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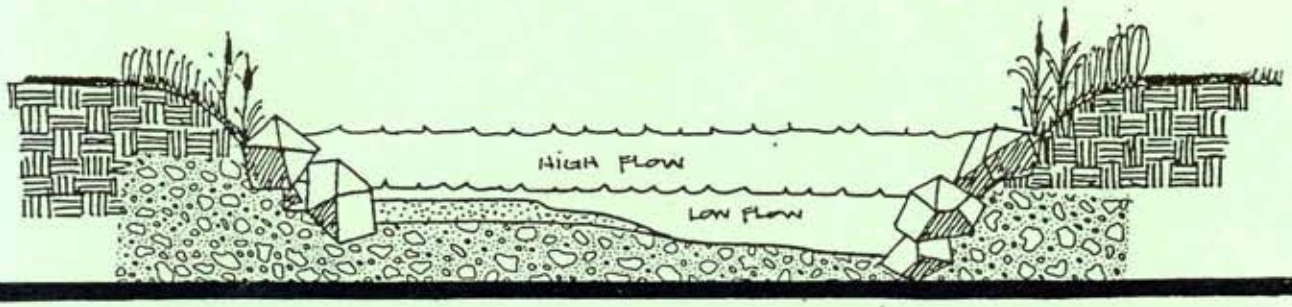
JORDAN RIVER NONPOINT SOURCE MANAGEMENT PLAN

FOR HYDROLOGIC MODIFICATIONS

MARCH, 1995



BOARD OF SALT LAKE COUNTY COMMISSIONERS

DEPARTMENT OF COMMUNITY
& SUPPORT SERVICES

JORDAN RIVER NONPOINT SOURCE MANAGEMENT PLAN

HYDROLOGIC MODIFICATIONS

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Water Resource Planning Coordinator

March, 1995

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UNITED STATES GOVERNMENT

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I. INTRODUCTION

A draft nonpoint source management plan was developed for the Jordan River in October, 1988. Although the State of Utah never formally adopted this plan, it formed the basis for the negotiated an interagency cross-section design, since constructed for a 1991 river restoration demonstration project on the Jordan River located in Murray, Utah.

This demonstration, which featured all the design components developed in the 1988 Draft Plan, subsequently received the first national EPA nonpoint category award in 1992. It has sparked intense interest of upstream cities along the River, and several planning efforts are under way for park & recreation master plans in Bluffdale, Riverton, Draper, South Jordan, and West Jordan.

Despite the success of this landmark demonstration project on the Jordan, Region VIII EPA determined that no additional funding for the "Hydrologic Modification" nonpoint source category could be awarded to the county or its cities for this type of work, until a specific plan element was developed and added to the existing county and state nonpoint plan. It is the objective of this plan update to provide that element, and facilitate further restoration work on the Jordan River.

Major changes have occurred since the Draft 1988 Plan:

-- A federal entitlement for acquisition of wetlands identified along the Jordan River, via the Central Utah Project completion;
-- Completion of a meander corridor study funded by Salt Lake County under a contract with CH2M-Hill engineers;
-- Updated methods for classifying streams and solving problems based on morphological characteristics, in addition to engineering approaches;

o Wetland Acquisition Authorized under Central Utah Project Completion Act

The federal wetland acquisition entitlement resulted from passage of the Central Utah Project Completion Act. It authorizes $ 7.0 million for fee title purchase of 935 acres of prime wetlands on the upper Jordan within the next 3-4 years.

In anticipation of this program, a committee was convened to study different various acquisition and management proposals. In June, 1993, the proposals were submitted to the C.U.P. Mitigation Commission for specific line-item funding of property acquisition beginning in 1995.

A federal EPA grant has been awarded, under sub-agreement with the Utah Division of Wildlife and Salt Lake County, to develop a specific wetland parcel acquisition plan. The components of this plan include setting aside areas adjacent to the Jordan River as wetland reserves in perpetuity. It will also identify zones near the river where compensatory mitigation could occur in conjunction with Section 404 permits, and areas where constructed wetlands are feasible for treating stormwater discharges now required for permitting by EPA. Project completion is scheduled for July, 1994.

o Jordan River Meander Corridor Study

The meander corridor study recommends excluding any new development in the historic floodway/meander boundary on the upper Jordan, and has resulted in a draft regulatory ordinance (requested by the County Commission) planned to be adopted and implemented during 1993. The CH2M-Hill study defines each river reach and its historic hydrology, geology & geomorphology, sedimentation characteristics, and artifical modifications. It analyzes river stability using various hydraulic, historic and comparative models, and sets forth specific management alternatives for implementation by Salt Lake County.

o Natural River Classification Framework

The Jordan River plan includes a "morphological arrangement of stream characteristics organized into relatively homogeneous stream types" and provides "a stream hierarchical inventory untilizing the stream classification system....with specific examples of applications for riparian and water resource management." (Rosgen, March 1993)

Although this work applies mainly to natural streams, a summary of Jordan River applications using the approach is presented as a supplement to the CH2M-Hill recommendations.

o Development of Mainly "Non-structural" Cross-sections

Consequently, the extent of proposed structural bank stabilization improvement--mainly rock rip-rap--has been drastically reduced in the Jordan River "master" cross-section design. The new emphasis is on non-structural improvement using mainly native vegetation and restoration of riparian understory and overstory species and limited bank re-grading to enhance meander or oxbow conditions.

II. RESOURCE INVENTORY UPDATE

As described previously, there are four elements which update the Jordan River Nonpoint Source Management Plan with an hydrologic modification component.

A. Jordan River Meander Corridor/Stability Study

In March, 1993 Salt Lake County completed a study of the Jordan River and the factors which impact its stability. The study was contracted to CH2M-Hill engineering consultants. The purpose of the study was "to develop a stability management plan that could be used by Salt Lake County and the ten incorporated cities that border the Jordan River to manage and protect the river, as well as development along the river:"

> Detailed historical, empirical, and geomorphic analyses were conducted to assess the existing river stability and to identify existing and potential future stability problems. The detailed stability analyses indicated that long-term degradation and bank erosion are likely to occur throughout the study reach of the Jordan River until a more stable slope and channel pattern is established. A stable slope will be provided through increased meandering and strategic placement of grade control structures. A stable channel pattern will develop naturally by increased meander development.

Variables including hydrology, flooding, geology, geomorphology (channel/slope characteristics), soil type, sedimentation, sediment source, and historical modifications (channelization, utility crossings, dredging, grazing) were included in the stream analysis.

A regulated, managed meander corridor that will contain the projected channel changes has been proposed based on CH2M-Hill's work. In addition, Salt Lake County has developed an ordinance which would restrict and manage future growth or development proposals within the corridor. The meander corridor limits maps are included as Appendix A.

A river stability management plan has been recommended by the study which prioritizes management alternatives and practices designed to manage stability problems. It is intended that these practices be used as one of the key components in total river corridor management. The major findings of the study are:

- **There is little natural about the Jordan River.** The Utah Lake Compromise agreement, irrigation practices, and development alter the ability of the river to behave "naturally."

- **Past channeling & straightening have aggravated instability problems.** Channel slope has artificially increased causing higher flow velocities and rates of sedimentation.

- **The Jordan River of the future will have:** more meanders with smaller wavelengths and radius curvatures, flatter channel slopes, 3:1 banks, more riparian vegetation, and an increased width/depth ratio.

- **Efforts to prevent the river from returning to its natural state are cost-prohibitive.** From a tax-dollar standpoint, it is more cost-effective to prevent development within the historic meander channel and manage the river to promote return to its historic equilibrium.

The study divided the Jordan River into nine management reaches:

Reach 1: Turner Dam to Joint Diversion
Reach 2: Joint Diversion to 14600 South
Reach 3: 14600 South to 12600 South
Reach 4: 12600 South to 10600 South
Reach 5: 10600 South to North Jordan Diversion
Reach 6: North Jordan Diversion to 6400 South
Reach 7: 6400 South to Brighton Diversion
Reach 8: Brighton Diversion to Millcreek Confluence
Reach 9: Millcreek Confluence to 2100 South

For all stream reaches, prioritized recommended management alternatives were developed which include:

- Restricting development within the meander corridor.
- Allowing bank erosion to occur within the corridor until "pre-channelization sinuosity" is re-estabilished.
- Revegetate and regrade channel banks after the stable channel pattern is established.
- Bridge inspection & monitoring program.
- Channel monitoring using monumented cross-sections.
- Survey of corridor limits, for use in community development plans.
- Acquisition of key meander zone land parcels.
- Regulation of future bridge and utility crossings to ensure design for scour and flood conveyance.

Specific structural solutions were recommended for each stream reach by priority. (Rip-rap projects shall incorporate native grass, shrubbery, and trees as part of project design. Grade controls shall incorporate canoe & fish passage criteria). These are summarized below:

STREAM REACH	STRUCTURAL SOLUTIONS	PRIORITY
1	Monitor Bank Erosion/Stability	High
	No structural measures recommended	N/A
2	Monitor Bank Erosion/Stability	High
	No structural measures recommended	
3	Rip-rap above 12600 South (bridge prot.)	Low
	Rip-rap above 12600 South (sewer prot.)	High
4	Grade control at 10600 South	Low
5	No structural measures recommended	N/A
6	Grade controls at 7800/9000 South	Moderate
	East bank rip-rap	Low
	Sharon Steel tailings stabilization	Low
7	Grade controls at 4800 South & I-215	Low
	Grade controls at 5400 South	High
	West bank rip-rap	Moderate
	Monitor Bank Erosion/Sediment Deposition	Low
	Dredge deposition @ L.C. Creek confluence	High
8	Grade controls at 3300 & 3900 South	Moderate
	Rip-rap east & west banks	Low
	Dredge deposition @ B.C. Creek confluence	Moderate
	Monitor sediment deposition @ X-sections	High
9	Dredge deposition @ Millcreek confluence	Moderate

A summary of channel stability problems identified during the study is presented below. This information includes data developed during the 1987 "Stream Reach Inventory and Channel Stability Evaluation for the Jordan River," the basis for the first draft Jordan River Nonpoint Source Management Plan.

STREAM REACH	STABILITY PROBLEM
1	o Bridge scour at Railroad Crossing o No significant stability problems
2	o Some potential for long-term degradation near 14600 South area
3	o Some potential for erosion damage due to long-term degradation at 12600 South & utility crossings (Mainly sewer interceptor)
4	o Severe bank erosion will continue, but net deposition in the reach will not affect stability.
5	o Some deposition upstream of No. Jordan Diversion. o Bank erosion will increase, but be contained within the corridor. o No signficant stability problems.
6	o Bridge scour at 7800 & 9000 South, worsened by long-term degradation. o Bank erosion upstream of 6400 South o Bank erosion upstream of 7800 South near Tailings
7	o Bank erosion, sediment deposition, & bridge scour at 5400 & 4800 South. o Sediment deposition at confluence with LC Creek Bank erosion upstream of I-215
8	o Bank erosion & sediment deposition near confluence with Big Cottonwood Creek. o Bank erosion upstream of 3300 South. o Signficant bridge scour at 4500, 3900 & 3300 So.
9	o extensive sediment deposition o No significant channel stability problems

B. Jordan River Classification and Restoration Utilizing Natural Stability Concepts

A classification system for natural rivers, and methods for river restoration using natural stability concepts, has been recently published by David Rosgen (March, 1993). These concepts, studied over the last twenty years, offer an holistic approach to river restoration which also includes development of hydrologic and geomorphic data employed by engineering models **(Figures One & Two).**

The chief limitation to this approach is that it typically applies to rivers which have not been subjected to extensive man-induced changes. However, many of the input factors, such as basin slope, stream reach gradient, width-depth ratios, geologic and soil framework, sediment characteristics, vegetative conditions, seasonal hydrology, and hydraulic geometry, are employed which collectively aid problem solving.

This work builds on intensive efforts in the mid-1970's by Leopold, Wolman, Shumm and others to typify river dynamics in a way that aids restoration and enhancement of beneficial uses, such as erosion control, fishery habitat, recreation, and water quality/supply maintenance.

o Classification of the Jordan River

The Jordan River is not natural, nor is it easily classified. Different segments of the Jordan, discussed by CH2M-Hill, have been impacted to varying degrees, not neatly defined within a standard geomorphic stream type or class approach:

> "Because the river is so unique and been so thoroughly altered, most of the established techniques for evaluating river stability have some weaknesses when applied to the Jordan River. In addition, the independent variables which control river geometry vary significantly within the study area. Thus, no one method would be completely satisfactory for the whole river. Also, there are no undisturbed reaches in the study area from which to extrapolate stable river geometry, and no nearby river is truly analogous. Furthermore, no methodology has been established to explicitly address all of the effects of urbanization."

Given these limitations, the following summary classifies the principal segments of the Jordan River following the method developed by Rosgen:

JORDAN RIVER CLASSIFICATION
BASED ON TYPOLOGY DEVELOPED BY ROSGEN

STREAM REACH & X-SECTION	ENTRENCHED RATIO	W/D RATIO	SINUOSITY RATIO	SLOPE %	MATERIAL	CLASS
1-25	Slight	>12	High	.005	Gravel	C4
1-55	Entrenched	<12	Moderate	.008	Gravel	G4c
1-60	**Braided**	<12	Moderate	<.005	Gravel	DA4
2-210	Entrenched	<12	Moderate	<.02	Gravel	G4c
2-235	Entrenched	>12	Moderate	<.02	Gravel	F4
2-290	Slight	<12	Very High	<.02	Gravel	C4
3-320	Slight	>12	High	.003	Gravel	C4
3-355	Slight	>12	High	.003	Gravel	C4
3-470	Slight	>12	High	.002	Gravel	C4
4-485	Slight	>12	High	.001	Gravel	C4
4-561	Slight	>12	High	.001	Gravel	C4
4-575	Slight	>12	High	<.001	Gravel	C4c
5-621	Slight	>12	High	<.001	Gravel	C4c
5-670	Slight	<12	High	<.02	Gravel	C4
5-695	Slight	<12	High	<.02	Gravel	C4
6-740	Slight	<12	High	<.02	Gravel	C4
6-780	Entrenched	<12	Moderate	<.02	Gravel	G4c
6-890	Slight	>12	High	>.001	Gravel	C4
7-923	Moderate	>12	Moderate	<.02	Gravel	B4c
7-960	Slight	<12	High	<.02	Gravel	C4
7-1000	Slight	>12	High	<.001	Gravel	C4c
8-1120	Moderate	>12	Moderate	<.02	Gravel	B4c
8-1150	Slight	<12	Very High	<.02	Gravel	C4
8-1180	Slight	<12	Very High	<.02	Sand	C5
9-1265	Entrenched	<12	Moderate	<.02	Sand	G5c

Source: CH2M-Hill. Jordan River Stability Study Appendix. Salt Lake County Public Works. May, 1993.

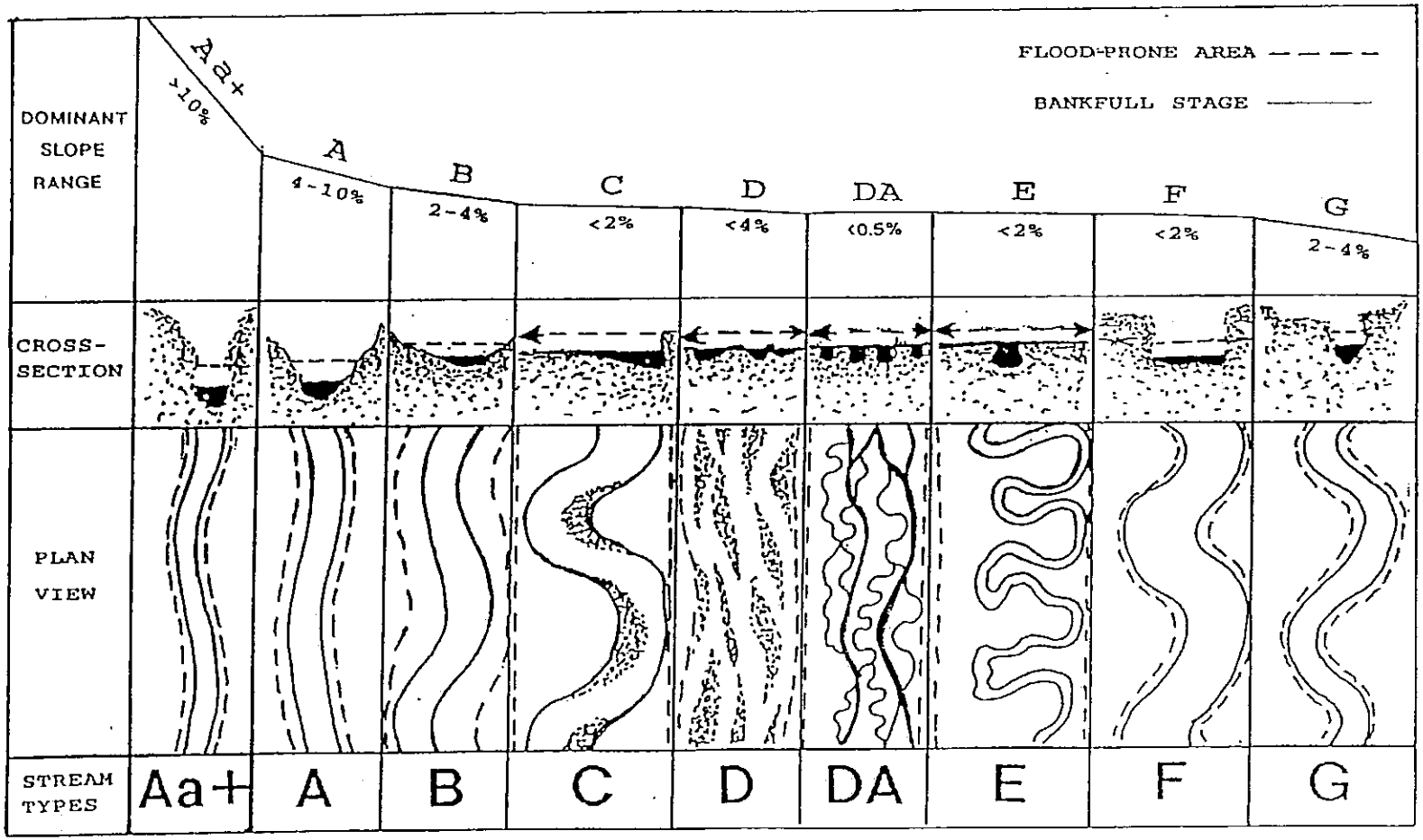

Figure 1 Broad level stream classification delineation showing longitudinal, cross-sectional, and plan-views of major stream types (from Rosgen, in review:, 1993).

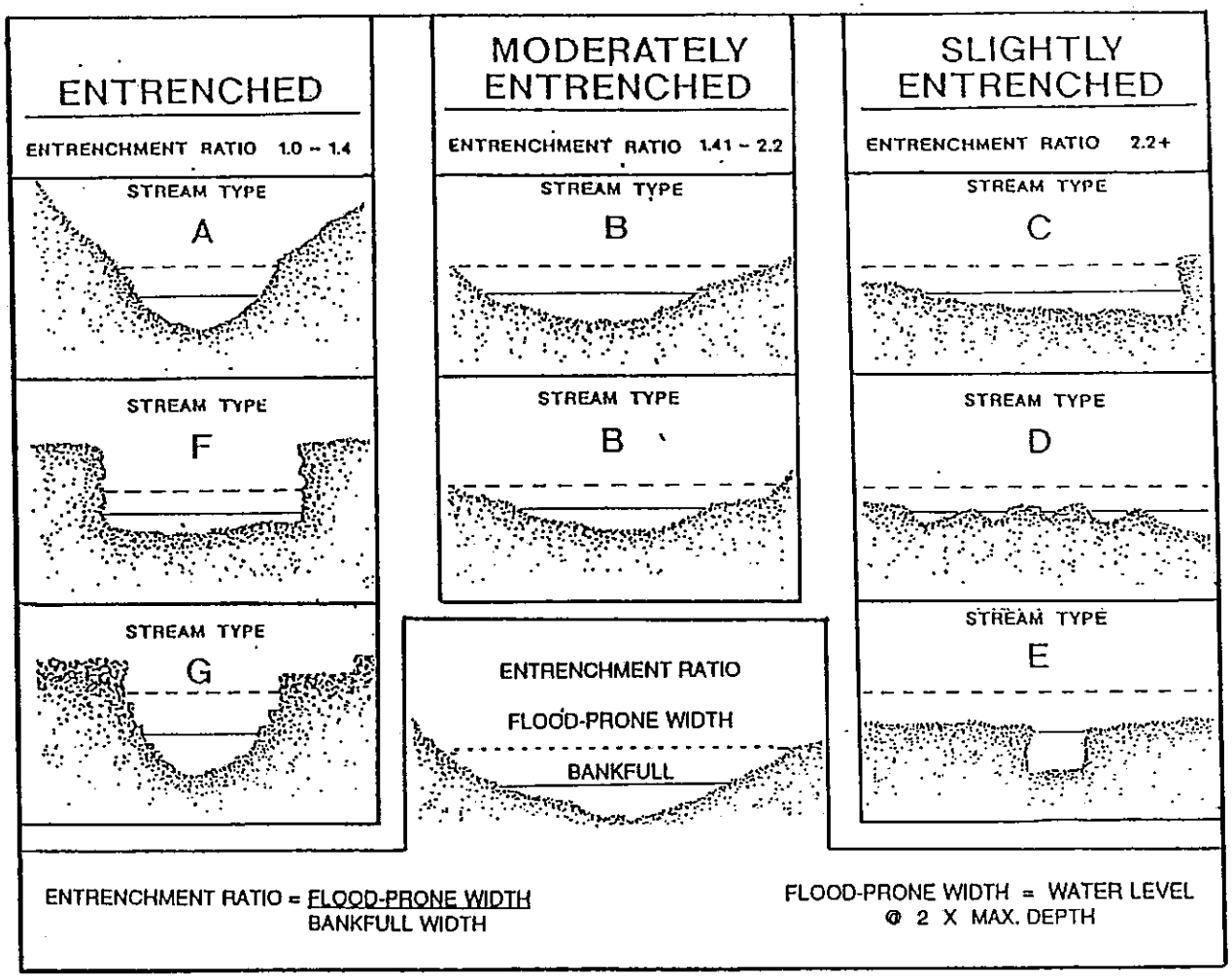

Figure 2 Examples and calculations of channel entrenchment.

o Restoration Measures Recommended by Rosgen Classification

The following management practices are recommended by Rosgen in "Stream Classification & Application," and are designed for application to specific conditions for particular stream classifications. The majority of these practices are directed at fish habitat enhancment, and most do not apply to the E, F, & G-rated stream segments of the Jordan.

MANAGEMENT PRACTICE	JORDAN RIVER STREAM TYPE							
	B4	C4	DA	E4	E5	F4	G4	G5
Rearing Habitat Enhancement:								
Check Dams/Grade Controls	F	F	F	NR	NR	NR	NR	NR
Instream Boulder Placement	P	P	P	NR	NR	NR	NR	NR
Streambank Boulder Placement	**G**	**G**	F	NR	NR	NR	NR	NR
Single Wing Deflectors	P	P	F	NR	NR	NR	NR	NR
Double Wing Deflectors	P	P	F	NR	NR	NR	NR	NR
Channel Constriction	P	P	F	NR	NR	NR	NR	NR
Bank Cover	P	F	P	NR	NR	NR	NR	NR
Floating Log Cover	F	G	P	NR	NR	NR	NR	NR
Submerged Shelters	F	G	P	NR	NR	NR	NR	NR
Half Log Cover	P	P	P	NR	NR	NR	NR	NR
Migration Barrier	P	P	P	NR	NR	NR	NR	NR
Spawning Habitat Enhancement:								
V-Shaped Gravel Traps	P	P	P	NR	NR	NR	NR	NR
Log Sill Gravel Traps	P	P	NR	NR	NR	NR	NR	NR
Gravel Placement	P	P	P	NR	NR	NR	NR	NR

Key: Ex - Excellent G- Good F- Fair P- Poor NR- Not Rated

- **Recommended Hydrologic Modification Management Practices for the Jordan River.**

The following management practices are recommended based on combined evaluation and analysis of CH2M-Hill, Salt Lake County, Rosgen Classification, and State of Utah adopted practices:

1. **Restrict Development within Meander Corridor.** To continue invasion of the corridor and impose increased bank stabilization to protect development will exacerbate efforts of the river to reach some level of natural equilibrium. Passage of a county-wide ordinance to restrict such development is in final planning stages.

2. **Coordinated River Corridor Planning.** Due to the nature of multi-agency jurisdiction on the river, it is critical that a coordinated watershed management advisory board be created to effectively address future conflicts for development within the Jordan River corridor. This process is important to overall planning for implementation of management practices over the long-term. Refer to the Jordan River Sub-Basin Watershed Council.

