in the administration and enforcement of this act, and in making determinations upon which said orders shall be based, he may establish a groundwater pumping level or levels in an area or areas having a common groundwater supply as determined by him as hereinafter provided. Water in a well shall not be deemed available to fill a water right therein if withdrawal therefrom of the amount called for by such right would affect, contrary to the declared policy of this act, the present or future use of any prior surface or groundwater right or result in the withdrawing the groundwater supply at a rate beyond the reasonably anticipated average rate of future natural recharge..."

The statutes call for the "full economic development" of the resource with the restriction that "reasonable ground water pumping levels" be maintained. The total development is limited to the "reasonably anticipated average rate of future natural recharge". Recognition is given that excessive declines in water levels may occur and some protection is noted for the means of diversion. It is difficult to determine if the statement concerning full economic development refers to the use of the resource beyond the flow component. No guidelines are given for the use of stock groundwater except as an elevator to help maintain reasonable pumping levels.

Groundwater administration in Idaho has been limited to the designation of five critical groundwater areas. This designation closes the area to the future applications to appropriate groundwater but does not affect any of the existing pumpers or those holding valid outstanding permits.

Groundwater Management Under the Idaho Code

Two levels of resource management are allowed under the Idaho statutes. It is possible for the director of the Department of Water Administration to deny a permit for a new user

in a groundwater basin on the basis that unappropriated groundwater is not available. The Director may indicate that unappropriated groundwater is not available in an area by the declaration that the area is a critical groundwater area. This designation serves as a notice to new users that applications for permits will either be denied or approved in reduced quantities. The recent decision in the case of Tappen v. Smith indicates that the director of the Department of Water Administration does have sufficient power to create critical groundwater areas and to prevent new uses of groundwater on the basis that unappropriated groundwater is not available. Because of this case, it is assumed for this study that the director of the Department of Water Administration has sufficient power to close areas to future appropriation.

Two main restrictions are presented in the Idaho Code that could result in closure of wells with valid water rights. These are noted as the recharge limitation and the pumping lift limitation. The recharge limitation is the limit on development to the "reasonably anticipated average rate of future natural recharge". The pumping lift limitation is the protection that the individual user has in the maintenance of "reasonable groundwater pumping levels".

Groundwater Administration Under the Pumping Lift Restriction

An outline of groundwater administration under the criteria of reasonable groundwater pumping levels is presented in Figure 3. A number of decisions must be made in order to arrive at a management plan. The first level of decision involves the

