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Quantification of Indian Rights: Problems of Proof

Harry R. Sachse

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QUANTIFICATION OF INDIAN RIGHTS:
PROBLEMS OF PROOF

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FEDERAL IMPACT ON STATE WATER RIGHTS

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QUANTIFICATION OF INDIAN RIGHTS: PROBLEMS OF PROOF

I. What is to be proved

A. The Applicability of the "Practicably Irrigable Acres" test as defined by <u>Winters</u> v. <u>United States</u>, 207 U.S. 564 (1908)

1. Is it the test for land currently in irrigation?

2. Is it the test for land under state permits or certificates - whether irrigated or not?

B. The role of land ownership: is all land on the reservation to be studied or just Indian-owned land?

1. currently irrigated non-Indian land

2. irrigable non-Indian land

II. How to prove it.

A. Land Classification

1. Bureau of Reclamation studies

2. Soil Conservation Service studies

3. New Work

a. what standards for soil

b. what level of detail

c. who does it

B. Engineering Studies

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2. extensions of existing irrigation
3. importance of cost
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1. The historical use of subsidy in Indian and non-Indian water projects
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A. Is this much detail necessary?

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CONCEPTUAL IRRIGATION DEVELOPMENT PLAN
AND IRRIGATION WATER REQUIREMENTS
WIND RIVER INDIAN RESERVATION
WYOMING

April 1981

Stetson Engineers Inc.
San Francisco West Covina

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Wyoming

April 1981

Stetson Engineers Inc.

Introduction

The agricultural development of study of the Wind River Indian Reservation has been divided into two segments - one dealing with lands which are within historically developed areas and which can be served by existing irrigation projects (sometimes referred to as the "historic lands") and the other dealing with lands for which new irrigation projects must be developed if the lands are to be put to agricultural use. These latter lands are sometimes referred to as the future lands.

This report limits itself to a discussion of the water requirements of the future lands and the costs inherent in the development of the irrigation systems necessary to supply water to the future project land.

A CRITICAL REVIEW OF ECONOMIC CRITERIA FOR DEMONSTRATING PRACTICABLY IRRIGABLE ACREAGE WITH APPLICATION TO THE WIND RIVER INDIAN RESERVATION

REPORT PREPARED FOR

THE SHOSHONE AND ARAPAHOE TRIBES

by

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AUGUST, 1981

A CRITICAL REVIEW OF ECONOMIC CRITERIA FOR DEMONSTRATING PRACTICABLY IRRIGABLE ACREAGE WITH APPLICATION TO THE WIND RIVER INDIAN RESERVATION

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A CRITICAL REVIEW OF ECONOMIC
CRITERIA FOR DEMONSTRATING PRACTICABLY
IRRIGABLE ACREAGE WITH APPLICATION TO THE
WIND RIVER INDIAN RESERVATION

PURPOSE OF THE REPORT

I have been asked to apply my professional skills and experience[1/] in an effort to respond to the following two questions:

1. What economic tests related to the feasibility of irrigation projects, particularly including benefit-cost tests, might be appropriate, from the economist's view point, for demonstrating practicably irrigable acreage?

2. Given a response to question 1, to what extent do the irrigation projects for the Wind River Reservation, as structured by Stetson Engineers and Keller Engineers, satisfy these appropriate economic criteria for practicably irrigable acreage?

At the outset, I must point out that "practicably irrigable acreage" is not a term of art in any of the several disciplines concerned with irrigation development; this is certainly the case in the economics discipline. This is to say that in describing "practical" irrigation, different criteria will be used by the soil scientist, the irrigation engineer and the economist, as examples, and the choice of any one of these criteria as "the" method for demonstrating practicably irrigable acreage will be arbitrary.