3. **Monitor Bank Erosion and Stability.** Existing water quality monitoring must be supplemented with physical resource monitoring of erosion and sedimentation rates within the corrdior, particularly along those reaches where modifications are possible. This practice is consistent with EPA's new policy to require physical parameters together with traditional chemical & biological variables.

4. **Terrace Reconstruction.** Re-grading steep embankments assists the river in stabilizing rates of sedimentation, stream flow velocity, flood storage elevations, and natural revegetation. The minimum grading standard should be no less than 3:1 finished slopes, and include native revegetation.

5. **Meander Reconstruction.** Where appropriate, projected meanders should be assisted through incremental re-grading to reduce lateral cutting & excessive sedimentation, and accelerate the re-establishment of sinuosity and balanced meander wave-lengths. The minimum grading standard should be no less than 3:1 finished slopes, and include native revegetation.

6. **Riprap Boulder Placement.** Structural streambank stabilization, particularly where facility protection is merited, should be implemented through use of large boulder riprap material, keyed into banks to prevent back-wash during high flows. **Emphasis for boulder placement is on lower bank slopes, with mid/upper slopes re-graded to minimum 3:1 and revegetated.**

7. Grade Control Check Dams. These structures are placed above bridges to attenuate high flow velocities downstream, and assist upstream channel slope restoration. Grade controls have the effect of increasing upstream sinuosity and meander, through inducement of artifical sedimentation behind them. To reduce future need for dredging or flushing flows, such controls should be designed to pass a percentage of sediment downstream, and be fitted with canoe ramps and fish passage ladders.

8. Constructed Wetlands/Filter Strips/Floodplain Ponds. Such practices are very similar in both function and design. These are off-site swale excavations or old oxbows located at the upper bank slope, usually within the flood channel, meander corridor, or floodplain. They feature a wide littoral zone of seasonal saturation enabling the establishment and maintenance of hydrophytic plants, such as salix, carex, scirpus, juncus, or other wetland species. In some areas, the introduction of overstory species such as Populus (Cottonwood) at the upper banks may be appropriate for riparian diversity and increased bank stability.

9. Revegetation/Restoration. This refers to the revegetation of graded bank slopes using mainly native plant species or those known to occur within the ecosystem range. These include grasses, forbs, shrubs, and trees indigenous to the Jordan River corridor area, exclusive of Tamarisk.

10. Grazing Management. Grazing should be restricted from instability hazards within the meander corridor, or within areas to be restored through structural or non-structural managment practices. Restriction involves mainly fencing.

11. Off-stream Stock Water. Another method of grazing management is providing stock watering facilities away from the river, to encourage use outside areas targeted for riparian restoration. Most off-stream stock watering facilities are utilized in conjunction with fencing.

12. Snag Removal. This is not a common problem along the Jordan River, but is significant along valley stream tributary to segments of the river. It consists of removing overstory vegetation "snagged" in the water which could promote flooding at constrictions during high flows. Typically utilized during emergency or flood events.

13. Warranted Dredging. Where warranted to protect bridges and at creek confluences required by agreement with the Army Corps of Engineers, "dredging shall be limited to material deposited above the surveyed 1990 flow line. Disposal of dredged material should be conducted in a manner that will minimize disruption of riparian ecosystems."(CH2M-Hill, 1993)

14. Submerged Shelters. For the Jordan River, shall consist of native shrubbery placed on lower banks to provide overhead cover.

15. Floating Log Covers. Installation of floating logs, "fastened together and cabled to the bank, streamside or boulder, free to float and drift with rising and falling stage of the river."

III. JORDAN RIVER SUB-WATERSHED MANAGEMENT SUMMARY

o Watershed Description

The Jordan River watershed within Salt Lake County encompasses 488,960 acres. Of the total acreage, 171,000 is comprised of mountainous terrain which provides roughly 70% of the total groundwater recharge to the deep confined aquifer. The remainder of the watershed is the valley province, comprising 318,000 acres. The Jordan River watershed supports the largest population of any geographic area in Utah, with approximately 800,000 residents.

The Jordan River sub-watershed is 40 miles long beginning at the Jordan Narrows and ending at Farmington Bay. The highest River elevation at the Narrows is 4470 falling 260 feet to 4210 at Farmington Bay. The watershed elevation ranges from Twin Peaks (11,328 feet) to the Great Salt Lake (4,210 feet). Average annual precipitation is 12-15 inches in Salt Lake Valley and 35-60 inches in the Wasatch Mountains.

The U.S. Geological Survey estimates the average annual discharge of Utah Lake into the Jordan River at 271,000 acre-feet, with creeks from the Wasatch adding 141,000 acre-feet, and the Deer Creek and Provo Reservoir canal contributing another 82,000 acre-feet. The total estimate of surface water inflows is about 494,000 acre-feet. However, diversions and losses between the Jordan Narrows and 2100 South result in a mean annual Jordan River discharge of 228,000 acre-feet at the Surplus Canal diversion.

o Current Water Quality Data Collected for the Jordan River

The most current data for the Jordan River has been collected by the Salt Lake City-County Health Department, which monitors the river monthly to semi-monthly. In addition, sediment samples have been collected in conjunction with CERCLA assessments of the Jordan, as well as wetland pond monitoring in conjunction with recent 319 project implementation and 404 permit requirements (Appendix D).

o 1991-92 Jordan River Ambient Water Quality Data

The City-County Health Department has used Equal Width-Integrated sampling on the Jordan River since 1989. This method provides more accurate data, consistent with those collected by the U.S. Geological Survey during the Nationwide Urban Runoff Assessments of 1979-82. The method samples the entire water column across the channel width, as opposed to a point (usually near the stream edge surface) water sample.

The significance of this method is particularly important to evaluating wasteloads (mainly heavy metals), which are calculated by using sample composites (stream-width multiplied by water column depth) multiplied by stream discharge.

The parameters sampled include temperature (centrigrade), dissolved oxygen, pH, conductivity, total coliform, fecal coliform, fecal strep, biochemical oxygen demand, total suspended sediment, total Kjeldahl nitrogen, ammonia, chloride, nitrate, sufate, total dissolved phosphorus, hardness (CACO3), arsenic, chromium, copper, lead, selenium, and zinc.

Graphs which summarize potential problem parameters where water quality standards have either been violated or show potential problems for future water quality management are shown in Appendix D.

o Sources of Water Quality Problems

1. Hydrologic & Habitat Modifications:

The Jordan River has been radically altered since the settlement of Salt Lake valley. The largest alterations have been in the form of land use invasion, dredging, straightening, and construction of irrigation diversions. These activities have severely impaired diverse habitat for warm and coldwater game fishes, and diminished upstream movement.

The Jordan is characterized by trapezoidal channels which produce fish species most suited to uniform bottom conditions. Subsequently, the dominant fish species are carp and sucker. Recent studies of the River (Biowest, 1987) indicate that where limited higher quality habitat occurs, other more desireable game fishes occur.

Past management practices along the Jordan have severely impacted fish cover factors which reduce suitable habitat. The removal of sediment and flattening of the River channel destroy pool and riffle ratios which are critical to the establishment and maintenance of high quality fishery production.

JORDAN RIVER
WATER QUALITY PROBLEM PARAMETERS
AND POTENTIAL SOURCES

PARAMETER	AFFECTED SEGMENT	POTENTIAL SOURCES
Suspended Sediment	3300-4500 South 9000-14400 South	Hydrologic Modif. Bed/Bank Erosion Construction
Total Phosphorus	6400 South 2100 South-1800 North	Agriculture/Hyd.Mod. Urban
Total Ammonia	2100 South-1800 North	Urban/Irrigation
Total Nitrate	5400 South-1800 North	Urban/Irrigation Hydrologic Modif.
Total Zinc	6400-3300 South	Hydrolgic Modif. Urban/Illicit Mining
Total Lead	7800-3300 South North Temp-1800 North	Hydrologic Modif. Mining Urban
5-Day BOD	4500 South-1800 North	Urban/Irrigation
Dissolved Oxygen	N Temple-1800 North	Urban/Irrigation Hydrologic Modif.
Coliform Bacteria (Total and Fecal)	6400 South-1800 North	Hydrologic Modif. Irrigation/Urban Agriculture/Illicit

Flooding in 1983-84 aggravated bank-cutting which increased downstream sediment loads requiring dredging. Upstream dredging of the outlet of Utah Lake enlarged the channel to drain the Lake faster. This may produce higher velocities and volumes of critical flows.

2. Urban Stormwater Runoff

Urban runoff assessments completed in 1982 indicate that stormwater discharges produce short-term shock loads of contaminants, many of which may violate acute instream concentrations allowed under water quality standards.

High concentrations of coliform bacteria violate the Class 2B standard for non-contact recreation during and soon after storm events. High concentrations of heavy metals in storm runoff may bioaccumulate in aquatic organisms and travel up the food chain to humans. The beneficial use of the Jordan for fishing has possibly been impaired by storm discharges through decreasing fish reproduction.

3. Illicit Disposal Practices

Illegal disposal of solid waste, hazardous substances, or construction materials such as sediment, broken concrete, rebar, or other materials has over time collectively impaired potential uses of the Jordan River for recreation and fisheries.

Unauthorized discharge of dredged and fill material into adjacent wetlands has robbed the Jordan of natural stream buffers which perform valuable water pollution control functions, and destroyed critical habitat for predatory game fish which control more undesireable non-game fish.

The illegal dumping of hazardous or toxic materials into the Jordan via storm drains, groundwater, or surface water features such as canals has created large-scale fish kills, and impaired the survival and reproduction of more sensitive species.

The unauthorized placement of construction wastes along the banks and within the channel of the Jordan has destroyed the aesthetic values essential to increased use of the River for floating, canoeing, and other forms of leisure recreation, and may pose extreme dangers and safety problems to river recreationists.

o Recent Fishery Studies and Future Data Needs

Studies conducted by Biowest for the Central Valley Water Reclamation Facility (CVWRF) on the Jordan River (in cooperation with Salt Lake County and the State of Utah) attempted to determine whether fishery production is impaired chiefly by nonpoint or point sources of pollution.

Preliminary conclusions of this effort imply that habitat damage on the river is most responsible for the dominance of non-game omnivore fishes. Past river manipulation has destabilized sedimentation and fluvial patterns in the river restricting the density and diversity of macroinvertebrates the river could produce. The possibility for food-chain contamination should be studied.

o Potential Benefits of Improving the Jordan River

If the Jordan River were managed to optimize river recreation and urban fishing, 482,000 recreational visitor-trips and 25,000 fishing trips could occur annually, with an economic value to the community of $ 1.2 million. Presently these dollars are being spent elsewhere with higher attendant energy consumption and cost.

The Utah State Comprehensive Outdoor Recreation Plan (SCORP) estimates that demand for these opportunities at the local level is expected to grow with population increases. Salt Lake County will require at least 408 miles of bicycle trails, 77 miles of hiking trail, and 131 miles for equestrian trails. Managing the Jordan River for trail development could meet 15% of the demand for bicycle trails, 78% for hiking trails, and 46% for equestrian trails. The Jordan River has tremendous potential for management of multiple resources with higher benefit returns to the taxpayer. Benefit estimates are summarized in Appendix H.

o 1992 Jordan River Sediment Data

During the course of CERCLA investigations conducted in support of the Sharon Steel, Bingham Creek, and Midvale Slag superfund remediation projects, sediment was sampled the entire length of the Jordan, for lead, zinc, copper, arsenic and cadmium. Total copper, cadmium and zinc are potential problems for food chain organisms and animals (benthic invertebrates, fish and waterfowl). The principal sources appear to be urban and mining-related. Graphs are summarized in Appendix D.

o Restored and Constructed Wetland Water Quality

Data has been collected in the last four years for wetlands constructed for mitigation of losses associated with the Murray Parkway Golf Course, and restored oxbow wetlands located within the Murray-Jordan River Parkway 319 demonstration project.

The 2-acre twin ponds constructed on the Jordan at Murray Parkway Golf Course (1989-90) display important trends in reduction of total phosphorus, nitrate, ammonia, biochemical oxygen demand, copper and lead.

The Winchester Street Oxbows (formerly the principal Jordan River channel of 1952), contain water concentrations of lead and arsenic significantly lower than that of the Jordan River, and do not appear to be source of nutrient or metal export to the river. Results of wetland recent sampling (Appendix D) indicate that constructed or restored wetlands are effective in reducing pollution loads to the Jordan River, and are an important component to the hydrologic modification plan.

D. Acquisition of Wetlands for Hydrologic Modification Management

Studies conducted in 1985-86 on the Jordan River identified the functional values of wetlands along the river corridor. These values include flood control, shoreline anchoring, sediment trapping, nutrient and pollutant retention, in addition to important wildlife and recreational roles.

Salt Lake County was instrumental in securing authorization of $6.9 million in the Central Utah Project Reauthorization Act for purchase of about 1000 acres of the highest priortiy wetlands performing important functional values. In June, 1993, the Salt Lake County Wetland Acquisition Committee further prioritized individual wetland basins targeted for acquisition in a report to the Central Utah Project Mitigation Commission, responsible for securing the appropriations through Congress.

In October, 1993, Salt Lake County received a grant from Region VIII EPA and Utah Division of Wildlife Resources to develop a parcel-specific/owner-specific acquisition schedule for the following priority wetland parcels:

o Relationship of Wetlands to the Jordan River Meander/Stability Corridor

The maps in Appendix A indicate the relationship between the meander corridor boundary and priority wetlands in the Jordan River advance identification study. The table below estimates acreage of wetlands as a percent of the total meander corridor. Stream reaches referenced are based on aerial figures one through nine.

WETLAND ACREAGE WITHIN THE JORDAN RIVER MEANDER CORRIDOR

STREAM REACH	MEANDER CORRIDOR ACREAGE	WETLAND ACREAGE	PERCENT WETLAND ACREAGE
2100-3500 South	169	66	39%
3500-4800 South	257	116	45%
4800-6400 South	294	140	48%
6400-8300 South	110	25	23%
8300-10000 South	257	117	45%
10000-11800 South	294	135	46%
11800-13600 South	312	168	54%
13600-15500 South	279	240	86%
15500-Utah County	206	73	35%
TOTAL	**2,178**	**1,080**	**50%**

Planning for acquisition of these and other priority wetlands will be completed in Spring, 1994, with the first congressional appropriation for property anticipated in federal fiscal year 1995. Salt Lake County may utilize flood control mill levy funds for purchase of remaining non-wetland property parcels which fall within the meander corridor.

- **Relationship of Wetlands to the Jordan River Floodplain Identified by the Federal Emergency Management Agency**

The relationship between the meander corridor boundary and the 100 year floodplain identified by the Federal Emergency Management Agency (FEMA) is summarized below. **Generally the entire 100 year floodplain boundary falls within the meander corridor. The table estimates acreage of flooded land outside the meander corridor.** Stream reaches referenced are based on aerial figures one through nine.

FLOODPLAIN AND WETLAND ACREAGE OUTSIDE THE JORDAN RIVER MEANDER CORRIDOR

STREAM REACH	MEANDER CORRIDOR ACREAGE	FLOODPLAIN ACREAGE	WETLAND ACREAGE
2100-3500 South	169	95	210
3500-4800 South	257	68	65
4800-6400 South	294	2	90
6400-8300 South	110	11	80
8300-10000 South	257	35	175
10000-11800 South	294	25	65
11800-13600 South	312	8	280
13600-15500 South	279	0	180
15500-Utah County	206	2	30
TOTAL	**2,178**	**246**	**1175**

FEMA is reviewing the preliminary 100-year floodplain boundaries, which are the product of updated hydrologic estimates of projected flows. Planning in floodplain areas is restricted to structures built above grade. Failure by municipalities to require appropriate planning requirements may result in increased municipal insurance rates.

E. Jordan River Meander Study Implementation and the Jordan River Flood Management Ordinance

Based on the findings of the Jordan River Stability Study (referred to also as the Meander Corridor study), the Board of Salt Lake County Commissioners directed the county Department of Public Works Engineering Division to develop an ordinance to restrict development within river meander boundaries. Local municipalities have struggled with impending development proposals along the Jordan River corridor, and generally support the effort of the county to complement the local planning process.

Salt Lake County possesses statutory authority under the Utah Code for county-wide flood control. The proposed ordinance includes a provision for special permits on new development, resolution of mapped boundary disputes, and requirement for special studies and reports to resolve such disputes.

The Jordan River Flood Channel Management Ordinance is included as Appendix B.

F. The Jordan River Sub-Basin Watershed Management Council

Proposed 1993 amendments to Title III (33 U.S.C. 1311 et.seq.) of the Federal Clean Water Act include Section 321 provisions for Comprehensive Watershed Management. Salt Lake County has established an institutional watershed management unit, with approval of the Jordan River Sub-Basin Watershed Management Council, on June 21, 1993.

This Council, composed of federal, state and local agency representatives, will undertake the following planning and management activities, with technical support from the Salt Lake County Commission Staff Office, Wasatch Front Regional Council, and in-kind services of municipal and county agencies:

1. Characterize the waters and land uses of the various watershed management areas.

2. Identify problems related to water quality within each watershed management area.

3. Identify short and long-term goals for watershed management.

4. Evaluate and select practices to meet these goals.

5. Identify and coordinate specific point and nonpoint source projects necessary to reduce pollutant loadings or restore water quality or habitat within the watersheds.

6. Identify institutional arrangements required to carry out plan implementation.

7. Update the Area-Wide Water Quality Management Plan

The Jordan River Sub-Basin Watershed Management Council Ordinance is included as Appendix C.

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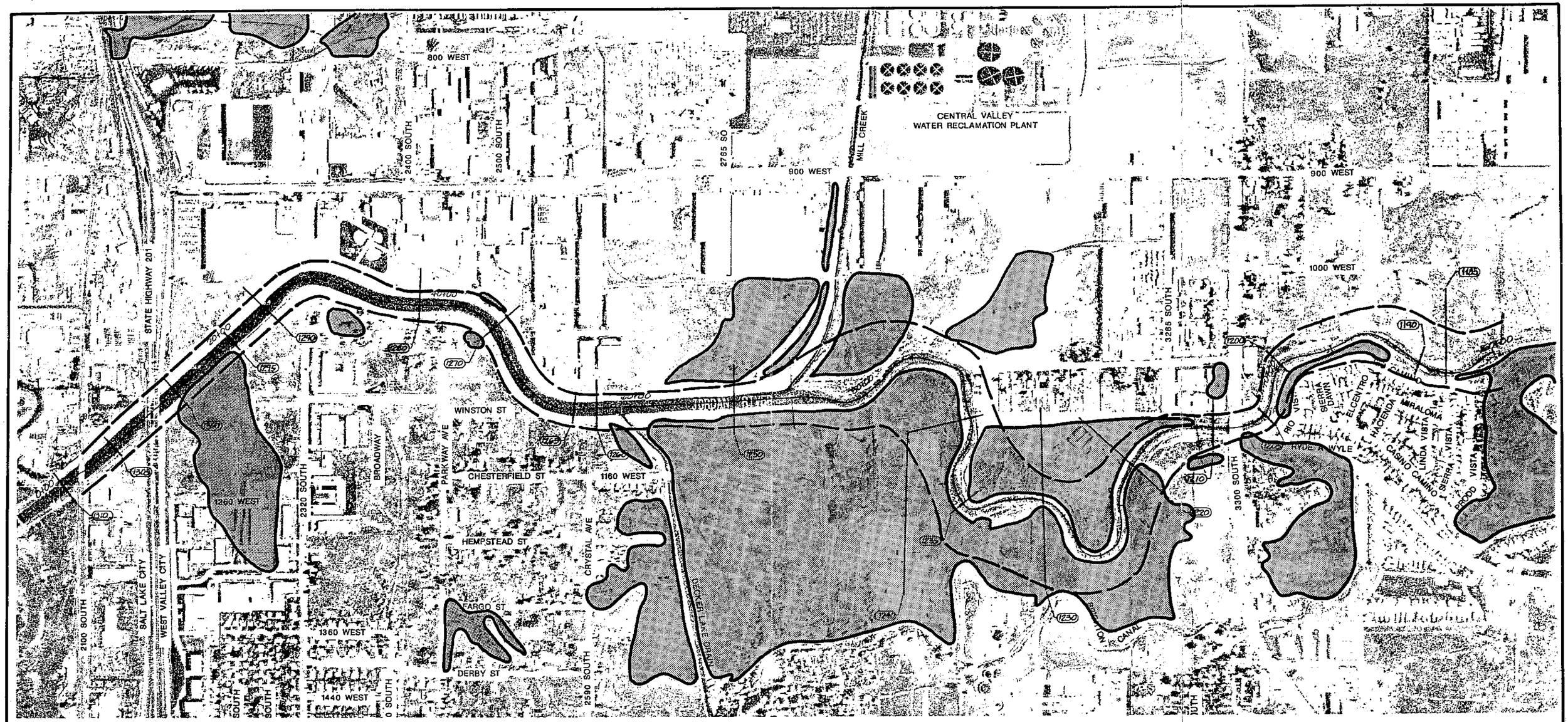
APPENDIX A

JORDAN RIVER MEANDER CORRIDOR AND INCLUSIVE WETLANDS



SALT LAKE COUNTY
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LEGEND

MEANDER CORRIDOR

WETLAND AREA DELINEATED IN WAIDS STUDY

Reference: Jordan River Advance Identification (WAIDS) Study

WETLAND AREAS ALONG THE JORDAN RIVER

JORDAN RIVER STABILITY STUDY

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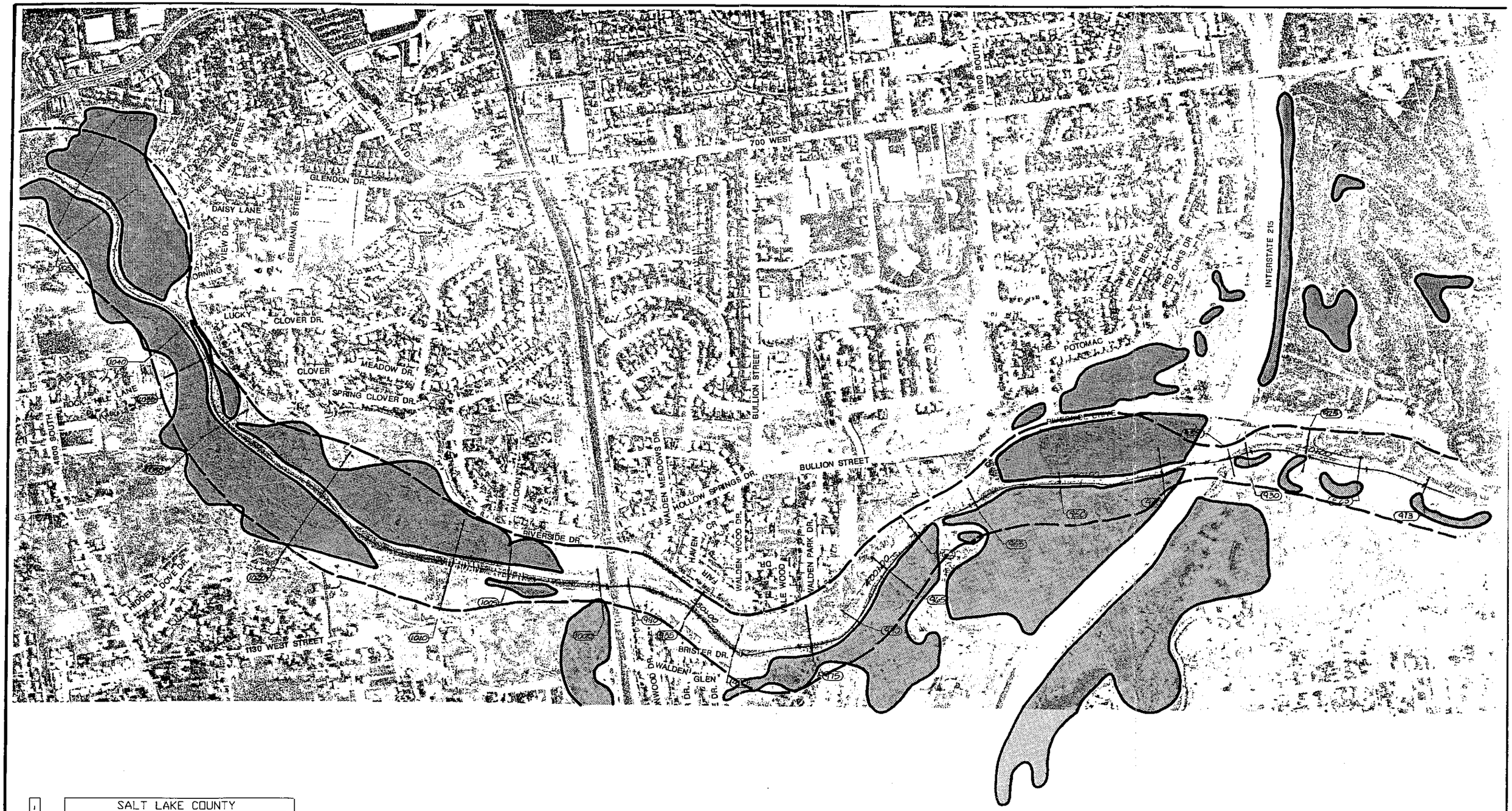

