

Appendix A

**ARTICLE 2. REGULATIONS FOR THE ALLOCATION AND USE
OF AGRICULTURAL WATER WITHIN WESTLANDS WATER DISTRICT**

2.1 PURPOSE

Westlands Water District has long-term contractual and legal entitlements with the United States for a firm supply of 1,150,000 acre-feet (AF) of Central Valley Project (CVP) water during each water year. In some years, the District may acquire additional water pursuant to its entitlements, or other water. Pursuant to District Resolution No. 128-95, the Board of Directors has adopted the following Regulations establishing the rules and procedures for allocation and use of agricultural water.

2.2 GLOSSARY OF TERMS AND DEFINITIONS

- A. agricultural water - water used for irrigation and other agricultural purposes.
- B. Agricultural Water Allocation Application and Purchase Agreement (referred to as Allocation Application) - an agreement between the District and a water user which describes the land held by the water user, the amount of water requested by the water user, and which obligates the water user to accept and pay for all water supplied by the District.
- C. allocation - amount of water ratably distributed from any source of supply to eligible District lands.
- D. Area I - lands which formed a part of Westlands Water District on June 28, 1965 (the original Westlands area), as shown on Westlands Water District Dwg. No. 582, dated December 21, 1976, revised November 1, 1986, entitled "Areas of Water Service Priority."
- E. Area II - lands which formed a part of the original Westplains Water Storage District on June 28, 1965 (the original Westplains area), as shown on Westlands Water District Dwg. No. 582, dated December 21, 1976, revised November 12, 1986, entitled "Areas of Water Service Priority."
- F. Area III - lands which became a part of Westlands Water District after July 1, 1965 (the annexed area), as shown on Westlands Water District Dwg. No. 582, dated December 21, 1976, revised November 12, 1986, entitled "Areas of Service Priority."
- G. area entitlements - amount of contract water allocated for each District area.
- H. contract water - any water obtained under the contractual and legal entitlements including additional and interim supplies.
- I. cropland - irrigable acreage as determined by U.S. Consolidated Farm Service Agency (CFSA), formerly the ASCS, measurements.
- J. cushion - water set aside for system losses and other uses.
- K. entitlements - water provided pursuant to the contractual and legal obligations between Westlands Water District and the United States for water supply and distribution: 900,000 AF under the 1963 Contract and 250,000 AF of provisional water under the Barcellos Judgment.
- L. furnish - to deliver or provide.
- M. M&I water - water used for incidental, nonagricultural purposes.
- N. other water - water other than contract water.
- O. overuse - use in excess of available supply.
- P. per acre entitlement - ratably share of contract water:
The Area I entitlement is 900,000 AF divided by the number of Area I cropland acres for which Allocation Applications are timely received; the Area II entitlement is 250,000 AF divided by the number of Area II cropland acres for which Allocation Applications are timely received.
- Q. rescheduling - carryover of water for use in the next water year.
- R. system gain - an increase in water available for allocation due to the difference in relative accuracy between state operated and maintained headworks meters and District operated and maintained water

delivery meters.

- S. system loss - either a direct loss or a reduction in water available for allocation because of the difference in relative accuracy between state operated and maintained headworks meters and District operated and maintained delivery meters.
- T. transfer - assignment of water from one water user to another.
- U. unused water - available supply at the end of the water year.
- V. water user - landowner or lessee of land who has submitted and executed an Allocation Application.
- W. water year - each 12-month period that begins on March 1 and ends on the last day of February following.

2.3 CONTRACTUAL ENTITLEMENTS

- A. The entitlement of agricultural water for Area I is 900,000 AF less water needed for municipal and industrial (M&I) purposes, system losses, and other uses.
- B.
 - 1. The entitlement of agricultural water for Area II is 250,000 AF less water needed for M&I purposes, system losses, and other uses.
 - 2. Area II's entitlement will be supplemented by any amount of the Area I entitlement not timely applied for and purchased pursuant to these Regulations.
 - 3. Any contract water in addition to the 1,150,000 AF in any water year shall be allocated to Area II until the average per acre allocation of contract water for all Area II eligible cropland is equal to the average per acre entitlement for all Area I eligible cropland.
- C. No contract water shall be allocated to Area III until the allocation of contract water for eligible cropland in Areas I and II is equal to the per acre entitlement in Area I. Additional contract water then available to Area III will be allocated until the per acre allocation is equal to the per acre entitlement in Area I.
- D. Any contract water in addition to the quantities described above will be allocated ratably on a per acre basis to satisfy timely applications first to eligible cropland in Areas I and II, then to eligible cropland in Area III, and finally on a first-come, first-served basis to all District cropland.
- E. Prior to the calculation of per acre entitlements in any water year, the General Manager shall set aside from the available water supply the amount of water needed for M&I purposes, system losses, and other uses approved by the Board of Directors. The General Manager may later allocate this water according to these Regulations if it is no longer necessary for such purposes.
- F. If the United States does not provide the District with a full supply of contract water, the shortage will be proportionately applied to the area entitlements.
- G. If there is a reduction in the rate at which water can be delivered to the District because of operational or other limitations, each water user's share of the delivery rate will be equitably adjusted as determined by the General Manager.

2.4 OTHER ALLOCATION RULES AND PROCEDURES

- A. Other water obtained by the District shall be made available to all cropland in the District without regard to area priority and shall be allocated on a per acre basis, unless otherwise directed by the Board of Directors.
- B. Allocations of water shall be increased or decreased as more or less water becomes available for distribution within the District.
- C.
 - 1. System loss will be deducted first from the water set aside in each Area for such purposes, and

second, from individual allocations in direct proportion to the water used by each water user.

