

PERFORMANCE REPORT

As required by

FEDERAL AID IN FISHERIES RESTORATION ACT

Federal Aid Project F-30-R-2

Statewide Fishery Management Recommendations

Job B: Management Recommendations for Proposed Reservoir
and Other Public Water Projects

Navasota River and Lake Limestone

Robert L. Bounds
Inland Fisheries Management Program Director

District II-C
Dwane Q. Smith
District Management Supervisor

Clayton T. Garrison
Executive Director
Texas Parks and Wildlife Department
Austin, Texas

David L. Pritchard
Chief, Inland Fisheries

Robert J. Kemp
Director of Fisheries

February 4, 1977

F-30-R-2
Performance Report
Job B - District II-C

Objective: To recommend habitat improvement, fisherman information, fish population manipulation, vegetation control, pollution control, fisherman access and facility development and fishing regulations for existing and proposed public waters of Texas.

I. Summary:

Quarterly fisheries management surveys were conducted on the Navasota River to supplement existing knowledge of the ichthyofauna, aquatic macrophytes, physicochemical and stream channel characteristics; and to evaluate the quality of existing fish habitat and fisherman access.

Lake Limestone Dam, currently under construction at River Mile (R.M.) 125 is scheduled for completion in early 1978. Impounded waters are expected to create a reservoir of 14,200 a. Impoundment will result in alterations in both physical and biological characteristics of the stream.

Fishing access to the Navasota River is largely confined to highway crossings; facilities available for fishermen are deficient. Creation of Lake Limestone, with adequate fisherman access and facilities, could greatly improve fisherman utilization of the Navasota River. Quality of habitat for sport fishes could be enhanced by minimizing the removal of brush from the lake basin. Introduction of threadfin shad, Florida largemouth bass and white bass x striped bass hybrids is recommended to supplement first-year recruitment and to better utilize habitat. Dissemination of fish stocking, evaluation and current fish harvest information to anglers through appropriate media is also recommended. A continuous flow is needed for maintenance of the tail-water fishery and for conservation of the downstream riverine ecosystem.

II. Significant Deviation:

Flooding of the study area and manpower limitations precluded employment of some stream survey procedures as outlined in "A Manual of Survey and Management Techniques for Reservoir and Stream Management."

III. Cost: \$4,200

Man-Days 85

IV. Prepared by: Dwane Q. Smith
District Management Supervisor

John M. Mitchell
Fish and Wildlife Technician

Date: February 4, 1977

Approved by:

Robert L. Bower
D-J Management Coordinator

Roger L. McCabe
Regional Management Supervisor

Methods and Materials

Sampling was conducted at four stations selected to represent upper, middle and lower sections of the stream. Sampling locations were chosen to represent increases in stream order according to Horton (1945), and changes in land resource areas from the headwaters of the Navasota River to its confluence with the Brazos River. Locations of sampling stations are described in the Survey Results and Discussion section of this paper.

Surveys were conducted quarterly at each station to evaluate fish communities, aquatic vegetation and water quality. Stream channel parameters were recorded at least once for each station.

Aquatic vegetation was surveyed along 200-ft stream sections located at four sampling sites. Species collected were preserved with methanol and identified in the laboratory according to Correll and Correll (1975), Fassett (1975) and Muencher (1944).

Fish samples were collected with a 20-ft x 6-ft, 3/8-in. ace weave straight seine. specimens collected were preserved in 10% formalin solution and identified in the laboratory according to Hubbs (1970) and Eddy (1957). Scientific and common names of fishes were listed according to Bailey, et al. (1970).

Access and facilities surveys were conducted by visual inspection in conjunction with other survey efforts.

Water temperature and dissolved oxygen were measured with a YSI Model 57 meter; specific conductivity was measured with a YSI Model 33 meter. Hydrogen ion concentration was measured with an Instrumentation Laboratories Porto-Matic Model 175 meter. Total alkalinity, chlorides, hardness and turbidity were measured with a Delta Scientific Model 50 meter. Total dissolved solids, nitrate-nitrogen and phosphate concentrations were measured according to Standard Methods (American Public Health Association, 1971). Flow data were obtained from the U. S. Department of the Interior, Geological Survey and were taken at State Highway 164 near Groesbeck (R.M. 145), at U. S. Highway 79 near Easterly (R.M. 105), and at U. S. Highway 190 near Bryan (R.M. 68). Locations of current flow gauging stations are shown in Fig. 1.

Results and Discussion

Watershed Physical Characteristics

The climatology of the Navasota River and its watershed is broadly characterized as mild, with hot summers and moderate winters. The mean annual temperature is approximately 67 F, ranging historically from a maximum recorded 114 F to a minimum of -7 F. The length of the growing season averages about 250 days. Rainfall throughout the Navasota River watershed averages about 39 in. annually, with a maximum of 65.46 in. recorded in 1919, to a minimum of 17.69 in. in 1917. The period of heaviest rainfall normally occurs from April through June. The watershed also experiences recurring periods of drought and heavy rainfall. The most severe drought period occurred from June 1947

through March 1957. Flooding of the watershed has been known to occur at almost any time of the year, but usually occurs during months having heaviest average rainfall.

The Navasota River and its flood plain are typically comprised of a combination of various clays, silts, sands and gravels. The headwaters region is generally characterized by marly clay soils which become increasingly more sandy as the river progresses southeastward toward the East Texas timber belt. The general land elevation of the headquarters region of the Navasota River is about 650 ft above mean sea level and decreases to about 185 ft above mean sea level at the confluence with the Brazos River.

The Navasota River watershed is found within out-croppings of the Upper Cretaceous, Eocene, Oligocene, and Miocene strata. Formations of decreasing age are found as the river progresses from the headwaters toward the confluence. The principal outcroppings are largely comprised of consolidated marls, soft limestone, sands, clays, silty clays and sandy clays (U. S. Army Corps of Engineers, 1965).

Descriptive Data

The Navasota River watershed is located in east-central Texas between 30° 20' and 31° 50' north latitude and 95° 55' and 97° 00' west longitude. The Navasota River, intermittent in its upper reaches, is largely a permanent stream which originates in southeastern Hill County about 1.5 m northeast of Mount Clam. The river is about 95 R. M. long from its source to its confluence with the Brazos River near Washington, Texas. The river has a drainage area of 2500 m² and an average streambed slope of 2.6 ft/m. The drainage system of the Navasota River is bounded on the east by the Trinity River drainage and on the west by the Brazos River drainage. The Navasota River Basin (Fig 2) is located within the Texas Biotic Province (Blair, 1950). The principal tributaries are Christmas, Big, Steel, Lake, Clear, Camp, Cedar, Wickson, Carters, Lick, Gibbons, Peach, Holland, and Big Creeks in order of their confluence with the Navasota River from source to mouth.

The Navasota River arises in the Blackland Prairie land resource area and traverses alternating Post Oak Savannah and Blackland Prairie land resource areas as it flows toward its confluence with the Brazos River (Fig 3). Such stands of timber as oak, pecan, elm, bois d'arc and mesquite are frequently found along streambeds throughout the Blackland Prairie regions; pecan, walnut and other water demanding trees are most commonly found along streambeds within the Post Oak Savannah regions.

Land use is largely for livestock production and agriculture (Dallas Morning News, 1973). The flood plain consists mainly of agricultural grazing land, much of which is classified as unimproved (U. S. Army Corps of Engineers, 1965).

The Navasota River is relatively free of pollution (U. S. Army Corps of Engineers, 1971), but organic pollution, apparently the sewage effluent from the City of Mexia, has been reported (Rosenburg, et al, 1972).

Reservoirs Within the Watershed

Lake Mexia, completed on June 5, 1961, was constructed on the Navasota River (R.M. 170) in Limestone County near Mexia by the Bistone Municipal Water Supply District. Lake Mexia was constructed for municipal and industrial water supply purposes.

Lake Springfield is located on the Navasota River (R.M. 160) in Limestone County within Fort Parker State Park. Constructed by the Texas Parks and Wildlife Department, the lake is used for municipal and industrial water supply purposes and recreation.

Camp Creek Lake is located on Camp Creek, a principal tributary of the Navasota River. Camp Creek Lake was constructed in 1949 for recreational purposes by the Camp Creek Water Company of Bryan, Texas.

Other reservoirs constructed on the watershed include Teague Lake and Holman Reservoir, constructed by the City of Teague for municipal water supply; and Lake Normangee located within Normangee City Park, constructed for recreation.

Proposed reservoirs to be constructed by the U. S. Army Corps of Engineers include the Millican and Navasota #2 projects. The Millican dam site would be located at R.M. 24.1, and the Navasota #2 site at R.M. 83.4.

Lake Limestone, currently under construction at R.M. 125, will be controlled by the Brazos River Authority. This project is scheduled for completion in early 1978. The earth and concrete dam will impound about 217, 494 a.-ft of water, creating a 14,200-a. lake. A primary function of the reservoir will be to serve as a source of cooling water for two proposed steam electric power plants to be constructed by the Texas Utilities Generating Company (Brazos River Authority, Pers. Comm., 1976).

Endangered Populations

The Navasota River drainage has been regarded as an area of transition, containing some fishes found only in Austroriparian drainages; others found commonly in the Brazos and Colorado River drainages are absent or found only in scattered localities within the Navasota River drainage (Blair, 1950). Fishes associated with more eastern or Austroriparian drainages become more infrequent and disappear from collections toward the western boundary of the drainage.

Construction of proposed reservoirs on the Navasota River may be expected to create changes in the quality and quantity of fishes present. Species associated with lotic areas will be reduced in number or eliminated in areas where riffles or sandbars are destroyed, and in areas where streamflow is greatly reduced. Alteration of the river channel below the Millican dam site at R.M. 24.1 could result in the disappearance of the most southeastern population of stoneroller (Campostoma anomalum) recorded from Texas. Bigscale logperch (Percina macrolepida) has been collected from the Navasota drainage, but is found in lentic habitat and probably will not be threatened (Rosenburg et al., 1972).

Stream Access

Currently, access to the Navasota River is quite limited. Since the flood plain is almost entirely controlled by private ownership, access is limited largely to those few roadways which cross the stream. Sport fishing activity is largely confined to existing impoundments on the river and its watershed. Much of the fisherman access to these is limited by landowners, controlling authority or private club restrictions (U. S. Department of the Interior, 1965).

Streamflow

Monthly streamflow data were obtained from the U. S. Department of the Interior, Geological Survey for the period October, 1975 to September, 1976. Measured at upper, middle and lower stations, mean monthly streamflow values correspond to historical streamflow and precipitation records for previous years (U. S. Army Corps of Engineers, 1965). Figure 4 graphically illustrates annual streamflow patterns for upper, middle and lower stations on the Navasota River. Streamflow fluctuations for the months of October through February were slight to moderate with more dramatic increases seen from March through July. Streamflow was greatest in April and May and smallest in August. Streamflow fluctuations were greatest at the upper station and less pronounced at middle and lower stations where volume and drainage area are greater.

Survey Results and Discussion

Station I

Location



Station I is located on the Navasota River in Limestone County, on State Highway 164, approximately at R.M. 145, some 5 m east of the City of Groesbeck.

Stream Channel

Stream width varied between riffle, flat and pool areas of the stream. Channel measurements (Table 1) define the upper segment of the Navasota River as shallow and narrow, with more clearly defined riffle, flat and pool areas than lower segments of the stream. Greatest pool depth of the station was 3 ft; riffle depth was 1-ft. Mean current velocity, recorded in March, was 2.12 ft/sec. (Fig. 17) when water level was slightly above normal. All segments of the stream, according to Lagler (1969), were classified as having a "rapid" current velocity during this period. Substrate composition was largely muck and clay (Table 2).

Habitat Types

Stream width measurements revealed pools were wider than riffles or flats. Pools were small and exposed with little submerged or overhanging cover. The stream study area consisted of approximately 20% pools, 30% riffles and 60% flats.

Water Quality

Water quality (Table 3), while within recommended limits for fish and wildlife (McKee and Wolf, 1971), often exhibited the greatest degree of fluctuation at this station. Total dissolved solids approached the recommended limits for public drinking water (U. S. Public Health Service, 1962) in the month of September (Fig. 5). Specific conductivity rose to 1090 micromhos/cm in September (Fig. 6). Values for other water quality parameters are presented in Fig. 7 through 14.

Vegetation

Quarterly surveys of a 200-ft stream section failed to reveal the presence of aquatic macrophytes from this area. Current velocity, wide fluctuations in volume of flow and turbidity are all probable contributing factors which prevent the establishment of aquatic macrophytes here and elsewhere along the Navasota River.

Ichthyofauna

The predominate species collected from Station I was red siner. Other species frequently collected were mosquitofish, bullhead minnow and bluegill. Species less frequently collected were longnose gar, gizzard shad, green sunfish and dusky darter (Table 4). The number of specimens collected was greatest in November and smallest in September (Fig. 15). Species diversity for Station I was lowest in March, but increased slightly and remained constant for subsequent collections (Fig. 16).

Station II

Location

Station II is located on the Navasota River at approximately R.M. 114, 5 m west of the City of Marquez. At this location, the river forms the boundary between Leon and Robertson Counties.

Stream Channel

Stream measurements revealed an increase in overall width for riffles, flats and pools from the preceeding station (Table 1). Pool and riffle areas were slightly less frequent. Greatest pool depth was 4.5 ft, depth of flats was 3 ft and riffle depth 1-ft. Mean current velocity (Fig. 17) recorded in March was 1.77 ft/sec. Predominate constituents of the substrate were clay and muck (Table 2).

Habitat Types

Pool width remained greater than the width of riffles and flats. Pools were wider and somewhat deeper; but remained exposed with only a slight increase in the amount of available cover. Station II consisted of about 15% pools, 15% riffles and 70% flats.

Water Quality

Measurements of water quality (Table 5, Fig. 7-14) exhibited fluctuations which generally were less pronounced than those seen upstream at Station I. Pattern and degree of fluctuation occasionally did not parallel other stations upstream or downstream, but were generally more similar to stations located further downstream.

Vegetation

No aquatic macrophytes were seen from quarterly surveys of a 200-ft stream section at this station.

Ichthyofauna

Red shiner was the predominate species collected from Station II. Bullhead minnow, mosquitofish and dusky darter were species frequently collected. Species collected are shown in Table 6. The number of individuals collected was greatest in September (Fig. 15) and was considerably greater than March or November collections. Species diversity was also greatest in September collections when a slight increase was evident (Fig. 16).

Station III

Location

Station III is located on the Navasota River at the Old San Antonio Road, 6 m southwest of the City of Normangee (about R.M. 80). At this location the Old San Antonio Road serves as the north-south boundary between Robertson and Brazos Counties on the east bank of the river, and between Leon and Madison Counties on the west bank.

Stream Channel

Stream widths at Station III indicate the river channel continues to increase in width as it progresses toward its confluence with the Brazos River (Table 1). Other observations revealed the relative lack of riffle and pool areas. The river and its flood plain exhibited a broader and more uniform appearance. Stream measurements taken at Station III were more representative of the extremes than of the pool, riffle and flat areas at this location. A fairly uniform maximum depth of 4 ft was maintained when flow was near normal. Current velocity (Fig. 17), measured in March, was rapid with a reading of 1.56 ft/sec. The substrate consisted mainly of sand (Table 2).