While, as noted above, there is no real reason why economic criteria concerning irrigation projects should be viewed as more or less relevant for the practicably irrigation rule than criteria from any other discipline,

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[1/] See Vita at the end of this report for a summary of my experience.

concern with economic criteria for practical irrigation is justified given that in the bulk of pending Indian water rights cases, lawyers for the United States are using one, particular economic measure -- a benefit-cost test based on principles and standards established by the Water Resources Council in 1973[2/] -- as a means for demonstrating practicably irrigable acreage for assessments of Indian agricultural water uses. Thus, a critical evaluation of economic criteria related to assessments of water reclamation projects, including the Water Resources Council's benefit-cost test, may be timely for this court's deliberations.

In what follows, I address question 1 (Economic Tests) in section I; included in this section are my conclusions concerning discounting practices and an appropriate real rate of discount. I address question 2 (application to planned projects) in section II. Concluding remarks are offered in section III. A detailed description of my analyses related to question 1 is given in Appendix A at the end of the report; Appendix B provides supporting data for analyses concerning question 2 and Appendix C provides historical data regarding Bureau of Reclamation projects.

I. AN APPROPRIATE ECONOMIC MEASURE FOR PRACTICABLY IRRIGABLE ACREAGE

1. Based on the purpose for reserved water rights as shown in Winters and Arizona v. California (see section 2 of Appendix A), I have chosen the following three criteria against which various economic measures are to be

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[2/] 38 Federal Register, 24,777 (1973).

assessed in terms of their appropriateness as measures for practicably irrigable acreage (PIA).

A. Measures for PIA should not penalize the Indians for not having exercised their reserved rights to water in the past.

B. When relevant, measures for PIA should recognize the priority of Indian water rights.

C. Since PIA is a means adopted by the court by which future needs of Indians may be included in water rights quantifications, measure for PIA cannot discriminate against the satisfaction of future needs.

2. Given these criteria, I then examined two methods for calculating benefit-cost measures in terms of their potential appropriateness as measures of PIA: first, benefit-cost measures derived under the 1973 Principles and Standards adopted by the Water Resources Council, and second, standard benefit-cost measures, those which are now widely used throughout the world and which were used by U.S. agencies prior to 1973.

3. It is important to understand the distinction between these two measures. The standard benefit-cost measure is one wherein all benefits attributable to a water reclamation project, to whomsoever these benefits may accrue, are included as project benefits. Normally, total project benefits (excluding municipal/industrial and power features) include the following components:

(i) direct irrigation benefits

(ii) indirect irrigation benefits

(iii) public benefits from irrigation

(iv) area redevelopment benefits

(v) other benefits (flood control, recreation, etc.)

The benefit-cost measure derived under the 1973 WRC guidelines excludes as benefits the components (ii) and (iii) (as well as a good part of benefits included in (iv)) listed above; i.e., only the following benefits, called NED benefits, are included:

(1) direct irrigation benefits

(2) (parts of) area re-development benefits

(3) other benefits

From this difference in the scope of benefits included in the standard total benefit-cost measure and the NED benefit-cost measure, two questions are relevant: first, does the exclusion of benefits (ii) and (iii) -- the substance of "secondary benefits" -- make any substantial difference in terms of the resulting benefit-cost measure? Second, what is the WRC's rationale for excluding secondary benefits ((ii) and (iii))?

The answer to the first question is definitely YES: exclusion of secondary benefits has a dramatic effect on the benefit-cost measure. Table 1 presents results from my study of 20 Bureau of Reclamation projects in the Wyoming and Pick-Sloan Regions (see Appendix C). The average benefit-cost ratio for total benefits is shown to be 1.32; when secondary benefits are excluded, the average benefit-cost ratio falls to .75. Of the twenty projects included in my study only 4 of the twenty projects would have had a benefit-cost ratio greater than 1 using only NED benefits.

In terms of the second question, secondary benefits are excluded by the WRC for two reasons (see Table A.4 in Appendix A):

(i) deficiencies in data and methods for estimating secondary benefits;

(ii) The WRC requirement that benefit-cost measures be determined under the assumption that the economy is fully employed.