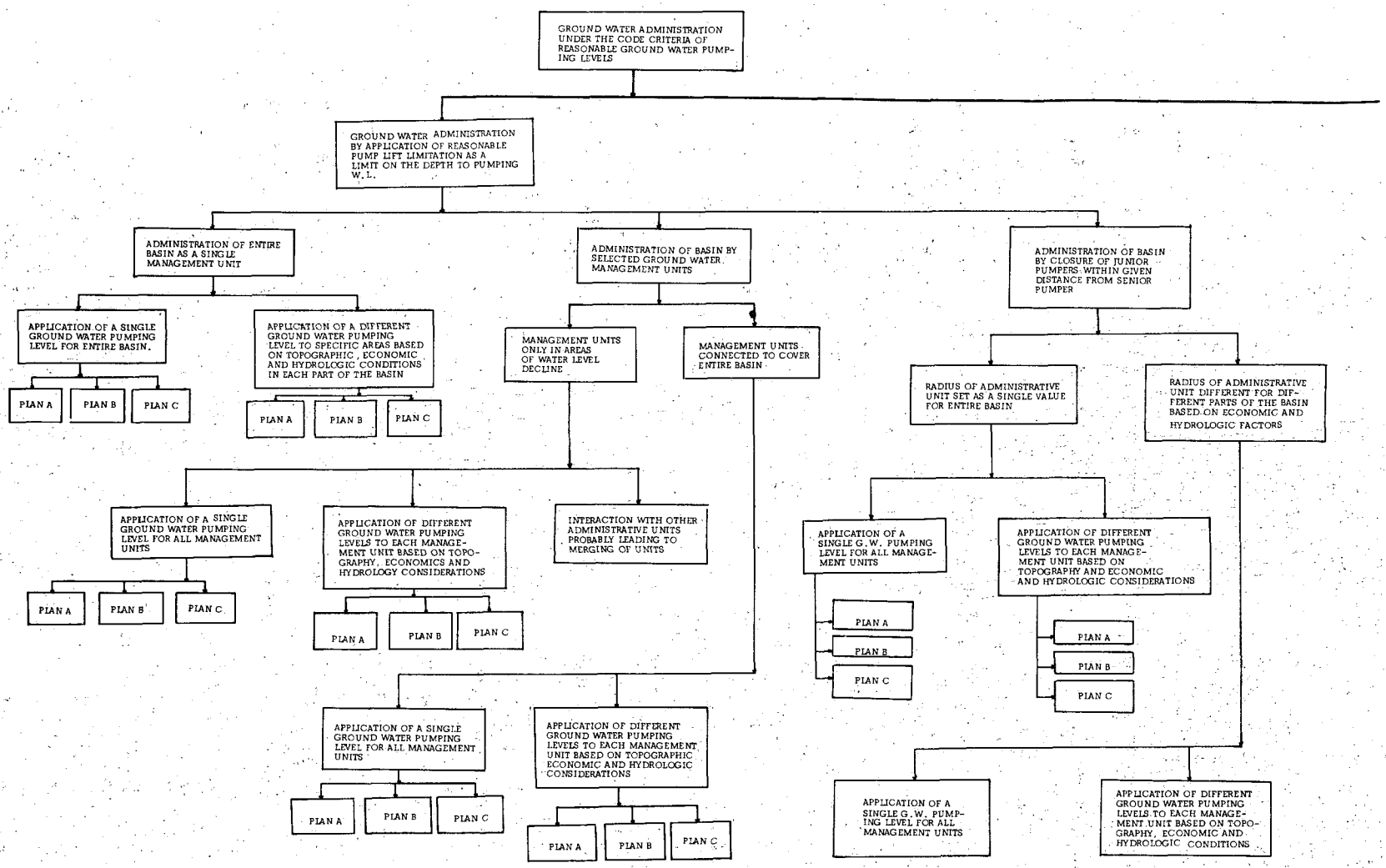


Figure 3

Alternatives for Groundwater Management Under the Concept of Reasonable Groundwater Pumping Levels

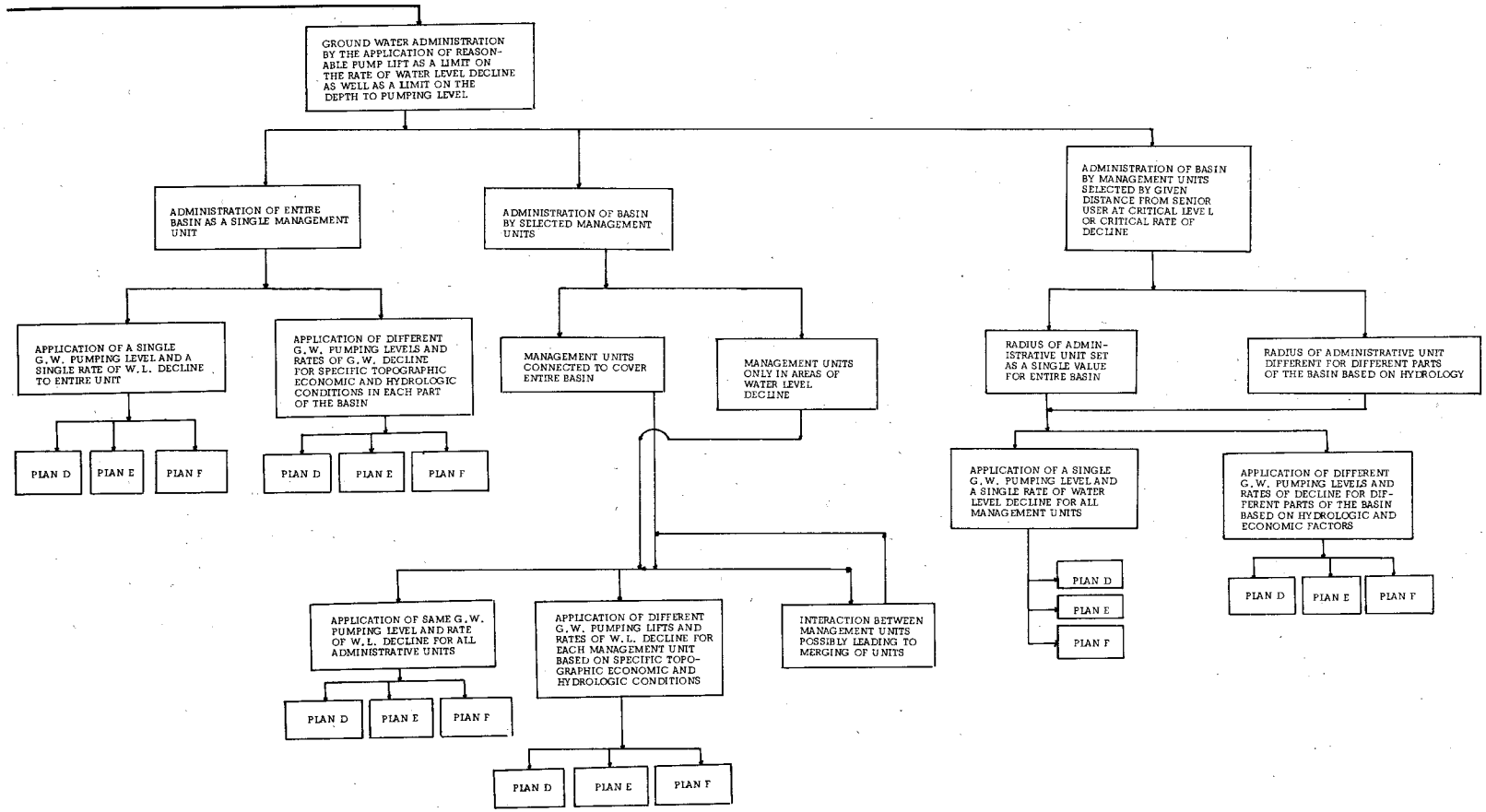
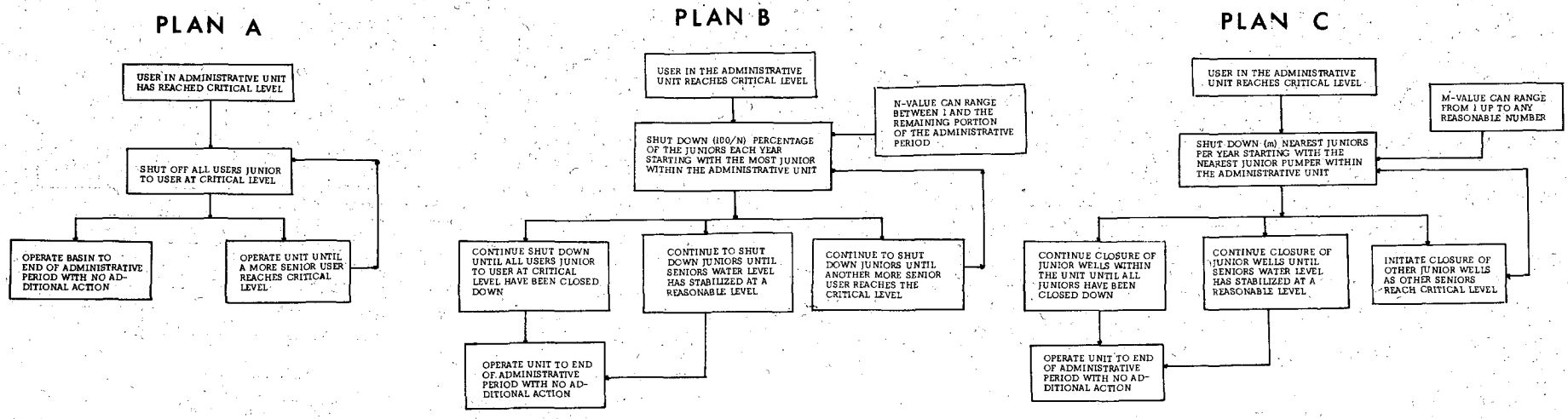