Habitat Types

Habitat at Station III has a wider, more uniform streambed and flood plain than the upper stations. The substrate, comprised largely of sand, differed from upper reaches of the stream (Table 2). Streambanks are wooded and have considerable overhang. An overall increase of cover in and above the stream was noted. Station III consisted of about 80% flats, 10% pools and 10% riffles.

Water Quality

Measurements for water quality (Table 7) revealed generally lower total alkalinity than at other locations (Fig. 7). Values for other water quality parameters are shown in Fig. 5-14.

Vegetation

Two species of aquatic macrophytes were recovered from Station III in the September survey. A vegetation survey of a 200-ft transect revealed the presence of yellow water lily (Nuphar advena) and arrowhead (Sagittaria falcata). Yellow water lily occupied less than 5% of the stream area surveyed and arrowhead occupied less than 1%. No aquatic macrophytes were observed during previous or subsequent surveys.

Ichthyofauna

Twenty-two fish species (Table 8) were collected at Station III. Greatest species diversity among the stations surveyed was found here (Fig. 16). While species diversity was greater, total number of fish collected from this station was not as great as for stations located upstream (Fig. 15). Mosquitofish and red shiner continued to be most abundant. Largemouth bass, white crappie, black crappie, other centrarchids and darters were collected.

Station IV

Location

Station IV is located 2 m north of the City of Navasota on State Highway 6 (about R.M. 11). At this location, the Navasota River serves as the eastern boundary of Brazos County and the western boundary of Grimes County in their southern reaches.

Stream Channel

An overall three-fold increase in stream width was seen for this station when compared with the upper-most survey station on the river. Station IV exhibited a maximum width of 70 ft and a minimum width of 59 ft (Table 1). Pool, riffle and flat areas of the stream were discernable, but did not vary greatly in width. Maximum channel depth recorded at this station was 5.8 ft; average depth was 4.2 ft. Substrate composition was largely sand, muck and clay. The presence of rubble and boulders was also noted (Table 2). A current velocity of 3.34 ft/sec. was recorded in March (Fig. 17).

Habitat Types

The Station IV area contained the greatest amount of cover within the stream, and consisted of snags and boulders. Considerable overhang was found along stream banks. This station consisted of about 80% flats, 10% pools and 10% riffles.

Water Quality

Values for water quality parameters (Table 9) were found to be within recommended limits for fish and wildlife (McKee and Wolf, 1971). Fluctuations of water quality parameters were observed, but only phosphate value fluctuations were greater than at other stations (Fig. 14). Other water quality data are shown in Fig. 7-14.

Vegetation

No aquatic macrophytes were observed from quarterly surveys of a 200-ft stream section at Station IV.

Ichthyofauna

Ten fish species were collected from the Navasota station (Table 10). Red shiner, ribbon shiner and silverband shiner were collected in greatest numbers. Figures 15 and 16 indicate a decline in numbers and species diversity. This is probably more accurately interpreted as a measure of the difficulty involved in the collection of fishes from this station. Swift current, numerous snags and deep water greatly hampered collection efforts.

Recommendations

Navasota River and Lake Limestone

A. Habitat Enhancement:

1. Technical assistance should be provided to the controlling agency to minimize destruction of potential fish habitat by brush clearing operations.
2. An inspection of the lake basin should be conducted to identify areas which may be deficient in fish habitat, and to identify for future marking existing structures in the basin which may be expected to serve as fish attractors.
3. Structures for the shelter and attraction of sport fishes should be installed in areas deficient in habitat and at locations of fishing piers.
4. A continuous discharge is recommended to maintain a tailwater fishery and for conservation of the fauna in the lotic and riparian ecosystems below the dam.

B. Angler Information:

1. Buoys should be installed to identify the location of natural structures which may be expected to attract and shelter sport fishes, and to identify the locations of proposed fish attractors.

2. Information regarding fish stocking and the results of any subsequent evaluations of such stockings should be disseminated to anglers through appropriate media.
3. Permanent sources should be identified from which current fish harvest information may be obtained. Information should be obtained, assessed and disseminated to anglers on a weekly basis.
4. The controlling agency should provide maps locating access and facilities, fish attractors and river channel.

C. Population Manipulation:

1. Stocking of threadfin shad is recommended for the reservoir as a supplement to existing forage populations needed to establish and sustain stocks of sport fishes.
2. Since no largemouth bass were recovered from quarterly fisheries surveys of stations above R.M. 125, first-year recruitment from existing brood stock may be low. Stocking of Florida largemouth bass is recommended to supplement first-year recruitment of young-of-the-year largemouth bass in the reservoir.
3. Stocking of white bass x striped bass hybrids is recommended to provide an additional sport fish which may more efficiently utilize the open water (pelagic) habitat of the reservoir. Conditions associated with new reservoirs, survival and growth from previous stockings, and the absence of competition from other open water predators suggest good survival and growth of these hybrids may be attained in Lake Limestone.

D. Vegetation Control:

No vegetation control is recommended.

E. Pollution Control:

No recommendations for pollution control are made.

F. Access and Facilities: (See Figure 18)

1. At least six concrete launch ramps with catwalks and adequate parking facilities should be constructed to provide boating access to the lake. Ramps should be located in the lower, middle and upper areas of the lake.
2. Park areas should be constructed in upper, middle and lower reaches of the lake. At least five designated park areas, with electrical hook-ups should be constructed in areas within close proximity to the water and near launch ramps. These areas should have adequate drinking water, restrooms and public shower facilities.
3. At least one fishing pier or jetty should be constructed within each

of the five recommended camping areas. Such facilities are needed to provide fishing access for the elderly, handicapped and non-boaters.

4. Fisherman access to dam and tailwater areas should be developed. Developments should include all weather roads and lighted parking areas for both tailwater and dam.

G. Fishing Regulations:

No changes in existing fishing regulations are proposed.

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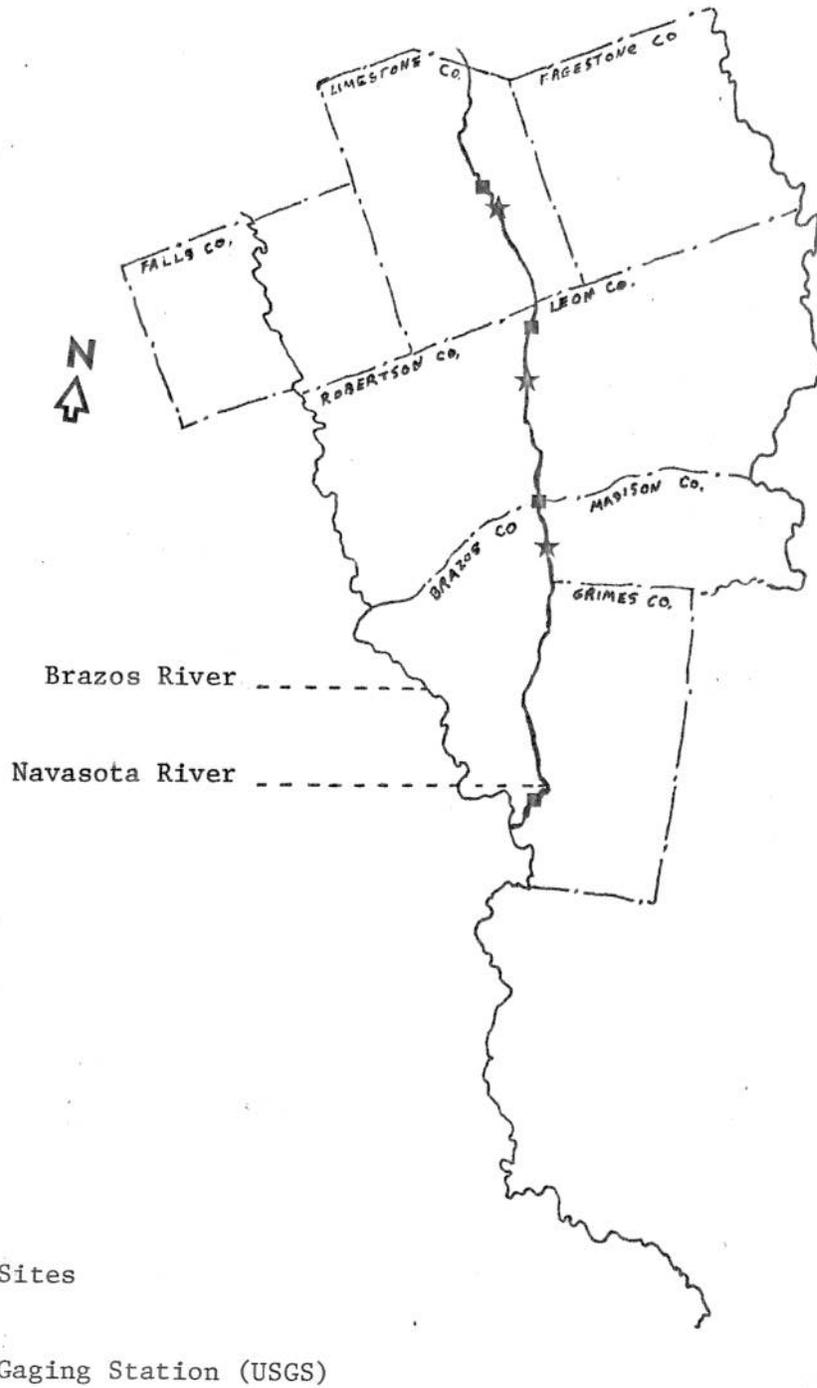


Figure 1. Locations of survey sites and streamflow gaging stations, Navasota River, 1976.

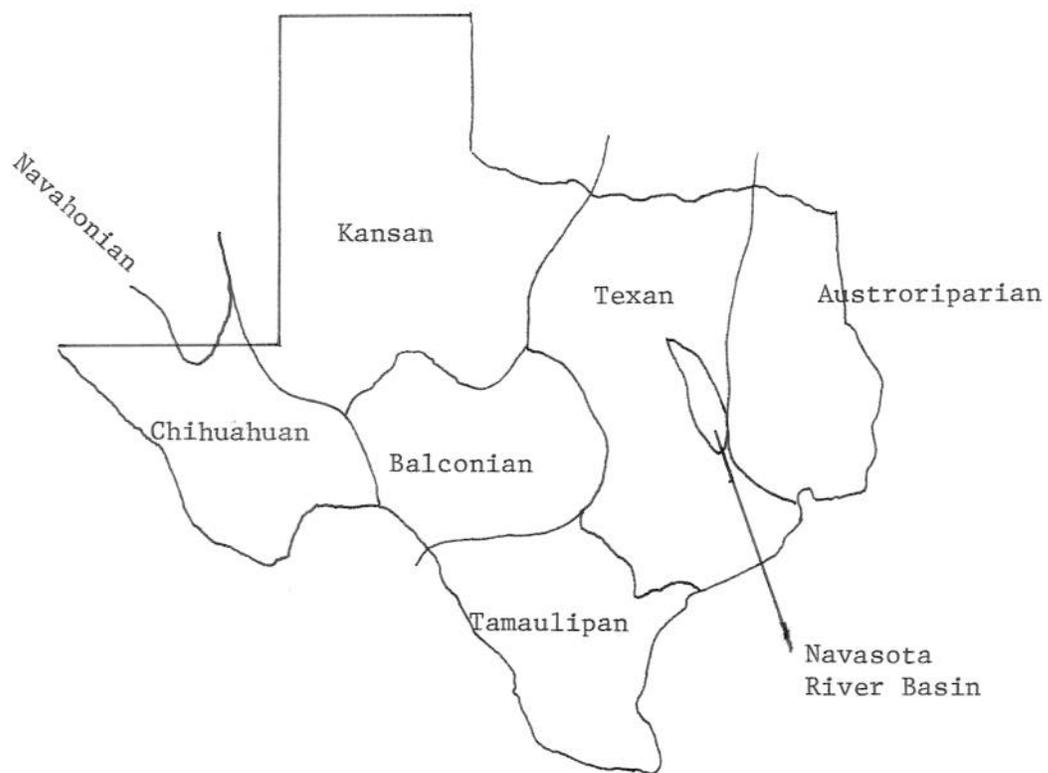


Figure 2 . The location of the Navasota River Basin within the Biotic Provinces of Texas (Blair, 1950).

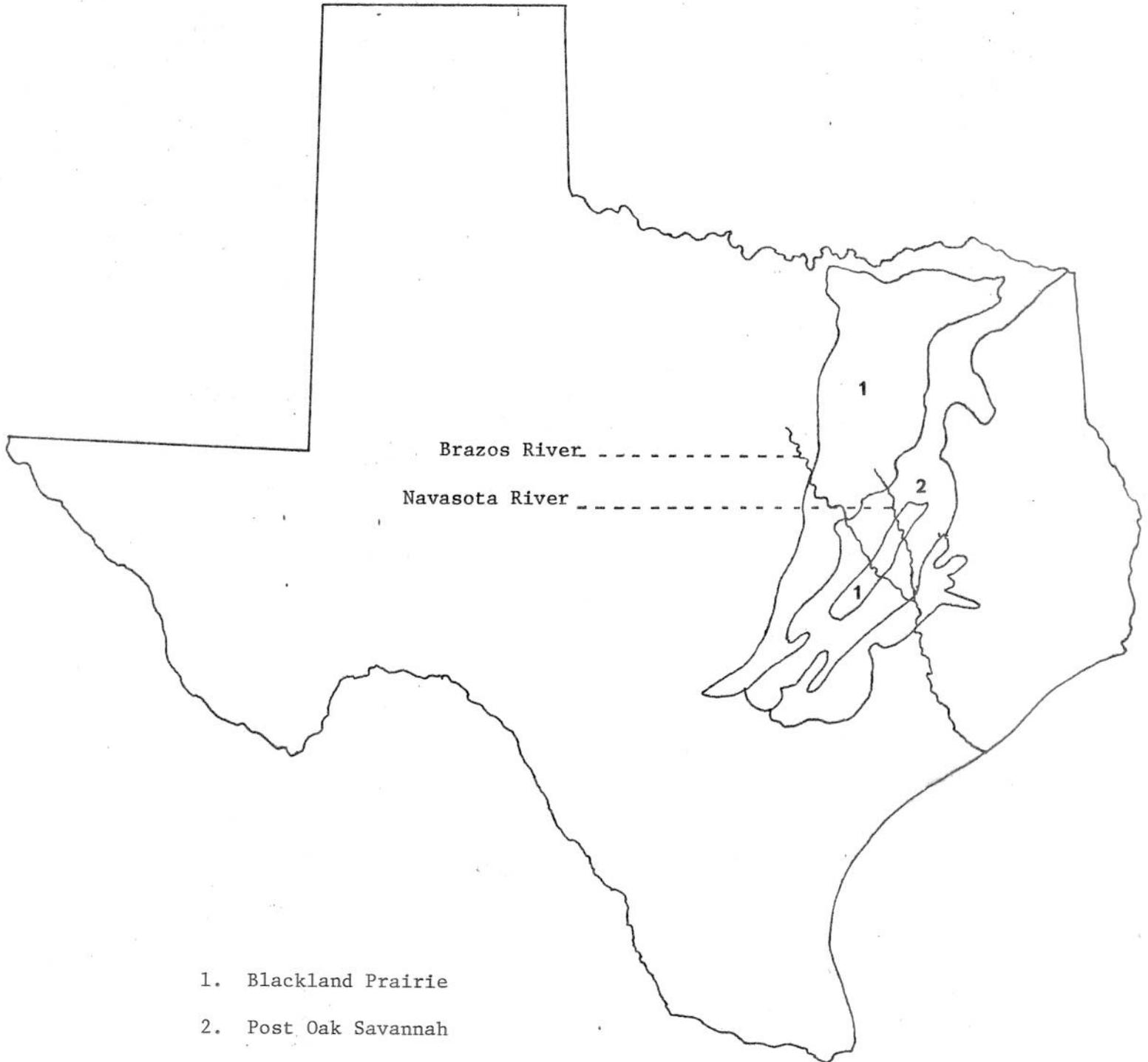


Figure 3. Location of Navasota River with respect to Blackland Prairie and Post Oak Savannah land resource areas.