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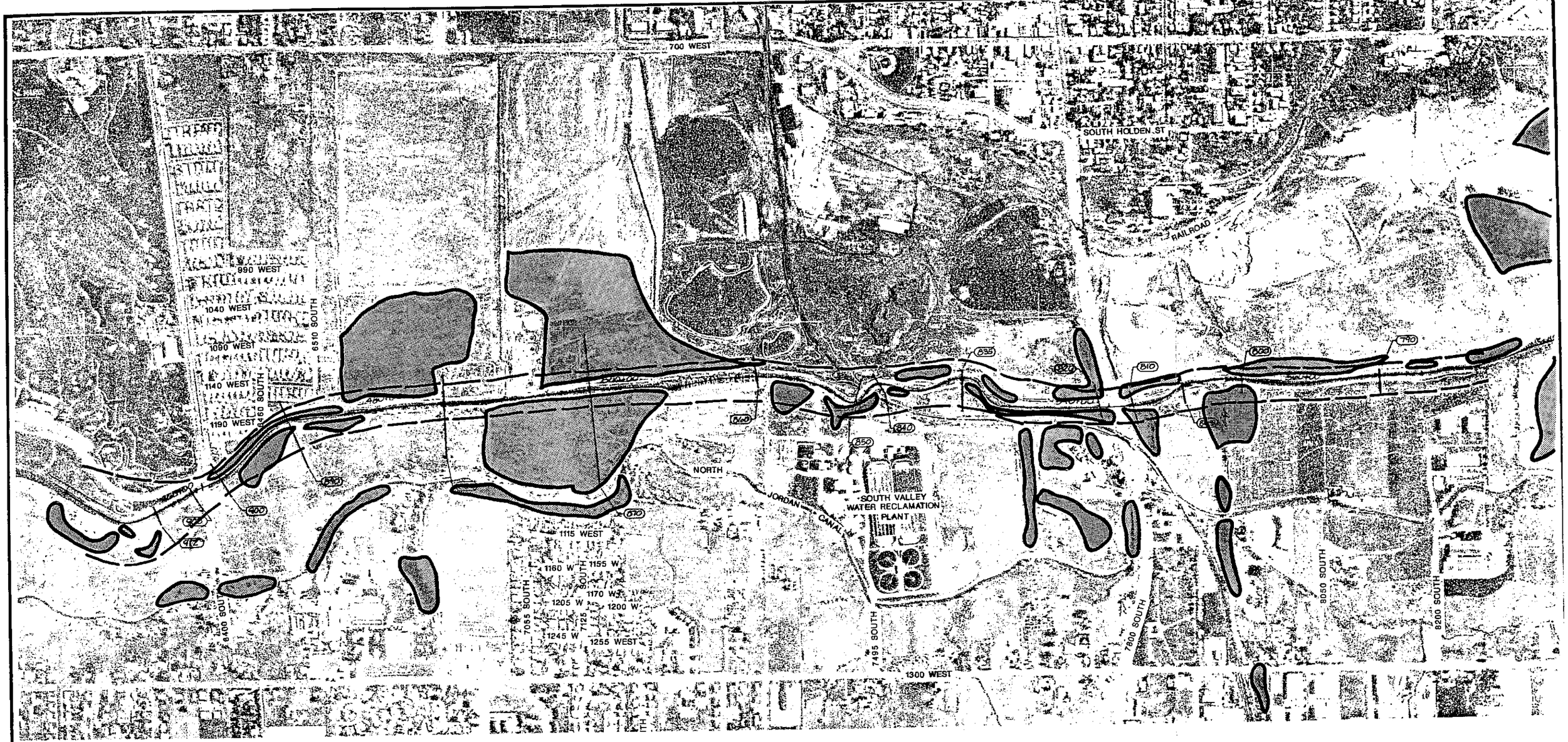

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WETLAND AREAS ALONG THE JORDAN RIVER

JORDAN RIVER STABILITY STUDY

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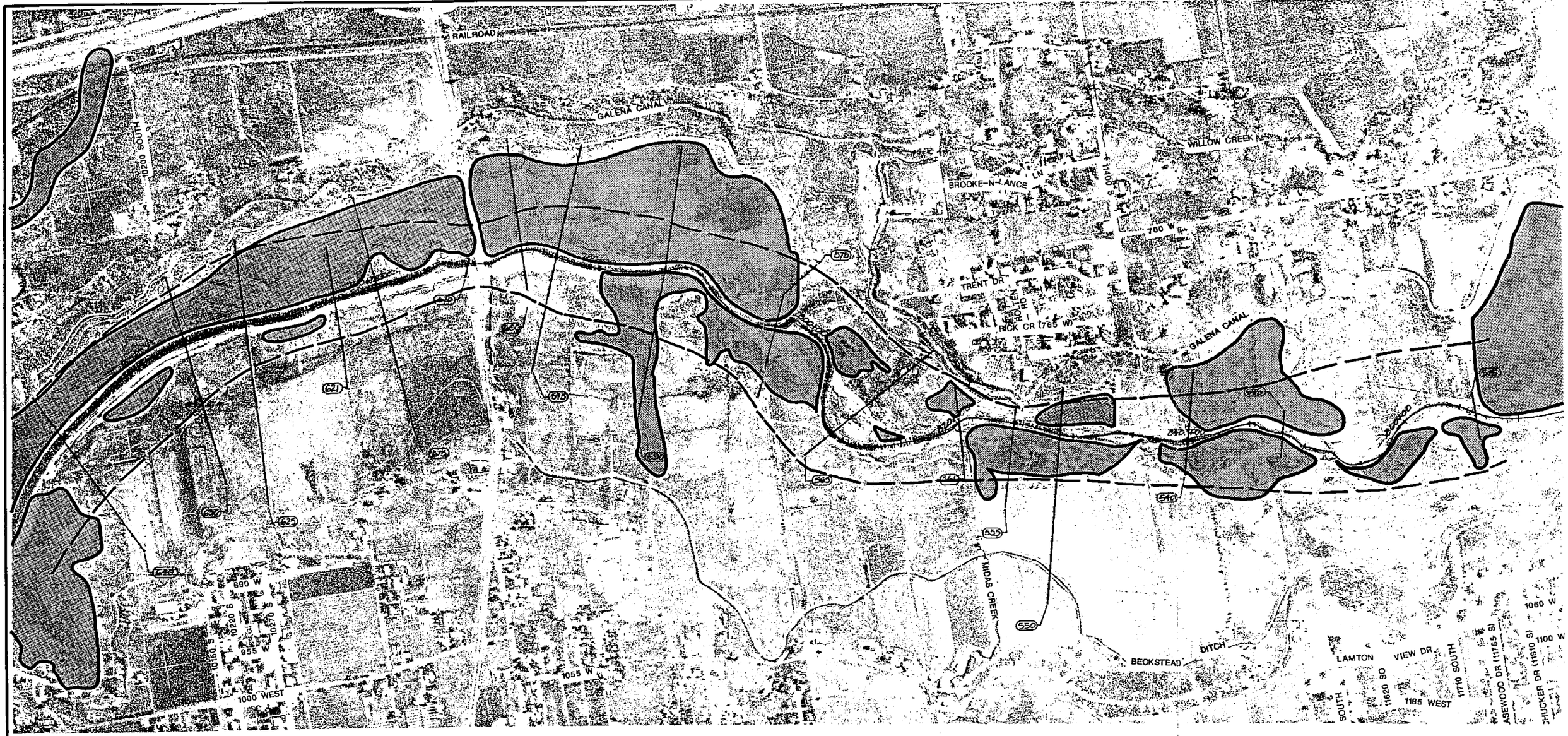

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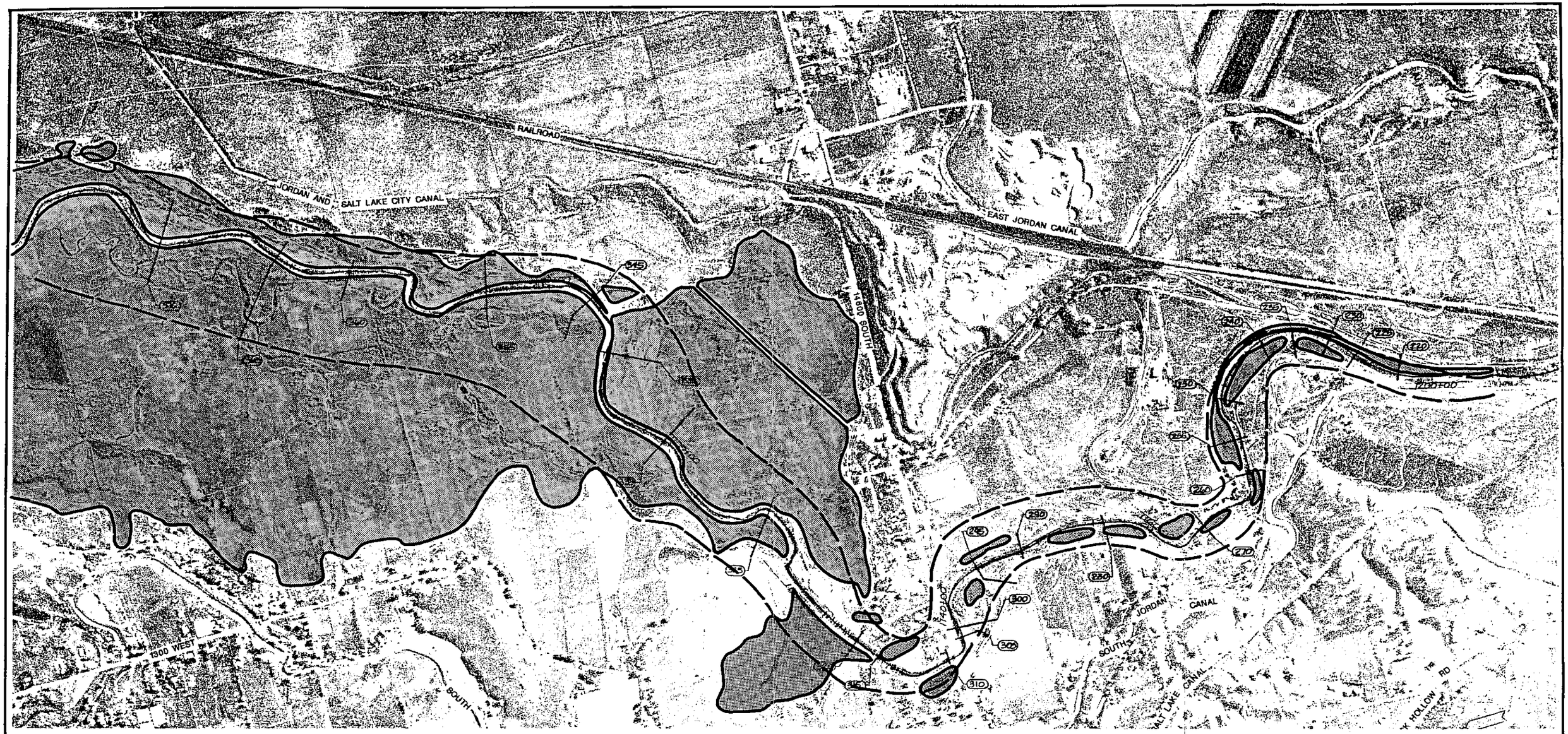

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WETLAND AREAS ALONG THE JORDAN RIVER

JORDAN RIVER STABILITY STUDY

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WETLAND AREAS ALONG THE JORDAN RIVER

JORDAN RIVER STABILITY STUDY

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APPENDIX B

JORDAN RIVER MEANDER CORRIDOR ORDINANCE

DRAFT

ORDINANCE NO._____ DATE: September 9, 1993

AN ORDINANCE ENACTING CHAPTER 17.10 OF THE SALT LAKE COUNTY CODE OF ORDINANCES, 1986, RELATING TO FLOOD CONTROL.

The Board of County Commissioners of the County of Salt Lake ordains as follows;

SECTION I. Chapter 17.10 of the Salt Lake County Code of Ordinances, 1986, is hereby enacted to read as follows:

Chapter 17.10

JORDAN RIVER FLOOD CHANNEL MANAGEMENT ORDINANCE.

Sections:

17.10.010 Findings.

A. The Jordan River in Salt Lake County is a dynamic landform continually undergoing the processes of bank erosion, long-term channel bed degradation, bridge scour, sediment deposition and meander migration. Potential flooding hazards along the river corridor are directly related to natural erosion and

sedimentation processes that are part of the river's natural dynamics and also to human activities that include channel straightening, urbanization of the watershed, and changing land use within the river corridor.

B. The Jordan River has experienced both episodic and gradual channel movement throughout the past 136 years. The most recent episode of severe bank erosion and channel movement occurred during the 1983-1987 floods. Recent studies indicate that channel instability hazards along the river will continue to occur and may increase in severity with changing flow regimes and hydrologic cycles, such that a completely stable slope and channel pattern will never occur.

C. In order to better provide for the protection and use of the Jordan River channel for storm drainage and flood control, it is necessary and desirable to adopt a county-wide management plan designed to promote greater channel stability within the flood channel corridor.

17.10.020 Purpose of provisions.

The purpose of this ordinance is to protect the public health, safety, and general welfare of the citizens of Salt Lake County by adopting regulations designed to:

A. Establish the boundaries of the Jordan River flood channel under the statutory jurisdiction of the county for purposes of county-wide flood control;

B. Provide for the protection and use of the Jordan River

flood channel located within both the unincorporated county and the incorporated municipalities within the county;

C. Provide for the most effective expenditures of public funds for flood control projects on the Jordan River;

D. Minimize damages due to flooding and the resulting need for expenditures of public funds for relief and rescue efforts which must be undertaken as a result of the encroachment of incompatible development and land uses within areas subject to erosion and flooding by the Jordan River;

E. Ensure that those who occupy the areas within the Jordan River flood channel assume responsibility for their actions which may increase flood or erosion hazards to their own property or to the property of others.

17.10.030 Definitions.

As used in this chapter:

A. "Channel instability hazard(s)" means any or all of a variety of problems affecting river channel stability including, but not limited to, bank erosion, long-term channel bed degradation, bridge scour, sediment deposition, and meander migration.

B. "Channel meander" means lateral movement of the river by various fluvial processes including erosion and deposition at bends, the shift of a channel to form chutes and islands, and the cutoff of a bend to form oxbow lakes.

C. "Construction" or "Development" means any man-made change

to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavating, or bank stabilization activities.

D. "Long-term channel bed degradation" means a significant erosion problem affecting river channel stability, characterized by progressive channel scour which lowers the channel bottom, causing a variety of channel stability problems such as undercutting of channel banks, destabilizing of bank vegetation, and undermining bridge piers and utility crossings.

17.10.040 Applicability.

A. The regulations in this chapter are applicable to all lands within the Jordan River flood channel located within the unincorporated county and the incorporated municipalities in the county.

B. The boundaries of the Jordan River flood channel are hereby established and designated to be those coinciding with the "meander corridor" as shown on the channel meander/bend migration corridor maps on file with the county engineering division. The location and dimensions of these boundaries are identified in a scientific and engineering report entitled "Jordan River Stability Study," December 18, 1992, submitted to Salt Lake County by CH2M Hill, with accompanying maps and appendix, and any revisions thereto. The "Jordan River Stability Study" is hereby adopted by reference and declared to be part of this chapter as if fully described and set forth herein.

17.10.050 Disputes over boundaries or mapped hazards.

The boundary lines of the Jordan River flood channel as shown on the channel meander/bend migration corridor maps shall be determined by use of the scale appearing on the maps and through photo identification. Where there is a conflict between the boundary lines illustrated on the maps and actual field conditions, or where detailed investigations show that channel instability hazards are not present within a particular area, the dispute shall be settled as follows:

A. The person or entity disputing the boundary or the hazard(s) present within a particular area shall submit technical and geologic evidence to support such claim to the county engineering division in the form of a site-specific channel stability report (see section 17.10.080).

B. The engineering division may request various experts from federal, state, or local agencies to review the evidence and make recommendations prior to making a decision concerning the dispute.

C. The engineering division may allow deviations from the mapped boundary line only if the evidence clearly and conclusively establishes that the channel meander/bend migration corridor map boundary location is incorrect, or that channel instability hazards are not present within a particular area.

D. Any decision of the engineering division relating to either the location of the channel meander/bend migration corridor boundary line or the hazard(s) present within a particular area may be appealed to the board of county commissioners pursuant to the

procedures set forth in section 17.10.140.

17.10.060 Scope and conflict of laws.

The regulations in this chapter shall be supplemental to, and not in lieu of, all other applicable federal, state, and local laws and regulations. Property located within the Jordan River flood channel shall be developed and used only in conformance with the provisions set forth herein. In case of conflict between the provisions of this chapter and any other law or regulation, the most restrictive provisions shall apply.

17.10.070 Construction or development-- Special approval and permit required.

A. Before construction or development begins within any area of the Jordan River flood channel established in section 17.10.030, approval must be obtained from, and a special permit issued by, the county engineering division. Application for such approval and permit shall be made on forms furnished by the engineering division and shall include, but not be limited to:

1. Plans drawn to scale (six copies) showing the nature, location, dimensions and elevations of the area in question, including existing and proposed structures, fill, storage of materials, and drainage facilities; and

2. A description of the extent, if any, to which the river, including its bed, banks, and flood channel, are proposed to be altered or relocated as a result of the proposed construction or

development.

B. It shall be unlawful, and punishable as a misdemeanor, for any person or entity to begin construction or development within any area in the Jordan River flood channel without first obtaining the approvals and permit required by this chapter.

17.10.080 Studies and reports required.

Any applicant requesting approval for construction or development within any area of the Jordan River flood channel shall submit to the county engineering division six copies of the following studies and reports:

A. A site-specific channel stability report prepared by a registered professional engineer experienced in open-channel flow, fluvial geomorphology, and river mechanics identifying all known or potential channel instability hazards, originating on-site or off-site, which may affect the particular property and any upstream or downstream properties. This report shall include:

1. A detailed site map (scale: one inch equals one hundred feet or larger), showing the location of the present river bed within the channel meander/bend migration corridor, the location of all known or potential channel instability hazard areas, and the proposed location and setback distances for all proposed structures;

2. An analysis of the potential effects of any channel instability hazards on the proposed development and occupants thereof in terms of risk and potential damage;

3. Recommendations for avoidance or mitigation of the effects of any channel instability hazards, consistent with the purposes set forth in section 17.10.020;

4. An analysis of the potential effects of the proposed development, including recommended avoidance or mitigation activities, on upstream or downstream properties, developments, and occupants thereof in terms of risk and potential damage; and

5. A clear statement of the evidence and studies on which the recommendations and conclusions in the report are based, including supporting information such as aerial photographs, references with citations, and other documentation.

B. Other studies, reports, and plans shall be prepared and submitted by the applicant, at applicant's expense, as deemed necessary by the director of the engineering division where particular circumstances may require an analysis of more specific site-related problems involving such topics as geology, hydrology, soils, vegetation, drainage, and grading.

17.10.090 Duties of director of engineering division--Review of permit application.

A. The director of the county engineering division shall be responsible to review all applications, including studies, reports, and plans, and shall determine:

1. Whether the proposed construction or development is located within the Jordan River flood channel;

2. Whether the application, studies, reports, and plans

satisfy the requirements set forth in sections 17.10.070 and 17.10.080 of this chapter;

3. Whether the proposed construction or development is compatible with the county's protection and use of the Jordan River flood channel for purposes of storm drainage and flood control. In making this determination, the director shall specifically consider the following factors:

a. The potential effects of any channel instability hazards on the proposed development and occupants thereof in terms of risk and potential damage;

b. The potential effects of the proposed development, including recommended avoidance or mitigation activities, on upstream or downstream properties, developments, and occupants thereof in terms of risk and potential damage;

c. The feasibility and effectiveness of proposed measures for avoidance or mitigation of the effects of any channel instability hazards, consistent with the purposes set forth in section 17.10.020;

d. The public importance, benefit, or necessity of the facilities and services provided by the proposed development;

e. The compatibility and relationship of the proposed development with the comprehensive flood channel management program for the Jordan River and for that particular area;

f. The safe and effective accessibility to the property and the flood channel by governmental employees and equipment for the construction, operation, and maintenance of erosion and flood

control facilities and also for emergency operations;

g. The costs of providing governmental services during and after erosion or flood events, including costs for construction, operation, maintenance, and repair of erosion and flood control facilities; and

h. The compatibility of the proposed development with other applicable county ordinances relating to the Jordan River, including but not limited to the Jordan River Parkway Ordinance.

B. The director may, when deemed necessary or desirable, request and give consideration to recommendations from other federal, state, or local government agencies.

17.10.100 Duties of director of engineering division--Approval procedure.

A. Upon completion of the review process, the director of the engineering division shall either approve or deny the permit application. Approval of an application shall only be given upon a determination that, based on the required studies, reports, plans and other available data, the proposed construction or development plan is compatible with, and does not adversely affect, the county's right to protect, operate, maintain, and use the Jordan River flood channel for flood control and storm drainage purposes. Whenever the director determines that an area is subject to flood or erosion hazards which present an unreasonable risk to the safety of persons or property, including public property, such area shall not be approved for construction or development unless the

applicant can demonstrate that such risk can be reduced to a reasonable and acceptable level.

B. If the application is approved, the director shall issue a special permit, incorporating the application together with any additional requirements determined to be necessary to ensure that the purposes of this chapter are met. Such requirements may include, but are not limited to: construction of specific erosion and flood control improvements, location of structures, phasing of development, time schedule for completion, and revegetation program.

C. If the application is denied, the decision of the director of the engineering division may be appealed to the board of county commissioners pursuant to the procedures set forth in section 17.10.140.

D. The director of the engineering division shall maintain for public inspection all records pertaining to the provisions of this chapter.

17.10.110 Subdivisions in the Jordan River flood channel--County approval required prior to recording.

A. All proposed subdivision plats in the unincorporated county and in the incorporated municipalities in the county which are located wholly or partly within the Jordan River flood channel, as shown on the Jordan River channel meander/bend migration corridor maps on file with the county engineering division, shall be reviewed and approved by the county engineering division prior

to their presentation to the office of the county recorder for recording.

B. In reviewing a proposed subdivision plat, the director of the engineering division shall follow the review and approval procedures set forth in section 17.10.080.

C. It shall be unlawful, and punishable as a misdemeanor, for any person or entity to record a subdivision plat in the office of the county recorder without first obtaining the approvals required by this chapter.

D. Any plat of a subdivision filed or recorded without the approvals required by this chapter is void.

17.10.120 Disclosure required.

Whenever a channel stability report required under this chapter concludes that channel instability hazards are present, the owner of such parcel shall record a restrictive covenant running with the land in a form satisfactory to the county prior to the approval of any construction, development, or subdivision of such parcel, which includes the following:

A. Notice that the parcel is located within the Jordan River flood channel and that channel instability hazards are present;

B. Notice of the existence and availability of the channel stability report for public inspection in the county engineering division;

C. An agreement by the owner of the parcel and any successor in interest to comply with any conditions set by the director of

the engineering division to minimize potential adverse effects of the channel instability hazards.

17.10.130 Warning and disclaimer.

A. Historically, large floods periodically occur in the Jordan River flood channel, resulting in bank erosion, long-term channel bed degradation, bridge scour, sediment deposition and meander migration. The provisions of this chapter relating to erosion and flood protection are considered reasonable for regulatory purposes and are based on scientific and engineering considerations. It is anticipated that land within the Jordan River flood channel will continue to be subjected periodically to hazards and damages caused by erosion and flooding.

B. This chapter shall not create any liability on the part of the county, or any officer or employee thereof, for any erosion or flood damages that result from reliance on this chapter or any administrative decision lawfully made thereunder.

17.10.140. Appeal procedure.

A. Any applicant may appeal an adverse decision by the engineering division or its director by filing a notice of appeal with the board of county commissioners. The board shall hold a public hearing on the record and take such evidence as necessary to determine whether the decision by the engineering division was proper under the facts and the law.

B. The board may, in its discretion, designate a hearing

officer to conduct the hearing and prepare recommended findings of fact, conclusions of law, and decision. Either party may object to the recommendations of the hearing officer by filing the party's objections and reasons, in writing, with the board within ten days following receipt of the recommendations. If no objections are received within the ten days, the board may immediately adopt the recommendations of the hearing officer and issue its decision. If objections are received, the board may, in its discretion, hear additional evidence or require written memoranda on issues of fact or law prior to issuing its final decision.