Figure 3 (continued)



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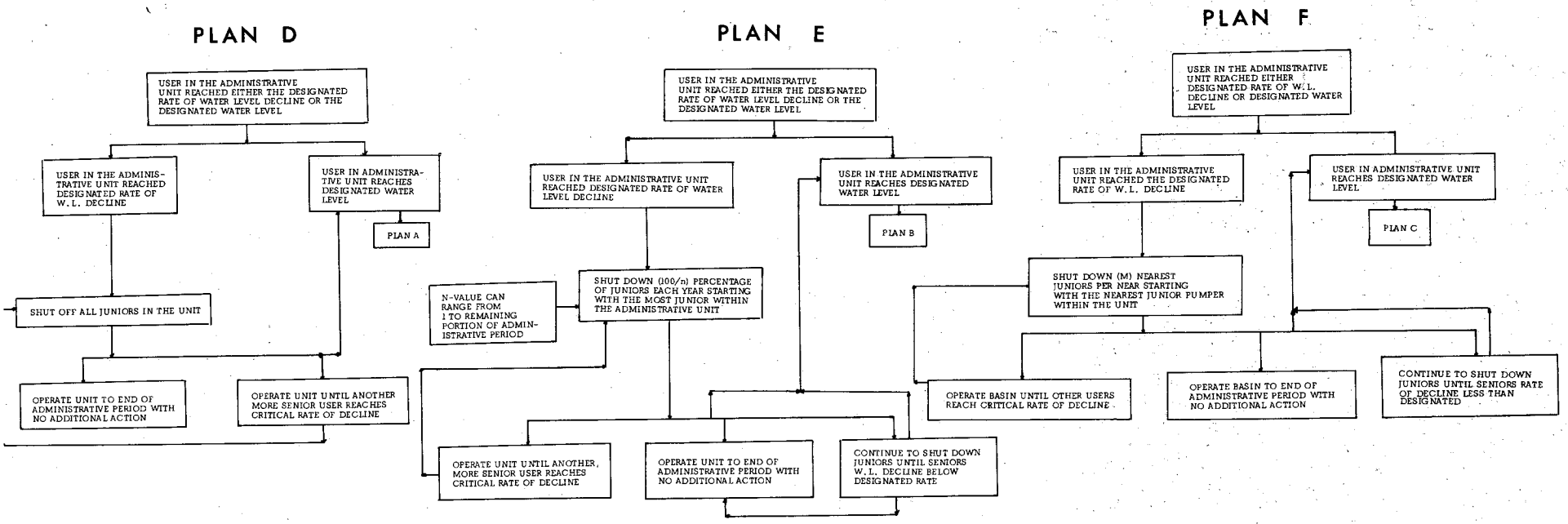

Figure 3 (continued)

selection of reasonable groundwater pumping levels as the primary administrative tool. The second decision concerns the definition of the pumping lift concept. Reasonable groundwater pumping levels can be interpreted as 1) a limit on the depth to pumping water level or, 2) a limit on the rate of water level decline plus a limit on the depth to pumping water level. If the pumping lift limitation is assumed to be the limit on the depth to pumping water level, then a decision must be made on the method of application of pumping level restriction to the basin. The Idaho Code allows the designation of a critical groundwater area as part or all of a groundwater basin. It is thus possible to apply the reasonable groundwater pumping lift restriction to all or only part of the basin.

The first alternative, noted in Figure 3, is to apply the restriction to a single administrative unit that includes the entire basin. The restriction may also be applied to selected groundwater management units which may or may not include the entire basin. The restriction may be applied to units defined by a given distance from the senior pumper who has reached the critical level. The selection of the size of the administrative unit is very important in the application of the pumping lift restriction. Administration of groundwater in the Raft River Basin has been limited to date to the declaration of the entire basin as a critical groundwater area. The basin is thus being treated at the moment as a single management unit.