TABLE 1

BENEFIT-COST MEASURES, TOTAL AND NED,
AVERAGES FOR 20 PROJECTS IN THE WYOMING-
PICK-SLOAN AREA

	TOTAL	NED
HISTORICAL AVERAGE, BENEFIT-COST MEASURES:	1.32	.75

SOURCE: Appendix Table C.1

Let me emphasize the following. Total benefit-cost measures -- including secondary benefits -- were the economic measures used for assessing the practicability of irrigable acreage in the bulk of U.S. Water Reclamation projects constructed up to 1973; for all practical purposes the only real difference between benefit-cost measures used for assessing projects during the 35 years prior to 1973 and the NED benefit-cost measure are attributable to the full employment assumption imposed by the WRC in 1973.

4. I think it is also important for one to recognize the following. The potential magnitude of "other", NED benefits -- flood control, recreation, etc., -- diminishes as water development activities accumulate. Thus, the first project along a given reach of a river may well have associated with it a broad range of "other" NED benefits. For obvious reasons, a second or third project in that given area will give rise to substantially less (if any) benefits of this type. One can then conclude that benefit-cost measures will likely be much higher for the first irrigation project in an area than for later projects.

The impact of "other" NED benefits on benefit-cost measures for the 20 projects in the Wyoming area that I have analyzed is suggested by data in Appendix Table C.3. On the average, for example, "other" NED benefits constitute 19.4% of total NED benefits.

5. Based on the above, I find that benefit-cost measures based on the WRC's 1973 guidelines, wherein only NED benefits are included as benefits, are not appropriate as measures for PIA inasmuch as its use clearly violates criteria A and B, i.e., Indians are penalized for not having exercised their rights at an earlier time. This follows from two observations.

(i) the use of the full employment assumption imposed by the WRC in 1973 -- which then disallows the inclusion of secondary benefits in "practicality" measures for Indian projects -- penalizes the Indians for not having exercised their reserved rights prior to 1973 (criterion A).

(ii) earlier irrigation developments by non-Indians with water rights junior to those of the Indians will reduce NED benefits for Indian projects, thereby again penalizing the Indians for not exercising their reserved rights prior to developments by holders of junior water rights. (criteria A and B)

6. It is my opinion that the standard, total benefit-cost measure is the only economic measure that would be appropriate as a measure for practicably irrigable acreage -- "appropriate" in the sense of being roughly consistent with the purposes for the Indians' reserved rights to water. The total benefit-cost measure -- which includes secondary benefits -- will be a <u>conservative</u> measure for PIA inasmuch as practical considerations prohibit the derivation of benefit-cost measures that will be perfectly consistent with criteria A - C. Most importantly, one cannot in reality compute "other" benefits, diminished by earlier projects, as if the earlier projects had not been built; therefore, any total benefit-cost measure offered as a demonstration for practicably irrigable acreage will implicitly penalize the Indians for not being the first entity to develop a water project in a given area. This problem notwithstanding, <u>if</u> PIA is to be determined on economic grounds, the most <u>appropriate economic measure</u> related to the practicality of irrigated acreage which one can reasonably calculate is the total benefit-cost measure.

7. I have examined other economic measures which one might relate to PIA, <u>viz</u>., project costs allocated to irrigation, expressed in per acre and per acre-foot of diverted water bases. These cost measures, used alone, have little meaning for the practicality of irrigation projects for several, obvious reasons. High costs may be associated with practical projects if

associated benefits are relatively high. Efficient delivery systems can result in small water diversion requirements (per acre) which can be reflected by higher costs/acre-foot for modern projects than in earlier, less efficient projects.