17.10.150 Severability.

If any provision or clause of this chapter or the application thereof to any person or circumstance is held to be unconstitutional or otherwise invalid by any court of competent jurisdiction, such invalidity shall not affect other sections, provisions, clauses or applications hereof which can be implemented without the invalid provision, clause or application hereof. To this end, the provisions and clauses of this chapter are declared to be severable.

SECTION II. This ordinance shall become effective fifteen (15) days after its passage and upon at least one publication in a newspaper published and having general circulation in Salt Lake County.

APPROVED and ADOPTED this _____ day of _____, 1993.

DRAFT

BOARD OF COUNTY COMMISSIONERS
OF SALT LAKE COUNTY

ATTEST:

By_____
Chairman

_____
Salt Lake County Clerk

Commissioner Bradley voting_____
Commissioner Horiuchi voting_____
Commissioner Overson voting_____

wpjhtjordord5

APPENDIX C

ORDINANCE CREATING JORDAN RIVER SUB-BASIN WATERSHED MANAGEMENT COUNCIL

ORDINANCE NO. 1241 DATE: June 21, 1993

AN ORDINANCE ENACTING CHAPTER 17.06 OF THE SALT LAKE COUNTY CODE OF ORDINANCES, 1986, RELATING TO FLOOD CONTROL AND WATER QUALITY AND PROVIDING FOR THE CREATION OF THE JORDAN RIVER SUB-BASIN WATERSHED MANAGEMENT COUNCIL.

The Board of County Commissioners of the County of Salt Lake ordains as follows:

SECTION I. Chapter 17.06 of the Salt Lake County Code of Ordinances, 1986, is hereby enacted to read as follows:

Chapter 17.06

JORDAN RIVER SUB-BASIN WATERSHED MANAGEMENT COUNCIL

Sections:

17.06.010 Findings.

A. Pursuant to the provisions of the federal Clean Water Act, the Salt Lake County Board of Commissioners has been designated and approved as the area-wide Water Quality Planning Agency for Salt Lake County by the Governor of the State of Utah and by the United States Environmental Protection Agency. Pursuant to state statutes, the Board also has county-wide responsibility for flood control on all natural channels and flood plains, including the Jordan River and its tributaries.

B. The Board recognizes that numerous federal, state, and local government agencies have jurisdiction over and share responsibility for the management and regulation of the Jordan

River and its tributaries which flow through Salt Lake Valley and which provide multiple uses, including flood control, wildlife and fishery habitat, recreation, and water supply for irrigation and other purposes.

C. A need exists for increased communication and cooperation among these government agencies in order to promote efficient planning, implementation, and coordination of management and regulatory activities pertaining to the Jordan River watershed, and also to prevent or minimize the occurrence of conflicting or duplicative efforts. Increased communication and cooperation among these government agencies can be effectively assisted through the creation of an inter-jurisdictional advisory council specifically designed to promote such communication and cooperation and which will assist the Board of County Commissioners in fulfilling its responsibilities for area-wide water quality planning and flood control activities.

17.06.020 Purpose of Provisions.

The purpose and intent of this chapter is to: (1) facilitate the performance of the responsibilities of the Salt Lake County Board of Commissioners with regard to its role as the area-wide Water Quality Planning Agency for Salt Lake County and with regard to its county-wide flood control authority, and (2) facilitate more effective communication and cooperation among the various government agencies which have jurisdiction over and share responsibility for the management and regulation of the Jordan

River and its tributaries which flow through Salt Lake Valley.

17.06.030 Definitions.

For the purpose of this chapter, the following words shall have the following meanings:

A. "Jordan River sub-basin" means that portion of the Jordan River hydrologic unit extending from the Salt Lake County boundary with Utah County northward to the Davis County boundary, eastward including all Wasatch Canyon environs to the Wasatch and Summit County boundaries, and westward including all Oquirrh Canyon environs to the Tooele County boundary.

B. "Watershed" means all of the combined natural sub-basin drainage units within the Jordan River sub-basin, listed and on file in the office of the Salt Lake County Board of Commissioners. It includes designations for canyon and urban watersheds as single management units which contribute flow to the Jordan River and water storage to the Great Salt Lake.

17.06.040 Creation of Council.

There is hereby established as an advisory council to the Salt Lake County Board of Commissioners a "Jordan River Sub-Basin Watershed Management Council", hereafter referred to in this chapter as the "Council".

17.06.050 Duties of Council.

The Council may meet as often as deemed necessary, according

to current planning and management needs, and shall:

A. Prepare an annual report, in coordination with all government agencies represented on the Council, which addresses activities along the Jordan River and contributory watersheds relating to: water quality and pollution control, flood control, parkway and other development, wildlife habitat and wetland conservation, and proposed plans to effectively manage and regulate these activities;

B. Review and evaluate development proposals within the flood channel, flood plain, meander corridor, wetlands, and other areas of important riparian resource value along the Jordan River, and evaluate potential impacts of such proposals;

C. Recommend and prioritize planning activities to address or mitigate impacts of development proposals, and coordinate among the parties to effectively review, monitor, and evaluate the progress of plan implementation;

D. Coordinate and integrate the interests of parties which may be impacted by proposals for development or mitigation, and assist local, state, and federal management agencies in the prioritization of proposals for potential funding and cost sharing;

E. Recommend priorities for acquisition of critical water-related resources, including wetlands, riparian corridors, meander corridors, wildlife reserves, and park lands;

F. Provide legislative and public education support for present and future stream and river corridor projects and programs, and encourage continuing review of new developments and

considerations of innovative practices in technological, legal, and administrative aspects of watershed management.

17.06.060 Composition and Selection of Council Members.

The Council established in section 17.06.040 above shall be comprised of one representative from each of the following government agencies:

A. Federal agencies: U.S. Army Corps of Engineers Regulatory Section, Bountiful, Utah; and U.S. Fish and Wildlife Service, Salt Lake City, Utah;

B. State agencies: Division of Water Quality, Division of State Lands, Division of Water Resources, State Engineer (Stream Alteration Permit Program), Division of Wildlife Resources, Division of Parks and Recreation, and Department of Agriculture;

C. Local agencies:

1. Salt Lake County: Commission Staff, Development Services Division, Engineering Division, Operations Division, Parks and Recreation Division, Environmental Health Division, and Attorney's Office;

2. Municipalities: Salt Lake City, South Salt Lake City, Murray City, Midvale City, Sandy City, West Valley City, West Jordan City, South Jordan City, Draper City, Riverton City, Bluffdale City, and the Town of Alta.

Appointment to the Council shall be by the Board of County Commissioners after receiving nominations from each specific agency or municipality. Upon appointment, each representative may serve

as a member of the Council and may designate a substitute representative for any particular meeting or other purpose. The Board shall appoint a chairperson and a vice-chairperson from among the members of the Council.

SECTION II. This ordinance shall become effective fifteen (15) days after its passage and upon at least one publication in a newspaper published and having general circulation in Salt Lake County.

APPROVED and ADOPTED this 21 day of June, 1993.

BOARD OF COUNTY COMMISSIONERS
OF SALT LAKE COUNTY

By _____
Chairman pro tem

ATTEST:

Isabelle V. Vasquez
Deputy Salt Lake County Clerk

Commissioner Bradley voting absent
Commissioner Horiuchi voting aye
Commissioner Overson voting aye

C.A.#93-0303B

APPROVED AS TO FORM
Salt Lake County Attorney's Office
By L. Thorpe
Deputy County Attorney
Date 6.15.93

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APPENDIX D

SUMMARY OF WATER QUALITYDATA & ANALYSES

APPENDIX D: SUMMARY OF WATER QUALITY ANALYSES.

I. MONTHLY WATER QUALITY DATA COLLECTED BY SALT LAKE COUNTY

A. TOTAL SUSPENDED SEDIMENT. Fluctuations of total suspended sediment averages at eleven sample stations range from 120-145 mg/l between the Jordan Narrows and 7800 South, 100-120 mg/l from 6400-2100 South, and 92-115 mg/l from 1700 South to 1800 North. While river gradient may account for up to 60% of the natural sediment load, substantial loading from nonpoint sources located between 7800-9000 South and between 9000-11400 South probably occurs. Dredge piles eroding into the river are located within the latter reach, and a 220 acre Superfund Mill Tailing site is eroding into the river at 7800 South. Record flood flows in excess of 2000 cfs produced erosion of channelized, straightened river banks.

B. DISSOLVED OXYGEN. The upper 20 miles of the Jordan River falls approximately 230 feet, while the lower 25 miles drops only about 40 feet (6:1 ratio). Within the upper stream gradient reach, the greatest fall occurs between the Narrows and 12300 South (145 feet), with the reach between 9000 South and 5800 South falling 65 feet. Substantial oxygenation of the stream occurs on the upper half of the river, with average ranges between 9.8-12 mg/l dissolved oxygen. Minimum coldwater fishery standards require 6.5 mg/l, slightly lower for warmwater fisheries (5.5 mg/l). Although DO may not totally inhibit fishery uses, the data show that significant drops in DO on the lower-gradient reach of the Jordan correlate with increases in oxygen-demanding organisms such as total or fecal coliform.

C. BIOCHEMICAL OXYGEN DEMAND. The State's water quality indicator parameter of BOD exceeds recommended levels of 5 mg/l in the river from 3900 South downstream. They are highest at North Temple where a major storm drain with base flow discharges to the river. These levels are most likely associated with coliform bacteria, and the correlation between these two parameters with dissolved oxygen is very close.

D. TOTAL AND FECAL COLIFORM. Fecal and other coliform species are capable of "settling into sediments and reproducing exponentially" (Struck, 1988). While fecal coliform standards (200 mpn/100 ml) are met upstream of 6400 South, they deteriorate drastically downstream to 1800 North, with two-year averages at 3200 mpn/100 ml. A similar pattern emerges with total coliform, generally meeting standards of 5000 mpn/100 ml above 1700 South, averaging 22,000 mpn/100 ml downstream. The lack of oxygenation-producing gradient restricts supply of instream oxygen in downstream reaches.

Growth of bacteria in bottom sediment and subsequent demand of oxygen is inferred in DO and BOD data. While these concentrations may substantially inhibit warmwater fishery potential, they also exceed standards for Class 2B "non-contact" recreation by several orders of magnitude. The source of high river coliform bacteria could be:

A. Indigenous to the depositional nature of the river in lower reaches.

B. Related to base flows entering the lower river through storm drains or other more indescreet nonpoint sources.

C. Loss of dilution flows into the Surplus Canal, resulting in higher coliform concentrations downstream.

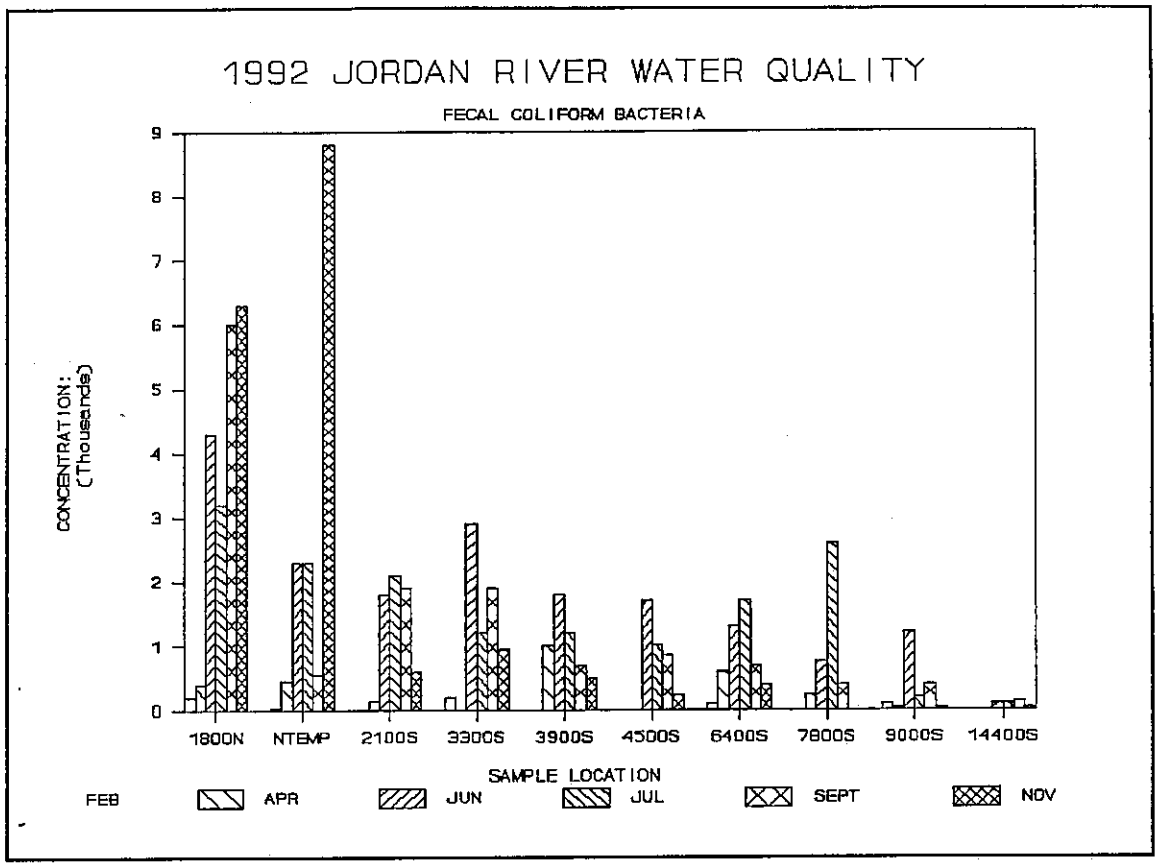
II. STORET DATA: UTAH BUREAU OF WATER POLLUTION CONTROL 1984-86.

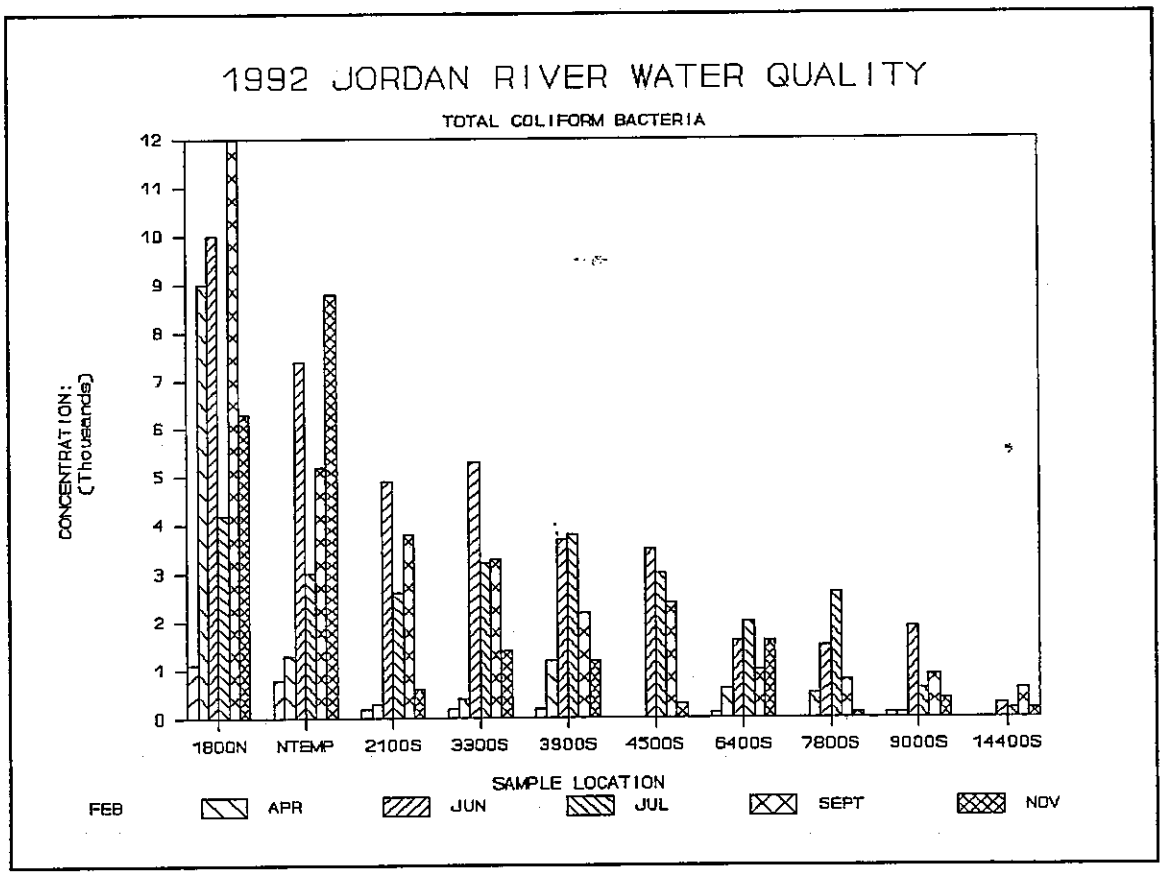
A. NUTRIENT LOADS: NITRATE & PHOSPHORUS. Both of these parameters are "pollution indicators" which imply that "investigations should be conducted to develop more information where ....these levels are exceeded." Phosphate as P levels in excess of .05 mg/l, and nitrate as N in excess of 4 mg/l indicate pollution levels meriting further investigation.

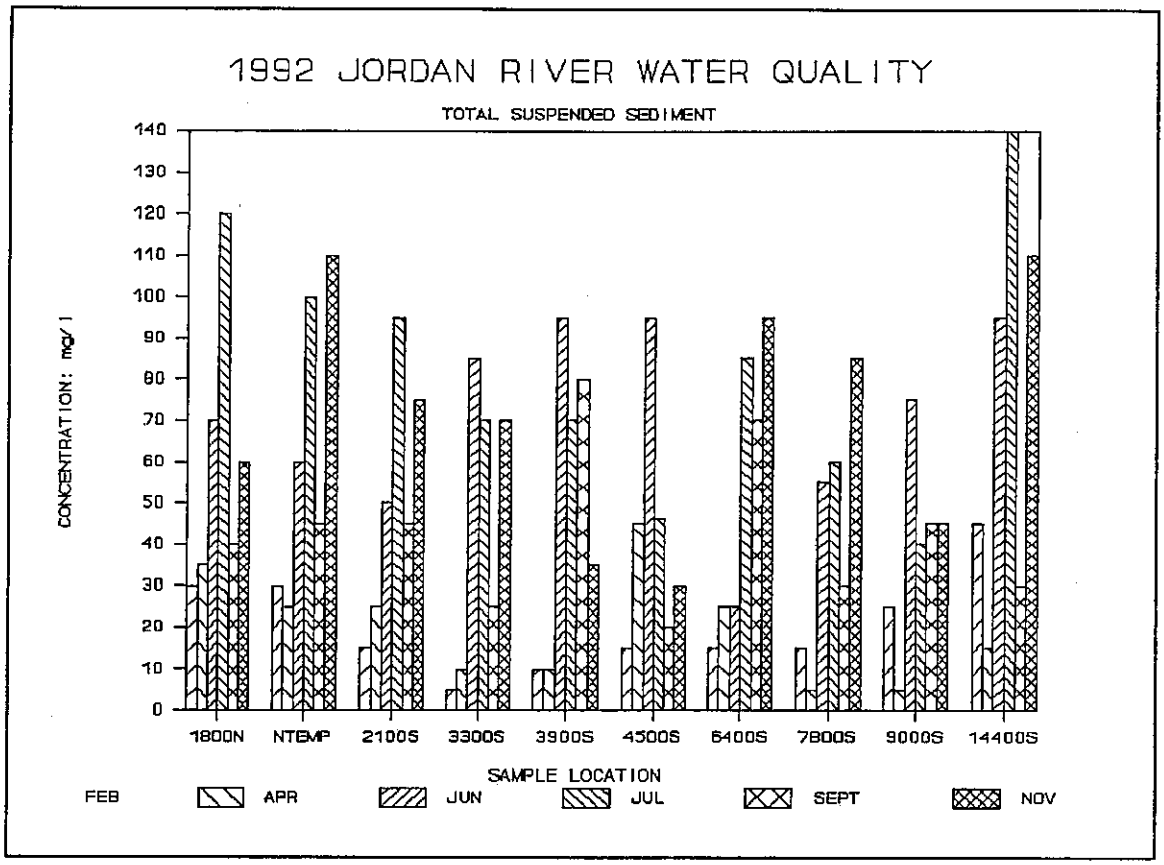
Phosphorus exceeds the indicator level for the entire length of the Jordan River, while nitrate increases significantly downstream but does not exceed indicator levels. Past studies by Hydroscience (April, 1977), indicate significant loads of Ortho-phosphorus, total phosphorus, and nitrates in surface return flows to the Jordan river.

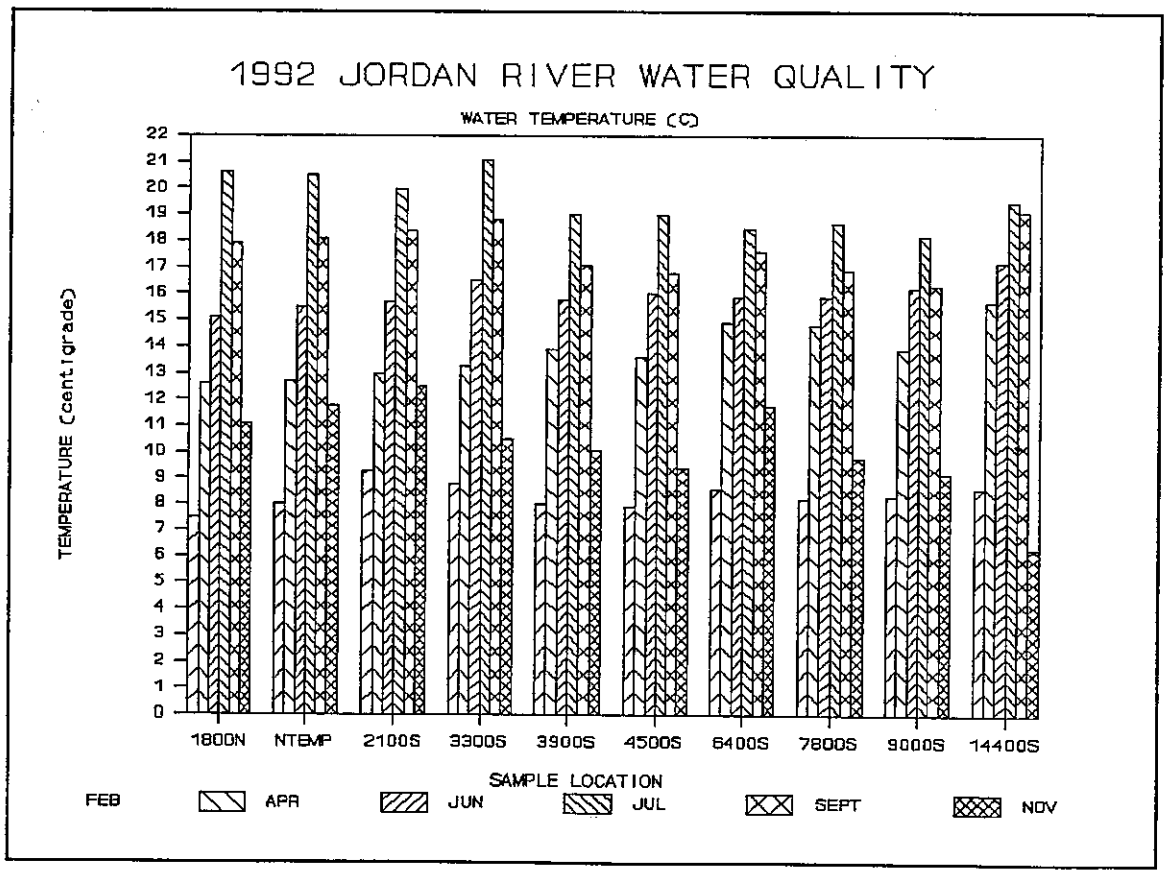
The relative contribution of man-induced versus natural loads to the Jordan is not well quanitified, but irrigation surface return flows are known to possess concentrations at .24-.40 mg/l from 1972-75 surveys. Sprerling & Glenne estimate canal phosphorus at .1-.5 mg/l, and return flow phosphorus at .1-.4 mg/l. Return flows also have higher coliform, nitrate, BOD and TDS concentrations than canal water from Utah Lake. These surface return loads to the river account for the largest proportion of nutrient entrained in bottom sediment and transported downstream.