Two primary alternatives are outlined for the selection of the reasonable pumping lift value for the basin. The first and simplest application of the reasonable pumping lift concept

is the application of a single groundwater pumping level for the entire basin. Based on the assumptions noted by Young and Ralston (1971), the pumping level would be designed for a typical irrigator for the entire basin without reference to growing season and crop variations within the basin and differences in topographic features. The second major alternative in the application of reasonable pumping lifts to a single unit covering the entire basin is the application of different groundwater pumping levels in each part of the basin based upon specific topographic, economic and hydrologic conditions. Under this plan, a reasonable groundwater pumping level would better fit the conditions in each part of the basin. It would be difficult, however, to interface the groundwater pumping lift management scheme when conflicting users have different reasonable pumping lift values.

Once the reasonable pumping lift value is selected for the basin or for parts of the basin, considerable question exists on the application of that value to users within the basin. Three basic plans of application of the reasonable pumping lift value within the administrative unit are presented in Figure 3. These plans are repeated throughout the various alternatives noted on the diagram. Each of these plans is initiated when any user in the administrative unit has reached the designated critical level. Under plan A, the administrative official would shut off all users junior to that user that has reached the critical level. Thus, if the user at the critical level were the most senior user in the basin, all of the other users in the basin would be shut off. However, if

he were the second most junior user, only the most junior user would be shut off. Two basic courses of action are possible following this closure of juniors. The basin may be operated to the end of the administrative base period with no additional administrative action. However, if another user within the administrative unit reaches the designated critical level, all users junior to him would be shut off with administration following this general plan to the end of the administrative base period.

Plan B also would be initiated when a user in the administrative unit reaches the designated critical level. Under this plan the administrative officer for the state would shut down (100/n percentage) of the juniors each year starting with the most junior within the administrative unit. This would continue for (n) years with (n) being any number between 1 and the remaining number of years in the administrative period. Administration would follow this guideline until either 1) all users junior to the user at the critical level had been shut down or 2) the senior's water level had been stabilized at the designated reasonable level. In either of these cases, administrative action would be terminated for the remainder of the administrative period. However, if another user reaches the critical level, administration action would include shutting off (100/n percentage) of the users junior to that user each year.

Plan C would be initiated when any user in the administrative unit reaches the critical level. Under this plan, (m) nearest juniors would be shut down per year starting with the

nearest junior user within the administrative unit. The (m) value can range from 1 up to any reasonable number. The users to be shut down would be the nearest junior users so that all users, junior to the pumper at the critical level, would be grouped irrespective of priority. Administration under plan C would continue until either 1) all users junior to that user at the critical level have been closed down, or 2) sufficient juniors have been closed down to stabilize the senior's water level at the designated reasonable level. Administration would then continue without further action to the end of the administrative period. However, if another user reaches the critical level within the administrative unit, administration would include the closure of (m) juniors per year near that senior user.

Plan A provides for the closure of a probable large number of users without examination of the positive benefit for the senior who has reached the critical level. This plan would be advisable only if the administrative unit were selected as a very small area. Plan B provides an important modification of Plan A in that only a portion of the juniors would be shut down each year with this closure to continue until either all juniors are closed down or the senior has been protected as to his reasonable pumping level. However, this plan still ignores the importance of the location of each particular user. In a large administrative unit, a user at great distance may be shut down with no immediate benefit to the senior. This plan would also provide reasonable administrative action in small administrative units. Plan C would perhaps provide greatest

protection because those users closest to him would be shut down first. Conversely, all users junior to the user at the critical level would be assumed to have equal priority thus eliminating some of the value of the water right. Location would be an important factor in the certainty of water use.

The administrative unit may be selected as other than the entire basin. Administration of the groundwater resource in a basin may be performed in selected groundwater management units or in groundwater management units based on a given distance from a senior pumper who has reached the designated critical level (Figure 3). The selected administrative units may connect to cover the entire basin or may be located only in areas of immediate water level decline. Selection and application of reasonable pumping lift value or values would follow the same course of action as described for management of the basin as a single unit. However, the complicating factor of interaction between selected administrative units would have to be considered. Closure of juniors under this application of the reasonable pumping lift concept would follow plan A, plan B, or plan C described previously.

The size of the administrative unit could be based on a given distance from a senior pumper who has reached the designated reasonable pumping lift. The radius of the administrative unit could be set either as a single value for the entire basin or modified for different parts of the basin based on hydrologic and economic factors. The application of selected reasonable pumping lift value or values would follow the format described previously with final application of the critical

value under plan A, B, or C as described above.

Reasonable pumping lift has been discussed previously as a control on the depth to pumping level. It is also possible to interpret reasonable pumping level as a combination of control on the rate of water level decline and control on the depth to pumping water level. As is shown in Figure 3, this interpretation provides a different set of alternatives for closure of junior users.

Plan D is initiated when a user in the administrative unit reaches either the designated rate of water level decline or the designated pumping water level. If a user in the administrative unit reaches the designated rate of water level decline, all users junior to him in the unit are shut off. This plan is directly parallel to Plan A. Upon this action the unit would either be operated until the end of the administrative period with no additional action, operated until another, more senior user reaches the critical rate of decline or operated until a user reaches the designated reasonable pumping lift. In the second case, all users junior to the second person reaching the critical rate of decline would be shut off. When a user reaches the designated reasonable pumping lift value, plan D then reverts directly to plan A.