While cost data alone have little meaning in terms of the practicality of an irrigation project, their use along with appropriate benefit-cost measures can be useful for the purpose of circumscribing the nature of irrigation projects that have been judged practical in economic terms. These measures are given below for the projects in the Wyoming area studied by me. Based on the average of past projects in the Wind River area, projects involving practicably irrigable acreage had the following characteristics (ranges for these data are given in parentheses);[3/]

Total benefit-cost measure	1.32	(.74 to 2.25)
NED benefit-cost measure	.75	(.36 to 1.46)
Project Cost/acre-foot[4/]	$23.92	($8.67 to $63.12)
Project Cost/acre[4/]	$1,875.00	($$675 to $3,971)

8. I have argued that an NED benefit-cost measure is clearly inappropriate as a measure for PIA and that the most appropriate economic measure for this use is the total benefit-cost measure. In the derivation of either of these measures, however, one will commonly use discounting practices. I have studied the appropriateness of using discounting practices in developing measures for PIA and I arrive at the following conclusions.

(i) Strictly speaking, discounting practices are not appropriate for PIA measures in that criterion C

[3/] See Appendix C.1

[4/] Reference is made here to project costs allocated to irrigation and water diversions for irrigation.

is clearly violated: discounting discriminates against the satisfaction of needs for water by future Indian generations.

(ii) If, however, one is to discount values in the total benefit-cost measures, one must use a "real" discount rate. The WRC rate of 7-plus% is <u>not</u> a real rate--this is explicitly recognized by the WRC. In my opinion, a real rate in the 2 1/2%-4% range should be used in deriving total benefit-cost measures for Indian projects. Real discount rates in this range will reflect: real rates used in earlier reclamation projects (thereby suggesting consistency with criterion A--penalizing Indians for not having exercised rights in the past) and an average of historical rates of change in real Gross National Product, which is accepted by many economists as a useful surrogate for a real discount rate.

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LAND AND LAND RESOURCES

INTRODUCTION

The land classification and drainage investigation conducted on the Wind River Reservation for historically irrigated lands consisted of a multi-step process that culminated in a historoic lands study base (see HKM's Historic Lands Study). This land base is defined as lands that have either a history of use or can be served from historic irrigation facilities. Two seperate study areas were developed: Major Project Lands and Non-Project Lands. Within these two areas land classification studies were performed to establish arability of lands not presently irrigated.

ESTABLISHMENT OF STUDY AREAS

A detailed description of study area establishment is contained in HKM's Historic Land Study Report. Only those non-irrigated lands that met the historic lands definition were studied in this program.

At this point, a distinction was drawn between the land classification program performed on lands within large irrigation projects and classification performed on small privately irrigated fields.

The primary difference in field programs involved tailoring the land classification criteria to suit the problems encountered in either a project or non-project setting. Arability standards for lands that must meet, for example, project drainage requirements, are more conservative than those for lands that have no project drainage requirements.

Project Lands Program

After study areas were established, previous soil and land investigations were evaluated. Soil investigations by the Bureau of Indian Affairs, Water and Power Resources Service (WPRS-formerly USBR), and the Soil Conservation Service have been conducted since the early 1900's in the Wind River Basin and on the Wind River Indian Reservation. For a description of previous investigations see HKM's report, "Land Classification of North Crowheart Unit, South Crowheart Unit, Big Horn Flats Unit, Riverton East Unit, Owl Creek Unit and Arapahoe Unit".

Lands to be studied within the project areas included all idle trust lands. The field program for project lands did not differ substantially from the future lands program as detailed in the previously referenced HKM Land Classification Report for future lands.

Lands were evaluated topographically and typically a hole was augered in each large tract of potentially arable land to provide relevent soils data. Stringent land classification standards were necessary to assure that the lands would sustain irrigation under project conditions without significant deterioration.

Project Classification Standards

The land classification standards utilized for the project arable land study were identical to those used for HKM's classification of North Crowheart, South Crowheart, Big Horn Flats, Owl Creek, and Arapahoe Units. See Table 1. A series of land classes were set up to identify the relative quality of arable lands and to catalogue the limitations of those lands.

Classes 1, 2, 3, 4, 5 and 6 were established. A brief description of each class is given below.

Class 1. Class 1 lands are of high quality for irrigation, and will yield high returns with minimum production and management costs.