2. System gain shall be apportioned to each Area according to total use and ratably allocated to individuals on a per acre basis.

- D. Other water made available to the District specifically for direct transfer to a water user shall be allocated to the water user for whom it was intended. This water may be used or transferred within or outside of the District at the discretion of the water user, subject to applicable state and federal laws and District approval, or any conditions of use placed on the water when it was first transferred into the District.
- E. Notwithstanding any other provisions of the Regulations, water made available for specified purposes shall be distributed and used in accordance with such specified purposes.
- F. All per acre allocations of water will be made on the basis of cropland acres as determined prior to the time of the allocation. Any changes to cropland acres will be used for future allocations only, and will not be used to adjust prior allocations.
- G. In order to receive an allocation, all cropland must be eligible under Reclamation law and any applicable District Regulations.

2.5 APPLICATION FOR WATER

- A. To receive an allocation of contract water for agricultural purposes in any water year, a water user must timely apply by filing an Allocation Application at a designated District office annually on or before January 15. Applications received after January 15 shall not receive an allocation unless the General Manager determines that there exists a water supply in excess of water requested by timely allocation applications.
- B. The General Manager may require supplemental application(s) for additional contract water or other water made available to the District.
- C. If more than one Allocation Application for the same parcel of land is timely received and there is a dispute between the applicants regarding who should receive the water, priority will be given to the landowner, if one of the applicants owns the land in question. If no applicant owns the land, priority will be given to the water user who can provide satisfactory evidence of the right to occupy the land and receive the water. A lease or written consent from the landowner is considered satisfactory evidence. If the dispute arises after the water has been allocated, remedy is limited to unused water.
- D. Contract water will not be allocated to any land for which water charges or assessments have been delinquent for 60 days or more at the time the water is allocated.

2.6 USE AND TRANSFER OF WATER

- A. No water may be transferred out of the District without District approval.
- B. Contract or other water may be used on any eligible cropland within the District.
- C. A water user may transfer his contract or other water to another water user in any area of the District. Such transfer shall be in writing on a form provided by the General Manager.
- D. The District will not transfer water from a water user to another resulting from a change in ownership or lease of land. However, if land is transferred by a change in ownership or lease with the result that the water user no longer owns or leases any District land, the unused water shall be transferred to the water user to whom the ownership or leasehold of such land has passed unless a transfer of water is requested pursuant to these Regulations.
- E. The General Manager may restrict or prohibit the use or transfer of water allocated to any cropland if a dispute exists among landowners regarding the allocation or use of such water.

- F. Water service shall be discontinued when a water user has exhausted his available water supply. Administrative fees for overuse of available water supply are set forth in the Terms and Conditions for Agricultural Water Service.
- G. Each water user shall take reasonable steps to reuse or control tailwater. The failure to do so shall constitute a waste of water.
- H. The General Manager is authorized, after oral or written notice to the water user, to lock the delivery facilities of, or discontinue water service to, any water user who violates these Regulations or Terms and Conditions for Agricultural Water Service.
- I. The unauthorized using, taking, or wasting of water is prohibited and may subject the water user to civil or criminal prosecution.

2.7 PAYMENT FOR WATER

No water shall be made available for delivery, transfer, or any other use by a water user who fails to make required payments. Rules for payment are set forth in the Terms and Conditions for Agricultural Water Service.

2.8 YEAR-END PROCEDURES

- A. After final water use and supply accounting is completed for the water year, the District will take the following action to address water supply overuse and unused water:
 - 1. Unused water may be rescheduled if such a program is available.
 - 2. If there is unused water that cannot be rescheduled, such water will be used to offset overuse of water supply by individual water users in a manner prescribed by the General Manager that is consistent with these Regulations.
 - 3. If there is insufficient unused water to offset all overuse, a water user's allocation of contract water in the following year will be reduced by the net amount of his overuse, first from the area in which the overuse occurred and then from any area in which the water user has an allocation of contract water. If this water user is not a water user in the following year, the net amount of overuse will be attributed to the cropland that had been farmed by the water user. Further, any allocation of contract water to that cropland will be reduced by the net amount of overuse attributable to such cropland.
- B. A water user whose unused water supply is used to offset overuse by other water users will be relieved of the obligation to pay for the amount of water used to offset such overuse.
- C. A water user with unused water that cannot be rescheduled or is not used to offset overuse by other water users will not be relieved of the obligation to pay for the unused water. The rate paid for such unused water shall include the cost of the water and any applicable District costs.

2.9 MISCELLANEOUS

- A. The General Manager is authorized and directed to do any and all things necessary to implement and effectuate these Regulations.
- B. An appeal from any decision made pursuant to these Regulations may be made to the Board of Directors. The appeal shall be in writing and shall be filed with the District Secretary within 15 working days after notice of the decision. The decision of the Board shall be final.
- C. The General Manager shall provide notice of any changes or revision to these Regulations to all District landowners and water users.

Appendix B

WESTLANDS WATER DISTRICT

OFFICE--3130 N. FRESNO STREET/MAILING--P. O. BOX 6056, FRESNO, CA 93703
TELEPHONE: WATER ORDERS (209) 241-6250/OTHER (209) 224-1523/FAX (209) 241-6276

TERMS AND CONDITIONS FOR AGRICULTURAL WATER SERVICE

1. The allocation and furnishing of water shall be subject to all regulations of the Board of Directors of the District as the same may exist now or hereafter be amended or adopted. In the event of a conflict between these terms and conditions and the regulations, the latter shall be controlling.