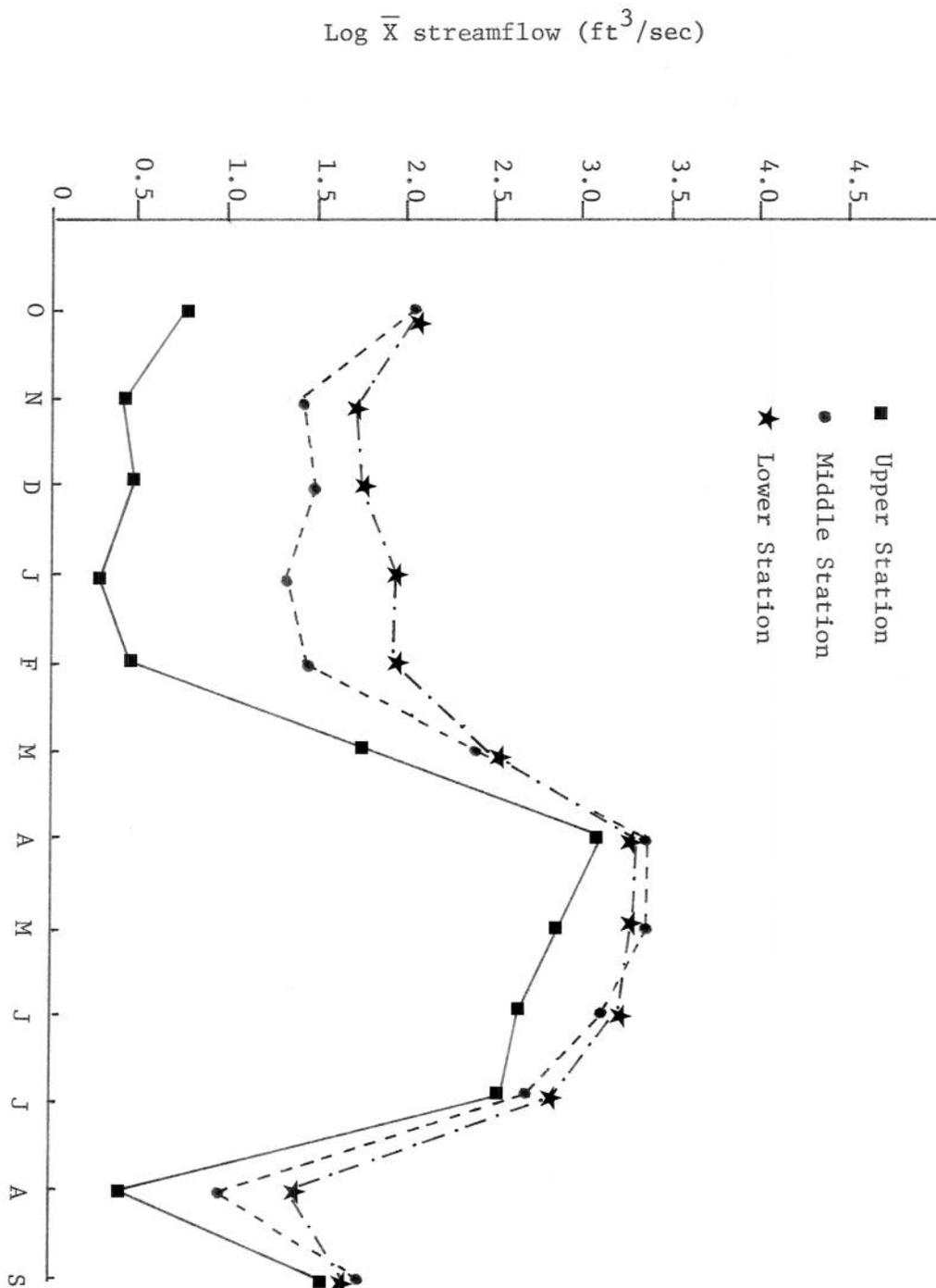


Figure 4 • Navasota River mean monthly streamflow, October 1975 - September 1976.

Total dissolved solids (mg/l)

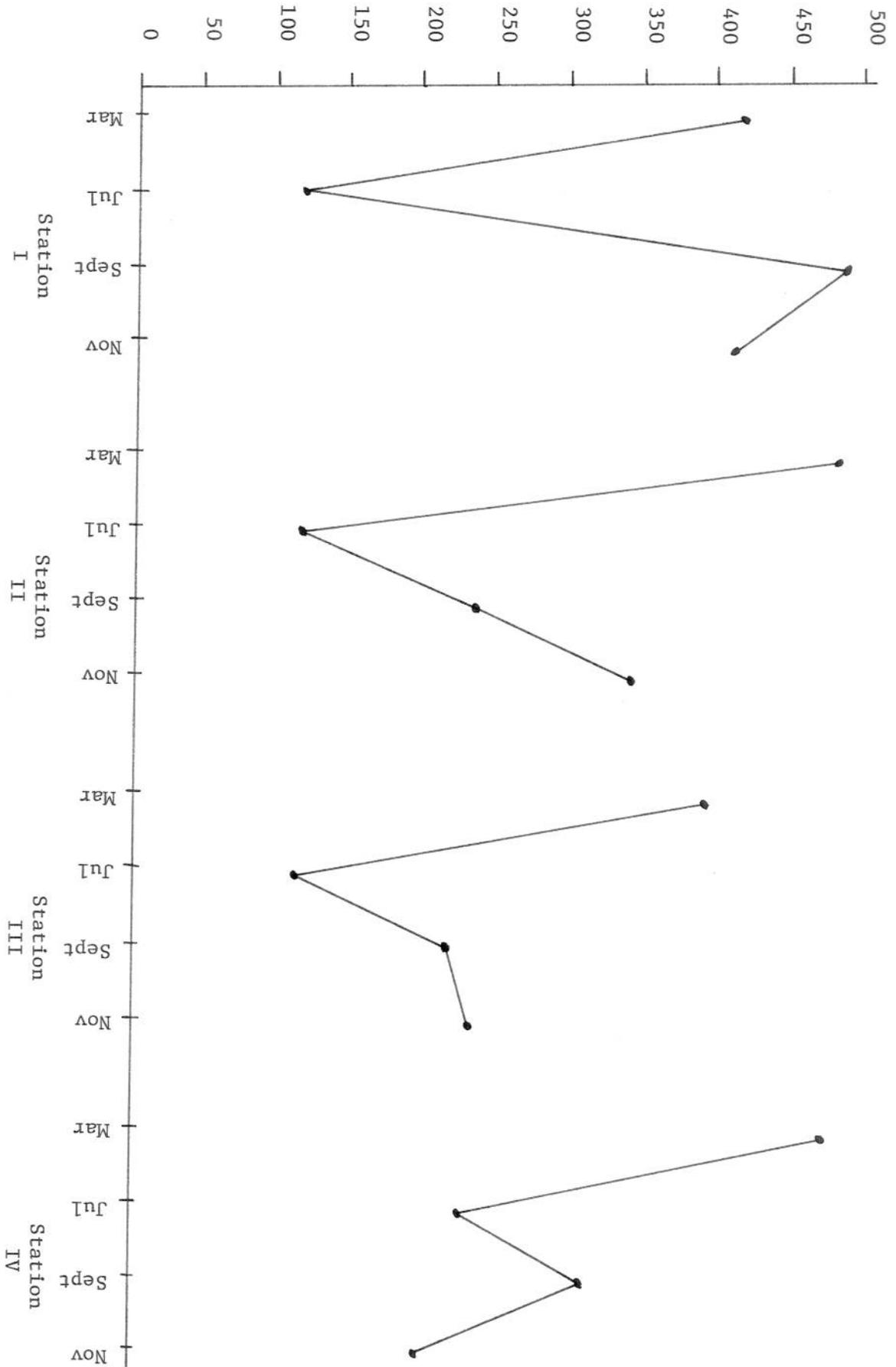


Figure 5 . Navasota River quarterly total dissolved solids values, 1976.

Conductivity (micromhos/cm)

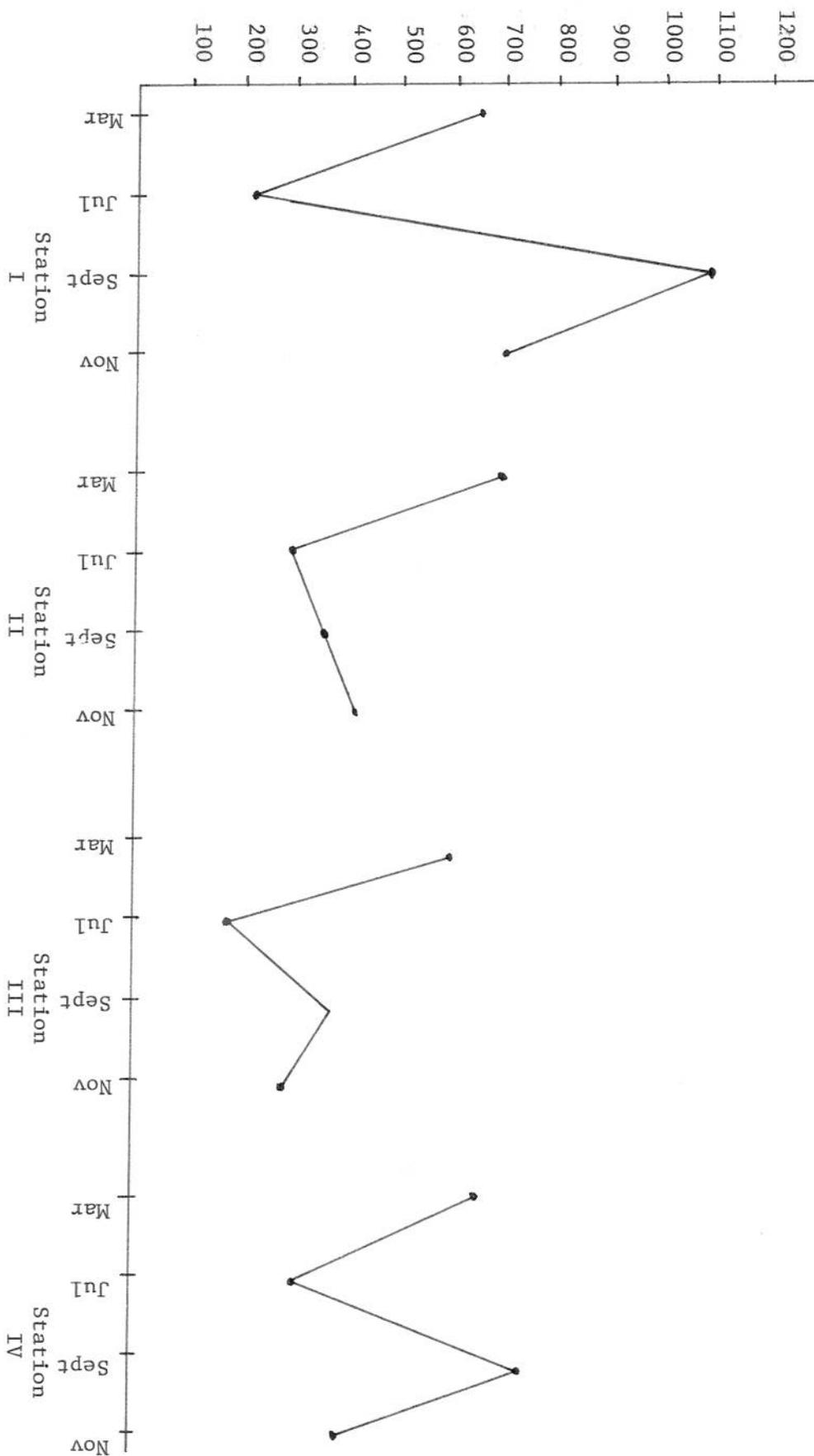


Figure 6 . Navasota River quarterly specific conductivity values, 1976.

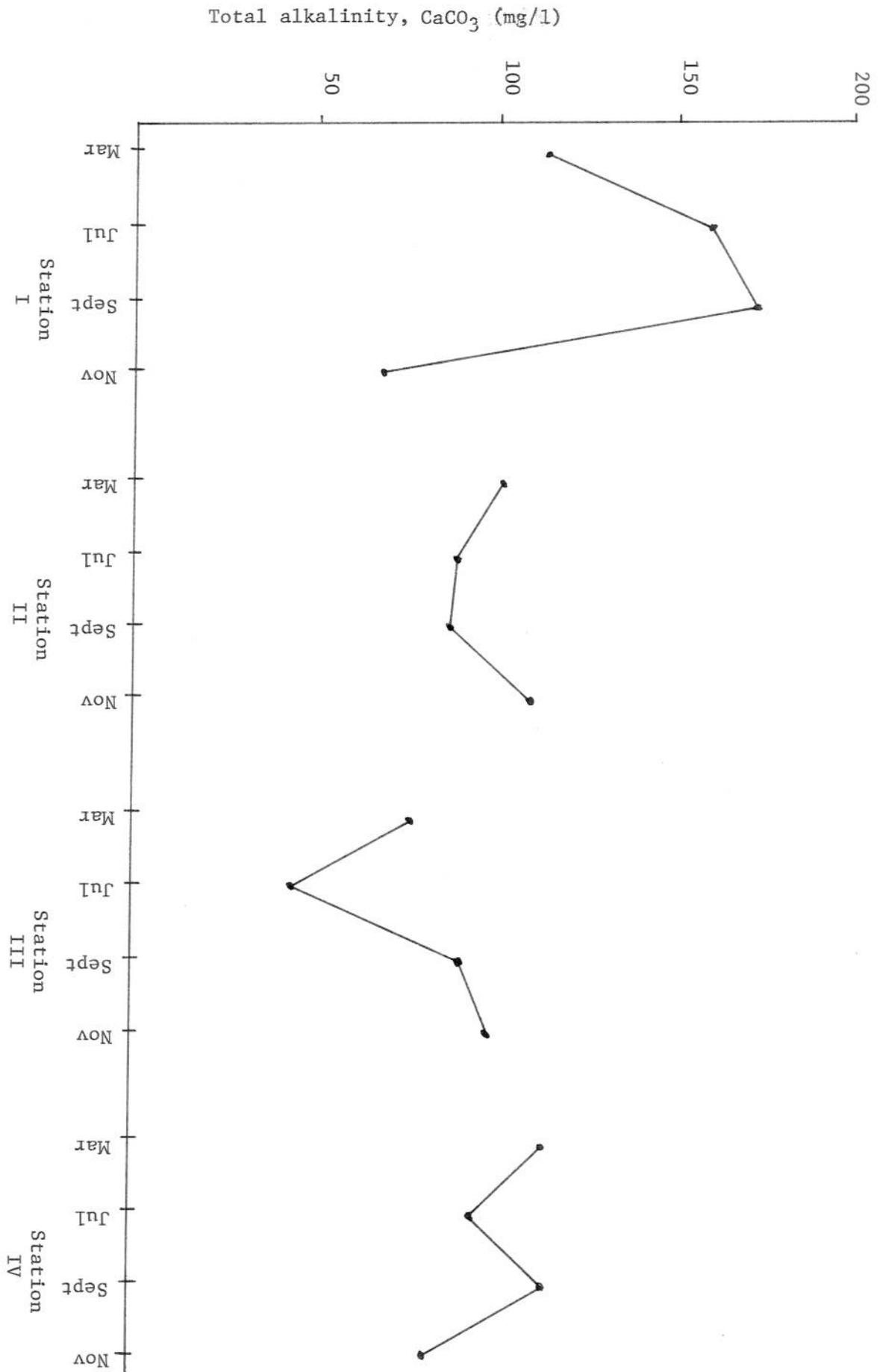


Figure 7 . Navasota River quarterly total alkalinity values, 1976.

