

Classifying the Saline Seeps of a Region into Best-Management Groupings¹

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ABSTRACT

Over 60 salinity investigations have been completed within a 9 township area near Avonlea, Saskatchewan. This level of study has provided detailed information on a large number of seeps. These have been grouped according to their common features and general landscape position, creating 3 seep classes: Uplands/Side-hill; Plains Transitional; and Bedrock Controlled. Recommendations from detailed farmer reports and local hydrogeologic test sites have been used to derive "best-management" strategies for each seep class. This approach will provide direction toward the treatment of future salinity requests, while promoting the realistic management of existing seeps.

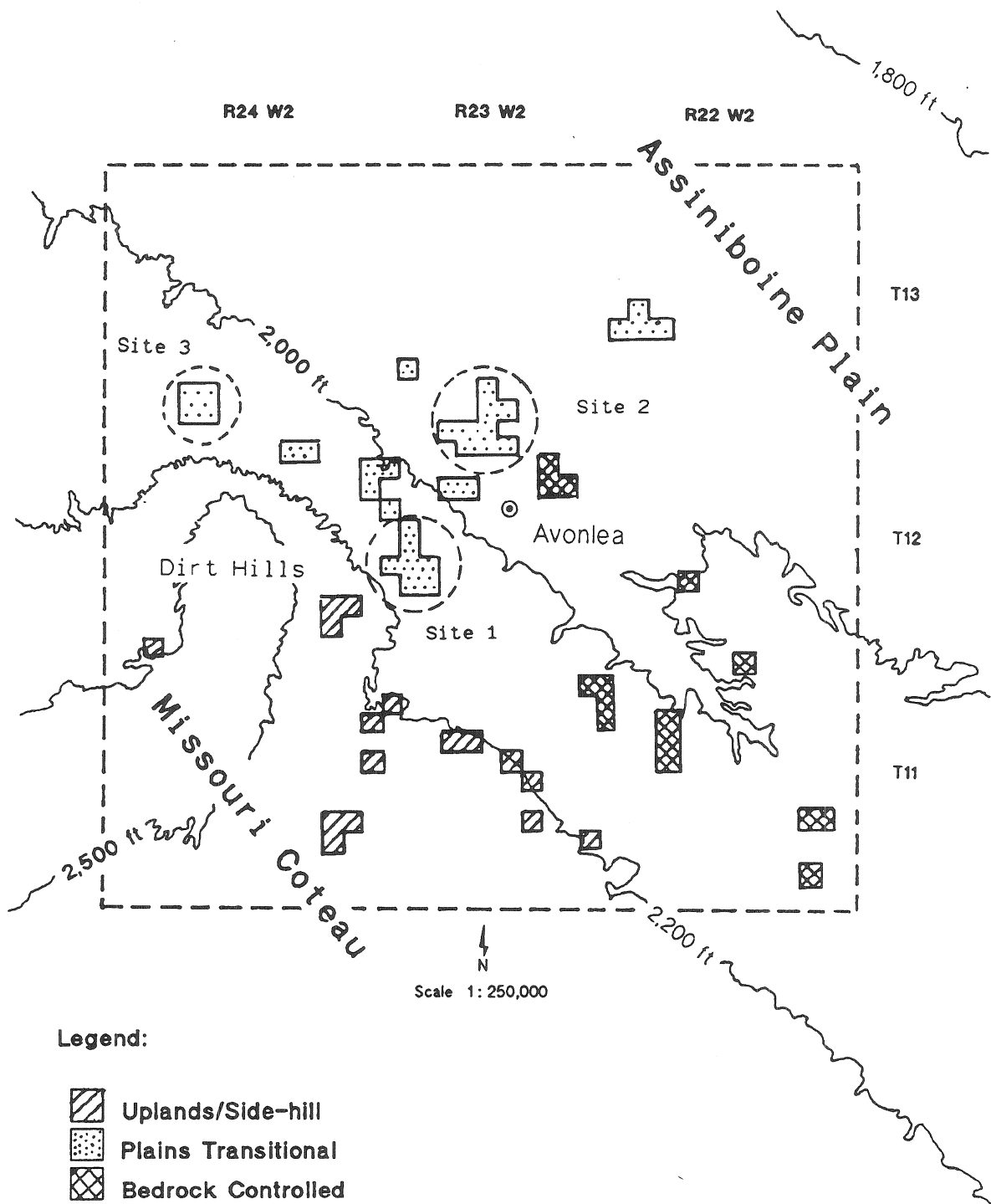
INTRODUCTION

During the 1980s, salinity investigations were performed on over 60 quarter sections of land near Avonlea, Saskatchewan (Figure 1). The need to continue detailed salinity investigation in the area is questionable in view of the extensive information already available.

The purpose of this study was to determine whether the saline seeps previously investigated in the Avonlea area, might be grouped according to their common features. This approach would then provide direction for the treatment of future salinity requests, while promoting the realistic management of existing seeps.

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Legend:


-  Uplands/Side-hill
-  Plains Transitional
-  Bedrock Controlled
-  Hydrogeological Test Sites

Figure 1. Investigation locations and seep groupings near Avonlea, Saskatchewan.

Landscape and Groundwater

The cause of saline soils near Avonlea can be related to the dominant landscape features of the area (Figure 1). These are: 1. The Missouri Coteau, a hilly upland to the south and west; 2. The Assiniboine River Plain, a level glacial plain to the north and east; and 3. An intermediate/transitional zone between the Coteau and the Assiniboine Plain (Christiansen 1961).

As groundwater recharges within the Missouri Coteau, it may percolate downward until reaching the sand/gravel lenses or sandstone layers of the Ravenscrag or Eastend formations (Christiansen and Whitaker 1976). This groundwater will then either discharge as a seep along the base of the Coteau, or add to existing groundwater levels within the Assiniboine Plain.