Class 2. Class 2 lands are good quality lands with only minor deficiencies.

Class 3. Class 3 consists of fair quality lands having more serious deficiencies than Class 2 lands.

Class 4. Class 4 lands are of marginal quality for irrigation and are used mainly for shallow rooted crops or pasture.

Class 5. Class 5 lands are those lands which have been placed into a deferred status pending further investigation. There were no lands included in a deferred status.

Class 6. Class 6 lands do not meet the minimum requirements for an arable rating under the land classification standards used in this study.

Map Symbol Code

In order to accurately express the limitations delineated in the specifications, it was necessary to develop a map symbol code. A fractional-type map symbol was used in the classification. A symbol of the same format as was used in the HKM undeveloped lands program was utilized.

The nature of the deficiencies are shown in the denominator and described in Table 2. A typical land classification symbol is shown in Figure 1. This code assures adequate information for planning the irrigation and drainage systems and in the subsequent economic feasibility analyses.

TABLE 1

LAND CLASSIFICATION STANDARDS

Wind River Indian Reservation, Wyoming 3-79

NOTE: Limitations defined apply to gravity and sprinkler methods of irrigation.

	CLASS 1	CLASS 2	CLASS 3	CLASS 4
SOIL				
TEXTURE	Sand loam to friable clay loam	Loamy sand to clay loam and silt loam	Loamy sand to light clay	Loamy sand to medium clay
SOIL DEPTH TO CLEAN SAND, GRAVEL, OR COBBLES	36" of FSL or finer or 42" of SL	24" of good free-working soil of FSL or finer or 30" of LS	18" of good free-working soil soil of SLor finer or 24" of LS	12" of good free-working soil of SL or finer
MOISTURE RETENTION (inches/48 inch depth)	A. Sprinkler-at least 5" B. Gravity-at least 6"	At least 4" At least 4.5"	At least 3" At least 3"	At least 2" At least 2"
ALKALINITY OF SOIL	Alkalinity will not be a problem in the presence of adequate drainage. SAR must be less than 12 in the upper 12". May be as high as 15 below 12" under optimum drainage conditions.	Permeability may be somewhat impaired by exchangeable sodium. SAR must be less than 12 in the upper 12". May be as high as 16 below 12" under optimum drainage conditions.	Permeability may be seriously impaired by exchangeable sodium but under equilibrim, SAR will not exceed 14 in top 12". Below 12" SAR may be as high as 20 under optimum drainage condition.	Same as Class 3
SALINITY	4 mmhos/cm E.C. maximum under average drainage conditions. 8 mmhos/cm maximum in top 48" where good leaching and drainage conditions exist.	4 to 8 mmhos/cm E.C. in an individual horizon may exceed 8 mmhos/cm under good leaching conditions. Most horizonts will have less than 8 mmhos/cm.	8 mmhos/cm maximum in top 24 inches. Maximum of 15 mmhos/cm tolerable at depths below 24 inches only if adequate leaching and drainage conditions exist.	16 mmhos/cm maximum in top 24 inches.

TABLE 1
LAND CLASSIFICATION STANDARDS
Wind River Indian Reservation, Wyoming 3-79
(Continued)

NOTE: Limitations defined apply to gravity and sprinkler methods of irrigation.