Cl⁻ (mg/l)

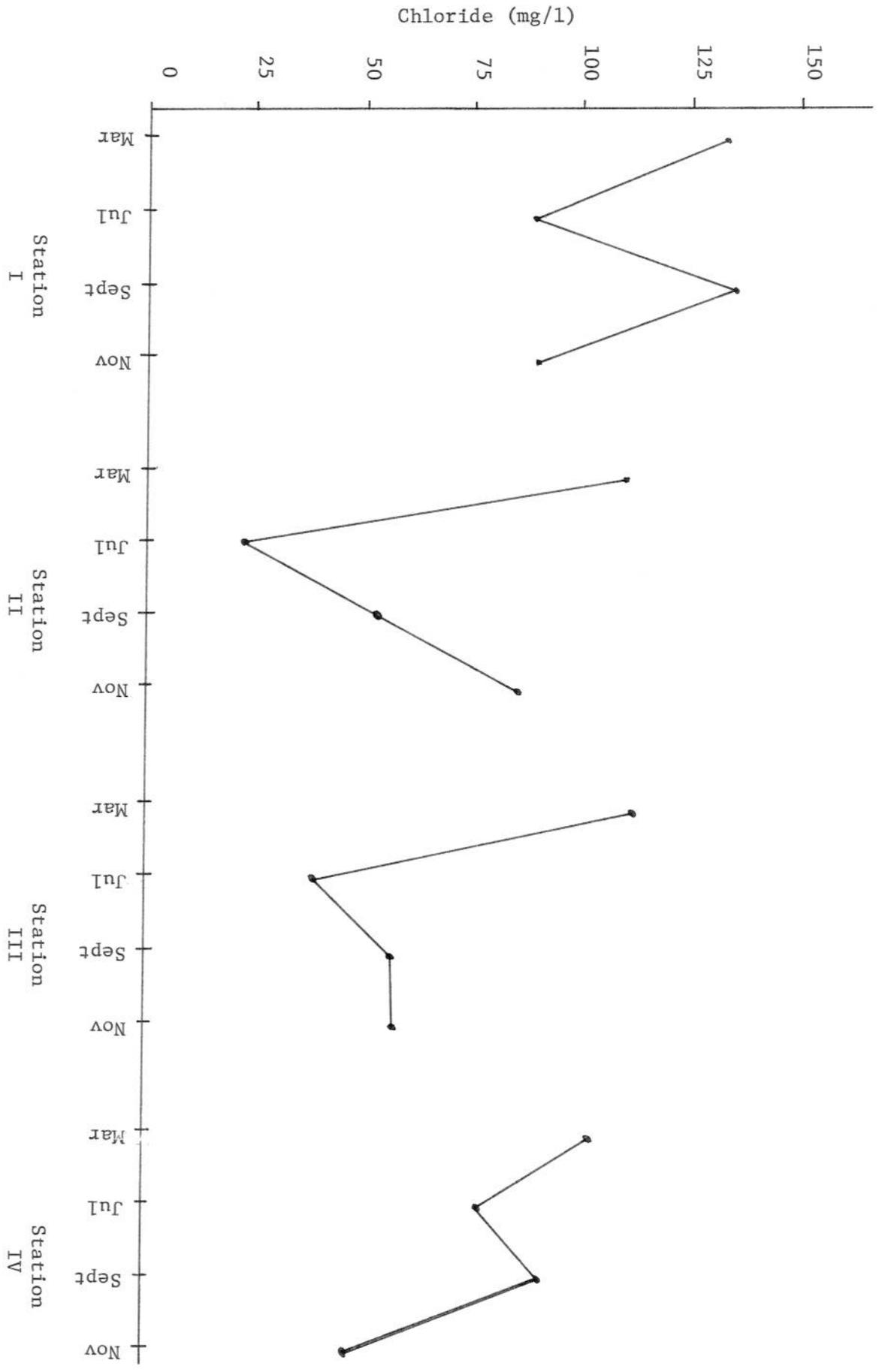


Figure 8 Navasota River quarterly chloride values, 1976.

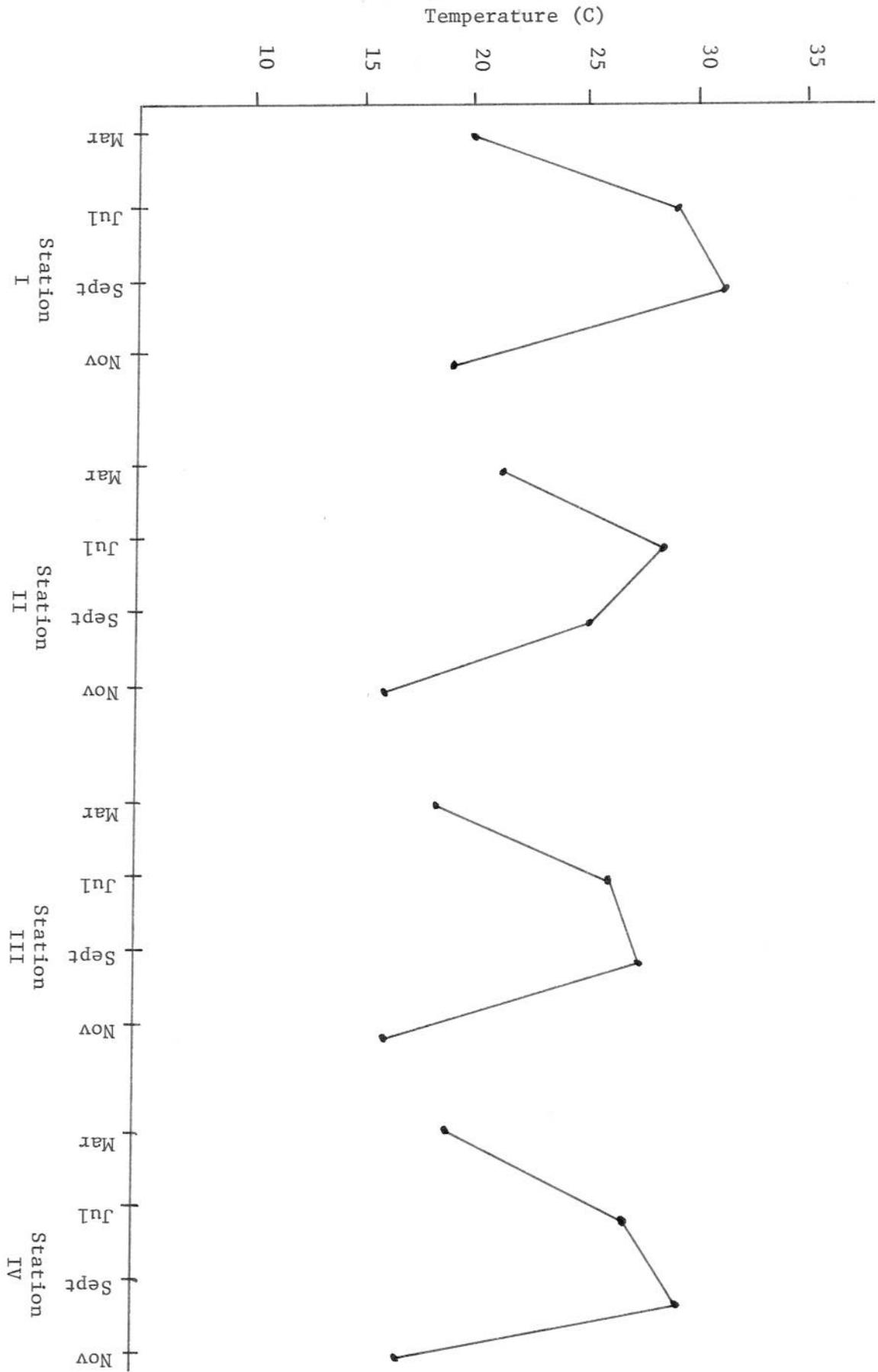


Figure 9 . Navasota River quarterly temperature values, 1976.

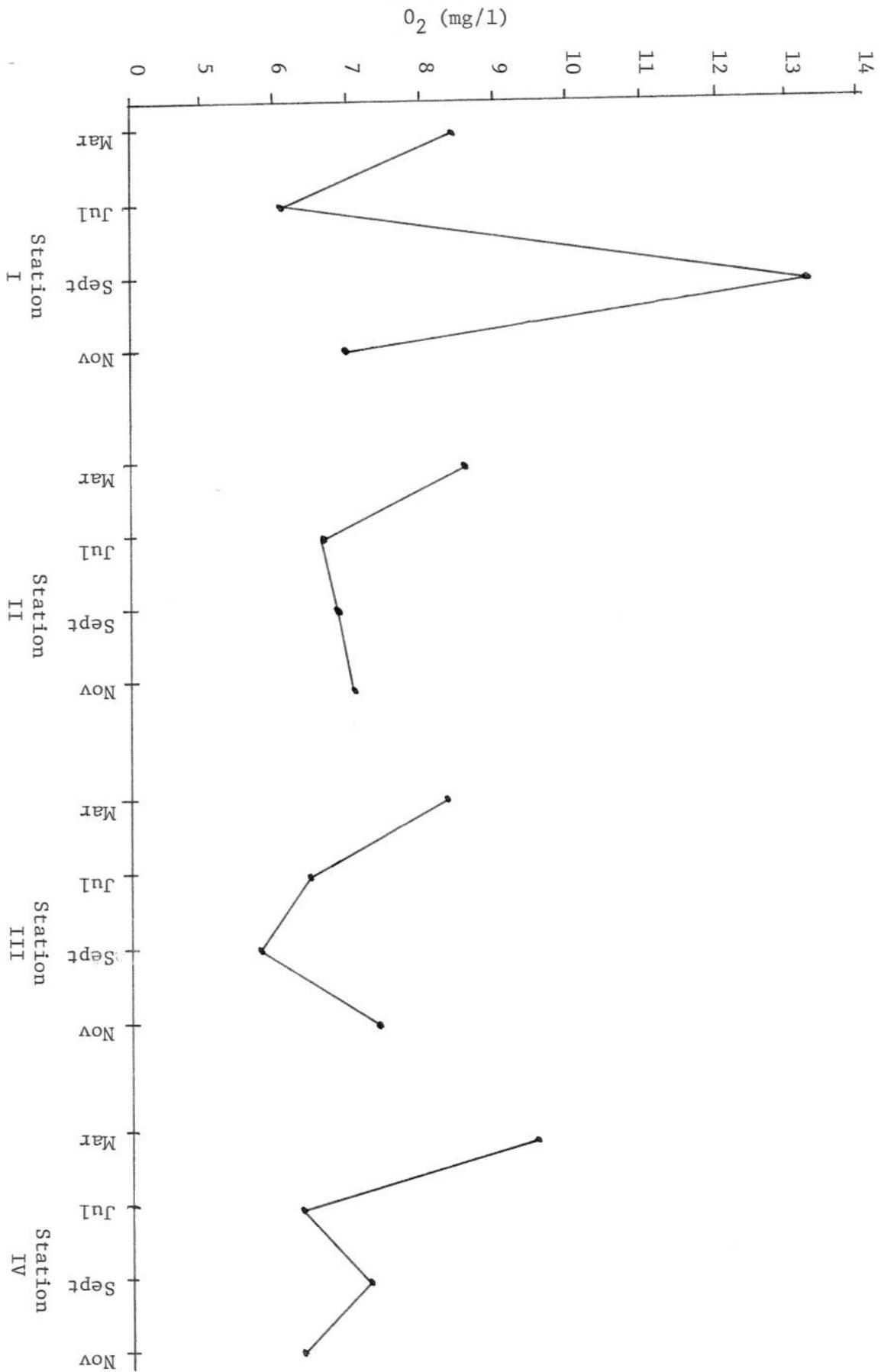


Figure 10. Navasota River quarterly dissolved oxygen values, 1976.