2. All water shall be delivered pursuant to a request by the water user for the delivery of a specific flow rate to a specific parcel of land. The request shall be made within the time and in the manner prescribed by the General Manager. An administrative fee of \$100 per meter will be charged for violations of these water order requirements. Such fee will be suspended, with verbal and written warnings issued instead, for the first two months of a water year that violations occur. Upon violations occurring in a third month of the same water year, the administrative fee will be charged to the water user for all meters found in violation during the water year, including those found during the first two months for which fees were originally suspended.

3. Water will be furnished by the District subject to the terms and conditions under which it is made available to the District including, but not limited to, the requirements of federal Reclamation law. The District will use its best efforts, to the extent that it has water and capacity available and taking into account the requirements of other water users to receive water from District facilities, to provide such water in the manner and at the times requested. The District may temporarily discontinue water service or reduce the amount of water to be furnished for investigation, inspection, maintenance, repair, or replacement of any of the District's facilities. The District will give the water user notice in advance of such temporary discontinuance or reduction, except in case of emergency, in which event no notice need be given. No liability shall accrue against the District or any of its officers, directors, or employees for damage, direct or indirect, because of the failure to provide water as a result of system malfunctions, interruptions in service necessary to properly operate and maintain the water distribution system, or other similar causes which are beyond the District's reasonable control.

4. By taking delivery of water from the District, the water user assumes responsibility for, and agrees to hold the District harmless from, all damage or claims for damage which may arise from his use of the water after it leaves the District's facilities.

5. The water furnished by the District is not in a potable state and the District does not warrant the quality or potability of water so furnished. By taking delivery of water from the District, the water user assumes responsibility for, and agrees to hold the District harmless from, damage or claims for damage arising out of the unpotability of water furnished by the District.

6. All water will be measured by the District with meters installed, maintained, and calibrated by it and such measurements shall be final and conclusive.

7. If a water user overuses his available supply, an administrative fee of \$30 will be charged for each occurrence when such overuse exists at month-end; provided, that if such overuse exists at January or February month-end, the water user will be charged \$50. In addition, an administrative fee of \$10 will be charged to the water user for each occurrence when overuse from a prior month remains on the account at the end of a subsequent month.

8. Charges for agricultural water, including power surcharges, if any, hereinafter referred to as "water charges,"

shall be established by the Board of Directors. The water charges shall include District operation and maintenance costs and any other costs determined by the Board to be payable as part of the water charges, including components established for the payment of all or a portion of the District's annual repayment obligation to the United States, administrative fees, and land-based charges. The water charges shall also include the applicable water rates required pursuant to the Reclamation Reform Act of 1982 and the Judgment in *Barcellos and Wolfson, Inc., et al. v. Westlands Water District, et al.*, and *Westlands Water District, et al. v. United States, et al.*, U.S. District Court, Eastern District of California, Nos. CV-79-106-EDP and CV-F-81-245-EDP, respectively. Water charges shall be adjusted retroactively to the extent required and authorized by federal or state law or regulations or District regulations. The General Manager may adjust the water charges as necessary and legally authorized to account for increases or decreases in the estimates used to establish the water charges.

9. As a condition of the District continuing to furnish water, the water user or landowner shall make all payments by the due dates specified: (a) for water and power used, and other water charges, after the District's billing and by the 25th day of the month in which the bill is mailed; provided, that the due date will be not less than 15 calendar days after the billing date, (b) for the "Water Allocation" component of the District's annual repayment obligation to the United States by July 25, (c) in advance for water allocated to but unused on land which is not subject to assessment by the District by the 25th day of June. A written guarantee in a form satisfactory to the General Manager from a recognized financial lending institution may be substituted in lieu of advance payment. When any deadline established herein falls on a Saturday, Sunday, or holiday, it shall be extended to the next working day. When necessary the General Manager may extend the payment due date for water charges up to the last day of the month. Any further extension of this date will require approval of the Board of Directors. Charges not paid by the applicable due date shall be delinquent. Payments postmarked on or before the due date shall be deemed to have been received by the due date.

10. All payments shall be made at the District's Fresno Office.

11. Advance payment may be required in total or in part for water transferred into the District from other agencies, pump-in water, or any allocation resulting from the District being able to obtain other water. The advance payment will be due by a date to be established by the General Manager.

12. All claims for overcharges or errors must be made in writing and filed with the District at its Fresno Office within 10 working days after the date the bill is received by the water user or landowner. In the event the water user or landowner files a timely written protest, the District's Finance & Administration Committee shall consider the protest as soon as practicable and notify the water user or landowner in writing of its decision. The Committee's decision shall be final, unless a written appeal to the Board of Directors is filed with the Secretary of the District within 15 working days after notice of the decision. In the event of an appeal, the decision of the Board shall be final. The filing of a protest or an appeal does not nullify the payment requirement or the District's right to discontinue water service as provided in these terms and conditions. However, in the event the protest or appeal is sustained, the District will refund the amount of the overcharge and penalty, if any.