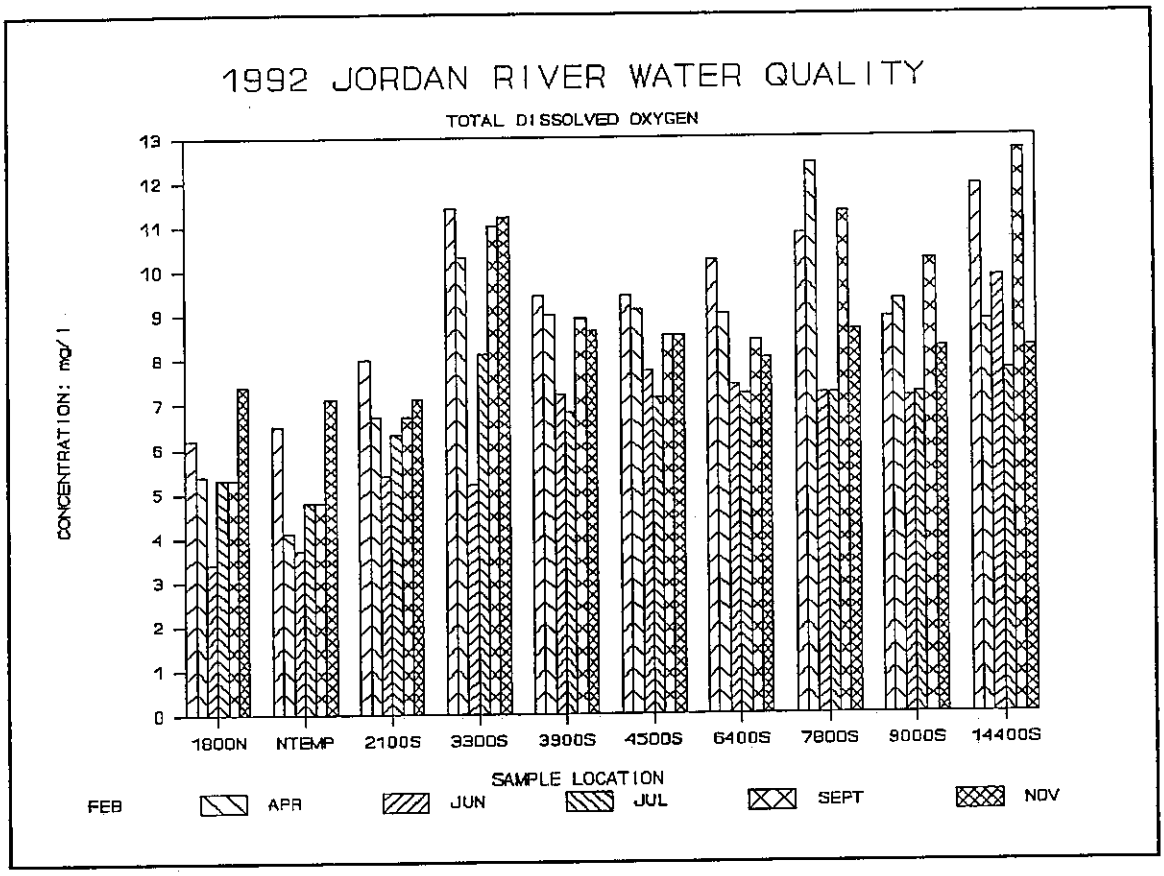
B. DISSOLVED OXYGEN (DO). The STORET data from 1984-86 indicate violation of DO criteria from about 500 North downstream. Recent data (1986-88) indicate an increase in dissolved oxygen well above that measured in 84-86. DO still continues to gradually decrease downstream from the Narrows to 1800 North. Oxygen demanding factors (BOD, CBOD, and coliform) are the likely source of this decline. Nutrient loads and river substrate conditions promote the presence of these oxygen-demanding factors.

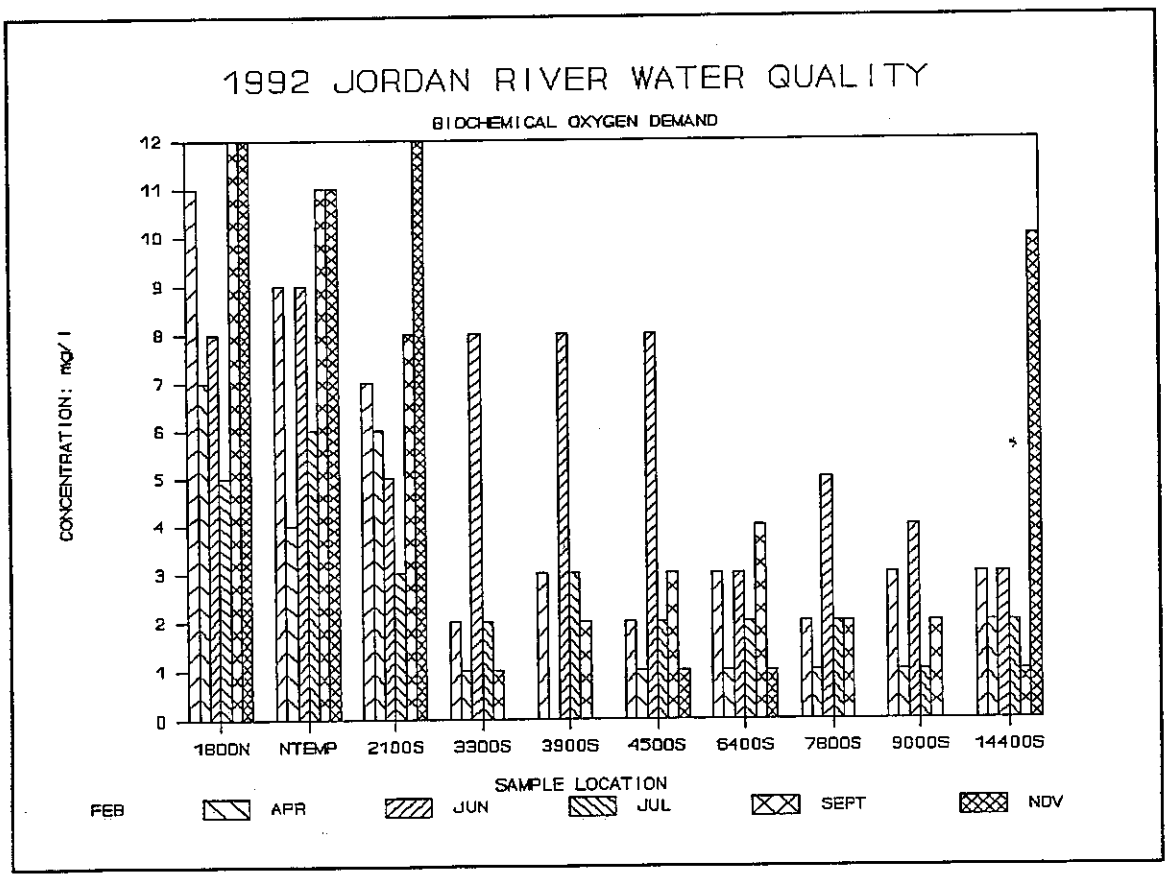

1992 JORDAN RIVER WATER QUALITY
FECAL COLIFORM BACTERIA
CONCENTRATION: (Thousands)
0
1
2
3
4
5
6
7
8
9
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

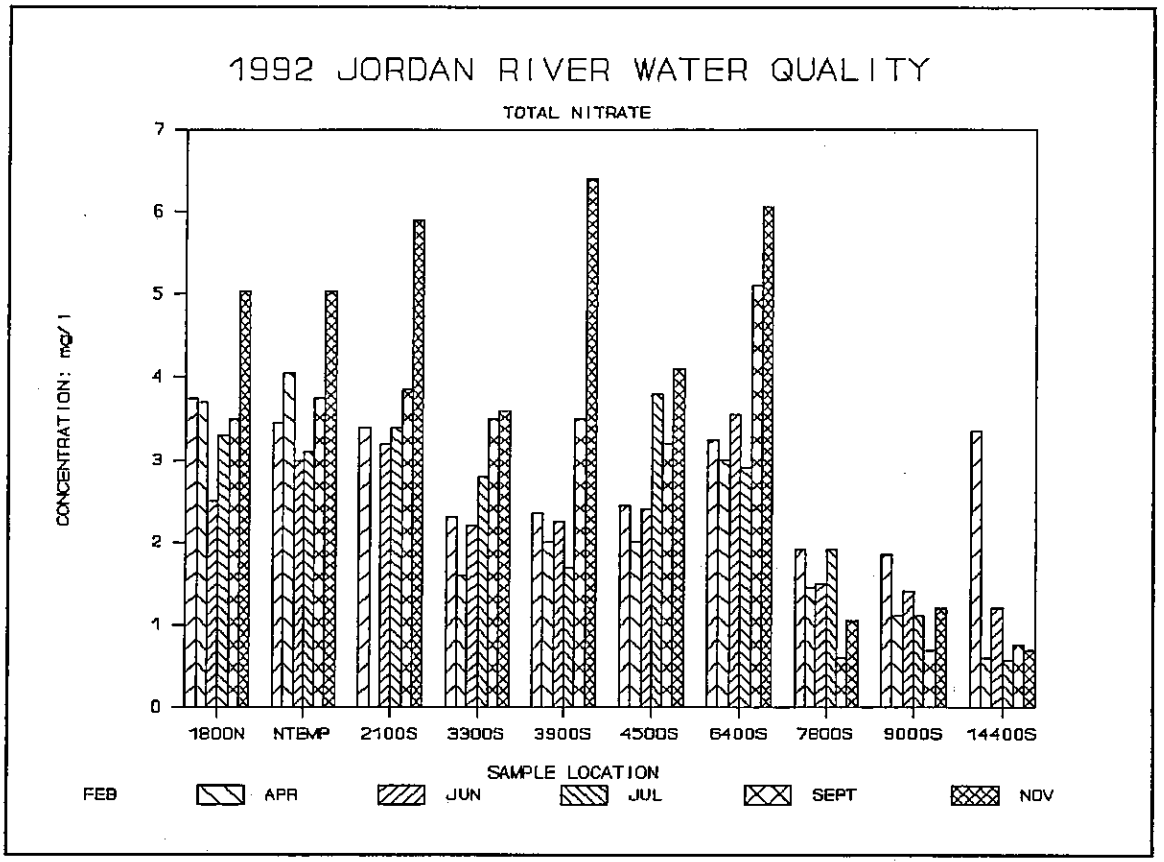

1992 JORDAN RIVER WATER QUALITY
TOTAL COLIFORM BACTERIA
CONCENTRATION: (Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
12
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

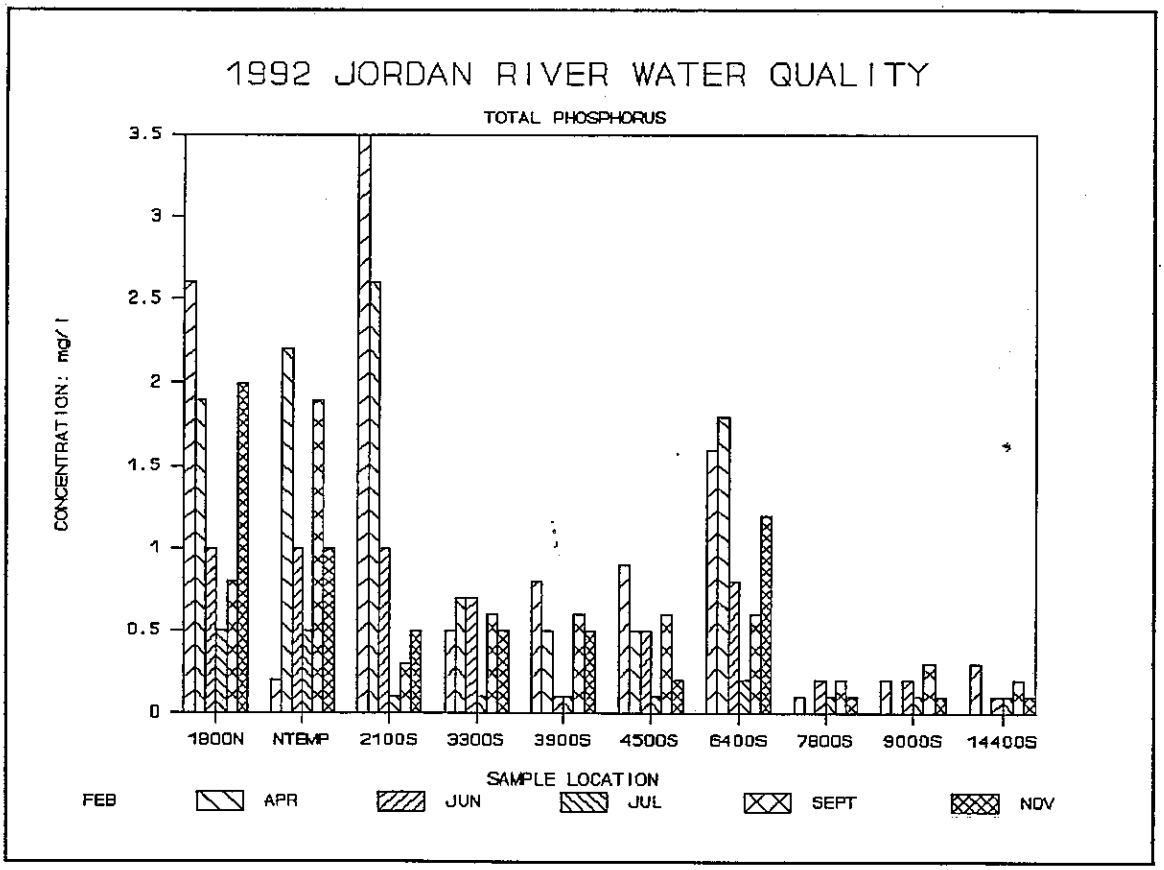

1992 JORDAN RIVER WATER QUALITY
TOTAL SUSPENDED SEDIMENT
CONCENTRATION: mg/l
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

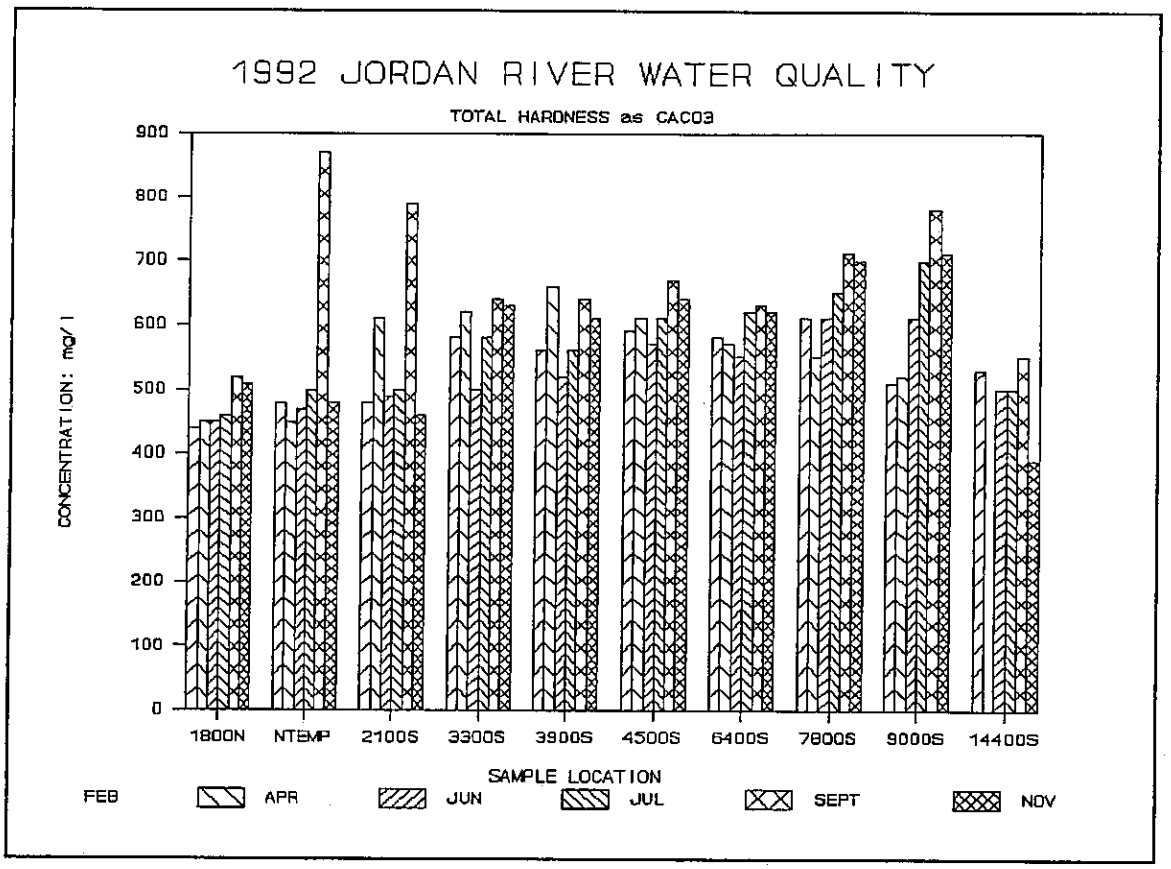

1992 JORDAN RIVER WATER QUALITY
WATER TEMPERATURE (C)
TEMPERATURE (centigrade)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

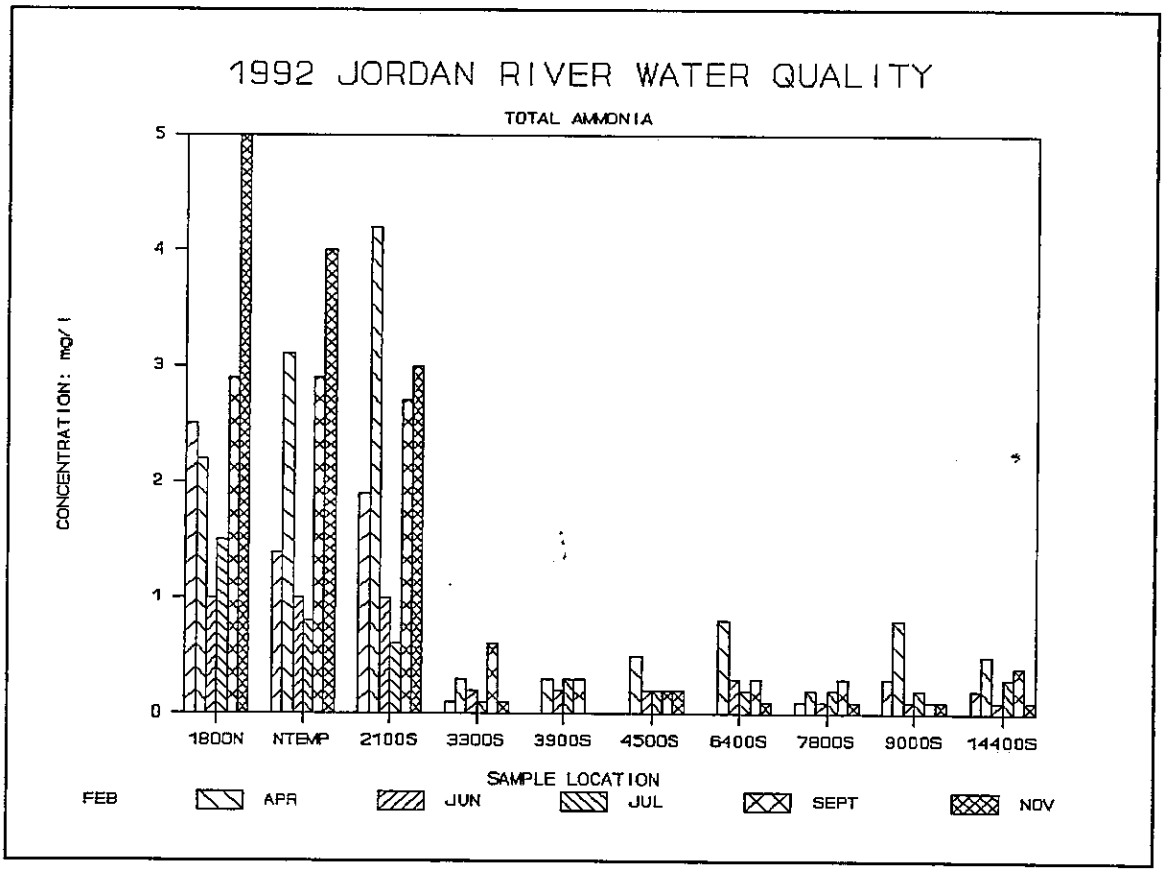

1992 JORDAN RIVER WATER QUALITY
TOTAL DISSOLVED OXYGEN
CONCENTRATION: mg/l
0
1
2
3
4
5
6
7
8
9
10
11
12
13
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

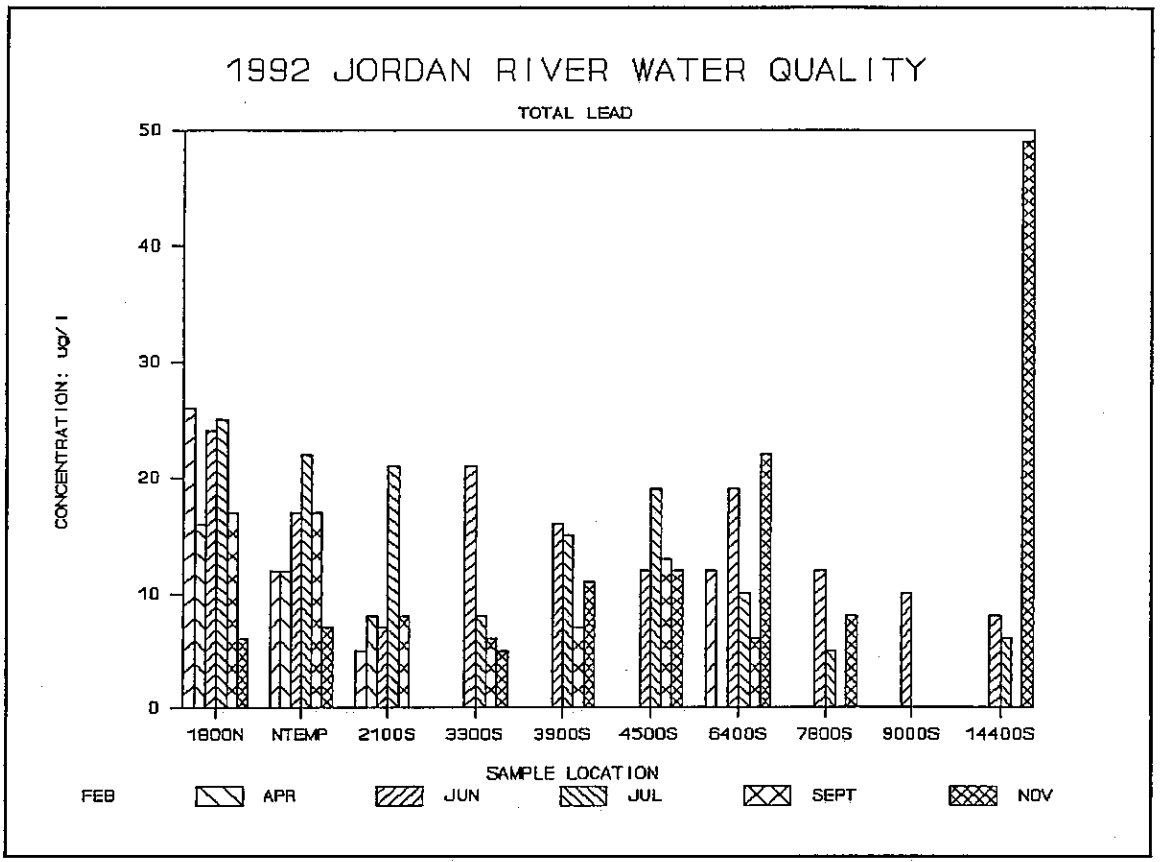

1992 JORDAN RIVER WATER QUALITY
BIOCHEMICAL OXYGEN DEMAND
CONCENTRATION: mg/l
0
1
2
3
4
5
6
7
8
9
10
11
12
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