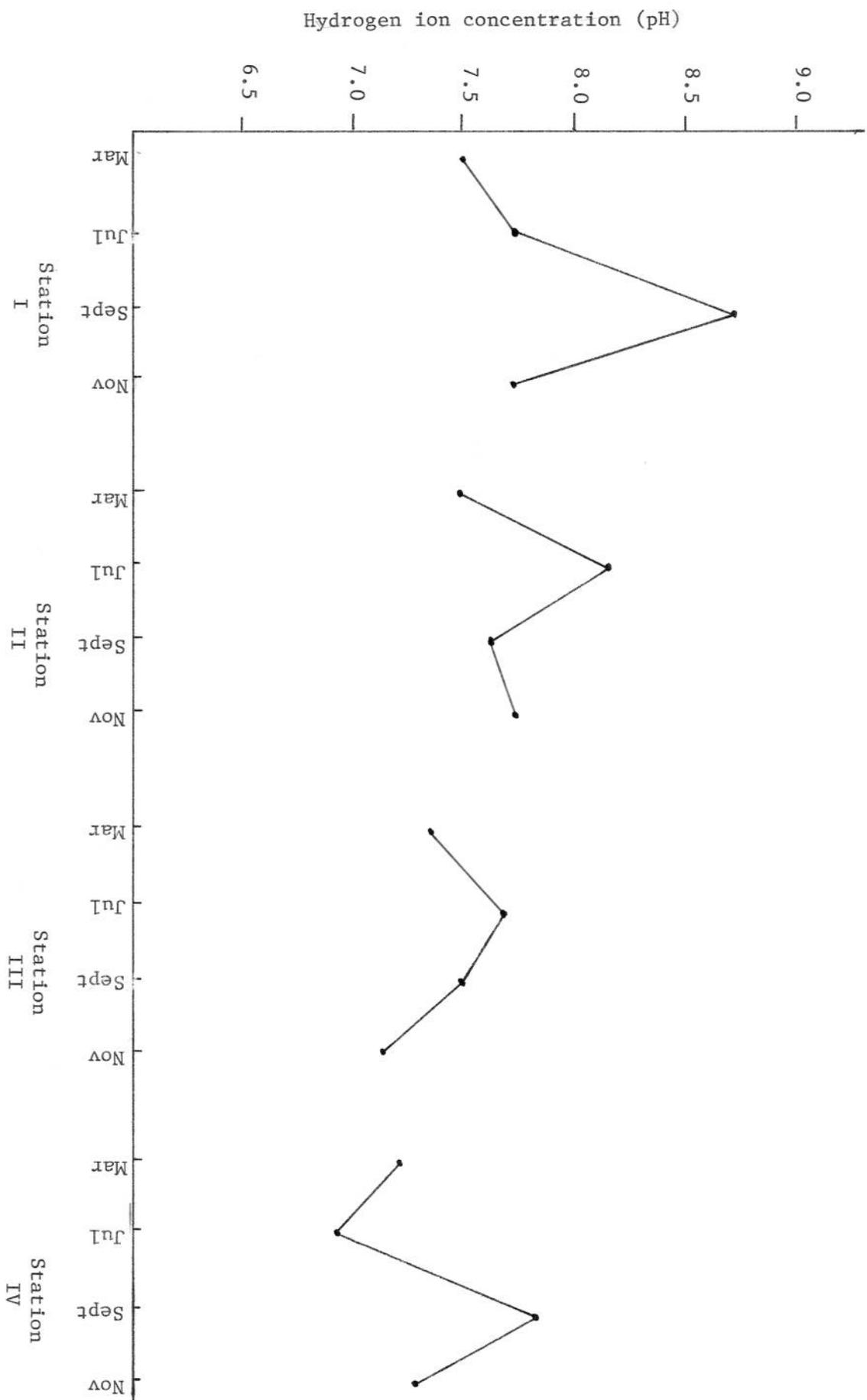


Figure 11. Navasota River quarterly hydrogen ion concentration values, 1976.

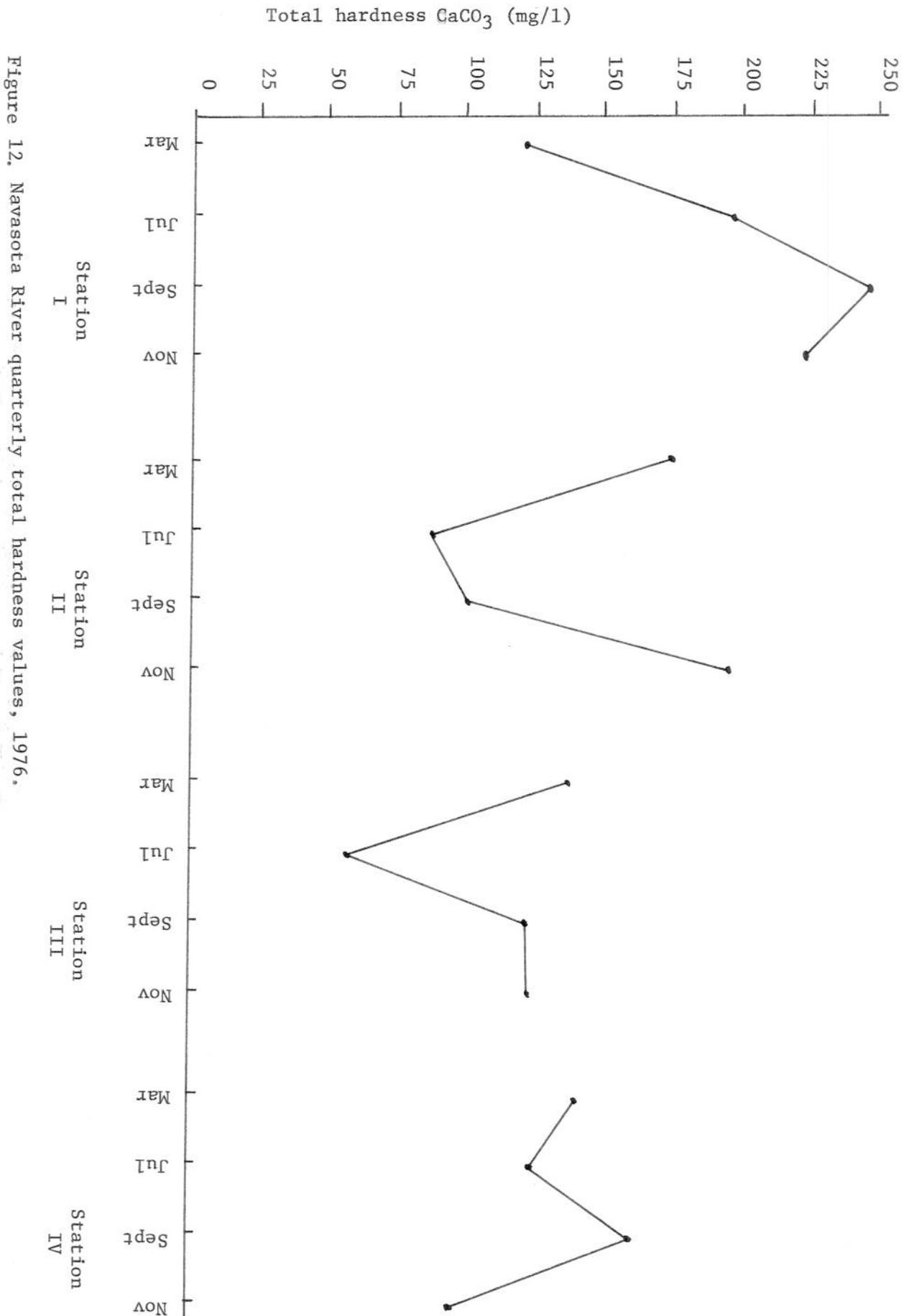


Figure 12. Navasota River quarterly total hardness values, 1976.

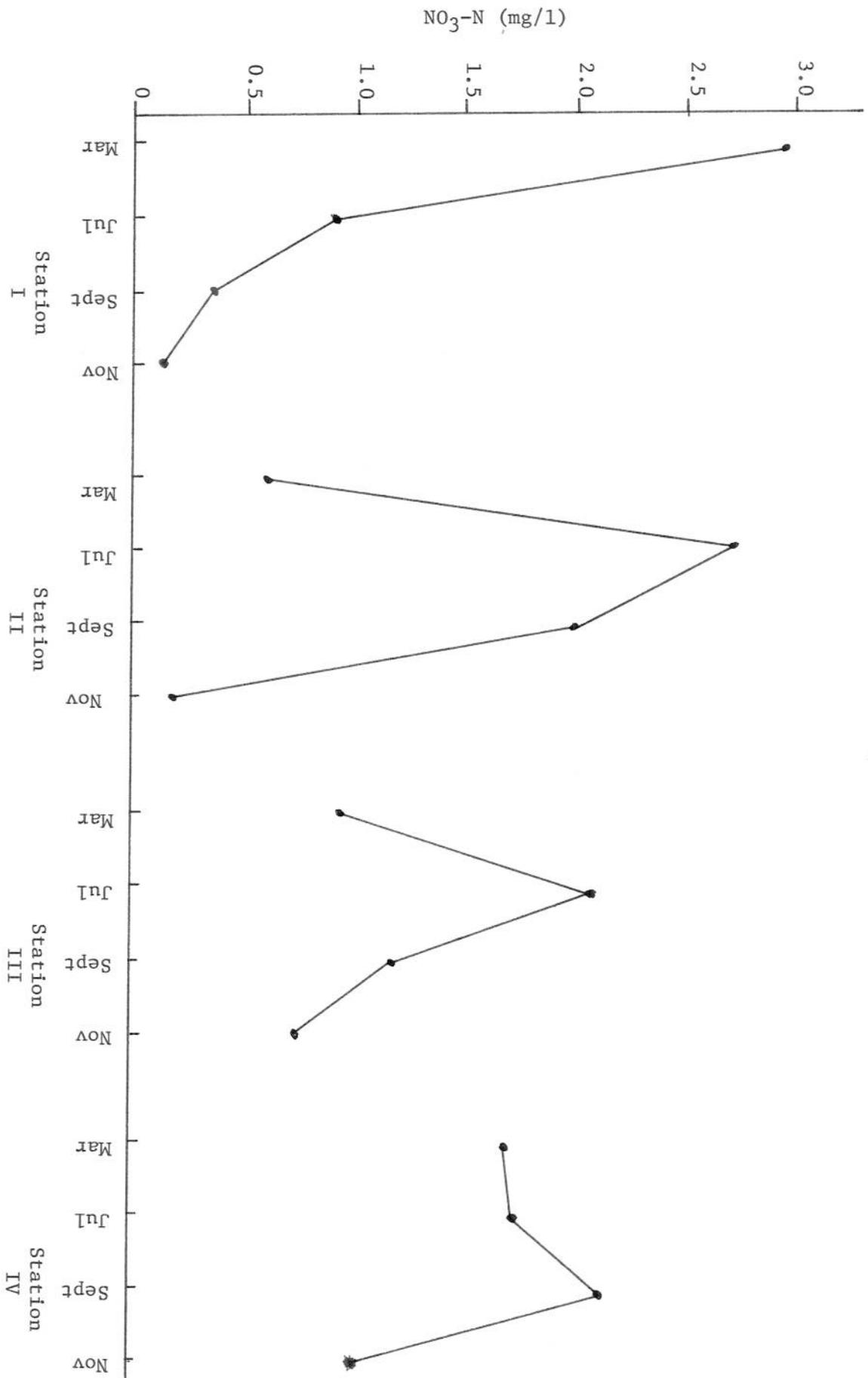


Figure 13. Navasota River quarterly nitrate nitrogen values, 1976.

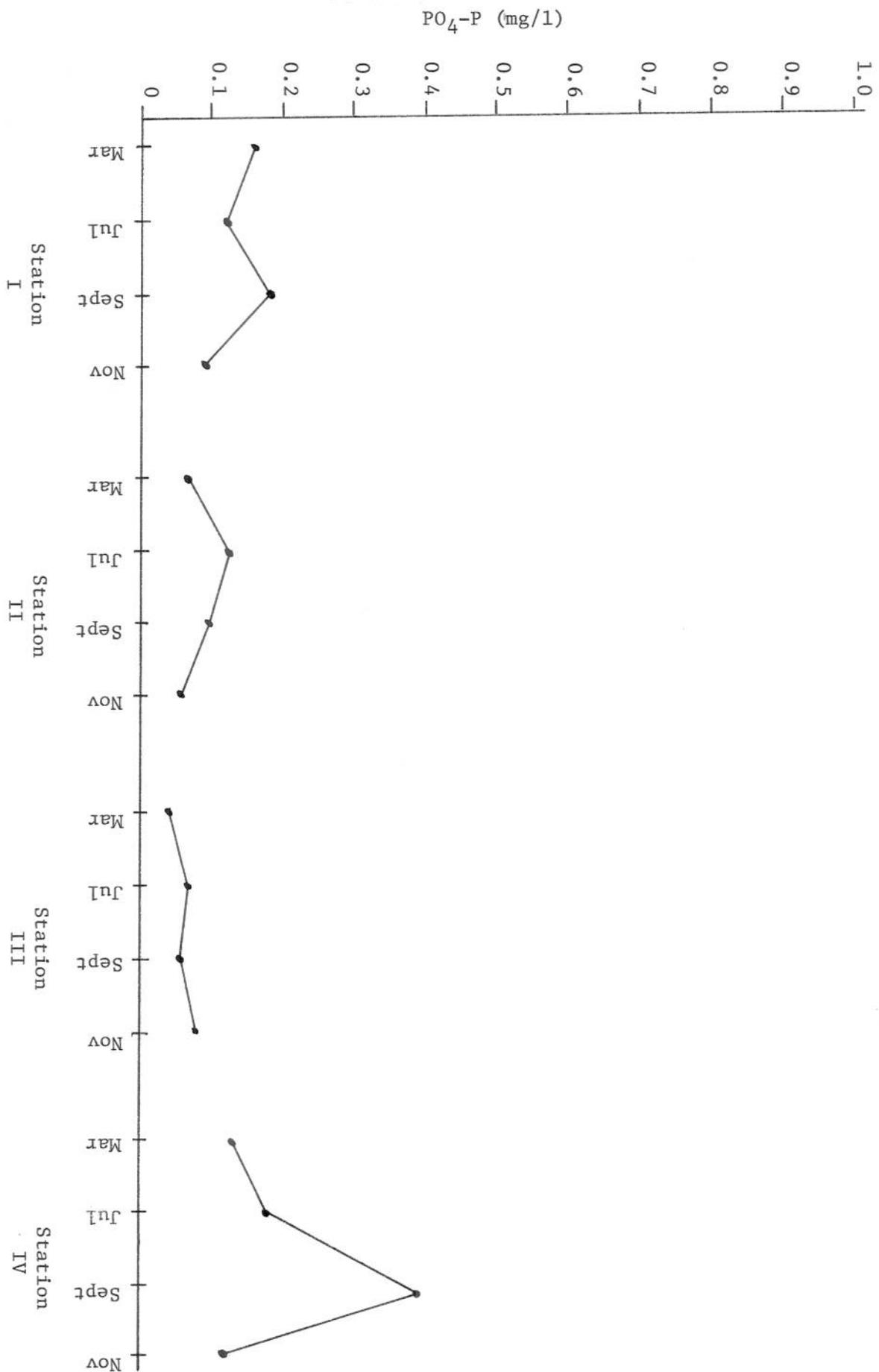


Figure 14 . Navasota River quarterly phosphate values, 1976.