13. Except for land-based charges, on the day following the payment due date, a penalty of 2 percent of that month's water charges shall be added to the delinquent unpaid water charges except as described hereafter. During any 12-month period the penalty for a water user's second delinquency shall be 5 percent and the penalty for a water user's third and any subsequent delinquency shall be 10 percent. The 2 percent penalty shall not be levied with respect to a water user's first delinquency in any 12-month period if the delinquent payment is received by the District on or before the last working day of the month, but the delinquency shall continue to be the water user's first delinquency for purposes of this paragraph. For land-based charges, on the day following the payment due date, a penalty of 10 percent of the charge shall be added to the delinquent unpaid water charges. Delinquent water charges shall bear interest at a monthly rate of 1 2 percent. Interest shall not, however, accrue after the delinquent water charges together with applicable penalties and interest have been added to, and become a part of, the annual assessment levied on the land by the District. All payments and credits shall be applied to the earliest delinquent charges.

14. On the 1st of the month following that in which water charges become delinquent, water service shall be discontinued, to the parcel of land when land-based charges are delinquent, and/or to the water user when other water charges are delinquent; provided, that when the 1st of the month falls on a Saturday, Sunday, or holiday, such service shall

be discontinued on the next working day.

15. At the time of filing the District's assessment book with the District Tax Collector, delinquent charges, together with applicable penalties and interest, may be added to and become part of the assessment levied by the District on the land which received the water or for which other water charges were incurred. If the water was not furnished, the applicable delinquent charges may be added to the land to which the water was allocated. The District shall notify the landowner of the anticipated amount(s) prior to adding the assessment. The added amount shall be a lien on the land and impart notice thereof to all persons. If the assessment becomes delinquent, penalties and interest will be added as provided by law.

16. As an alternative to the procedure described in Paragraph 14, the District may elect to file and record a Certificate of Unpaid Water Charges as provided in California Water Code Section 36729. This Certificate creates a lien in the amount of delinquent charges on any land owned, or acquired before the lien's expiration, within the recording County.

17. Agricultural water service shall not be provided to any parcel of land for which delinquent charges, together with applicable penalties and interest, are a lien on the land or for which the assessment is delinquent. No transfer of water attributed to a parcel of land for which charges are a lien on the land will be permitted until the delinquent charges are paid.

18. Agricultural water service shall not be provided to any water user with delinquent charges, notwithstanding the fact that the delinquent charges have been added to the assessment(s) on the parcel(s) for which they were incurred. No transfer of water allocated to a water user with delinquent charges will be permitted until the delinquent charges are paid.

19. The General Manager may require that all current charges be paid before the transfer of remaining water will be allowed.

20. All delinquent charges must be paid before water service can be restored.

21. If a water user's delinquent charges are delinquent for 60 days or more, or if a water user's delinquent charges are added to the annual assessments on any lands within the District, or the procedure in paragraph 15 is implemented, the General Manager shall require, as a condition of resumption of water service, that advance payment of all water charges be made for the 12-month period immediately following resumption of service, according to a schedule to be determined by the General Manager. A written guarantee in a form satisfactory to the General Manager from a recognized financial lending institution may be substituted in lieu of advance payment.

22. The General Manager, after consultation with and approval by the Finance & Administration Committee, may also require advance payment and/or payment by cashier's check or such other actions as he may deem necessary when a water user's account is determined, based on the payment history or other actions of the water user, to create a financial risk or hardship for the District or its landowners. Circumstances which constitute the basis for such a determination include but are not limited to the following: (1) instances of a water user's checks being returned unpaid or (2) instances where a water user whose account is delinquent has, in violation of District regulations, taken water from a District delivery.

23. Agricultural water service shall not be provided to any water user who has failed to file, or to any lands for which there has not been filed, the certification or reporting forms required pursuant to Reclamation law, and particularly the Reclamation Reform Act of 1982. Any water delivered in violation of this provision may be subject to penalty charges pursuant to federal law or regulation.

24. Agricultural water service shall not be provided to any water user who fails to provide the District with crop information at the time(s) and in the form required by the General Manager.

25. By applying for or taking delivery of agricultural water from the District, the water user agrees to these terms and conditions of service.

26. The District may modify or terminate these terms and conditions; provided, that such modifications or terminations are prospective only and notice thereof is given prior to the effective date.

Appendix C

United states Soil Government Center
Department of Conservation 680 campus Dr., Suite E
Agriculture Service Hanford, CA 93230
FAX 209-584-8715 Ph: 209 584-9209
Hanford Soil Survey Office - for West Fresno County SSA
By Kerry Arroues, Supervisory Soil Scientist, 11/23/93

GENERAL SOIL MAP WESTLANDS WATER DISTRICT

This general soil map shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas that are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