Plan E is very similar to Plan B. In this case when the user reaches the designated rate of water level decline (100/n) percentage of the junior users would be shut off each year starting with the most junior within the administrative unit. This operation would continue until 1) another more senior user reaches the critical rate of decline, 2) the first senior has

had his water level decline reduced below the designated rate of water level decline, or 3) a user in the area reaches the designated reasonable pumping lift value. Under the latter possibility, plan E would then revert to plan B.

Under plan F, when a user in the administrative unit reaches the designated rate of water level decline, (m) nearest juniors would be shut down each year starting with the nearest junior pumper within the unit. The basin would then be operated until either 1) other users reach the critical rate of decline, 2) the seniors rate of water level decline is reduced until it is less than the designated rate of decline, or 3) a user in the administrative unit reaches the designated reasonable pumping lift value. In the latter case, plan F would revert to plan C described previously.

The outline of decisions under administration of reasonable pumping lift as a limit on the rate of water level decline as well as a limit on the depth of pumping water level is similar to that discussed previously with the exception that the final plans of application of the reasonable pumping lift concept are plans D, E, and F, rather than A, B, and C.

Five basic levels of decision are described on Figure 3. First, the administrator must choose the particular management tool to apply to the basin. In this case, the choice is reaonable pumping lift. Secondly, the administrator must choose a definition of reasonable pumping lift. The definition may either be a limit on the depth to pumping water level or a limit on the rate of water level decline plus a limit on the depth to pumping water level. Third, the administrator must

choose the size of management unit and the length of management period. Fourth, he must select the pumping lift value or values and the rate of decline value or values to be applied in the management units. Fifth, he must select a method of application of the designated pump lift and rate of decline values to users in the administrative units.

Groundwater Administration Under the Recharge Limitations

The Idaho Code limits development in a groundwater basin to the "reasonably anticipated average rate of future natural recharge". The decision diagram for this administrative alternative is presented in Figure 4. One of the primary problems with administration of the resource under this criteria is the definition of the recharge limitation. Four alternative definitions are presented in Figure 4. First, the recharge limitation may be defined as the total water available for man's use in the basin (water yield). Second, the recharge limitation may be defined as the total recharge to the groundwater system. Third, it may be defined as equal to the total recoverable discharge from the groundwater system. Fourth, the recharge limitation may be defined as a time dependent function of the hydrologic, economic and well location conditions in the basin. The size of administrative units must be selected under any of these alternative definitions. A single administrative unit may cover the entire basin, or the basin may be administered through selected groundwater management units.

The application of a single recharge value to an administrative unit covering an entire basin would follow plan G