		CLASS 1	CLASS 2	CLASS 3	CLASS 4
SURFACE GRAVEL AND COBBLE		Relatively free	Moderately free, but affecting tilth and management.	Too stony for practical cultivations. Land can be worked for hay or improved pasture if other soil conditions are favorable.	Same as Class 3.
TOPOGRAPHY					
SLOPE	GRAVITY	0-2 percent	2-5 percent	5-8 percent	Same as Class 3
	SPRINKLER	0-8 percent	8-15 percent	15-20 percent	Same as Class 3
SURFACE	LEVELING GRAVITY	Light Leveling; 0 to 200 cu. yds. per acres. Maximum average cut 0.25 feet.	Medium leveling; 201 to 400 cu. yds. per acre. Maximum average cut 0.50 feet.	Heavy leveling; 401 to 700 cu. yds. per acre. Maximum average cut 0.88 feet.	Same as Class 3
	SPRINKLER	Not applicable	Not applicable	Not applicable	Not applicable
IRRIGATION PATTERN 1/ AND FIELD SIZE		Uniform to shape.	Slightly irregular in shape (few point rows, etc.)	Irregular in shape (several point rows, etc.)	Very irregular in shape (many point rows, etc.)
	GRAVITY	500 foot minimum run, 15 acre minimum size.	300 foot minimum run, 10 acre minimum size.	150 foot minimum run, 5 2/ acre minimum size.	Same as Class 3
	SPRINKLER	40 acre minimum size for side-roll. 100 acre min. size for center pivots	Same as Class 1 Same as Class 1	Same as Class 1 Same as Class 1	Same as Class 1 Same as Class 1
COVER (TREES 6" to 15" DIAMETER; LOW BRUSH)		0-8 trees per acre; 0-100 percent cover	0-18 trees per acre; 0-100 percent cover	18-35 trees per acre; 0-100 percent cover	35-50 trees per acre; 0-100 percent cover.

TABLE 1
LAND CLASSIFICATION STANDARDS
Wind River Indian Reservation, Wyoming 3-79
(Continued)

NOTE Limitations defined apply to gravity and sprinkler methods of irrigation.

	CLASS 1	CLASS 2	CLASS 3	CLASS 4
DRAINAGE				
SURFACE	No drainage problem anticipated.	Slight drainage problem anticipated which may be improved at relatively low cost.	Drainage problem anticipated which may be improved by expensive but feasible measures.	Same as Class 3
SUBSURFACE HYDRAULIC CONDUCTIVITY 3/	At least .10 in/hr	At least .10 in/hr	At least 10 in/hr	At least .10 in/hr 4/
SOIL DEPTH TO BARRIER 3/	At least 6 ft	At least 6 ft	At least 6 ft	At least 6 ft 4/

1/ Uniform shape refers to a field approximately rectangular or square in shape. As fields become more irregular in shape, field size limitations increase. Fields that are too small or irregular in shape for intermittent or continuous move sprinklers can be irrigated with hand move or solid set systems.

2/ Fields ranging in size from 5 to 10 acres are considered arable only if they are adjacent to other arable lands totaling at least 40 acres in size.

3/ With these parameters (depth and hydraulic conductivity) drain spacing should be at least 200 feet.

4/ No drainage requirement is necessary for these lands.