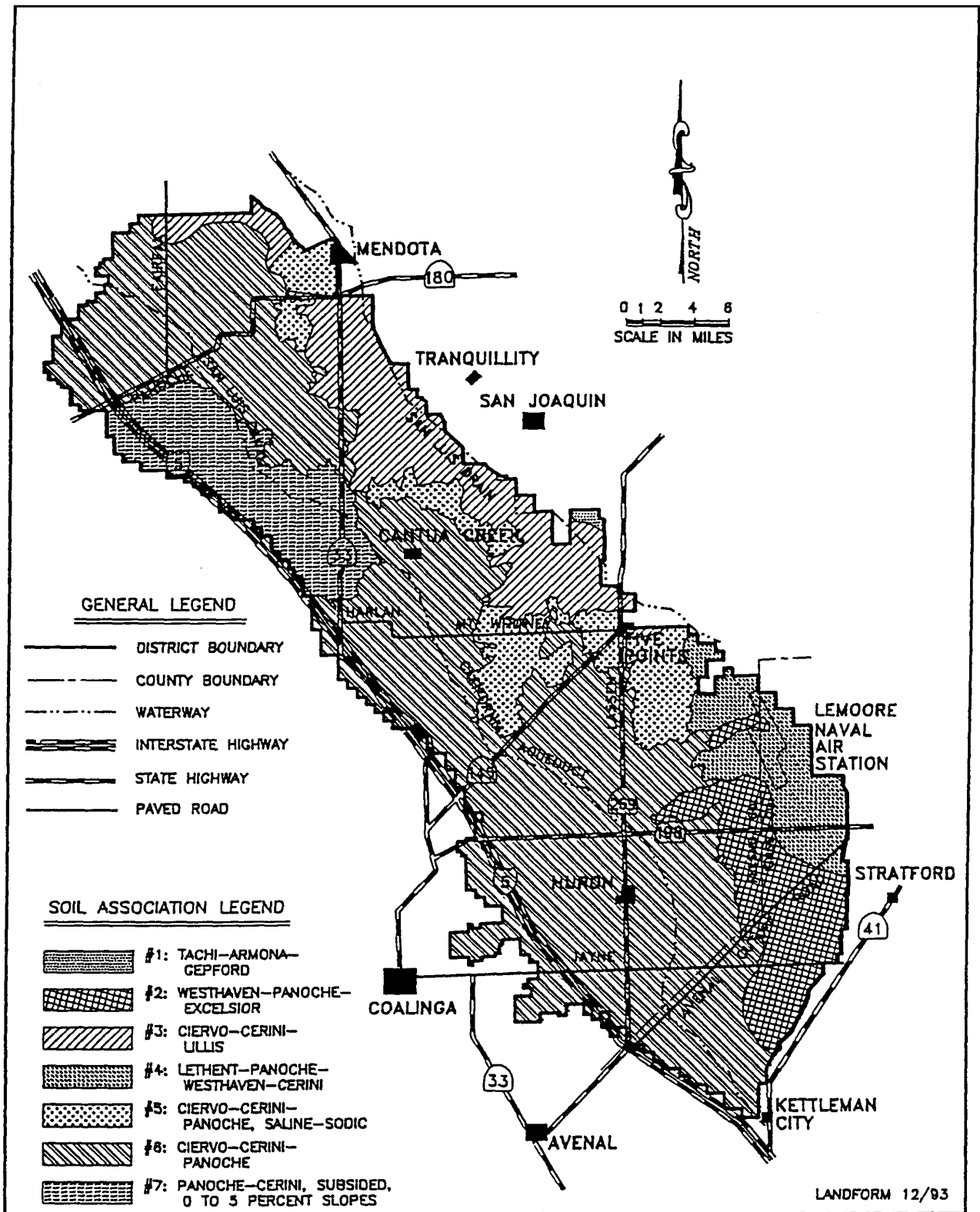
The general map units in this survey have been grouped into general kinds of landscape for broad interpretative purposes. Each of the broad groups and the map units in each group are described in the following pages. For further definitions of terminology used in these descriptions, use the table titled "TERMINOLOGY USED IN SOIL SURVEY DATA ENTRY OR MANUSCRIPT EDITING". As usual, on an ongoing soil survey, all information is tentative and subject to revision.

SOIL ASSOCIATION #1: TACHI-ARMONA-GEPFORD 1,000 acres

These soils are very deep, poorly drained, saline-sodic soils on flood plains and in flood basins. Effective rooting depth of the crops commonly grown in the area is limited by a perched water table that is at a depth of less than 6 feet.

-Tachi and Gepford soils have clayey textures with a high shrink-swell potential.
-Armona soils have loamy textures and are stratified. Effect on water operations and management and any limitations on agriculture resulting from soil problems within the Westlands water District:

If this unit is used for irrigated crops, the main limitations are salinity and sodicity, a high perched water table, very slow permeability and flooding. The high shrink-swell potential on the Tachi and Gepford soils should be considered before installing cement structures. High shrink-swell clay can cause cement structures to buckle.



LANDFORM 12/93

Intensive management is required to reduce the salinity and maintain soil productivity. Gypsum, sulfur, and sulfuric acid are among the soil amendments that can be used to reclaim this soil. If sulfur or sulfuric acid is used, lime should be present in the surface layer. Content of salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

-Tile drainage can be used to lower the water table if a suitable outlet is available.

-Because of the very slow permeability on the Tachi and Gepford soils and stratification on the Armona soil, the application of water should be regulated so that water does not stand on the surface and damage the crops.

-The risk of flooding can be reduced by the use of levees, canals and diversions.

SOIL ASSOCIATION #2: WESTHAVEN-PANOCHE-EXCELSIOR 47,000 acres

These soils are very deep, well drained and moderately well drained soils on low lying alluvial fans and low fan terraces.

-Westhaven soils are stratified and have silty textures.

-Panoche soils have loamy textures.

-Excelsior soils are stratified and have coarse-loamy textures.

Effect on water operations and management and any limitations on agriculture resulting from soil problems within the Westlands Water District.

If this unit is used for irrigated crops, the main limitations are stratification and moderately slow permeability.

-The Westhaven and Excelsior soils are limited by a stratified profile that restricts permeability. Because of the moderately slow permeability of these soils, the length of runs should be adjusted to permit adequate infiltration of water. Good irrigation water management on these stratified soils requires that irrigation amounts and timing are adjusted to account for the available water capacity which can vary depending on the size, depth and texture of the strata.