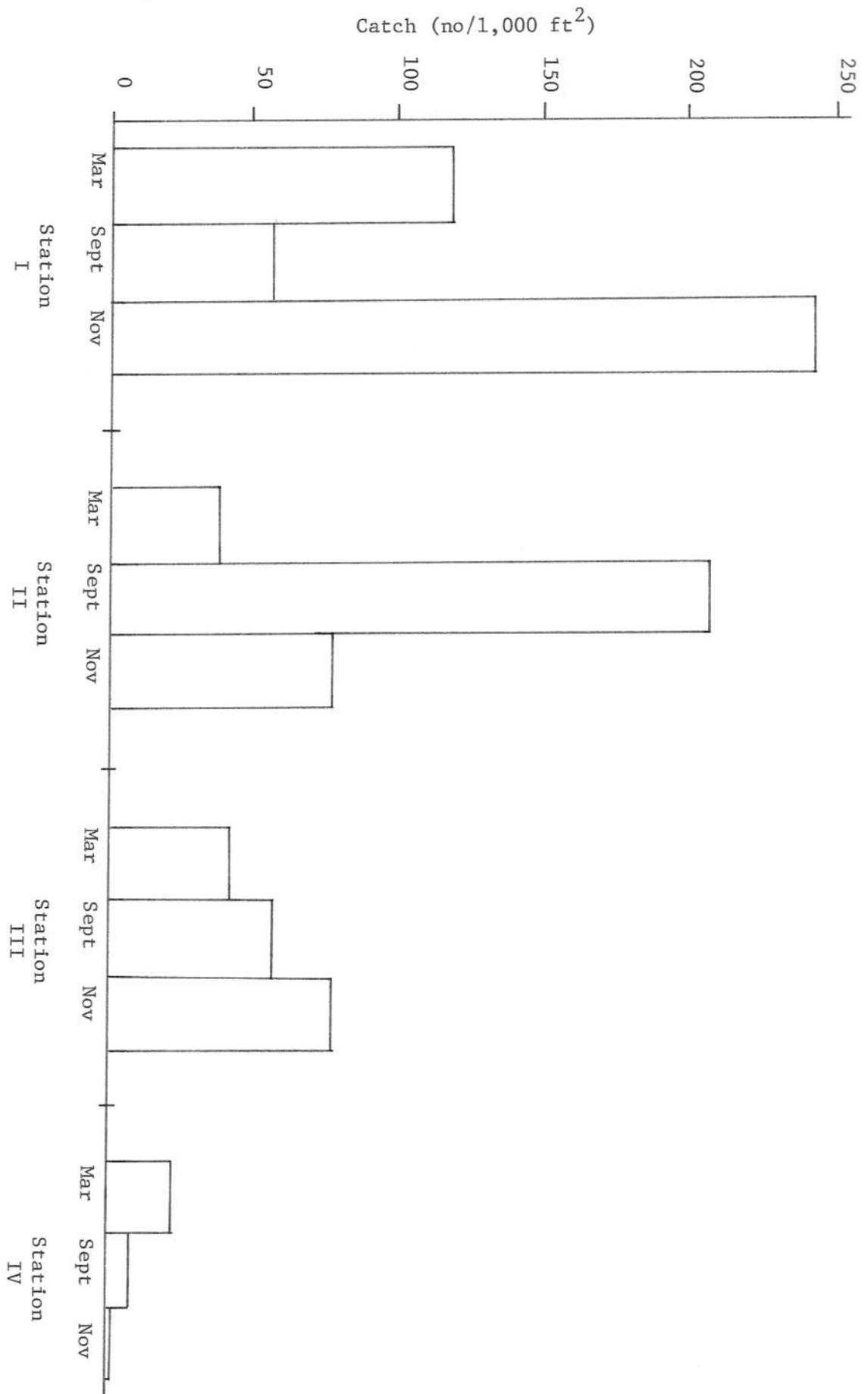


Figure 15. Navasota River composite catch data from seine samples, 1976.

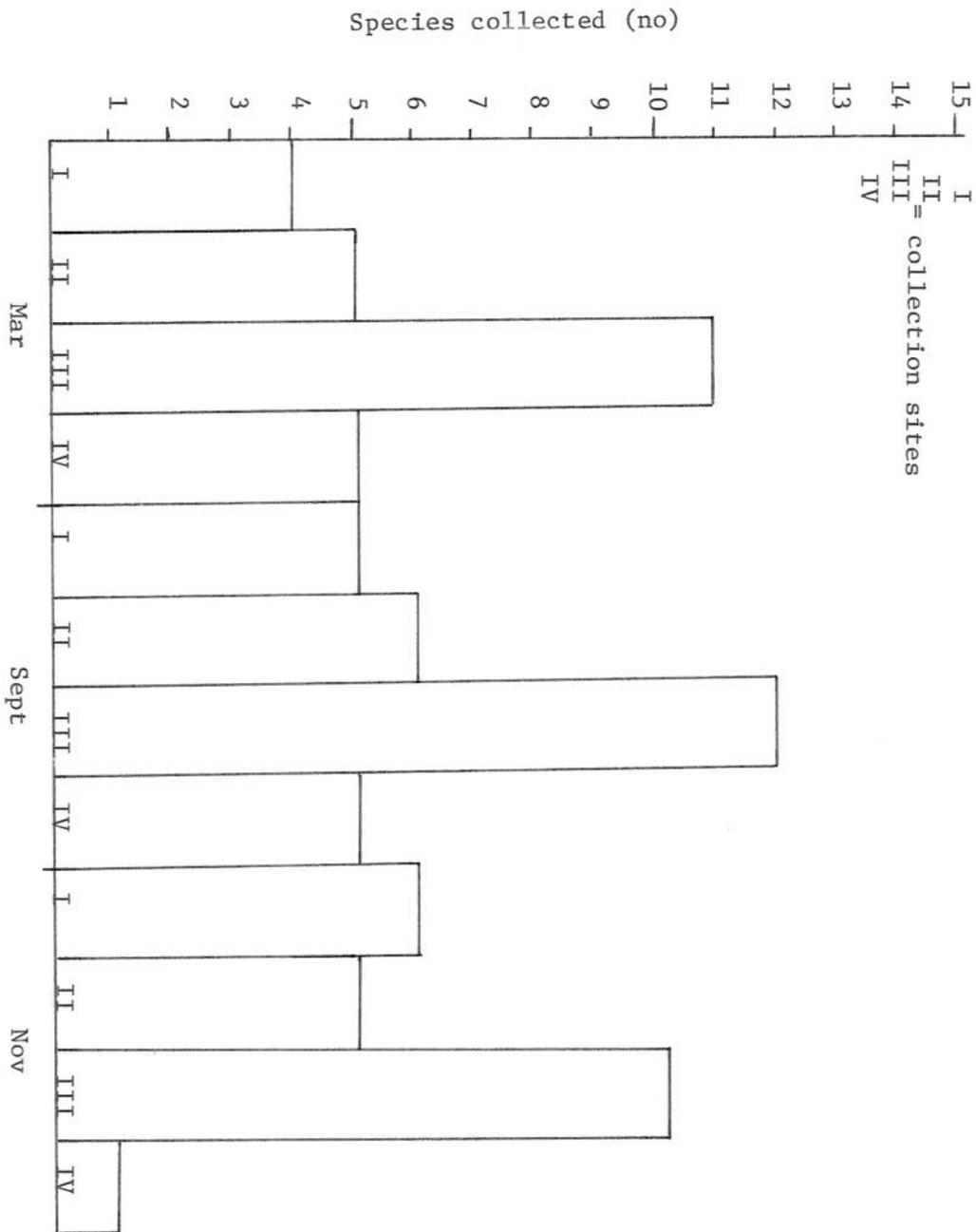


Figure 16 . Navasota River periodic species diversity of ichthyofauna by station, 1976.

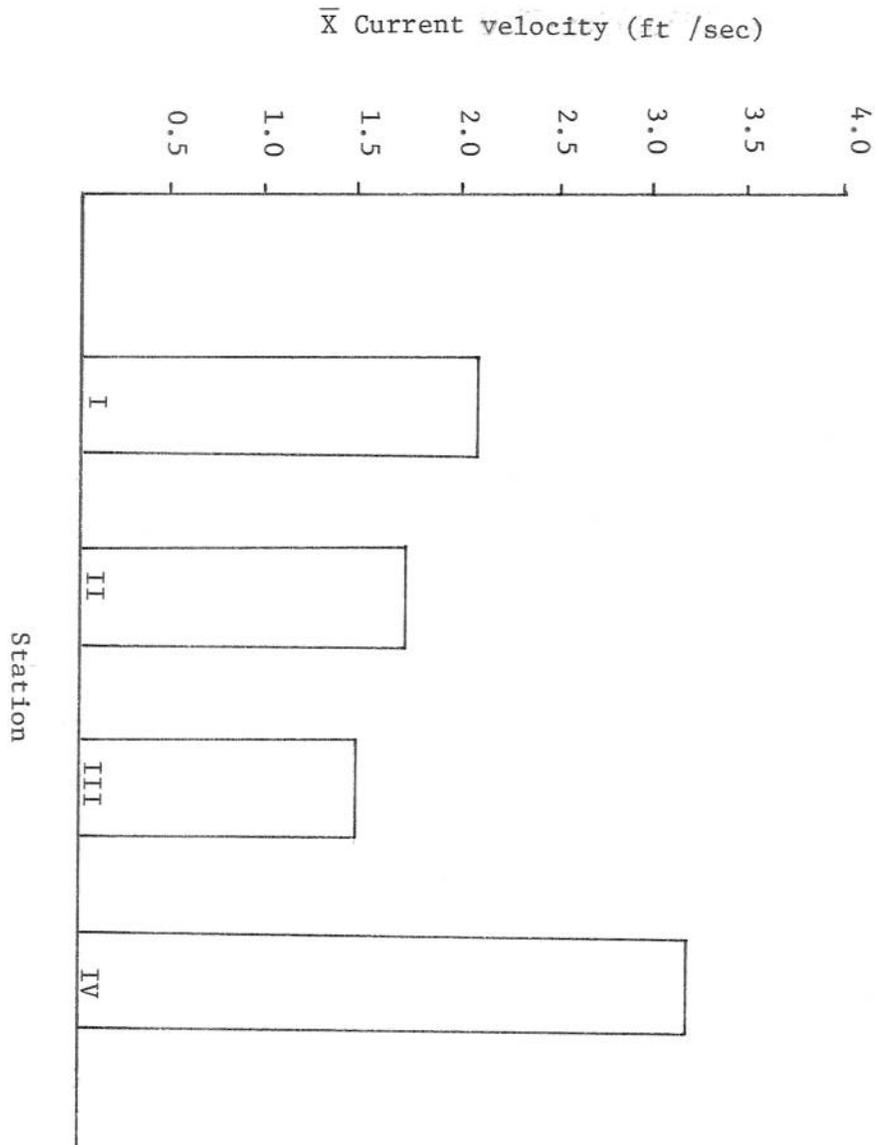


Figure 17. Navasota River mean current velocities, March 1976.

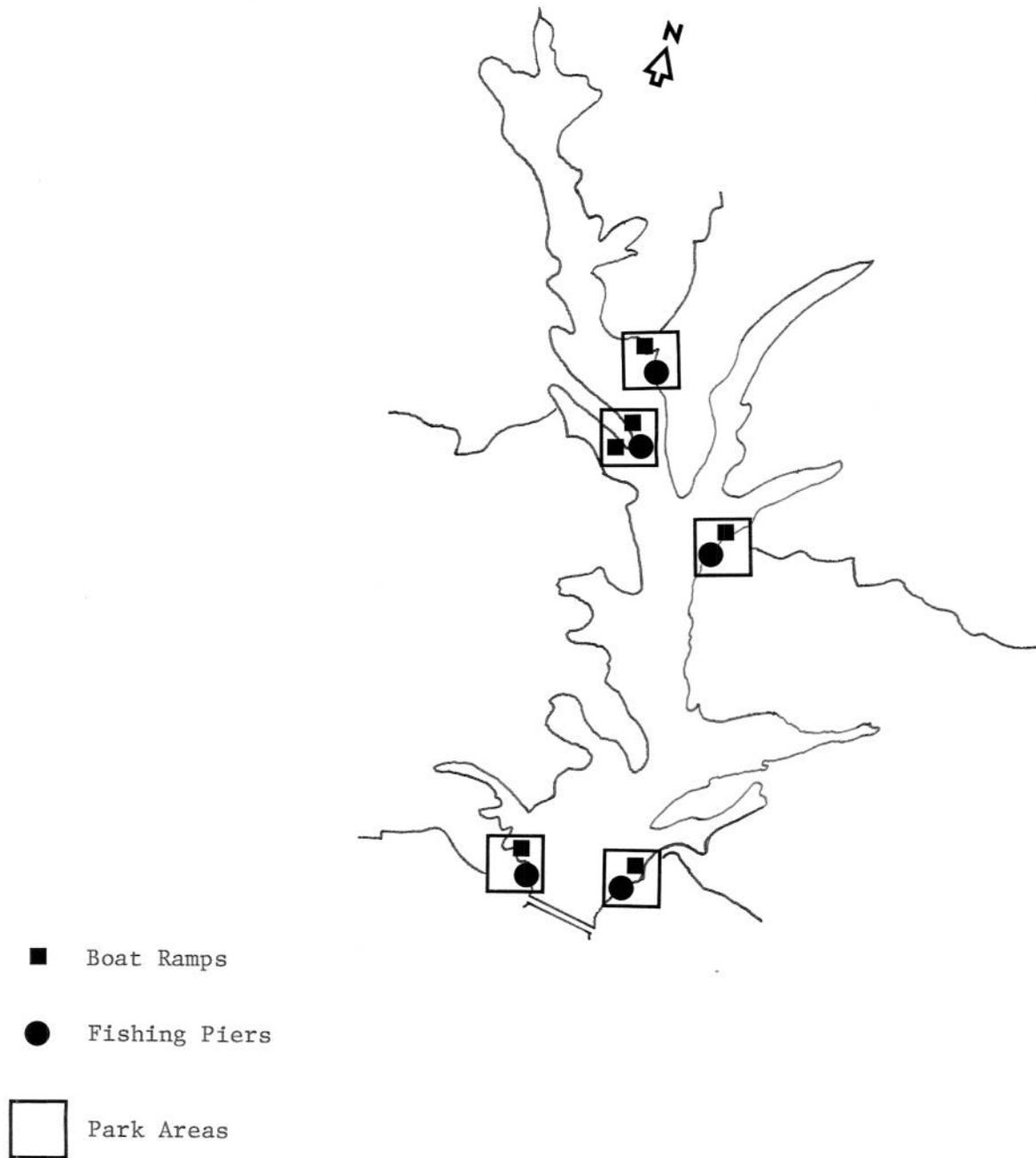


Figure 18. Location of proposed access and facilities, Lake Limestone, Navasota River.

Table 1. Stream widths, Navasota River, 1976.

	Stream width (ft)			
	Station I	Station II	Station III	Station IV
Rifle	11.0	18.0	39.0	59.0
Flat	17.5	31.5	44.0	67.0
Pool	22.5	34.5	51.0	70.0

Table 2. Stream substrate types of the Navasota River, 1976.