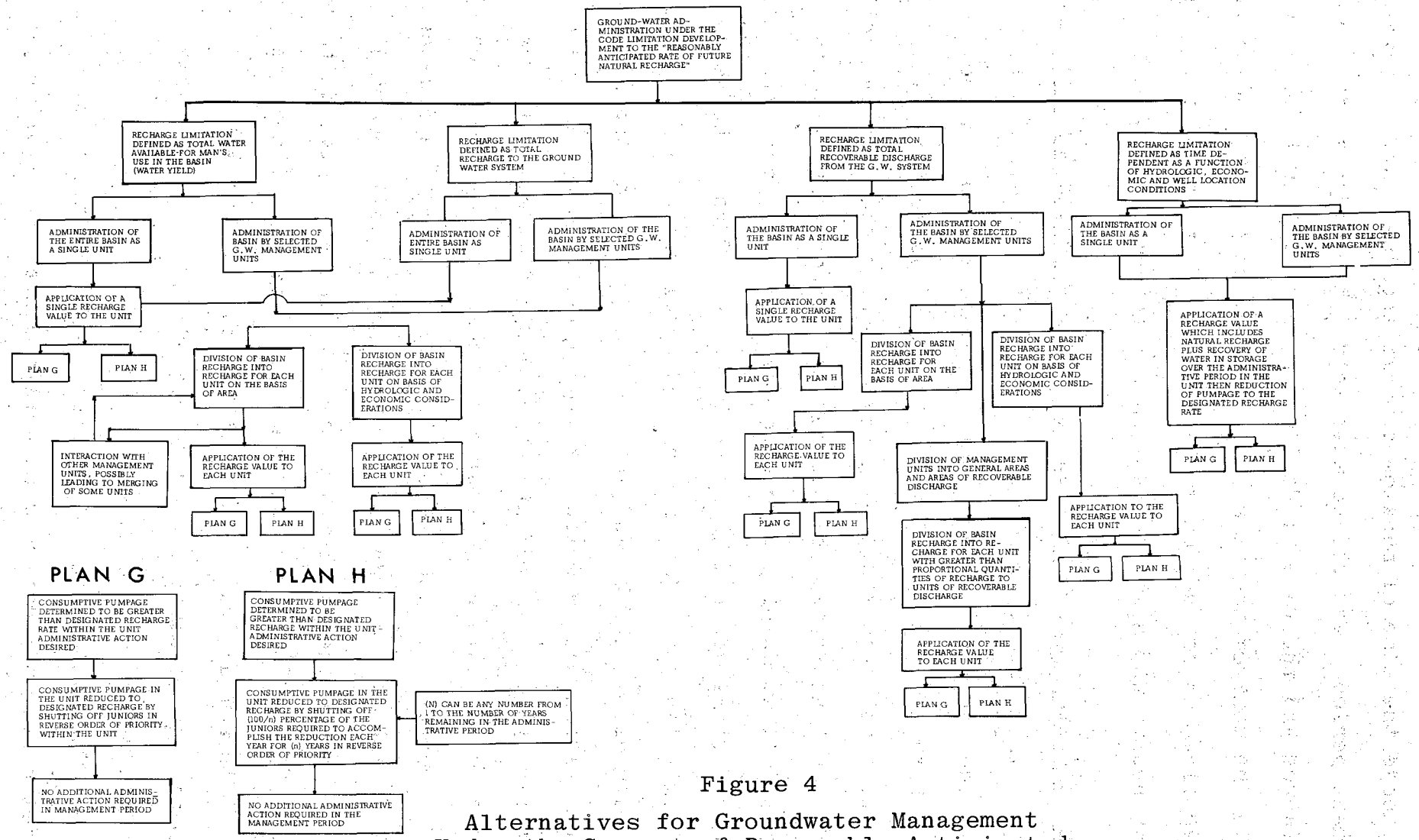

Figure 4

Alternatives for Groundwater Management Under the Concept of Reasonably Anticipated Average Rate of Future Natural Recharge

or plan H, as shown on Figure 4. Under plan G, the consumptive pumpage in the unit would be reduced to the designated recharge value by shutting off juniors in reverse order of priority within the unit. It is envisioned that the well closure would occur all at once. Under plan H the consumptive pumpage in the unit would be reduced to the designated recharge by shutting off (100/n) percentages of the juniors required to accomplish the reduction each year for (n) years in reverse order of priority. This alternative plan would spread the impact of the closure over a number of years.

A decision must be made on the division of the basinwide recharge value into recharge values for each specific unit if administration of the basin under the recharge limitation is to be performed in selected groundwater management units. As is shown in Figure 4, this division may be based on either the size of each administrative unit with respect to the total area in the basin or on the basis of hydrologic and economic considerations. In either case, the application of the selected recharge value to the users in each unit would follow either plan G or plan H described previously.

Administration of the resource under the recharge limitation defined as the total recharge to the groundwater system would follow the same pattern as described for the definition of the recharge limit as water yield. The only difference would be in the total magnitude of the defined natural recharge value.

Resource administration with the definition of recharge being recoverable discharge from the groundwater system would follow that described above with one exception. The division

of the basinwide recharge into recharge for each groundwater management unit would be varied on the basis of recoverable discharge within each management unit. For example, management units near discharge points might be allowed greater unit recharge than other units of the same size within the basin.

Administration of the recharge limitation with a definition of recharge being time dependent as a function of hydrologic, economic and well location conditions could vary widely from administration under other definitions of the constraint. The application of a recharge value which included both natural recharge and recovery of water in storage over the administrative period would allow a greater immediate development of the resource. In this case, the length of the administrative period would be very important as the development would revert back to the designated natural recharge to the area at the end of the assigned administrative period. Closure of juniors within the unit would follow either plan G or plan H described previously.

Five levels of decisions are apparent in the application of the recharge restriction for basin management. First, the administrator would select the recharge limit as the management tool. Secondly, the administrator would define the recharge limit. Third, he would select the size of the administrative unit or units and select the length of the management period. Fourth, he would select the reasonable recharge value or values for each unit. Fifth, he would select the method of application of the recharge limits to users within each administrative unit.

Steps in Groundwater Administration

The first indication of a groundwater problem is often excessive water level decline. Some decline of water levels must necessarily result from man's development of the resource. The water level decline must thus be interpreted as a water resource management problem. Under Idaho statutes, the probable, but not necessary, next step is the declaration of a critical groundwater area. This declaration prohibits new applications for permit to appropriate groundwater in the area. The next logical, and very necessary step is an adjudication of the groundwater rights. Under this process, each user has his recorded or non-recorded water right established with respect to priority, quantity of water and location of water use. The product of an adjudication is a priority list noting valid water rights and giving the priority date, the quantity of water and the lands irrigated. Pumpage must be discontinued for those wells without valid water rights. The water level decline may continue or the decline may be slowed or stopped as a result of this adjudication action. No further administrative action is required if the water levels stabilize.

If the water level decline continues, the next step is an evaluation of the physical aspects of the problem and a selection and application of a management tool. Four general classifications of physical problems may be outlined: 1) local water level decline with total basin pumpage believed less than basin recharge, 2) general water level decline with total basin pumpage believed less than basin recharge, 3) local water level decline with total basin pumpage believed to be greater than

basin recharge, and 4) general water level decline with total basin pumpage believed to be greater than basin recharge. The selection of the management tool is based on the type of physical problem. The administrative decisions noted on Figures 3 and 4 would then follow.

Analysis of Management Alternatives for Groundwater in Idaho

Management of groundwater under the appropriation doctrine must first include an adjudication of water rights. A mock adjudication of groundwater rights in the study basin was performed because an actual adjudication had not been conducted. The second step in groundwater management is the development of administrative procedures based on the physical aspects of the basin and the alternatives outlined in the legal code. Alternatives for groundwater management in Idaho are presented earlier. The third step in groundwater management is the application of the management procedures to the basin under consideration. In this study, management alternatives are applied to the mathematical model of the water resource system in the Raft River Basin. The analysis of alternatives for groundwater management in Idaho is based on operation of the model under given sets of constraints.