-The Panoche soils have no major limitations.

SOIL ASSOCIATION #3: CIERVO-CERINI-LILLIS 72,000 acres

These soils are very deep, moderately well drained to poorly drained, saline-sodic soils with a high perched water table on distal alluvial fans and low stream terraces.

-Ciervo soils have clayey textures which usually become coarser with depth.

-Cerini soils are stratified and have fine-loamy textures.

-Lillis soils are clayey with a high shrink-swell potential.

Effect on water operations and management and any limitations on agriculture resulting from soil problems within the Westlands water District:

-If this unit is used for irrigated crops, the main limitations are salinity and sodicity, a high perched watertable and slow permeability. The high shrink-swell potential on the Lillis soil should be considered before installing cement structures. high shrink-swell clay can cause cement structures to buckle.

-Intensive management is required to reduce the salinity and maintain soil productivity Gypsum, sulfur, and sulfuric acid are among the soil amendments that can be used to reclaim this soil. If sulfur or sulfuric acid is used, lime should be present in the surface layer. content of salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

-The Ciervo and Lillis soils have very slow permeability. The Cerini soil is limited by a stratified profile that restricts permeability and creates a perched water table. Because of the very slow and slow permeability of these soils, the application of water should be regulated so that water does not stand on the surface and damage the crops.

-Tile drainage can be used to lower the water table if a suitable outlet is available.

SOIL ASSOCIATION #4: LETHENT-PANOCHÉ WESTHAVEN-CERINI 40,000 acres

These soils are very deep, moderately well drained and well drained, saline-sodic soils on distal alluvial fans and flood plains. Much of this map unit has developed a high perched water table within 6 feet of the surface, especially near the northwest corner of Lemoore Naval Air Station.

- Lethent soils have clayey textures.
- Panoche soils have loamy textures.
- Westhaven soils are stratified and have silty textures.
- Cerini soils are stratified and have fine-loamy textures.

Effect on water operations and management and any limitations on agriculture resulting from soil problems within the Westlands Water District:

If this unit is used for irrigated crops, the main limitations are salinity and sodicity, a high perched water table, slow permeability and stratification.

-Intensive management is required to reduce the salinity and maintain soil productivity. Gypsum, sulfur, and sulfuric acid are among the soil amendments that can be used to reclaim this soil. If sulfur or sulfuric acid is used, lime should be present in the surface layer. Content of salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

-Lethent soils have very slow permeability. Westhaven and Cerini soils have slow permeability.

Panache soils have moderately slow permeability. Because of the moderately slow to very slow permeability of these soils, and stratification on the Westhaven and Cerini soils, the application of water should be regulated so that water does not stand on the surface and damage the crops.

-Tile drainage can be used to lower the water table if a suitable outlet is available.

SOIL ASSOCIATION #5: CIERVO-CERINI-PANOCHE 57,000 acres

These soils are very deep, moderately well drained and well drained, saline-sodic soils on mid alluvial fans and flood plains. Some of this map unit has developed a high perched water table within 6 feet of the surface.

- Cierva soils have clayey textures which usually become coarser with depth.
- Cerini soils are stratified and have fine-loamy textures.
- Panoche soils have loamy textures.

Effect on water operations and management and any limitations on agriculture resulting from soil problems within the westlands Water District:

If this unit is used for irrigated crops, the main limitations are salinity and sodicity, moderately slow permeability to very slow permeability, and a high perched water table in some areas.

-Intensive management is required to reduce the salinity and maintain soil productivity. Gypsum, sulfur, and sulfuric acid are among the soil amendments that can be used to reclaim this soil. If sulfur or sulfuric acid is used, lime should be present in the surface layer. Content of salts can be reduced by leaching, applying proper amounts of soil amendments, and returning crop residue to the soil.

-Ciervo soils have very slow permeability. Cerini soils have slow permeability. Panoche soils have moderately slow permeability. Because of the moderately slow permeability to very slow permeability of these soils, and stratification on the Cerini soils, the application of water should be regulated so that water does not stand on the surface and damage the crops.

-Where a perched water table within 6 feet of the surface is present, tile drainage can be used to lower the water table if a suitable outlet is available.

SOIL ASSOCIATION #6: CIERVO-CERINI-PANOCHE 342,000 acres

These soils are very deep, moderately well drained and well drained soils on alluvial fans and flood plains.

- Ciervo soils have clayey textures which usually become coarser with depth.
- Cerini soils are stratified and have fine-loamy textures.
- Panoche soils have loamy textures.

Effect on water operations and management and any limitations on agriculture resulting from soil problems within the Westlands Water District:

If this unit is used for irrigated crops, the main limitations are stratification on Cerini soils and slow permeability or moderately slow permeability.

-Ciervo soils have slow permeability. Cerini soils have moderately slow permeability. Because of the slow permeability on the Ciervo soils and moderately slow permeability and stratification on the Cerini soils, the application of water should be regulated so that water does not stand on the surface and damage the crops. Good irrigation water management on these soils requires that irrigation amounts and timing are adjusted to account for the available water capacity which can vary depending on the size, depth and texture of strata.

SOIL ASSOCIATION #7: PANOCHE-CERINI, SUBSIDED, 0 TO 5 PERCENT SLOPES
45,000 acres

These soils are very deep, well drained soils on alluvial fans and flood plains which have subsided unevenly across the landscape due to near-surface subsidence.