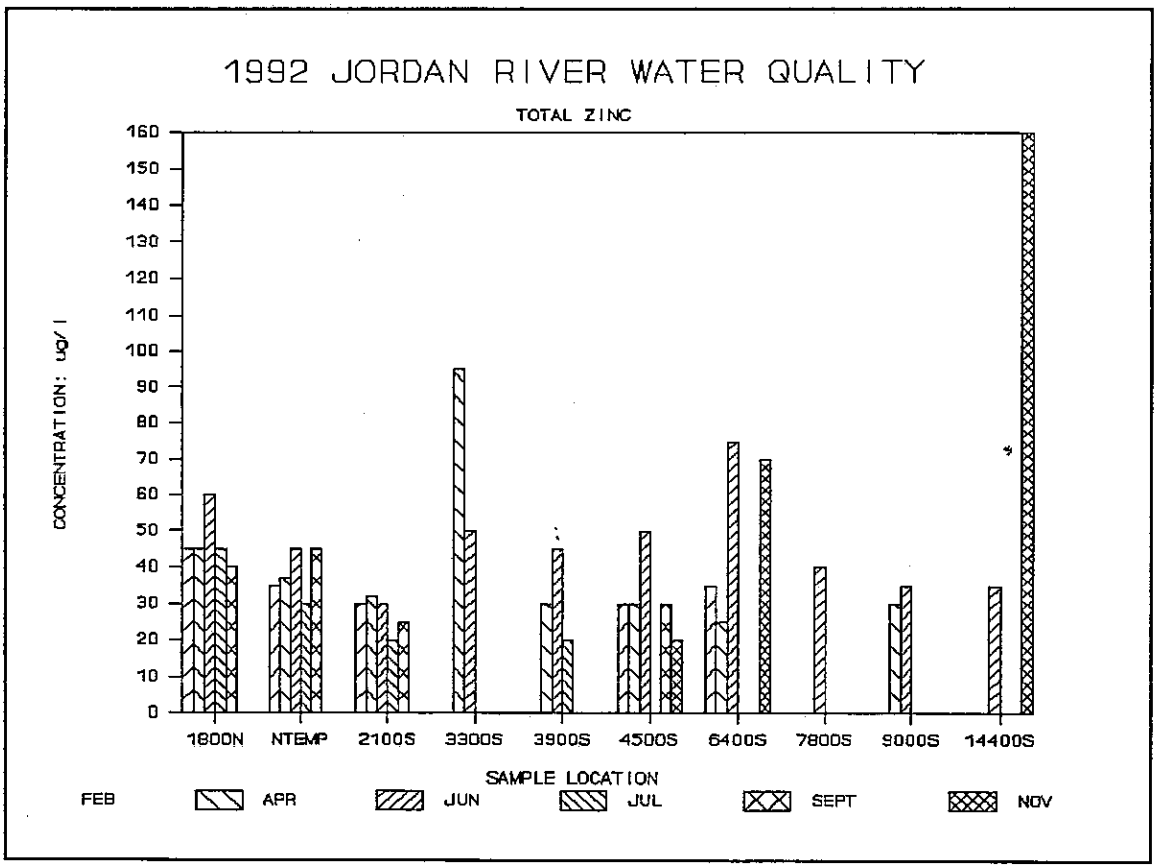

1992 JORDAN RIVER WATER QUALITY
TOTAL NITRATE
CONCENTRATION: mg/l
0
1
2
3
4
5
6
7
1800N
NTBMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

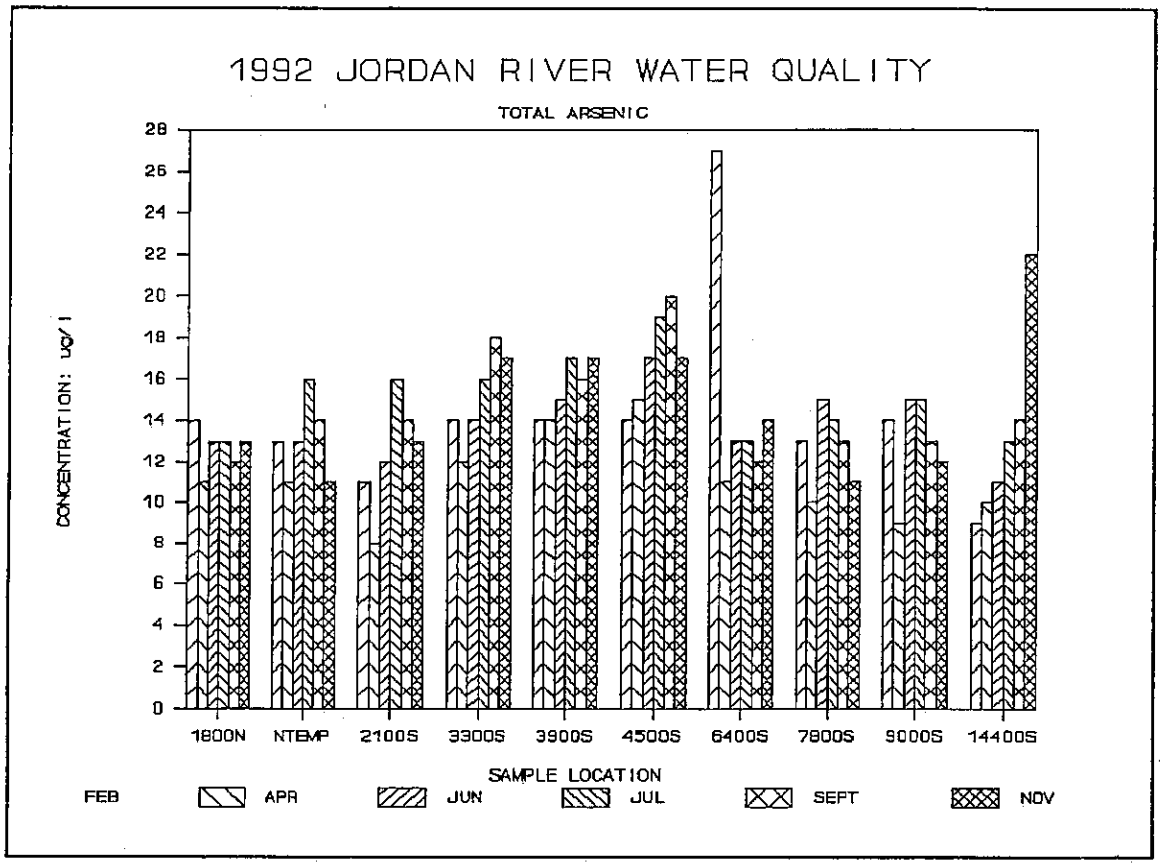

1992 JORDAN RIVER WATER QUALITY
TOTAL PHOSPHORUS
CONCENTRATION: mg/l
0
0.5
1
1.5
2
2.5
3
3.5
1800N
NTBMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

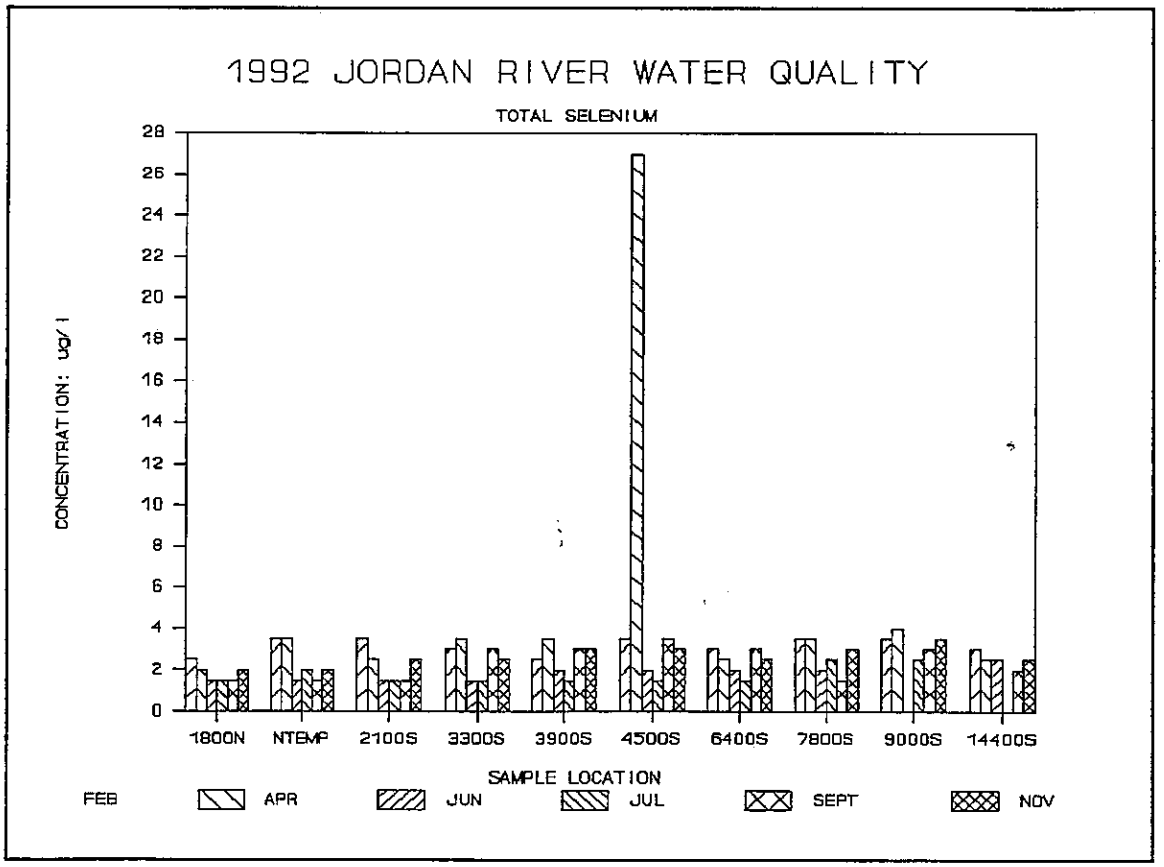

1992 JORDAN RIVER WATER QUALITY
TOTAL HARDNESS as CACO3
CONCENTRATION: mg/l
900
800
700
600
500
400
300
200
100
0
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

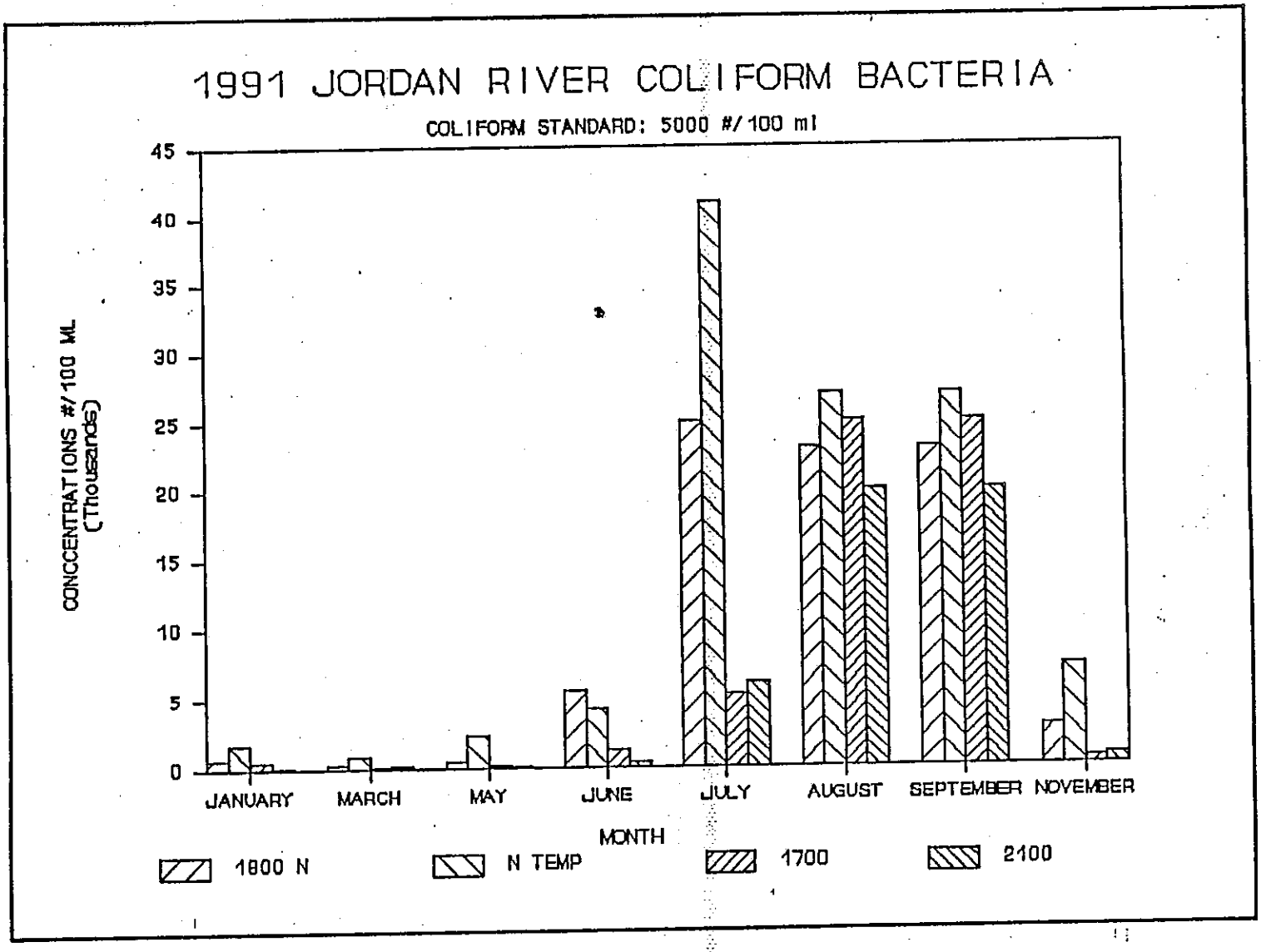

1992 JORDAN RIVER WATER QUALITY
TOTAL AMMONIA
CONCENTRATION: mg/l
5
4
3
2
1
0
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

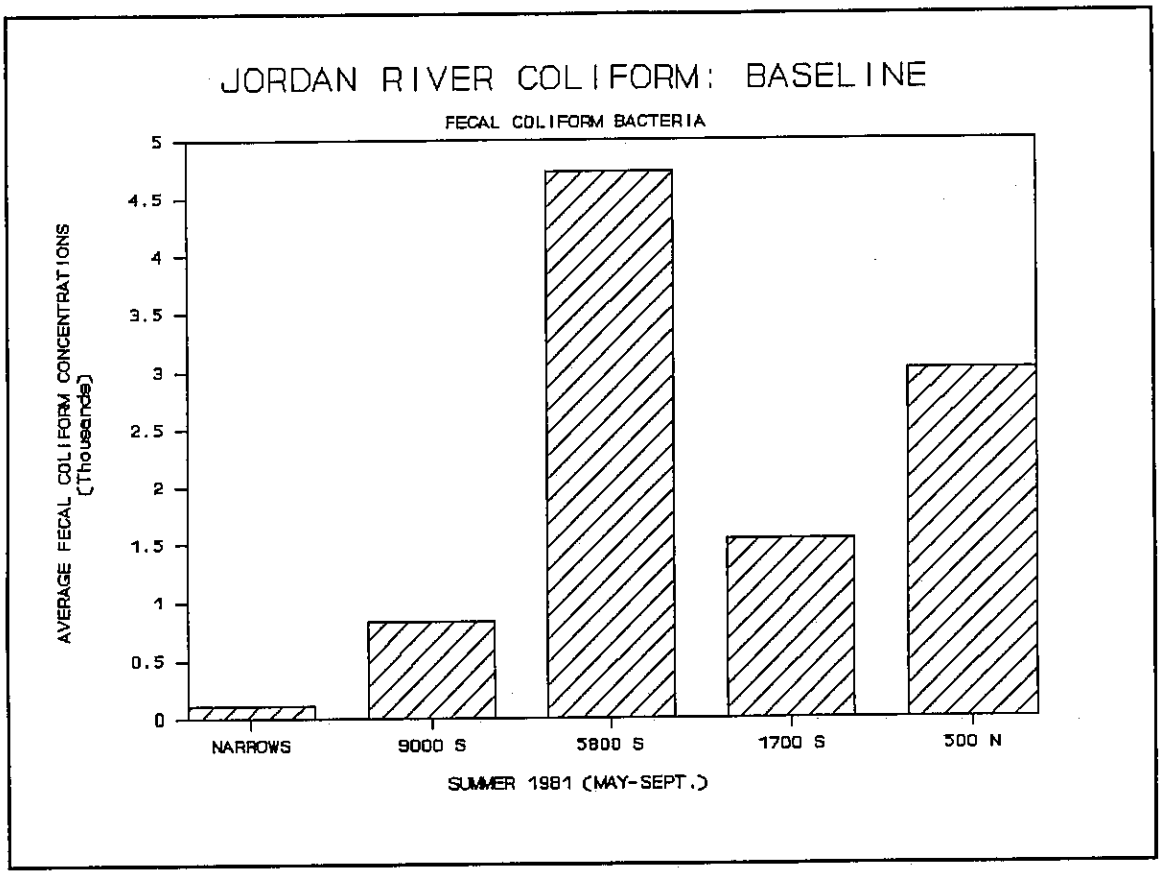

1992 JORDAN RIVER WATER QUALITY
TOTAL LEAD
CONCENTRATION: ug/l
0
10
20
30
40
50
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

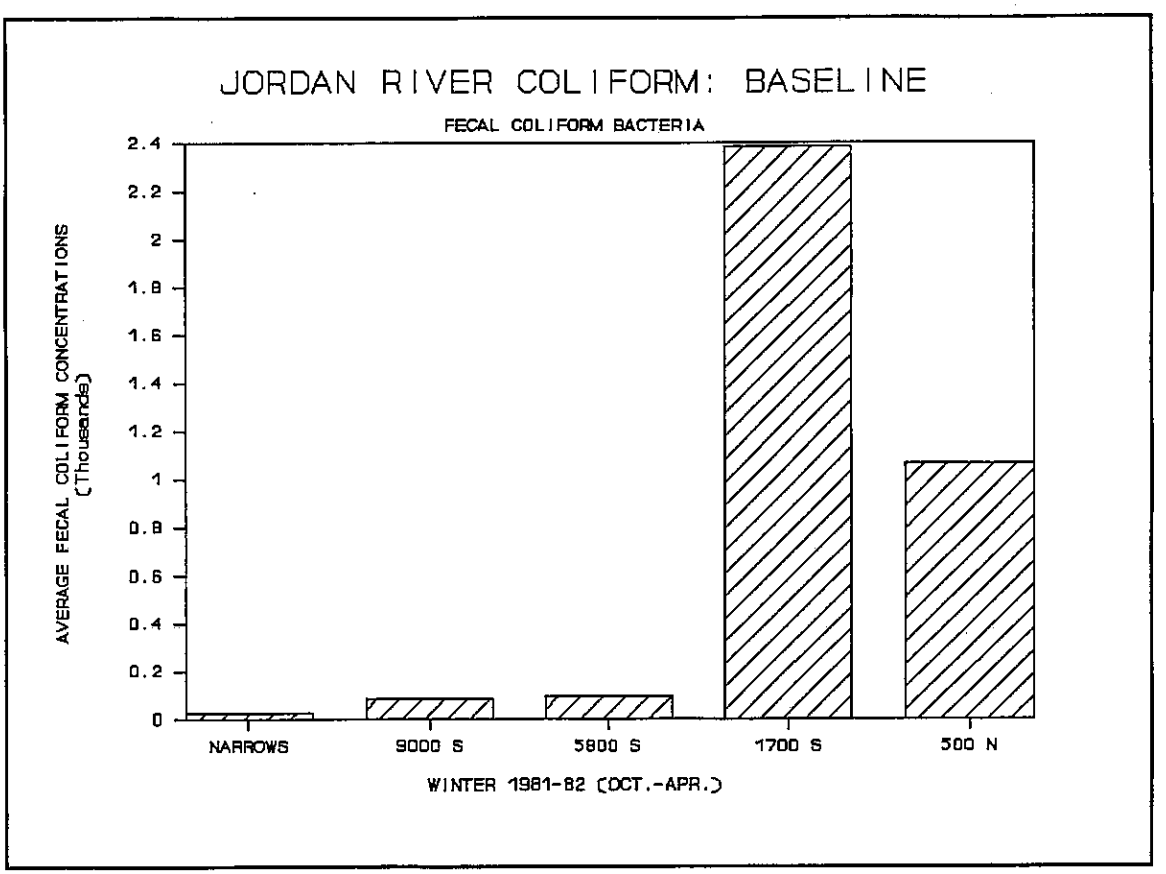

1992 JORDAN RIVER WATER QUALITY
TOTAL ZINC
CONCENTRATION: ug/l
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

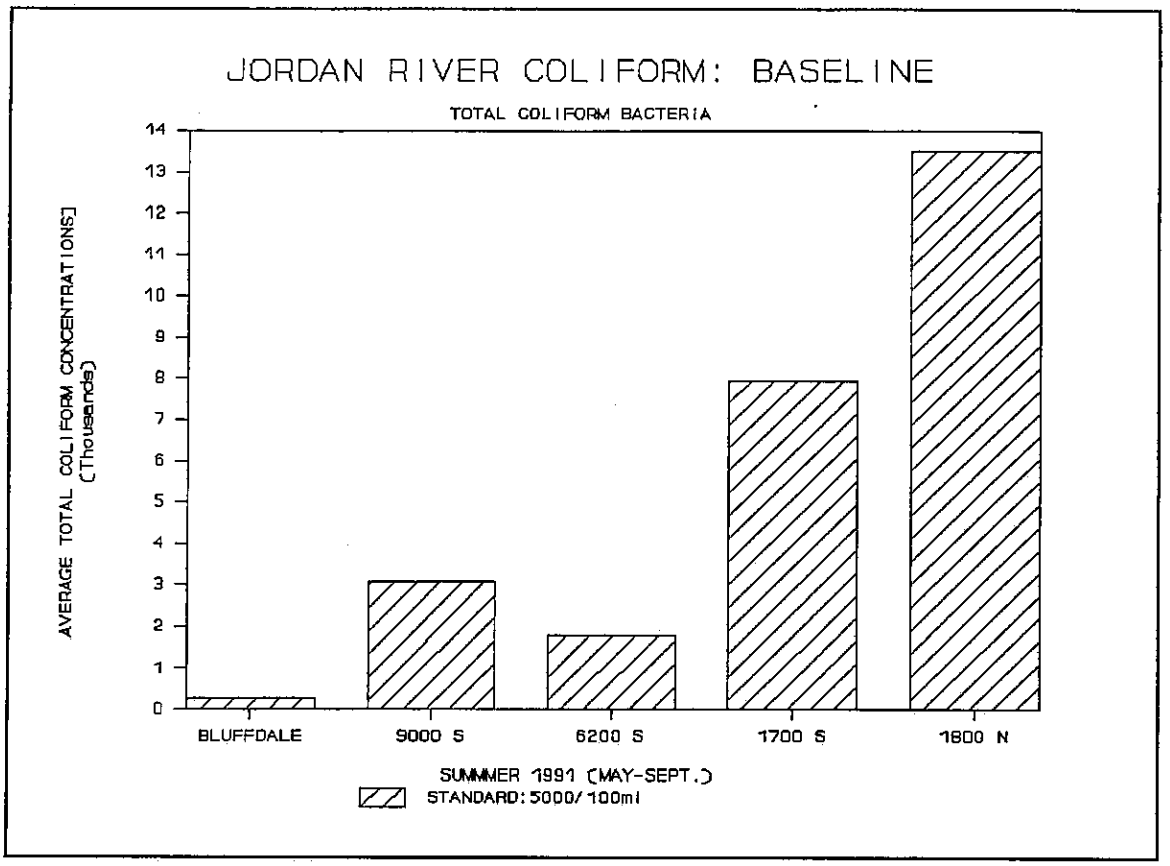

1992 JORDAN RIVER WATER QUALITY
TOTAL ARSENIC
CONCENTRATION: ug/l
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

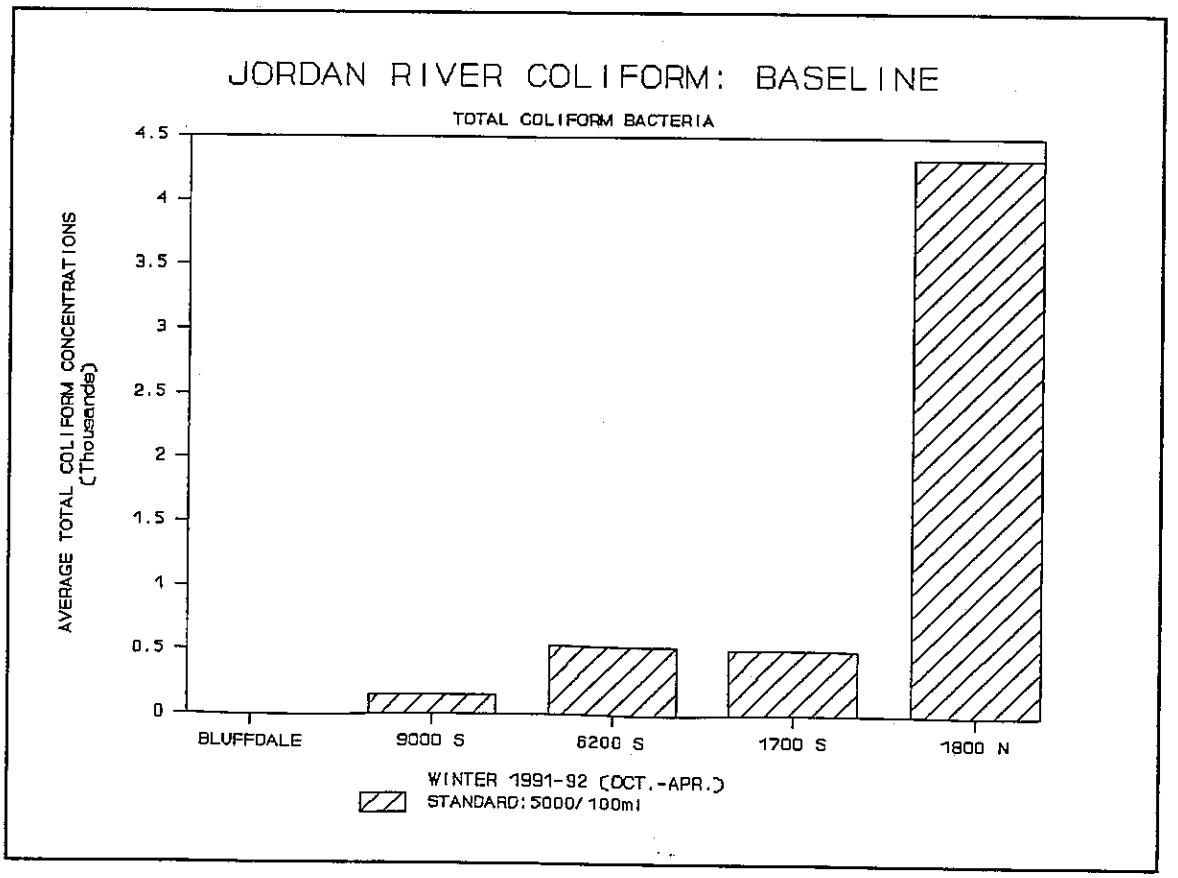

1992 JORDAN RIVER WATER QUALITY
TOTAL SELENIUM
CONCENTRATION: ug/l
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
1800N
NTEMP
2100S
3300S
3900S
4500S
6400S
7800S
9000S
14400S
SAMPLE LOCATION
FEB
APR
JUN
JUL
SEPT
NOV