Substrate type	Percent composition by station			
	I	II	III	IV
Muck	60	25	10	10
Detritus	5	5	5	2
Clay	20	30	6	10
Silt	5	20	6	5
Sand	5	10	70	60
Gravel	3	10	2	5
Rubble	2	0	1	3
Boulder	0	0	0	5
Bedrock	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	100%	100%	100%	100%

Table 3. Navasota River water quality, 1976. Station I

Parameter	Mar	Jul	Sept	Nov
Temperature (C)	20	28	31	19
Dissolved oxygen (mg/l)	8.4	6.0	13.0	6.6
pH	7.5	7.7	8.7	7.7
Conductivity (micromhos/cm)	650	215	1090	675
Total alkalinity (mg/l)	110	160	170	70
Chlorides (mg/l)	130	90	130	90
Total hardness (mg/l)	120	190	240	220
Turbidity (JTU)	45	50	59	17
Secchi (in)	7.25	6.0	13.0	14.0
Total dissolved solids (mg/l)	432	119	479	414
Nitrates (mg/l)	2.920	0.864	0.266	0.177
Phosphates (mg/l)	0.163	0.114	0.170	0.085



Table 4. Navasota River seine samples, 1976. Station I

Species	Catch/1000 ft ²		
	Mar	Sept	Nov
Longnose gar	0.4	0.8	
Gizzard shad			2.2
Red shiner	116.2	35.8	200.0
Bullhead minnow		10.8	8.8
Mosquitofish	0.4	6.7	17.7
Green sunfish			1.1
Bluegill	0.4	0.8	13.3
Dusky darter		1.7	

Table 5. Navasota River water quality, 1976. Station II

Parameter	Mar	Ju1	Sept	Nov
Temperature (C)	21.0	28.0	26.5	16.0
Dissolved oxygen (mg/l)	8.3	6.3	6.4	6.6
pH	7.5	8.2	7.6	7.7
Conductivity (micromhos/cm)	680	30	350	430
Total alkalinity (mg/l)	100	83	80	110
Chlorides (mg/l)	110	20	50	80
Total hardness (mg/l)	170	80	100	190
Turbidity (JTU)	125	150	64	34
Secchi (in)	6	4	6	11
Total dissolved solids (mg/l)	474	116	224	346
Nitrates (mg/l)	0.530	2.658	1.994	0.177
Phosphates (mg/l)	0.065	0.114	0.098	0.052

Table 6. Navasota River seine samples, 1976. Station II

Species	Catch/1000 ft ²		
	Mar	Sept	Nov
Red shiner	36.4	156.4	60.0
Blacktail shiner		0.7	
Bullhead minnow	0.7	12.1	13.3
Channel catfish		3.6	1.6
Mosquitofish	0.7	24.3	
Warmouth	0.3		
Bluegill		1.4	
Dusky darter		8.6	0.8

Table 7. Navasota River water quality, 1976. Station III

Parameter	Mar	Jul	Sept	Nov
Temperature (C)	18.0	26.6	27.0	16.0
Dissolved oxygen (mg/l)	8.0	6.0	5.6	7.2
pH	7.3	7.7	7.5	7.1
Conductivity (micromhos/cm)	600	190	378	285
Total alkalinity (mg/l)	70	40	80	90
Chlorides (mg/l)	110	30	50	50
Total hardness (mg/l)	130	50	120	120
Turbidity (JTU)	45	55	64	50
Secchi (in)	7	4	3	10
Total dissolved solids (mg/l)	394	108	200	218
Nitrates (mg/l)	0.930	2.038	1.130	0.665
Phosphates (mg/l)	0.033	0.065	0.057	0.078

Table 8. Navasota River seine samples, 1976. Station III

Species	Catch/1000 ft ²		
	Mar	Sept	Nov
Gizzard shad		0.6	
Golden shiner			1.0
Blackspot shiner			6.0
Pugnose shiner	1.6		
Ribbon shiner		5.0	
Red shiner	19.3	6.8	24.0
Sharpnose shiner	3.3	0.6	
Mimic shiner		0.6	
Bullhead minnow	6.3	1.8	6.0
Tadpole madtom		1.2	
Mosquitofish	7.6	32.5	12.0
Green sunfish			1.0
Warmouth	0.6		4.0
Bluegill	1.3	3.7	12.0
Longear sunfish			9.0
Largemouth bass		0.6	
White crappie		0.6	2.0
Black crappie		1.2	
Bluntnose darter	0.6		
Slough darter	0.3		
Logperch	0.3		
Dusky darter	0.3		

Table 9. Navasota River water quality, 1976. Station IV

Parameter	Mar	Jul	Sept	Nov
Temperature (C)	19.0	27.0	29.8	17.0
Dissolved oxygen (mg/l)	9.1	6.2	7.0	6.2
pH	7.2	6.8	7.8	7.3
Conductivity (micromhos/cm)	650	312	760	390
Total alkalinity (mg/l)	110	90	110	70
Chlorides (mg/l)	100	70	80	40
Total hardness	140	120	160	90
Turbidity (JTU)	80	250	82	95
Secchi (in)	6	4	4	7
Total dissolved solids (mg/l)	471	221	294	171
Nitrates (mg/l)	1.700	1.728	2.126	0.910
Phosphates (mg/l)	0.132	0.179	0.399	0.121

Table 10. Navasota River seine samples, 1976. Station IV

Species	Catch/1000 ft ²		
	Mar	Sept	Nov
Pugnose shiner	0.6		
Ribbon shiner		10.6	
Red shiner	11.2	0.7	
Silverband shiner	8.7		
Bullhead minnow	1.8		
Channel catfish		0.7	
Blackstripe topminnow		1.3	
Mosquitofish		2.0	
White crappie			1.1
Dusky darter	1.25		

6-Year Management Plan for the Navasota River
and Lake Limestone

I. Stream Description

The Navasota River begins about 1.5 miles northeast of the community of Mount Calm in Hill County and flows for a length of about 195 R. M. to its confluence with the Brazos River near Washington, Texas.

The Navasota River drainage begins in the Blackland Prairie and traverses alternating Post Oak Savannah and Blackland Prairie land resource areas as it flows toward its confluence. The marly clay soils of the headwaters region become increasingly more sandy as the river flows south-eastward toward the East Texas timber belt. The Navasota River drainage, found within the Texas Biotic Province, is bounded by the Trinity River drainage on the east and on the west by the Brazos River drainage.

Water quality of the Navasota River varies with location and volume of flow. The waters of the Navasota River generally may be described as alkaline and somewhat turbid, with moderate concentrations of chlorides, nitrates and total dissolved solids. Fish habitat and species diversity of fish populations vary with locations. Channel and flathead catfishes are the most frequently harvested sport fishes. Red shiner is the predominant forage species. Fisherman access is largely confined to highway crossings; facilities for fishermen are deficient.

Lake Limestone, a 14,200-acre reservoir located at R.M. 125, is scheduled for completion in early 1978. The primary function of the reservoir will be to provide a source of cooling water for steam electric generating plants. Needed water will be sold by the Brazos River Authority, the controlling agency of the reservoir, to the Texas Utilities Generating Company. Development of Lake Limestone can provide a resource with much potential for improvement of the fishery of the Navasota River. The implementation of appropriate fishery management techniques could prove helpful in the realization of such potential. Further, Lake Limestone can greatly improve fisherman access to the Navasota River through the development of adequate facilities for the accommodation of anglers.

II. Management Recommendations

1977	Man-Days
A. Habitat Enhancement	
1. Provide technical assistance to controlling agency to minimize destruction of potential fish habitat by brush clearing operations.	4
2. Inspect lake basin to identify areas which may be deficient in fish habitat and identify for future	

1977 con't		Man-Days
marking existing structures which may concentrate fish.		6
3. Install brush shelters in areas deficient in fish habitat, and at fishing pier locations before inundation.		12
4. Coordinate plans with controlling agency for maintenance of continuous flow release to tailwater areas.		4
Sub-Total		<u>26</u>
B. Angler Information		
1. None recommended.		
C. Population Manipulation		
1. None recommended.		
D. Vegetation Control		
1. None recommended.		
E. Pollution Control		
1. None recommended.		
F. Fisherman Access and Facilities		
1. None recommended.		
G. Fish Harvest Regulations		
1. None recommended.		
	<u>1977 TOTAL</u>	<u>26</u>
1978		Man-Days

A. Habitat Enhancement

1. None recommended.

B. Angler Information

1. Disseminate fish stocking and evaluation data to anglers through appropriate media.

2

1978 con't		Man-Days
2. Identify sources for obtaining weekly fish harvest information.		4
3. Encourage controlling agency to provide maps locating access and facilities, fish attractors, river channel, etc.		<u>2</u>
Sub-Total		8
C. Population Manipulation		
1. Stock threadfin shad (10/a.).		6
2. Stock Florida largemouth bass (100/a.).		<u>15</u>
Sub-Total		21
D. Vegetation Control		
1. None recommended.		
E. Pollution Control		
1. None recommended.		
F. Fisherman Access and Facilities		
1. Coordinate construction of concrete launch ramps, park areas and fishing piers and provide technical assistance (see attached map).		10
2. Coordinate and provide technical assistance for development of fisherman access to tailwater and dam areas.		<u>5</u>
Sub-Total		15
G. Fish Harvest Regulations		
1. None recommended.		
	<u>1978 TOTAL</u>	<u>44</u>
1979		Man-Days
A. Habitat Enhancement		
1. None recommended.		

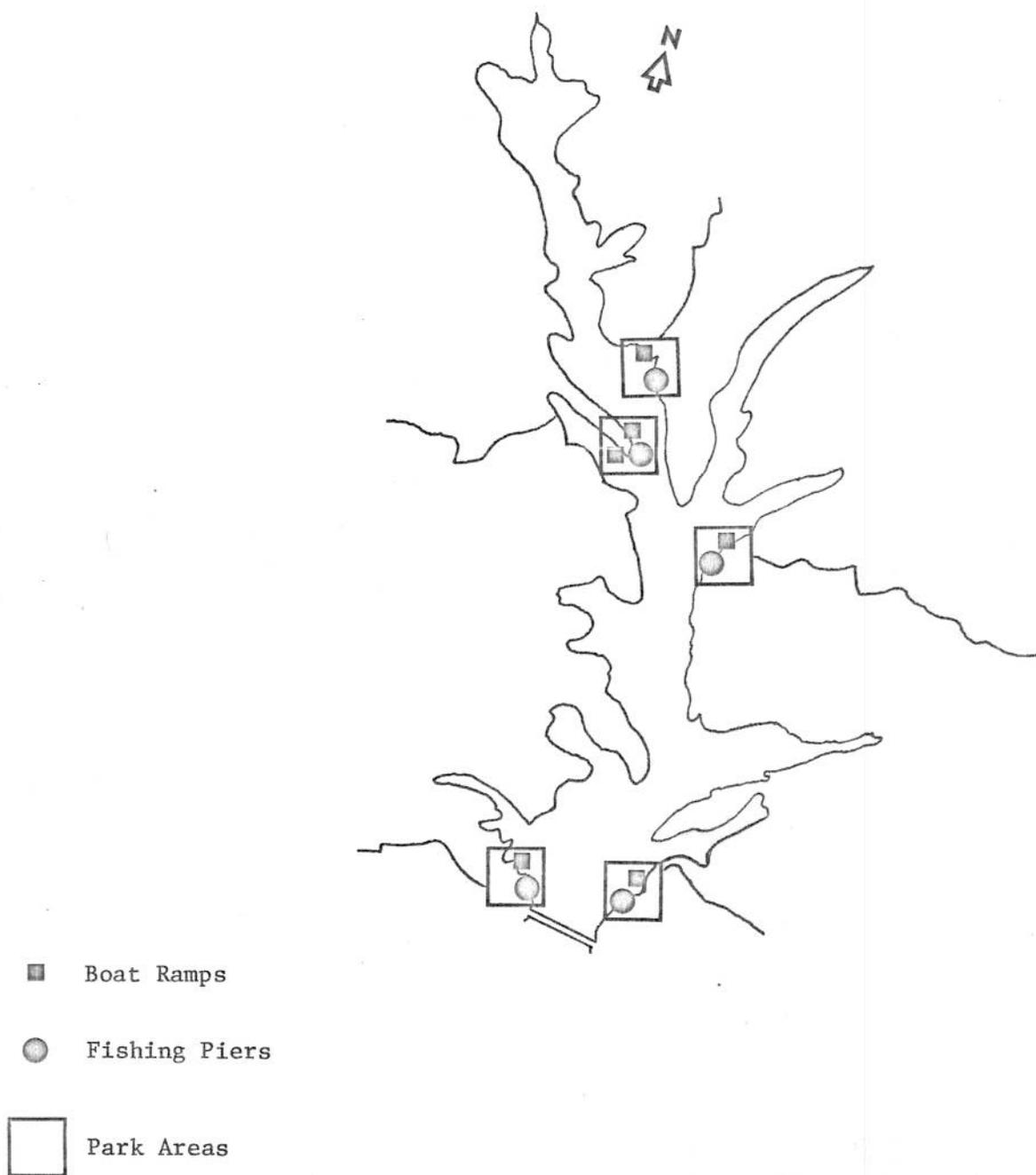
1979 con't		Man-Days
B. Angler Information		
1. Construct and install marker buoys at locations of natural and artificial fish attractor/shelters.		15
2. Disseminate fish stocking, evaluation and current fish harvest information to anglers through appropriate media.		<u>5</u>
Sub-Total		20
C. Population Manipulation		
1. Stock white bass x striped bass hybrids (10/a.).		<u>6</u>
Sub-Total		6
D. Vegetation Control		
1. None recommended.		
E. Pollution Control		
1. None recommended.		
F. Fisherman Access and Facilities		
1. None recommended.		
G. Fish Harvest Regulations		
1. None recommended.		
	<u>1979 TOTAL</u>	<u>26</u>

1980		Man-Days
A. Habitat Enhancement		
1. None recommended.		
B. Angler Information		
1. Disseminate stocking evaluation and current fish harvest information to anglers through appropriate media.		<u>5</u>
Sub-Total		5

1980 con't		Man-Days
C. Population Manipulation		
1. None recommended.		
D. Vegetation Control		
1. None recommended.		
E. Pollution Control		
1. None recommended.		
F. Fisherman Access and Facilities		
1. None recommended.		
G. Fish Harvest Regulations		
1. None recommended.		
	<u>1980 TOTAL</u>	<u>5</u>

1981		Man-Days
A. Habitat Enhancement		
1. None recommended.		
B. Angler Information		
1. Disseminate stocking evaluation and current fish harvest information to anglers through appropriate media.		<u>5</u>
Sub-Total		5
C. Population Manipulation		
1. Stock white bass x striped bass hybrids (10/a.).		<u>6</u>
Sub-Total		6
D. Vegetation Control		
1. None recommended.		
E. Pollution Control		
1. None recommended		

1981 con't		Man-Days
F. Fisherman Access and Facilities		
1. None recommended.		
G. Fish Harvest Regulations		
1. None recommended.		
	<u>1981 TOTAL</u>	<u>11</u>
1982		Man-Days
A. Habitat Enhancement		
1. None recommended.		
B. Angler Information		
1. Disseminate stocking evaluation and current fish harvest information to anglers through appropriate media.		<u>5</u>
Sub-Total		5
C. Population Manipulation		
1. None recommended.		
D. Vegetation Control		
1. None recommended.		
E. Pollution Control		
1. None recommended.		
F. Fisherman Access and Facilities		
1. None recommended.		
G. Fish Harvest Regulations		
1. None recommended.		
	<u>1982 TOTAL</u>	<u>5</u>