-Panoche soils have loamy textures.

-Cerini soils are stratified and have fine-loamy textures

Effect on water operations and management and any limitations on agriculture resulting from soil problems within the Westlands Water District:

If this unit is used for irrigated crops, the main limitations are near-surface subsidence, moderate hazard of water erosion, moderately slow permeability on the Cerini soil, and occasional flooding in low-lying areas. The near surface subsidence should be considered before installing cement structures. Subsidence can cause cement structures to buckle.

-Sprinkler or trickle irrigation is best suited where subsidence has occurred near the surface. Hollow areas caused by subsidence make furrow and border irrigation more difficult. Irrigation water needs to be applied at a rate that insures optimum production without increasing deep percolation, runoff and erosion.

-Because of the moderately slow permeability of the Cerini soil, the application of water should be regulated so that water does not stand on the surface and damage the crops. To avoid overirrigating, applications of irrigation water should be adjusted to the available water capacity, the water intake rate and the crop needs.

-Use of pipe, ditch lining or drop structures in irrigation ditches facilitates irrigation and reduces ditch erosion.

-The risk of flooding can be reduced by the use of levees, canals and diversions.

Appendix D

DEFINITIONS OF IRRIGATION TERMS

Acre-Foot (AF): The volume of water required to cover one acre to a depth of one foot (43,560 cubic feet). An acre-foot equals 325,851 U.S. gallons.

Advance Ratio (AR): For furrow irrigation, the ratio of the total time irrigation water is applied to the furrow (set time) to the time needed for irrigation water to reach the lower end of a sloping furrow (advance time).

$$AR = \text{Set Time} / \text{Advance Time}$$

Annual Distribution Uniformity (ADU): See “Distribution Uniformity.”

Annual Irrigation Efficiency (AIE): See “Irrigation Efficiencies.”

Applied Water (AW): Water applied to a field by irrigation, excluding the tailwater which runs off the field and is collected for reuse in the irrigation of another field on that farm, expressed as a depth of water in inches or feet.

Available Soil Moisture: The difference in soil moisture content between Field Capacity and Permanent Wilting Point. This represents the moisture which can be stored in the root zone for use by crops, expressed as a depth of water in inches or feet (Israelson & Hanson, 1979).

Beneficially Used Water (BU): Irrigation water used to satisfy a portion or all of the following: evapotranspiration, leaching requirement, special cultural practices, and/or water stored in the soil for use by crops, expressed as a depth of water in inches or feet (ASAE, 1988; Burt, et al., 1988).

Conservation: “. . . planned management of a natural resource . . .” (Webster’s New World Dictionary, 1989.)

Crop Root Zone: The soil depth from which a mature crop extracts most of the water needed for evapotranspiration. The crop root zone is equal to effective rooting depth and is expressed as a depth in inches or feet. This soil depth may be considered as the rooting depth of a subsequent crop, when accounting for soil moisture storage in efficiency calculations (Burt, et al., 1988).

Crop Water Requirement (CWR): The infiltrated water required to grow a crop, expressed as a depth of water in inches or feet (Burman, et al., 1981).

$$CWR = ET - EP + LRD + CP$$

Cultural Practices (CP): Irrigation water which is used for necessary farming practices such as soil reclamation, climate control, crop quality, and weed germination, expressed as a depth of water in inches or feet (Burt, et al., 1988).

Deep Percolation (DP): The amount of irrigation water that flows below the crop root zone and is unavailable for evapotranspiration, expressed as a depth of water in inches or feet (Merriam & Keller, 1978).

Depth of Water: The depth of a volume of water spread over a given area, expressed as a depth of water in inches or feet.

Distribution Uniformity (DU): The ratio of the average low-quarter depth of irrigation water infiltrated to the average depth of irrigation water infiltrated, expressed as a percent (ASAE, 1988).

Effective Precipitation (EP): That portion of rainfall that contributes to satisfying the evapotranspiration and/or leaching requirement of a crop, expressed as a depth of water in inches or feet (Burman, et al., 1981).

Electrical Conductivity (EC): The property of a substance to transfer an electrical charge and a measure of the salt content of water. EC_w is the term used as a measure of the salt content of irrigation water, EC_e is the term used as a measure of the salt content of an extract from a soil when saturated with water, expressed as decisiemens per meter (dS/m) (Doorenbos & Pruitt, 1984).

Evapotranspiration (ET): The amount of water loss over a period of time through transpiration from vegetation and evaporation from the soil, expressed as a depth of water in inches or feet (Doorenbos & Pruitt, 1984).

Evapotranspiration of Applied Water (ETA_w): The portion of the total crop evapotranspiration that is satisfied by applied water, expressed as a depth of water in inches or feet (Central Valley Water Use Study Committee, 1987).

Evapotranspiration Potential (ETP): Evapotranspiration potential is a value calculated with a modified Penman equation and is equal to daily alfalfa evapotranspiration when the crop occupies an extensive surface; is actively growing, standing erect, and at least eight inches tall; and is well watered so that soil water availability does not limit evapotranspiration, expressed as a depth of water in inches or feet (Burman, et al., 1980).

Field Capacity: Depth of water retained in the soil after ample irrigation or heavy rain when the rate of downward movement has substantially decreased, usually one to three days after irrigation or rain, expressed as a depth of water in inches or feet (Doorenbos & Pruitt, 1984).

Groundwater Table: The upper boundary of groundwater where water pressure is equal to atmospheric pressure, i.e., water level in a bore hole after equilibrium when groundwater can freely enter the hole from the sides and bottom (Doorenbos & Pruitt, 1984).