FIGURE 1

MAP SYMBOL CODE

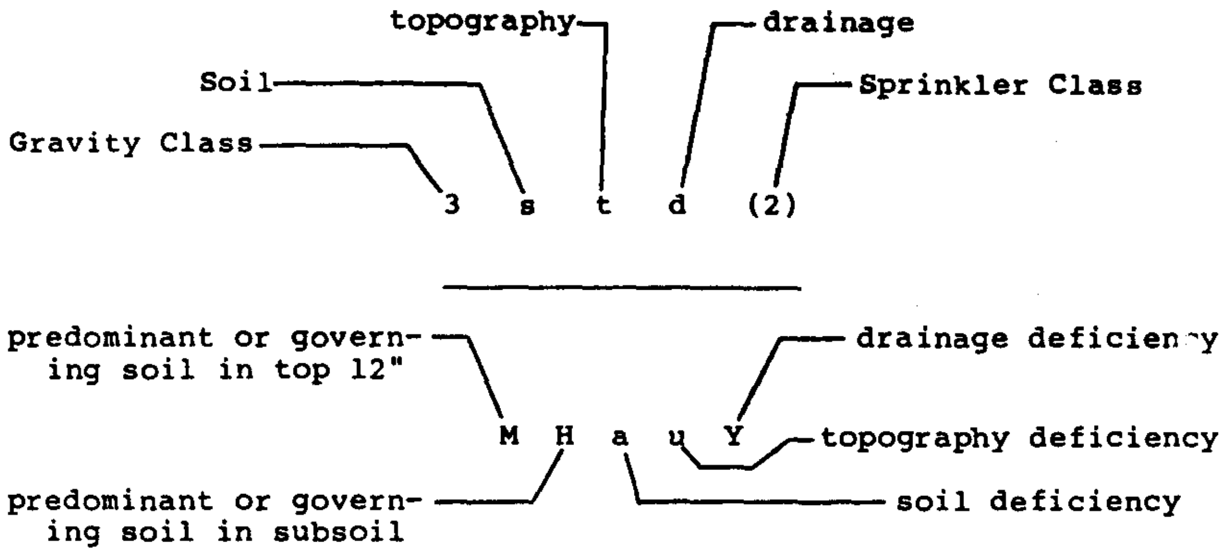

TABLE 2
EXPLANATION OF SYMBOL

Soil Symbols	Topography Symbols	Drainage Symbols
Clay .... H	Stone removal .... r	Flooding .... f
Clay loam	Leveling .... u	Good drainage... X
Silty clay loam ... M	Slope .... g	Restricted drainage....... Y
Silty loam	Length of run	Poor or negligible..... Z
Loam	Size, shape ...... j	
Fine sandy loam ... L	Cobble Tillage problem x	Bedrock or drainage barrier ... b
Sandy Loam		
Loamy sand V		
Sand		
Gravel .... K		
Bedrock or drainage barrier . b		
Available moisture holding capacity . q		
Salinity and/or alkalinity .... a		

Symbols will be used only when appropriate, not when in Class 1.

Methods

Land Classification. Field work was carried out at a modified semi-detailed level of investigation.

A semi-detailed classification as performed by WPRS (the former USBR) involves a careful examination of a land base. Potentially arable lands are studied at intervals of about one-half mile while non-arable lands are examined with less detail. Arable lands are separated from non-arable lands with considerable accuracy.

The minimum requirements for a WPRS semi-detailed classification are as follows:

Land classes recognized	1-2-3-4-6
Scale of base maps	1:12,000
Accuracy - percent	90
Field progress (square miles per classifier per day)	1-3
Minimum area of Class 6 to be delineated from larger arable areas - acres	0.5
Minimum area for change to lower class of arable land - acres	10
Minimum area for change to higher class of arable lands - acres	20
Minimum soil and substrata examination	
Borings or pits (5 ft. deep) per square mile	4
Deep holes (10 ft. or more per township)	2

HKM's modified semi-detailed study is similar to the WPRS semi-detailed study but calls for more deep holes, allowing a more accurate subsurface characterization.

Soils were considered from the standpoint of: texture; structure; depth to sand, gravel, bedrock or zones restricting either water movement and/or root development; and alkalinity or salinity.

Topography was evaluated on the basis of general slope, size and shape of field. Leveling was considered only in the gravity class determination.

Soil drainage was appraised on the basis of conditions anticipated with project irrigation. These include: evidence of a water table developing in the root zone; depth to bedrock or zone restricting water movement; and position of field in relation to surrounding potentially arable lands.

Each parcel of land was examined, evaluated and the appropriate land class boundary and preliminary symbol placed on the aerial photograph, location of all soil profiles were further documented on the photos. Shallow depth of soil to gravel or cobble in the profile in portions of the Reservation limited the depth of a number of hand augered holes, but often other evidence was available to ascertain depth to barrier. Cut banks and general observation of the morphology of the land helped make the classification accurate.

In federal or major private projects, idle and undeveloped lands typically had one hole augered per field which was logged and sampled. Each parcel was examined, evaluated and the appropriate land class boundary and preliminary symbol was placed on the aerial photograph. Thirty infiltration tests were run on these lands to determine how fast water will penetrate into the soil.