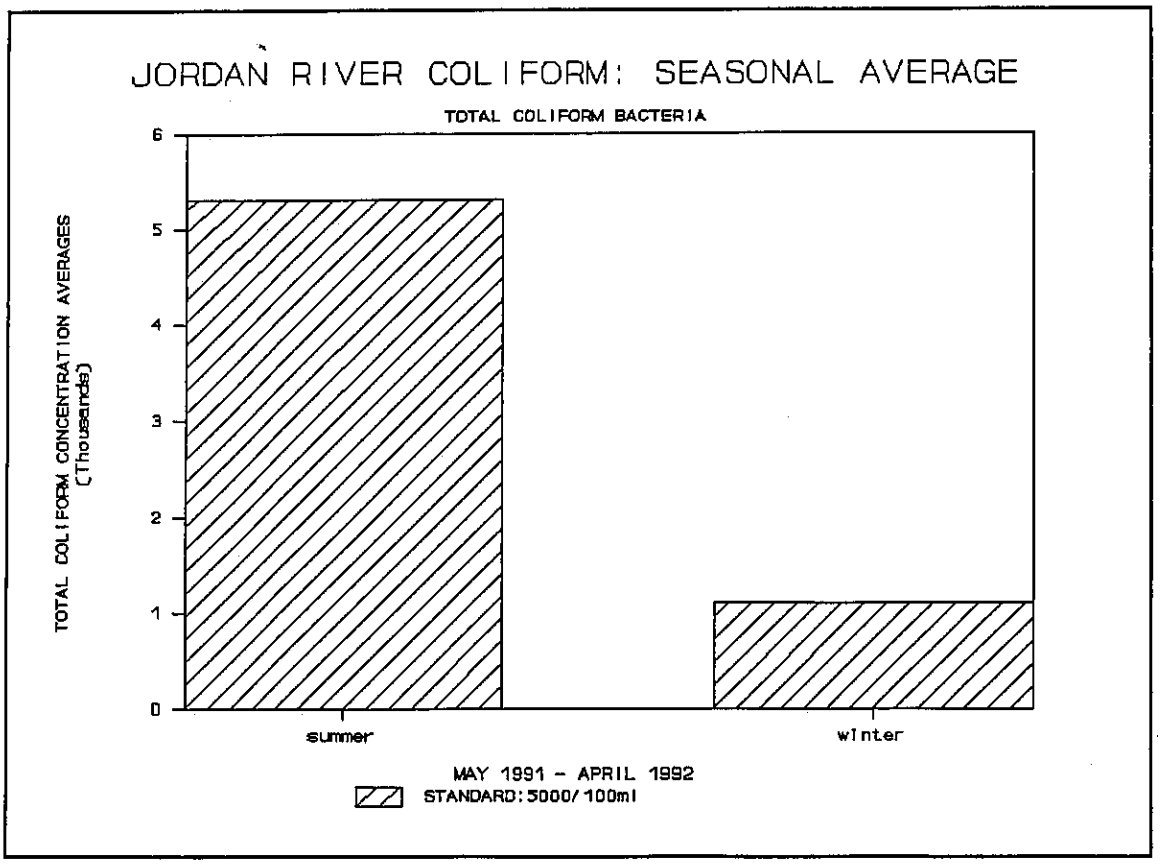

1991 JORDAN RIVER COLIFORM BACTERIA
COLIFORM STANDARD: 5000 #/100 ml
CONCCENTRATIONS #/100 ML (Thousands)
45
40
35
30
25
20
15
10
5
0
JANUARY
MARCH
MAY
JUNE
JULY
AUGUST
SEPTEMBER
NOVEMBER
MONTH
1800 N
N TEMP
1700
2100

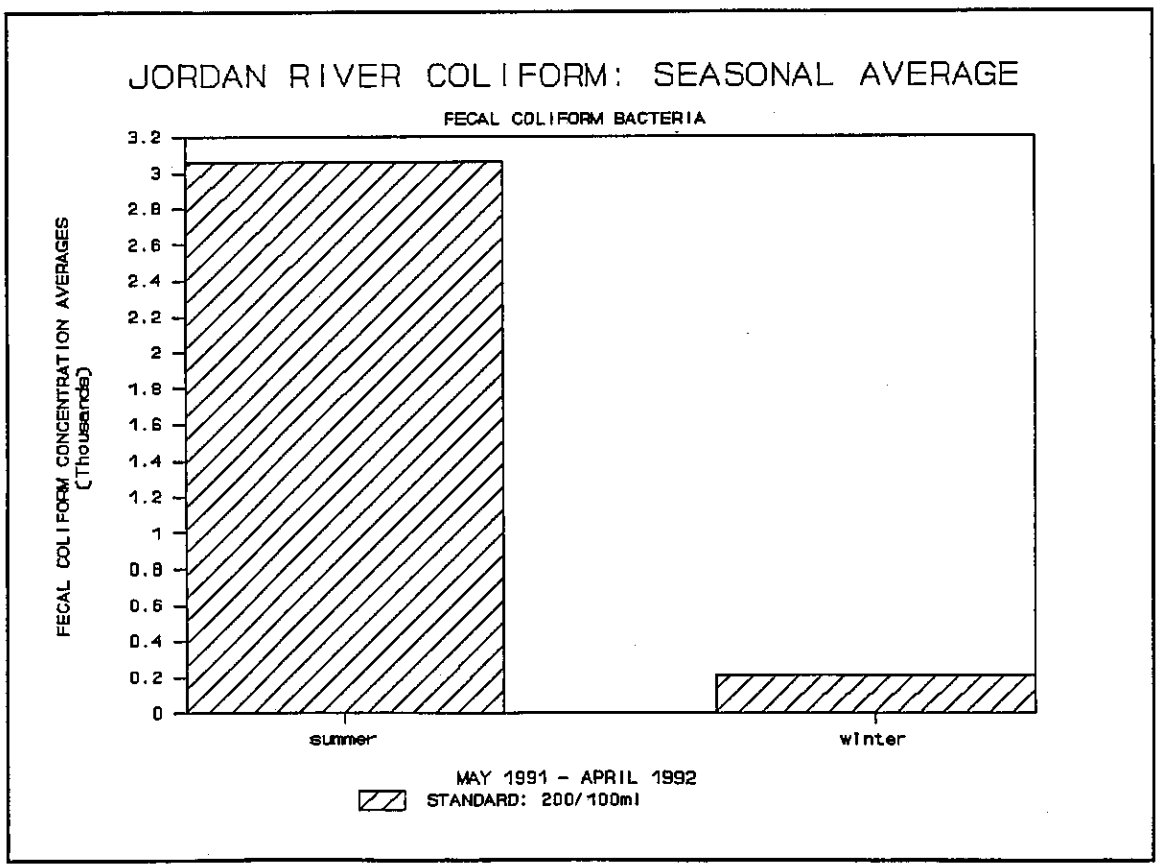

JORDAN RIVER COLIFORM: BASELINE
FECAL COLIFORM BACTERIA
AVERAGE FECAL COLIFORM CONCENTRATIONS (Thousands)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
NARROWS
9000 S
5800 S
1700 S
500 N
SUMMER 1981 (MAY-SEPT.)

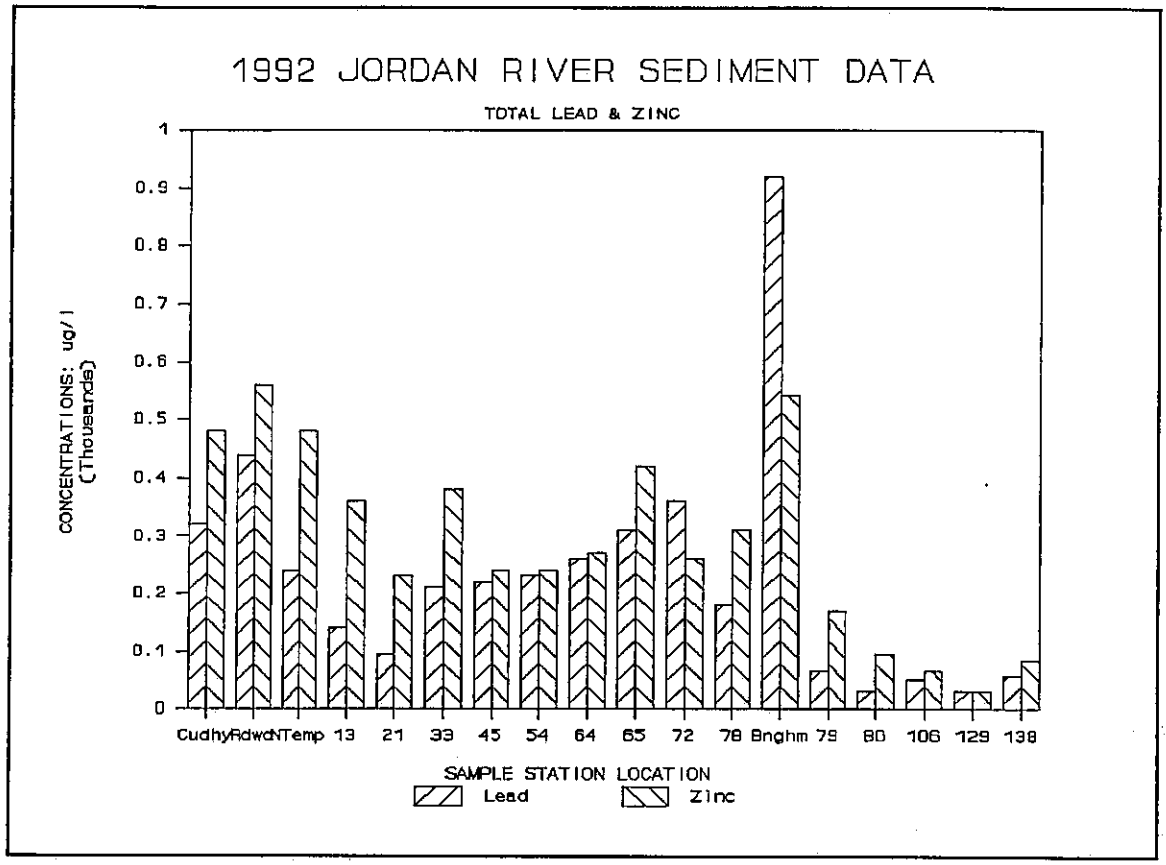

JORDAN RIVER COLIFORM: BASELINE
FECAL COLIFORM BACTERIA
AVERAGE FECAL COLIFORM CONCENTRATIONS (Thousands)
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
NARROWS
9000 S
5800 S
1700 S
500 N
WINTER 1981-82 (OCT.-APR.)

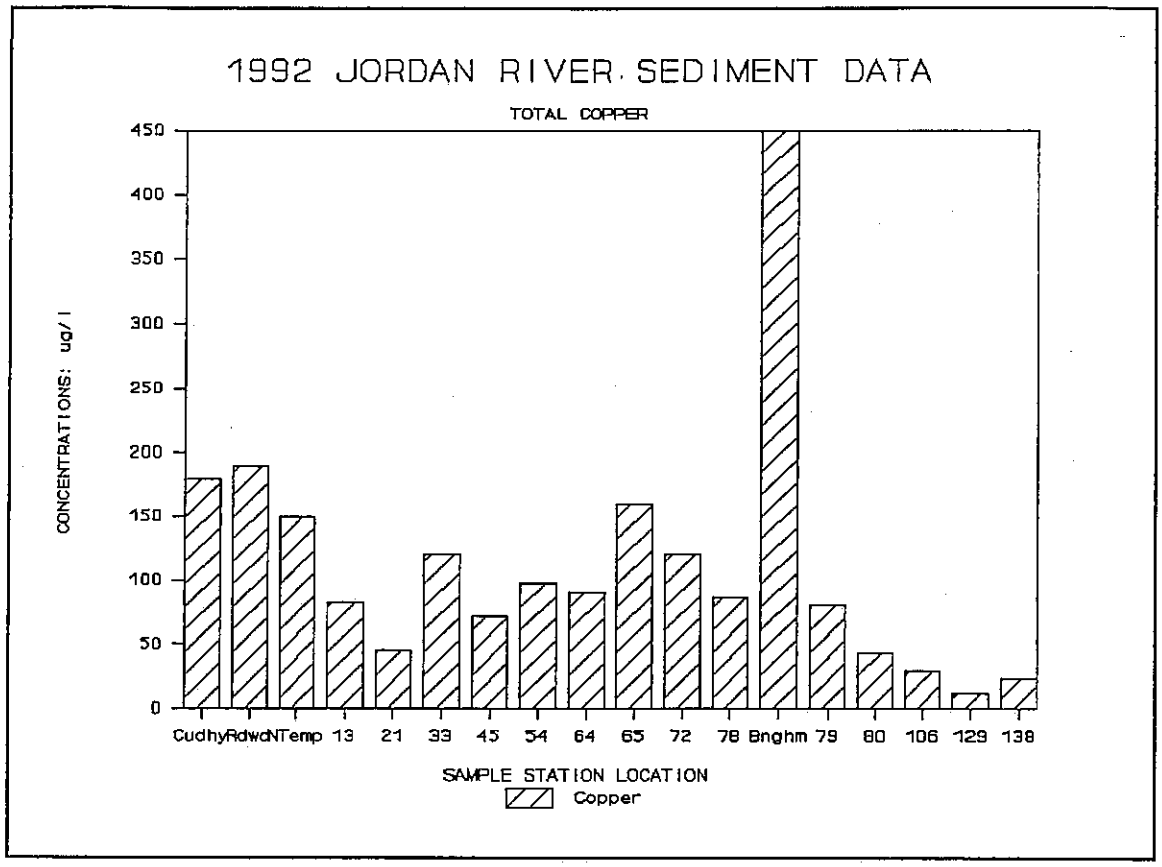

JORDAN RIVER COLIFORM: BASELINE
TOTAL COLIFORM BACTERIA
AVERAGE TOTAL COLIFORM CONCENTRATIONS (Thousands)
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
BLUFFDALE
9000 S
6200 S
1700 S
1800 N
SUMMER 1991 (MAY-SEPT.)
STANDARD: 5000/100ml

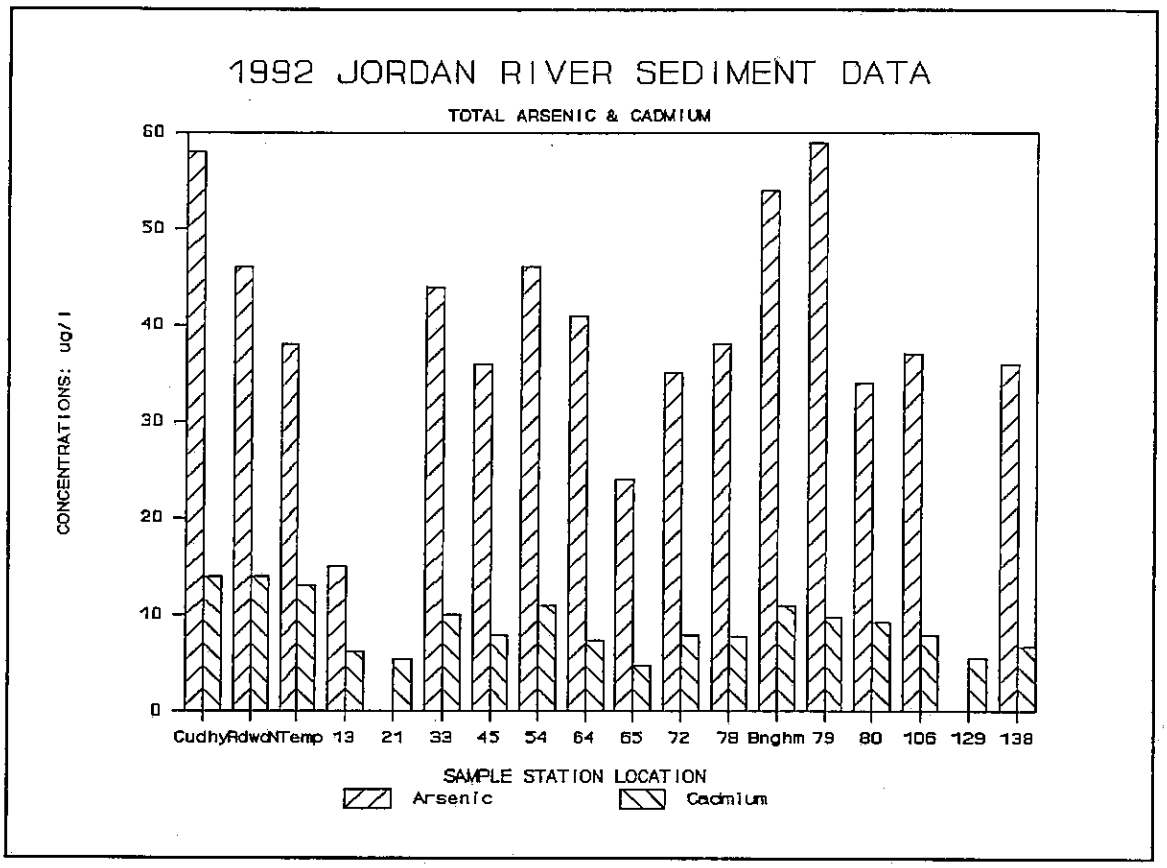

JORDAN RIVER COLIFORM: BASELINE
TOTAL COLIFORM BACTERIA
AVERAGE TOTAL COLIFORM CONCENTRATIONS (Thousands)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
BLUFFDALE
9000 S
6200 S
1700 S
1800 N
WINTER 1991-92 (OCT.-APR.)
STANDARD: 5000/100ml

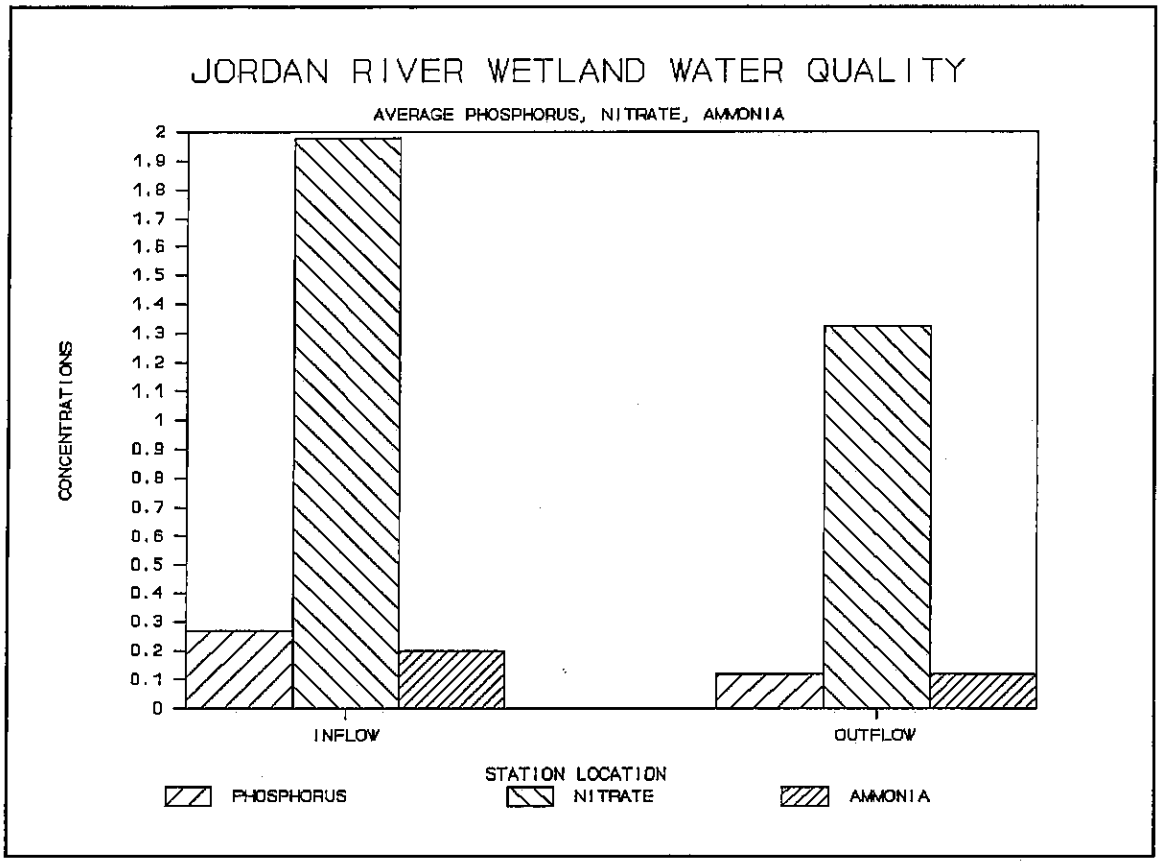

JORDAN RIVER COLIFORM: SEASONAL AVERAGE
TOTAL COLIFORM BACTERIA
TOTAL COLIFORM CONCENTRATION AVERAGES (Thousands)
6
5
4
3
2
1
0
summer
winter
MAY 1991 - APRIL 1992
STANDARD: 5000/100ml