Infiltration Rate: The rate of water entry into the soil expressed as a depth of water per unit of time in inches per hour or feet per day. The infiltration rate changes with time during irrigation (Burt, et al., 1988).

Irrigation Efficiencies: Irrigation efficiencies are used to determine the efficiency of replacing moisture in the soil profile and may be calculated for single or multiple irrigations and is the ratio of the depth of water stored to the depth of applied water. The equations for single and multiple irrigations are as follows:

1. **Preirrigation Efficiency (PIE):** This definition is used to calculate the efficiency of an on-farm preirrigation and is the ratio of the sum of the depth of water used for soil moisture replacement and cultural practices to the depth of applied water, expressed as a percentage (Burt, et al., 1988). No leaching requirement is included.

$$PIE = (SMR_1 + CP_1) / AW_1 \times 100$$

2. **Regular Season Irrigation Efficiency (RIE):** This definition is used to calculate the efficiency of one or more regular season on-farm irrigations and is the ratio of the sum of the depth of soil moisture replacement water and water used for cultural practices for each irrigation after the preirrigation to the sum of the depths of water applied during these irrigations, expressed as a percentage. No leaching requirement is included (Burt, et al., 1988).

$$RIE = (SMR_2 + CP_2 + SMR_3 + CP_3 + \dots + SMR_n + CP_n) / (AW_2 + AW_3 + \dots + AW_n) \times 100$$

3. **Annual Irrigation Efficiency (AIE):** This definition is used to calculate the efficiency of all on-farm irrigations and is the ratio of the sum of the depth of soil moisture replacement water and water used for cultural practices for all irrigations plus the water to satisfy the seasonal leaching requirement to the sum of the depths of water applied during all irrigations, including the preirrigation, expressed as a percentage (Burt, et al., 1988).

$$AIE = (SMR1 + CP1 + SMR2 + CP2 + \dots + SMRn + CPn) / (AW1 + AW2 + \dots + AWn) \times 100$$

Where n = total number of irrigations, n = 1 is the preirrigation.

Leaching Fraction (LF): The ratio of deep percolation (DP) to infiltrated irrigation water (V_{iw}), V_{dp} / V_{iw} . It is the fraction of water that enters the root zone by irrigation that is not used in ET and which passes below the root zone as deep percolation (Rhoades, 1991).

Leaching Requirement (LR): The theoretical amount of infiltrated irrigation water that must pass (leach) beyond the root zone in order to keep soil salinity within acceptable levels for sustained crop growth. Different models may be used to estimate LR. For uniform and no rainfall conditions, a simple estimate is:

$$LR = EC_w / (5EC_e - EC_w)$$

Where EC_w is the electrical conductivity of the infiltrated irrigation water and EC_e is the maximum EC of the saturated extract of the soil tolerable (not causing significant yield loss) by the crop in question. Actual leaching needed for salinity control may be more or less than this estimate dependent upon uniformity of irrigation/infiltration and amount and distribution of rainfall, respectively.

Leaching Requirement Depth (LRD): The depth of water corresponding to the leaching requirement including extra water for nonuniformity in distribution.

$$LRD = (ETAW / (DU / 100)) \times (LR / (1 - LR))$$

Low Quarter Depth: The average depth of water infiltrated into the quarter of the field infiltrating the least amount, expressed in inches or feet.

Minor Losses (ML): Water losses due to evaporation during irrigation, uncollected surface runoff from the field, and on-farm conveyance and storage systems expressed as a depth of water in inches or feet.

Permanent Wilting Point (PWP): The moisture remaining in a soil at a uniform soil moisture tension of about -15 bars of atmospheric pressure, which is the approximate tension at which plants irreversibly wilt due to moisture stress, expressed as a depth of water in inches or feet.

Preirrigation: An irrigation that occurs prior to the planting of a crop.

Preirrigation Efficiency (PIE): See "Irrigation Efficiencies."

Regular Season Irrigation Efficiency (RIE): See "Irrigation Efficiencies."

Salt Balance: The condition when the amount of salts added to a soil profile through irrigation and the amount removed by leaching are equal (i.e, no net gain nor loss of salt in the crop root zone). This balance will be established if adequate leaching occurs each year; the average root zone salinity at equilibrium will depend upon the amount of leaching and the quality of the applied water (Hoffman, et al., 1980).

Seasonal Application Efficiency (SAE): This term measures the efficiency of applied irrigation water based on crop water requirements, where evapotranspiration is estimated using a modified Penman equation and crop coefficients and is expressed as a percentage.

$$SAE = BU / AW \times 100 = CWR / AW \times 100$$

$$CWR = ET - EP + LRD + CP$$

Soil Moisture Deficit (SMD): The amount of water needed to refill the crop root zone to field capacity at the time of irrigation, expressed as a depth of water in inches or feet (Westlands Water District, 1985).

Soil Moisture Replacement (SMR): The amount of water that is used to replace a portion or all of the soil moisture deficit, expressed as a depth of water in inches or feet.

Tailwater: Applied irrigation water that runs off the lower end of a field. Tailwater is the average depth of runoff water, expressed in inches or feet.

Underirrigation (UI): The difference between the water actually stored in the crop root zone during an irrigation (soil moisture replacement) and the water needed to refill the root zone to field capacity (soil moisture deficit) in all or part of the field, expressed as a depth of water in inches or feet.