Application of Management Alternatives to the Model of the Study Area

Management alternatives are evaluated using the model of the water resource system in the Raft River Basin by the control of pumpage from individual wells. Each well is identified by location and water right priority. Specific management plans

include the operation or closure of wells based on priority and/or location.

A Basis Run was designed to provide the standard for comparison of the impact of various management alternatives on the water resource system. The model was operated for this run for the period 1971-1990, with only those wells with valid water rights operating. Punched output was obtained of the water level elevation at all nodes at the end of the pumping season each year. In addition, water level data were punched at the start and end of the pumping season for all nodes where pumping wells are located. These data were utilized for hydrograph plots. Groundwater outflow from the basin was also calculated at the start and end of the pumping season for each year.

Basis Run

The Basis Run represents administration of the groundwater resources in the basin after the water rights adjudication without any closure of wells with valid rights. Considerable water level change occurs in the basin during the period of 1971-1990. Areas of major decline coincide with concentrations of wells. The rate of decline is shown on Figures 5 and 6 for well locations. The rate of decline is approximately constant for most at Nodes 4536 and 5437. The groundwater outflow, as calculated by the model, steadily decreases with time as the impact of pumpage reaches the northern end of the basin.

Analysis of Reasonable Groundwater Pumping Levels as a Tool for Resource Management

A number of administrative alternatives for management of groundwater under the guidelines of reasonable pumping levels