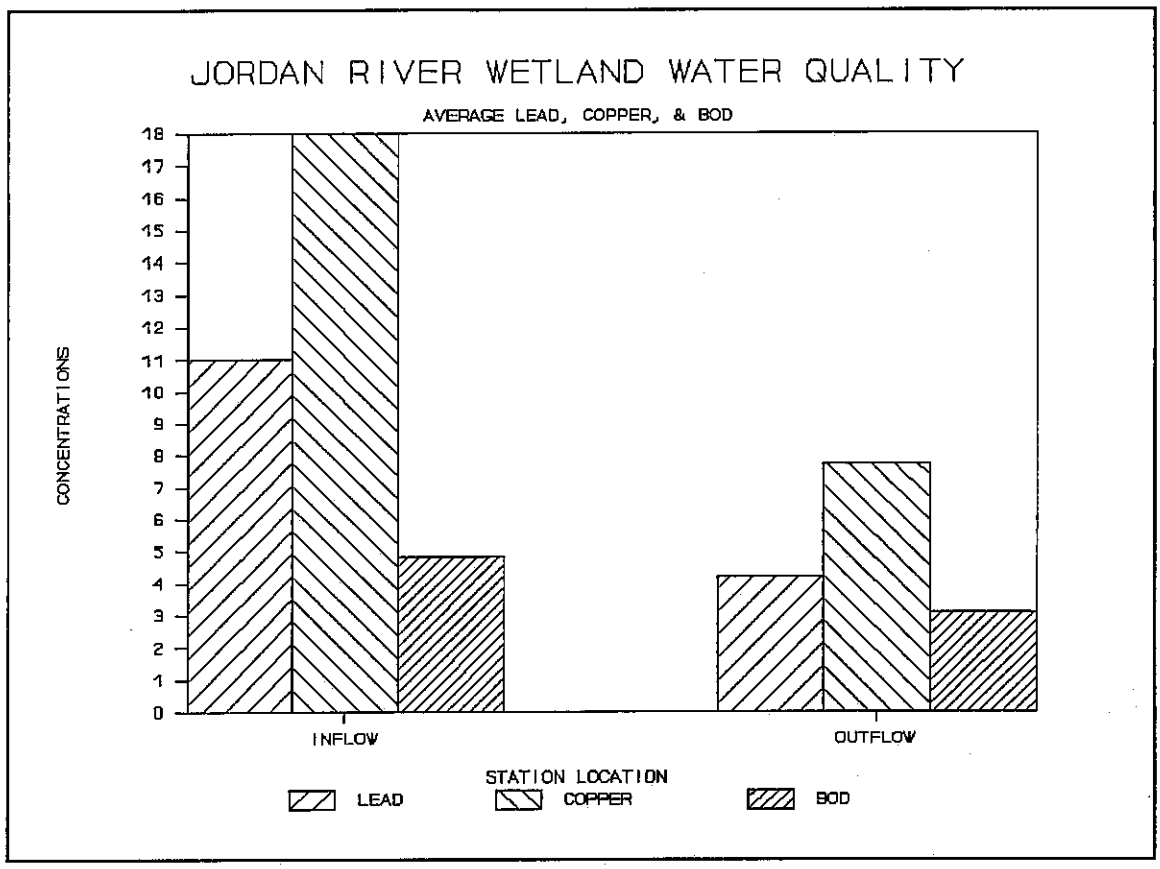

JORDAN RIVER COLIFORM: SEASONAL AVERAGE
FECAL COLIFORM BACTERIA
FECAL COLIFORM CONCENTRATION AVERAGES (Thousands)
3.2
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
summer
winter
MAY 1991 - APRIL 1992
STANDARD: 200/100ml

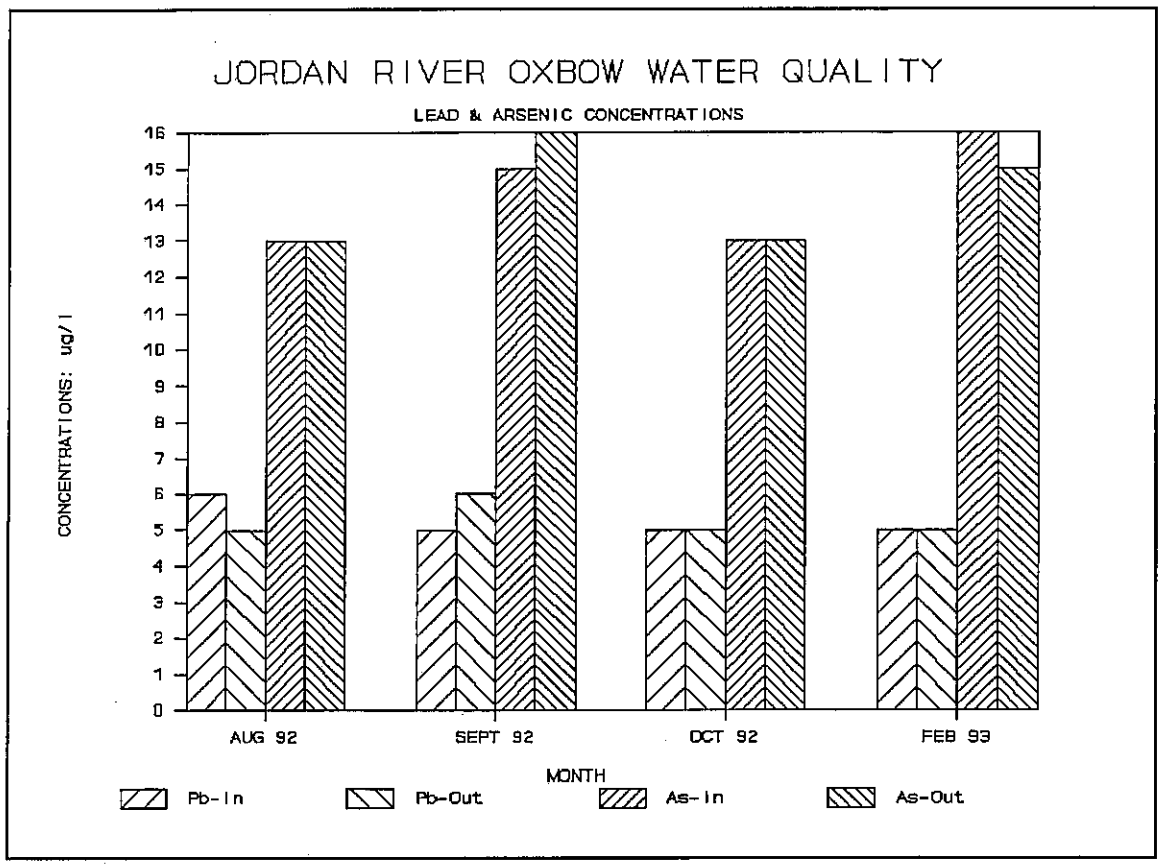

1992 JORDAN RIVER SEDIMENT DATA
TOTAL LEAD & ZINC
CONCENTRATIONS: ug/l
(Thousands)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
CudhyRdwdNTemp 13 21 33 45 54 64 65 72 78 Bnghm 79 80 106 129 138
SAMPLE STATION LOCATION
Lead
Zinc


1992 JORDAN RIVER SEDIMENT DATA
TOTAL COPPER
CONCENTRATIONS: ug/l
450
400
350
300
250
200
150
100
50
0
CudhyRdwdNTemp 13 21 33 45 54 64 65 72 78 Bnghm 79 80 106 129 138
SAMPLE STATION LOCATION
Copper


1992 JORDAN RIVER SEDIMENT DATA
TOTAL ARSENIC & CADMIUM
CONCENTRATIONS: ug/l
60
50
40
30
20
10
0
CudhyRdwdNTemp 13 21 33 45 54 64 65 72 78 Bnghm 79 80 106 129 138
SAMPLE STATION LOCATION
Arsenic
Cadmium


JORDAN RIVER WETLAND WATER QUALITY
AVERAGE PHOSPHORUS, NITRATE, AMMONIA
CONCENTRATIONS
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
INFLOW
OUTFLOW
STATION LOCATION
PHOSPHORUS
NITRATE
AMMONIA


JORDAN RIVER WETLAND WATER QUALITY
AVERAGE LEAD, COPPER, & BOD
CONCENTRATIONS
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
INFLOW
OUTFLOW
STATION LOCATION
LEAD
COPPER
BOD


JORDAN RIVER OXBOW WATER QUALITY
LEAD & ARSENIC CONCENTRATIONS
CONCENTRATIONS: ug/l
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
AUG 92
SEPT 92
OCT 92
FEB 93
MONTH
Pb-In
Pb-Out
As-In
As-Out

C. TOTAL SUSPENDED SEDIMENT (TSS). Comparison of 84-86 data from STORET with 86-88 data indicate a decrease in TSS concentrations over the entire Jordan River length. The decrease is largest between 7800 South and 2100 South. The cause of the decrease could be:

1. Reduced upstream river flow during the 86-88 period, which entrained less eroded material.
2. Increased discharges from new wastewater treatment facilities, creating more dilution.

Although STORET data display a relationship between TSS, nitrate, and phosphorus, no comparable numbers exists for County Health data collected for 86-88. Only un-ionized ammonia is analyzed by the City-County Health Department.

D. HEAVY METALS. The STORET record from 1984-86 examines concentrations for mercury and arsenic. Arsenic concentrations rise by 4 ug/l at 7800 South and decrease gradually downstream. Mercury concentrations are found at or below detection limits to 2100 South where they double to 500 North and return to detection limits at Cudahy Lane. Recent data collected at 9000, 7800, and 6400 South indicate increases of lead and mercury concentrations in that river segment. Better heavy metal data are found in U.S.G.S. studies. Further sampling of heavy metals is necessary to determine more accurate loads from natural and nonpoint sources such as storm drains and tributaries.

III. U.S. GEOLOGICAL SURVEY: JORDAN RIVER WATER RESOURCES INVESTIGATION REPORTS, 1980-8227.

The water ressources investigations reports were prepared by USGS from data compiled during the Nationwide Urban Runoff Program (NURP). Most data reflects storm runoff events rather than typical low flow periods. This is a particularly important since the majority of water quality data on the Jordan represents dry weather conditions.

The effect of stormwater pollutant shock loads on aquatic organisms is not well understood. There is a possibility that bio-uptake of heavy metals into the food chain occurs in the river, which may result in the suppression of reproduction of certain aquatic species. Additional investigation of these possible impacts through Use Attainability Analysis is now in progress.

Water resource investigation reports included a reconnaissance of toxic substances, dissolved oxygen regime, sanitary quality, and turbidity & suspended sediment.

A. RECONNAISSANCE OF TOXIC SUBSTANCES.

"The diversity of toxic substances with concentrations large enough to cause them to be problems increased from the most upstream sampling site the Jordan Narrows to the next two downstream sites at 9000 South and 5800 South. Concentrations of trace elements in stream-bottom materials also increased in a downstream direction."

Large increases first were observed at 5800 South street, and were sustained throughout the downstream study area. Concentrations of most trace elements in bottom materials at the mouths of the three major tributaries were similar to the concentrations in the Jordan River at the three downstream - sampling sites.

Copper and Zinc were exceptions. The mean zinc concentration in the three major tributaries was 282.9 microgram per gram, exceeding the mean concentration of 186.9 micrograms per gram in the three downstream Jordan River sites. The mean copper concentration in the three major tributaries was 49.7 micrograms per gram compared to the mean concentration of 64.5 micrograms per gram in the three downsteam Jordan River sites.

B. DISSOLVED OXYGEN REGIME. Summary and conclusions from WRIR # 84-4056:

1. Comparison of data for the Jordan at 1700 South and 5800 South show mean DO decreased from 1974-81 but have increased slightly since 1981. About one-half of all DO at 1700 South and 500 North violated State intended-use standard of 5.5 mg/l.

2. Nearly 90% of BOD concentrations downstream from 1700 South exceeded the standard.

3. Reaeration was closely related to channel slope, showing marked decreases downstream from 4800 South where slope decreases markedly.

4. Concentrations of phytopolankton chlorophyll-a decreased from a mean of 36 ug/l at the Jordan Narrows to 9 ug/l at 500 North due to death of algal cells and dilutions by inflowing streams.

5. Concentrations of DO in the river during storms averaged 6.9 mg/l, significantly smaller than the mean of 8 mg/l measured during nonstorm periods.

6. Oxygen-demanding wastes discharged from wastewater treatments plants constituted the greatest single-point source of BOD loading to the Jordan River. Total annual load from all WWTP's was estimated at 4.7 million lbs. 85% of this load was discharged to the river in the downstream reaches where the reaeration rates are the least.

7. Total oxygen-demanding load as measured by BOD of 6 million lbs. was dishcarged to the river from point sources in 1981, and consisted of 4.7 million lbs. from WWTP's, 1.4 million lbs. from nonstorm streamflow, and 33,000 lbs. from storm runoff. Diversion of 3/4 of the discharge of the Jordan River to the Surplus Canal decreased the total point-source load in the river downstream from 2100 South to 2.1 million lbs. Suspended and settleable fractions of the load could result in the accumulation of considerable quantities of oxygen-demanding sediments on the river bottom.

C. SANITARY QUALITY. Summary and conclusions from WRIR # 83-4252

1. Data collected from July 1980 through October 1982 showed a serious sanitary problem in the Jortdan River. Total coliform bacteria commonly exceeded 5000 colonies/100 ml and fecal coliform commonly exceeded 2000 colonies/100 ml in downstream reaches of the river.

2. In general, concentrations of all three indicator bacteria in the Jordan River increased in a downstream direction.

3. Wastewater treament plants at the time contributed significant concentrations of indicator bacteria to the river.

4. Mean total coliform bacteria concentrations from three major tributaries (Big Cottonwood, Little Cottonwood, and Mill Creeks) were all significantly smaller than the mean concentration in the Jordan River near their confluence.

5. Storm drains in the urban area of Salt Lake County contributed large concentrations of bacteria during storm runoff. Mean total coliform bacteria concentrations in storm drains ranged from 59,750 to 159,000 colonies/100 ml, and mean fecal coliform concentration ranged from 3240 to 23200 colonies/100 ml.

6. Mean total coliform, fecal coliform, and fecal streptococci bacteria concentrations from Millcreek were significantly larger in storm samples than in nonstorm samples (10 times).

D. TURBIDITY AND SUSPENDED SEDIMENT. Summary and conclusions from WRIR # 84-4019:

1. Clay-size particles could be a source of turbidity because at least 67% of the suspended sediment at the Jordan narrows is clay size or finer during November through May. Significant correlation exists between suspended sediment concentration and turbidity in the combined data from the five sampling sites on the Jordan River. Organic suspended sediment appears to be the dominant source of turbidity at 1700 South during November through May. Organic cations in WWTP discharges could be causing the precipitation of clay particles, thereby affecting turbidity in the river.

IV. HYDROSCIENCE. WATER QUALITY IMPACTS-POINT AND NONPOINT, 1977.

This report presents an analysis of the water impacts of point and non-point loads to the Jordan during the summer flow period. Although the information is dated, its conclusions still have merit.

1. During the summer, principal determinants of Jordan River quality are non-point and WWTP loads. "Upstream boundary" loads (Utah Lake) and tributary stream loads have a minor impact.

2. **Groundwater inflow is a major contributor to TDS and Nitrate in the river.** Other groundwater parameter loads are insignificant. "The TDS concentration in the shallow aquifer around the periphery of the valley, which is less affected by percolation of high TDS irrigation water, is lower as indicated by a TDS measurement of 725 mg/l in the shallow aquifer near the Narrows."

3. Irrigation return flows contribute significantly to all parameter loads except ammonia. Return flows contribute 500-1200 mg/l TDS; 3-4 mg/l CBOD; 1000 coliform/100 ml; .5-1.5 mg/l nitrate-nitrogen; and .2 mg/l phosphorus.

4. WWTP's contribute significantly to instream nitrogen and phosphorus loads, produce more than 50% CBOD, up to 6000 coliform/100 ml, and are soley the source of ammonia violations.

5. Dry weather storm drain discharges account for 15,000 coliforms/100 ml and 2 mg/l of the total CBOD observed.

6. Algal productivity has a minor influence on DO levels in the lower 30 miles of the river.

Hydroscience used a steady-state analysis that assumed "equilibrium concentrations" represent conditions in groundwater discharge and irrigation return flows. No data on storm loads to irrigation canals was available at the time. The results from this study only would apply to comparable low-flow summer periods.

APPENDIX E
APPENDIX F
APPENDIX G
APPENDIX H

APPENDIX E: JORDAN RIVER STREAM MILES IMPAIRED BY EXCESSIVE EROSION.

Based on qualitative numerical values assigned stream reaches in the Stability Evaluation, only segments with point values in excess of 76 (Excellent conditions = 36; Good = 76; Fair = 114; Poor = 152). Since completion of the Evaluation, several banks have naturally revegetated to provide adequate stability.

SEGMENT #	TOTAL STREAM MILES	FAIR/POOR STREAM MILES
I	3.5	.61 (3200′)
II	3.4	3.4 (17952′)
III	2.7	2.7 (14256′)
IV	2.3	2.3 (12144′)
V	1.8	1.52 (8004′)
VI	1.5	0
VII	1.7	.91 (4805′)
VIII	1.3	.20 (1056′)
IX	.57	0
X	.93	.38 (2000′)
XI	1.0	.09 (500′)
XII	1.0	.11 (600′)
Total	21.7	12.2 (68,132′)

The Channel Stability Evaluation examines both stream banks and averages conditions recorded on the rating sheets. A stream reach with 100% vegetation on one side and 0% on the other would be rated 50% vegetative cover. In most cases, only one bank may require stabilization. Rather than double linear foot estimates to reflect both banks, the number of fair-poor stream miles is used to reflect average conditions within the entire channel cross-section.

Natural revegetation is occurring at a rapid rate on many portions of the river. These areas may still require disturbance in order to reach the desired finished grade of the new bank channel. Other areas may already have begun sloughing in the flood channel to natural angle-of-repose and also started to revegetate. These areas should be conserved and eliminated from mechanical disturbance.

APPENDIX F: ESTIMATED COST OF CHANNEL IMPROVEMENTS (Source: Murray-Jordan River Parkway Demonstration Project, 1990-91.

These estimates were derived from EPA/Murray City demonstration project along the Jordan River at Murray Parkway. The demonstration cross-section included the following provisions:

1. Bank re-grading to 30% slope: 2,640 linear ft.
2. Rip-rap delivery/placement at tow: 2,000 linear ft.
3. Revegetation (seed, mulch, irrig.) 40,000 square ft.

Average slope length for a 30% finished graded slope is approximately 15 feet. Cost per linear foot = $ 24.00

1.	Bank re-grading to 30% slope:	$ 30,000.00
2.	Rip-rap	$ 70,000.00
3.	Revegetation	$ 25,000.00
	Total project cost:	$ 125,000.00

ESTIMATED COST FOR ALL STREAM SEGMENTS

A total of 68,132 linear feet of the Jordan River should be considered for application of this best management practice. The distribution of costs per river segment is as follows:

SEGMENT	FAIR/POOR LIN. FT.	TOTAL COST	EPA $	LOCAL $
I	3,200	$ 76,800	$ 46,080	$ 30,720
II	17,952	$ 430,848	$ 258,508	$ 172,340
III	14,256	$ 342,144	$ 205,286	$ 136,858
IV	12,144	$ 291,456	$ 174,874	$ 116,582
V	8,004	$ 192,096	$ 115,258	$ 76,838
VI	0	$ 0		
VII	8,176	$ 196,224	$ 117,734	$ 78,490
VIII	1,300	$ 31,200	$ 18,720	$ 12,480
IX	0	$ 0		
X	2,000	$ 48,000	$ 28,800	$ 19,200
XI	500	$ 12,000	$ 7,200	$ 4,800
XII	600	$ 14,400	$ 8,640	$ 5,760
TOTAL	**68,132**	**$ 1,635,168**	**$ 981,100**	**$ 654,068**

APPENDIX G: WETLAND DETENTION BASIN SIZING REQUIREMENTS AND COST

Sizing requirements for wetland detention basins are dependant on drain and watershed size. Minimum requirements are estimated below (International Conference on Constructed Wetlands)10 . Land values near the River are estimated at $6500-22,000/acre. Basin costs range from $10-15000/ac.

BASIN/WATERSHED RATIO (.02)	DRAIN SIZE	LAND COST (AV.)	CONSTR. COST (AV.)	TOTAL COST (EST.)
2/100 acres	21-36"	$ 13,000	20,000	$ 33,000
3.5/175 acres	36-48	$ 22,750	42,000	$ 64,750
5/250 acres	48->	$ 32,500	75,000	$107,500

FUNDING FOR WETLAND DETENTION BASINS AS A SECTION 319 NONPOINT SOURCE POLLUTION BEST MANAGEMENT PRACTICE.

The Environmental Protection Agency (EPA) will fund construction of wetland basins as a nonpoint source best management practice (BMP), where excluded from stormwater permits. This qualifies basins to be considered nonpoint BMP's rather than municipal wastewater public owned treatment works (POTW). EPA generally does not allow discharge of pollutants to natural wetlands, consistent with the section 404(b)(1) guidelines administered by the Army Corps of Engineers 404 permit program.

The State of Utah has assumed the discharge permit program from EPA, and considers nonpoint source facilities eligible for state revolving loans. Currently wetland basins are not required by the State in either Salt Lake City or County permits. They are, therefore, eligible for funding under section 319.

ESTIMATED COST FOR WETLAND STORMWATER BASINS: JORDAN RIVER

SEGMENT	NO./SIZE DRAINS	EST.COST	EPA $	LOCAL $
II	1/21"	$ 33,000	$ 19,800	$ 13,200
III	1/21"	$ 33,000	$ 19,800	$ 13,200
IV	2/30";42"	$ 98,000	$ 58,800	$ 39,200
V	2/72";84"	$ 216,000	$ 129,600	$ 86,400
VI	5/30";42";78"	$ 238,000	$ 142,800	$ 95,200
VII	2/36";27"	$ 66,000	$ 39,600	$ 26,400
VIII	5/66";36";48";30"	$ 272,000	$ 163,200	$ 108,800
IX	3/18";24";27"	$ 99,000	$ 59,400	$ 39,600
X	2/84";48"	$ 173,000	$ 103,800	$ 69,200
XI	1/8'	$ 103,000	$ 61,800	$ 41,200
XII	4/36";30";42";18"	$ 197,000	$ 118,200	$ 78,800
TOTALS		**$ 1,528,000**	**$ 916,800**	**$ 611,200**

APPENDIX H: RECREATIONAL BENEFITS FROM PROGRAM IMPLEMENTATION

Bank re-grading, revegetation and stabilization of eleven river miles along the Jordan should result in numerous recreational opportunities that have been forgone by the public to date. The selected design for bank re-grading will enable development and use of trails through river corridors of exceptional aesthetic quality.

The Jordan River State Park has kept records of monthly activities along the Jordan River for the last two years. The Park extends from 2100 South to 1200 North, covering approximately six stream miles. Numerous trail-related activities occur along this corridor, including sighteeing, jogging, bicycling, picnicking, horse riding, fishing and canoeing. Since 1986, visitations along the six mile parkway have exceeded 250,000, or an average of 138,000 per year.

Factors controlling estimates of potential recreation use along the Jordan River resulting from nonpoint pollution controls include available river miles, local "market" population, and demand for various types of recreation activity[30]. Three assumptions have been made in order to estimate recreation use along the new parkway corridor:

1. Activity-use patterns will be generally similar in the South end of Salt Lake valley, with smaller increases in activities controlled by physical or land use patterns. For example, horse riding may occur more frequently in the upper Jordan due to existence of more agicultural land. Water conditions for kayaking are generally better in the upper river than in the lower reaches.

2. About eleven river miles are proposed for bank stabilization and "river renewal." Local towns may desire to extend the parkway beyond the project limits. Therefore the recreational benefits are conservative and represent a minimum-use estimate. Trails will likely extend more than eleven river miles.

3. Local market population in the upper Jordan project area is about double that in the existing lower Jordan Parkway reach. The lower Jordan River Parkway market geographically includes over 200,000 within Salt Lake City municipal boundaries (about 33,000 people per river mile). The upper Jordan River market geographically includes about 583,000 or 26,500 people per river mile. (Source: Economic & Demographic Futures: 1980-2000).

Due to the similarities in local market populations and land use characteristics, projections of recreation use along the upper Jordan river were made using multipliers derived from average activities per mile developed from existing use data on the lower Jordan. Upper river projections were estimated by:

$$P = Rm \times ACT/act$$

where P = Projected average annual visits
Rm = River miles within the nonpoint project area
ACT = Average total activities per year
act = Average total activities per mile

Individual activity proportions within the total is derived from activity percentages determined in existing data. These percentages are:

Sightseeing:	13%
Jogging:	36%
Bicycling:	17%
Picnicking:	14%
Horse riding:	1%
Fishing:	4%
Canoeing:	1%

Estimates of fishing and horse riding will be largely underestimated due to increases in habitat conditions favoring greater fishery production and availability of a larger equestrian market population.

With division of total use projections by activity percentages within the upper Jordan River planning area, the projected recreational benefit (expressed as average annual visits) from stream restoration projects is estimated below:

Sightseeing:	31,845
Jogging:	91,498
Bicycling:	42,438
Picnicking:	34,320
Horse riding:	2,387
Fishing:	12,694
Canoeing:	3,795
Total:	253,869

ECONOMIC BENEFITS & LOCAL VALUE ACCRUING FROM THE NONPOINT POLLUTION CONTROL PROGRAM.

The economic value of recreation visitation is developed from recreational benefit data reported by the U.S. Army Corps of Engineers in the Preliminary Recreation Evaluation, Jordan River Basin (June, 1981).

Average expenditures per visit for in-community recreation were then estimated at $1.71. Today that average expenditure would be $2.25 based on average annual rates of inflation at 4%.

This visitation rate would apply to all activities except fishing, which has been documented by the State Division of Wildlife Resources at a net worth of $12.33 per visit (Geer, 1981).

Applying these expenditure/per visit data to average annual visits on the upper Jordan results in the following benefit projections:

ACTIVITY	AVERAGE ANNUAL EXPENDITURES
Sightseeing	$ 71,651
Jogging	$ 205,871
Bicycling	$ 95,486
Picnicking	$ 77,220
Horse Riding	$ 5,371
Fishing	$ 156,517
Canoeing	$ 8,539
TOTAL	$ 620,655