Within the Assiniboine River Plain, local groundwater may recharge and flow laterally through sand/gravel layers. This can cause the water table to rise in nearby areas.

PREVIOUS INVESTIGATIONS

Farmer Reports

On-farm salinity investigations (Figure 1) have involved about 30 landowners. Investigations generally included: a farmer interview; an EM38 salinity survey; drilling to log soil profiles for texture and chemistry; and limited monitoring of depth to the water table.

Detailed final reports were written for most projects (Klaassen 1984-1989). These contained an analysis of the factors contributing to salinity on the parcel and recommendations on how to control the problem. Most recommendations dealt with agronomic (cropping) solutions.

Hydrogeologic Studies

Three areas (Figure 1) were studied in greater detail to better understand groundwater interactions in the intermediate/transitional zone between the Coteau and the Assiniboine Plain. (Lebedin 1986, Lebedin 1987).

Site #1 - is underlain by glacial deposits, and has regional, intermediate and local groundwater flow. Poor groundwater quality and a high volume of artesian discharge limit agronomic potential. Tile drainage may be the only appropriate reclamation strategy.

Site #2 - has sand at ground surface and local to intermediate groundwater flow. Cropping practices might succeed but tile drainage may be necessary.

Site #3 - is very flat, with surficial and buried sand layers that pinch out to the north. Groundwater systems are local to regional, of poor quality, but low in discharge. Agronomic practices should be successful. Tile drainage is an alternative option.

CLASSIFICATION OF SEEPS

Results from the large number of investigations in the Avonlea area show that many seeps have common characteristics and can be sorted accordingly. These seeps tend to be grouped by landscape position. As a result, the seeps of Avonlea have been sorted into three general classifications: Uplands/Side-hill; Plains Transitional; and Bedrock Controlled (Figure 1).

Uplands/Side-hill

These saline lands are found primarily around the potholes of the Missouri Coteau uplands, and along the base of the Missouri Coteau.

Salinity in the upland area is mainly due to short-distance groundwater flow or poor surface drainage. Affected lands commonly occur along drainage channels and around ponded sloughs. Side-hill salinity occurs as groundwater discharges where the Coteau drops away to the Assiniboine Plain.