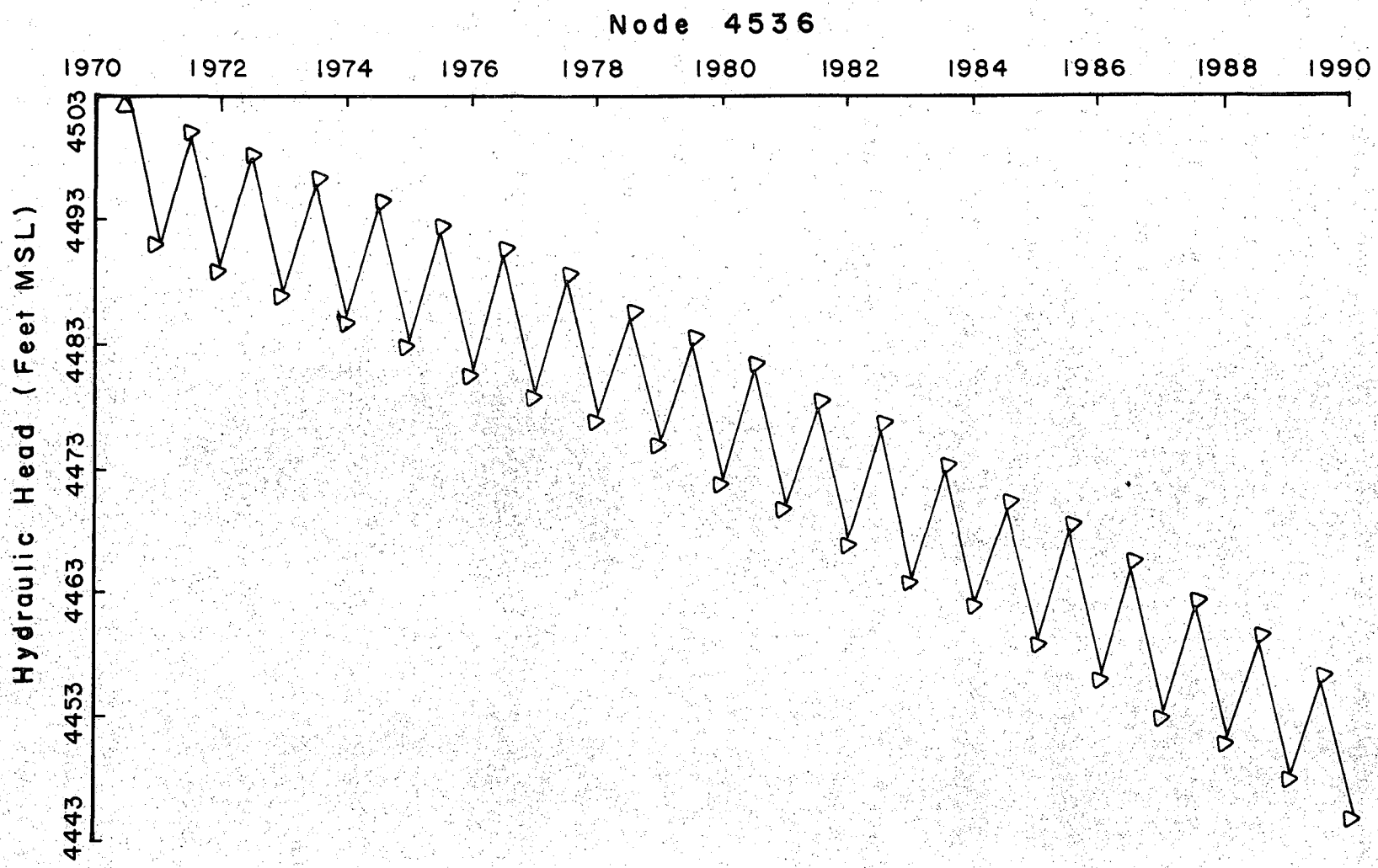

Figure 5
Hydrograph of the Well at Node 4536, Basis Run

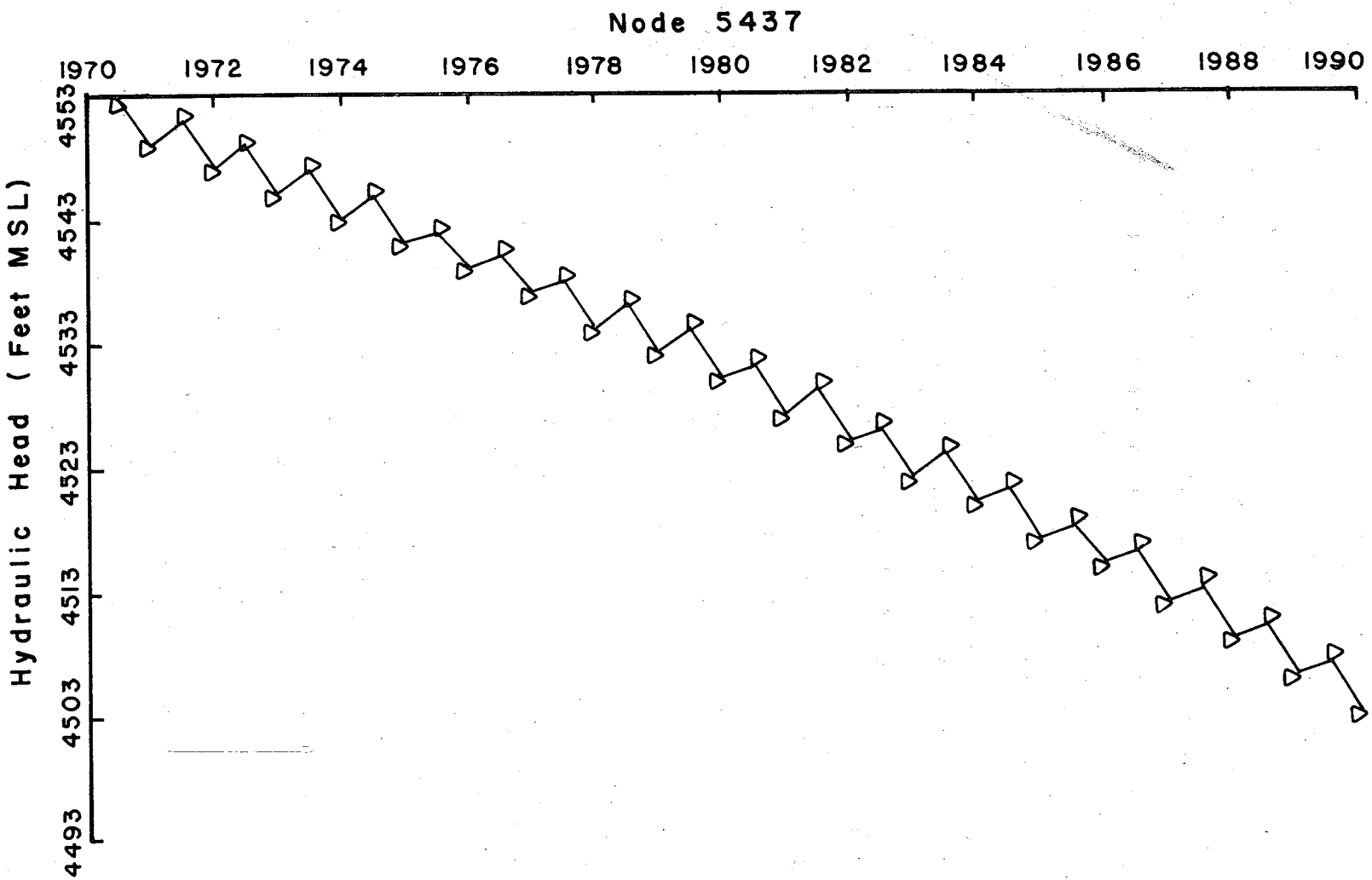

Figure 6
Hydrograph of the Well at Node 5437, Basis Run

are presented in Figure 3. Five levels of decision are noted on that figure.

1. Selection of a management tool (reasonable pumping lift).

2. Definition of the reasonable pumping lift concept.

   a. A limit on the maximum depth to pumping water level

   b. A combination limit on the maximum rate of water level decline and the maximum depth to pumping water level.

3. Selection of administrative management units and selection of length of management periods.

4. Selection of the pump lift (or pump lift and rate of decline) values for the administrative unit or units.

5. Selection of method of application of reasonable pump lift values to junior users in the administrative units.

The concept of reasonable pumping levels was first evaluated as a limit on the maximum depth of pumping water level. Pump lift was determined for each operating well for each year of the 1970-1990 period using data generated from the Basis Run and an array of land surface elevations for well locations. The pumping lifts in wells in the basin in 1975 are presented in Figure 7. Most of the wells with pumping lifts greater than 250 feet are located around the margin of the basin. The distribution of pumping lifts in 1975, 1980, 1985, and 1990 are presented in Figure 8. The modal pumping level increases from the range of 50-100 feet in 1975 to 100-150 feet in 1990. The mean pumping lift increased from 120 feet in 1975 to 144 feet in 1990.

The selection of reasonable groundwater pumping levels for a basin must be based on economic, social, physical, and political considerations. Young and Ralston (1971) present the only