According to landowners, most of these sites were saline as early as the 1950s and 1960s, becoming worse since then. Over 500 acres are affected within 13 quarter sections of land. This represents almost 25% of the land within those quarters.

Plains Transitional

These seeps occur largely within a transitional zone grading from the Missouri Coteau to the Assiniboine River Plain. They are dominated by regional to intermediate groundwater flow which may be under artesian pressure. These seeps may also be found near sandy soils and ridges and can have a significant local groundwater component.

Some sites contain Solonchic soils, having high sodium and hardpan-like features. They are often a part of the

Claybank Soils Association, a group known for its saline features.

Many sites were known by landowners to be saline as early as the 1940s. A few seeps are said to have developed more recently. Almost 1,500 acres are affected within the 31 quarters containing this group of seeps. This represents about 30% of the area.

Bedrock Controlled

Saline lands in this class have bedrock at a relatively shallow depth (<5 m) as a common feature. This bedrock is a conduit for moving groundwater into the area from the Missouri Coteau.

Most affected lands occur within isolated lows or along drainage channels in a fairly level landscape. Many are clearly historic in nature, with evidence of increasing severity (in degree though not extent) in recent years.

Saline lands can be confused with patchy solonchic features common to the area. Some sites show evidence that groundwater flow in coarser-textured surface soils is perched on top of the less permeable bedrock. The area of saline lands in this class is about 100 acres. This represents less than 5% of the total area (15 quarter sections).

BEST-MANAGEMENT GROUPINGS

The practices generally recommended for saline seep control are: plant salt tolerant forages in affected areas; and crop recharge uplands as often as practical. However, the blanket application of these recommendations to all seeps assumes a uniformity that is clearly non-existent.

Management Strategy

Sorting Avonlea seeps into groups has facilitated the formulation of a "best-management" strategy for each group (Figure 1). This management approach has been extracted from the reclamation and control mechanisms recommended in the farmer reports and hydrogeologic studies.

Uplands/Side-hill The best approach for this group is to seed affected lands to salt tolerant forages and to crop surrounding lands as often as practical.

Affected lands are inherently wet and attempts to return them to a crop/fallow rotation will be largely unsuccessful. Alfalfa is recommended as a high moisture-use crop to intercept incoming groundwater, or for upslope recharge control when compatible with farm operations.

Plains Transitional Where local groundwater flow appears to be a significant component, changing this balance can bring about the reclamation of these seeps. If salinity levels and water tables are initially high, cropping strategies will take some time to make a difference. Once established, however, cropping practices can be a workable means for controlling this class of seep.

Where regional groundwater is highly saline or artesian discharge is suspected, reclamation by agronomic means is unrealistic. Salt tolerant crops should still be grown on affected lands to stabilize them as much as possible. However, successful cropping is unlikely in the absence of tile drainage and an active leaching program.

Bedrock Controlled Reclamation under these circumstances is likely impractical. Cropping within affected parcels is the only practical means of dealing with salinity in small scattered patches. In a few cases significant coarse-textured layers convey local groundwater flow. Intensive cropping upslope of the seep and/or limited tile drainage may be appropriate.

SUMMARY AND CONCLUSIONS

Dominant landscape features within the Avonlea region are the Missouri Coteau, the Assiniboine Plain and an intermediate/transitional zone. Groundwater systems within these features have caused historic and recent salinity.

Detailed investigations on a large number of seeps have allowed affected lands to be grouped according to their common characteristics and landscape position. The resulting seep classes are: Uplands/Side-hill; Plains Transitional; and Bedrock Controlled.

Best-management strategies have been developed for each seep class, based on the control mechanisms previously recommended for seeps within the class. This best-management approach will promote the realistic management of existing seeps.

Sorting new sites into their potential seep class will provide insight into probable salinity causes and solutions. This will assure that resources for new investigations are targeted where they will best provide relevant information in a timely and cost-effective manner.

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