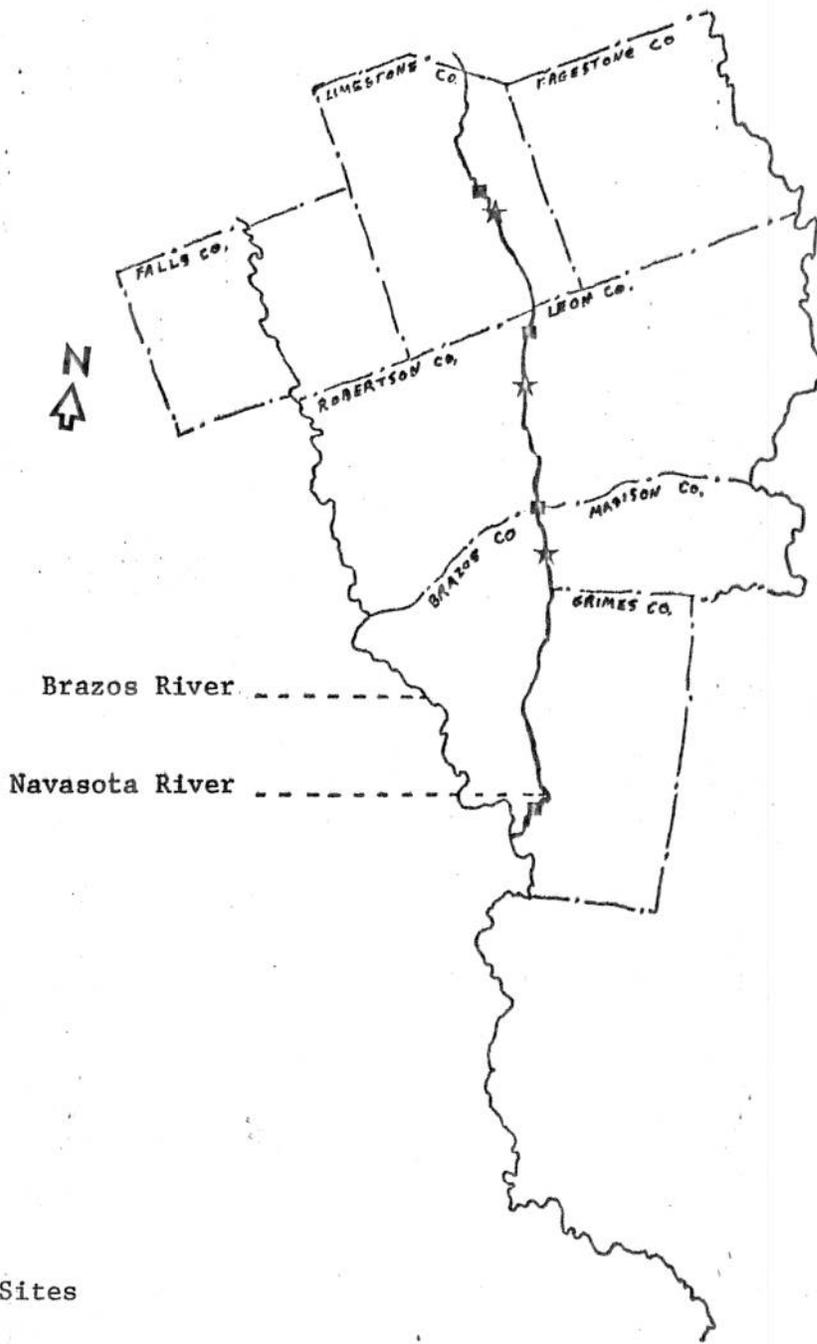
Location of proposed access and facilities, Lake Limestone, Navasota River.

APPENDIX

F-30-R-2, Job B

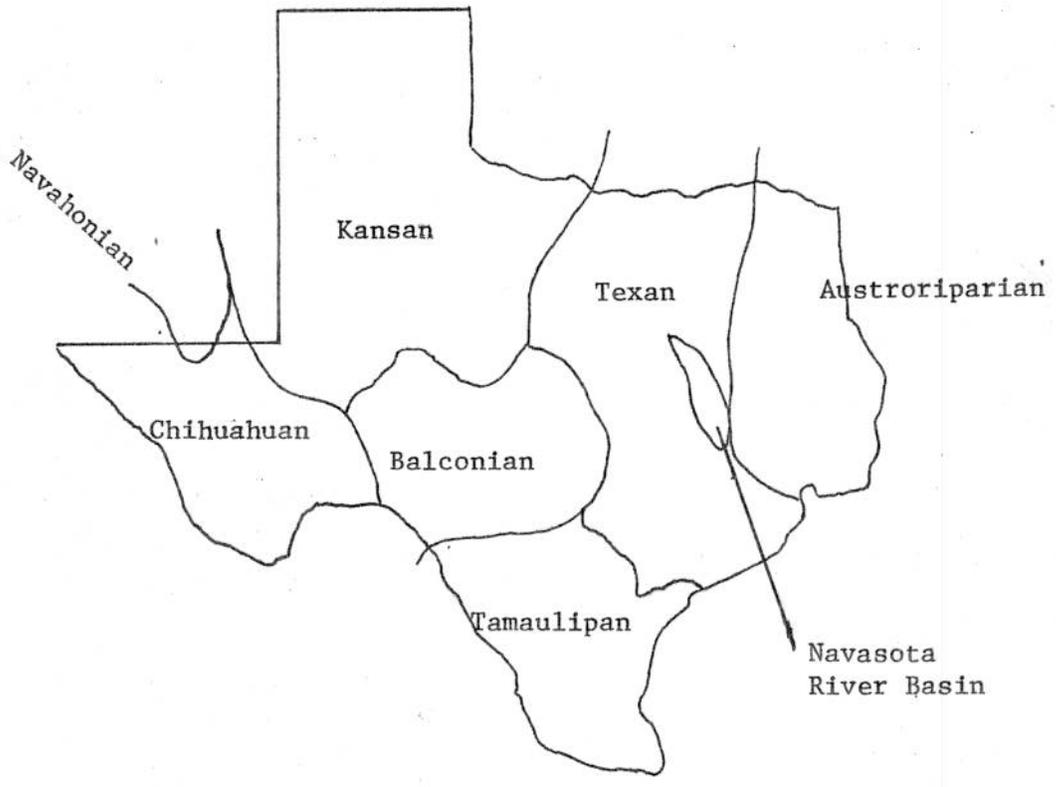
Navasota River

Appendix A
Maps
Navasota River

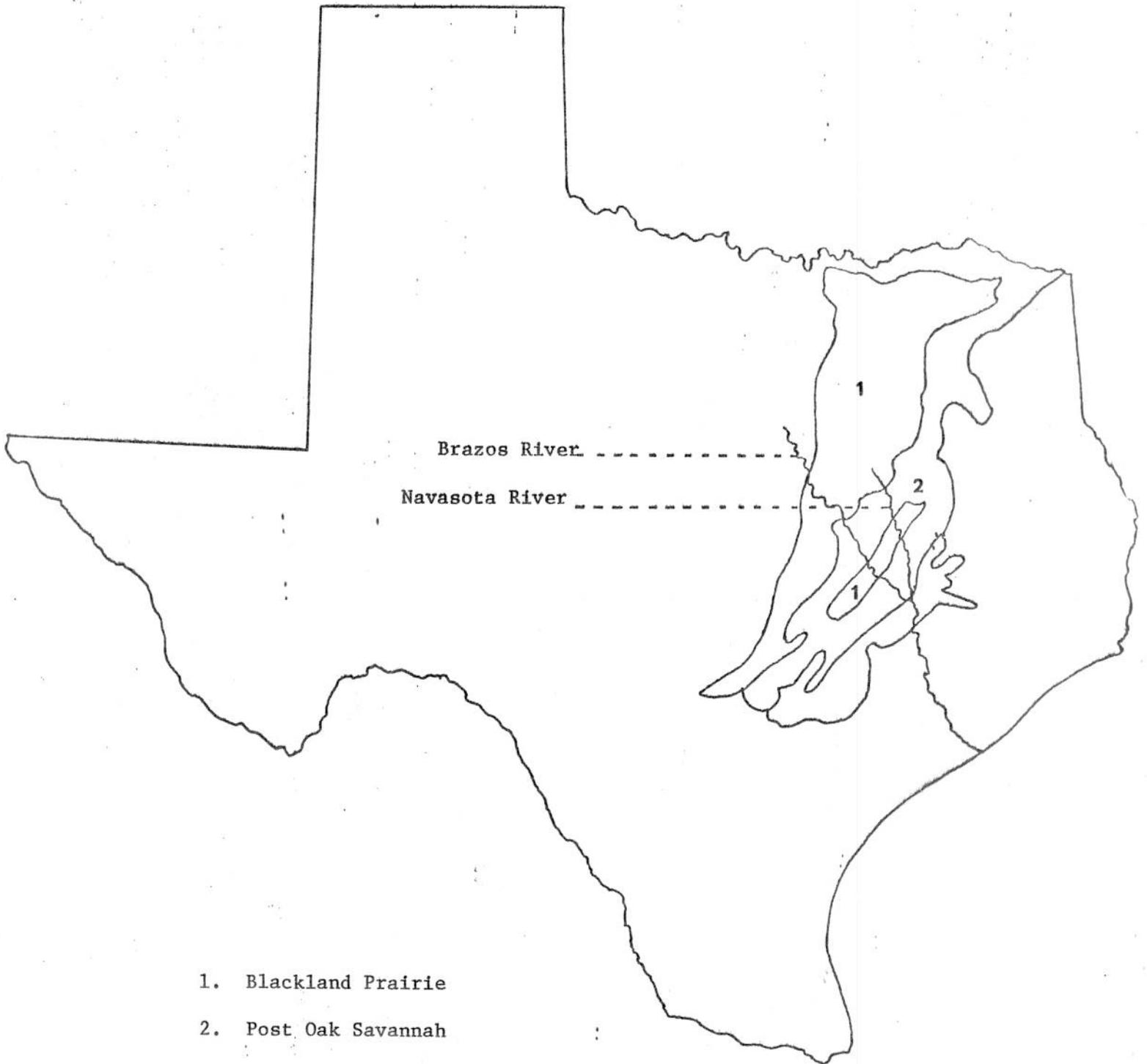


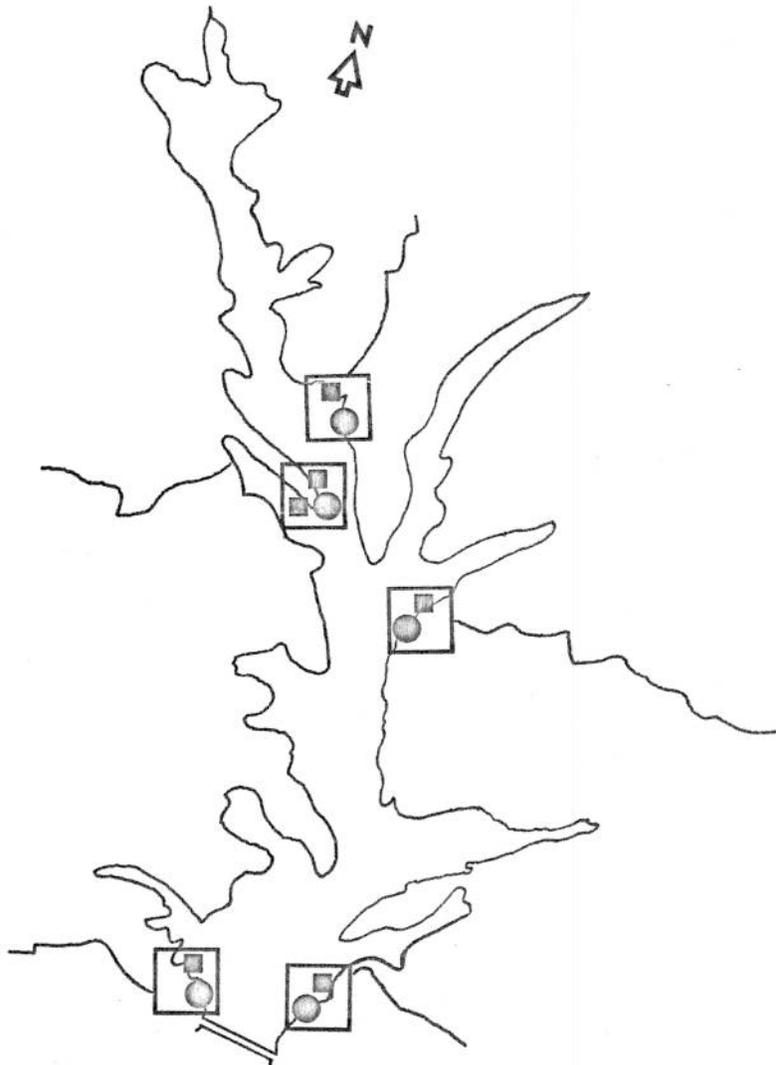
- Survey Sites
- ★ Stream Gaging Station (USGS)

Locations of survey sites and streamflow gaging stations, Navasota River, 1976.



The location of the Navasota River Basin within the Biotic Provinces of Texas (Blair, 1950).





■ Boat Ramps

● Fishing Piers

□ Park Areas

Location of proposed access and facilities, Lake Limestone,
Navasota River.

Appendix B
Seining
Navasota River

Navasota River seine samples, September, 1976. Station I.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/1,000 ft ² (no)	Catch/1,000 ft ² (gm)
Gizzard shad	1	13	13	-	111	-	0.8	10.8
Bullhead minnow	13	10	0.8	0.5-1.0	37	26-51	10.8	8.3
Red shiner	43	32	0.7	0.5-2.0	37	29-47	35.8	26.7
Mosquitofish	8	4.5	0.6	0.5-1.0	33	30-37	6.7	3.8
Bluegill	1	2.0	2.0	-	47	-	0.8	1.7
Dusky darter	2	3.0	1.5	1.0-2.0	53	45-60	1.7	2.5

Navasota River seine samples, September, 1976. Station II.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/1,000 ft ² (no)	Catch/1,000 ft ² (gm)
Bullhead minnow	17	15.0	.88	0.5-1.0	40.0	30-45	12.1	10.7
Red shiner	219	215	.98	0.5-2.0	38.0	25-57	156.4	153.5
Blacktail shiner	1	1	1.0	-	42.0	-	0.7	0.7
Mosquitofish	34	23	0.68	0.5-2.0	32.0	23-41	24.3	16.4
Channel catfish	5	8.0	1.60	1.0-2.0	44.0	40-48	3.6	5.7
Bluegill	2	2.0	1.0	1.0-1.0	38.5	38-39	1.4	1.4
Dusky darter	12	25.0	2.08	1.0-4.0	59.0	47-72	8.6	17.9

Navasota River seine samples, September, 1976. Station III.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/1,000 ft ² (no)	Catch/1,000 ft ² (gm)
Gizzard shad	1	11.0	11	-	105	-	0.62	6.90
Bullhead minnow	3	3.0	1.0	1.0-1.0	37	36-39	1.87	1.87
Red shiner	11	5.5	0.5	0.5-0.5	33	29-36	6.87	3.43
Mimic shiner	1	0.5	0.5	-	37	-	0.62	0.31
Sharpnose shiner	1	1.0	1.0	-	49	-	0.62	0.62
Ribbon shiner	8	7.5	0.9	0.5-1.0	39	36-41	5.0	4.68
Tadpole madtom	2	2.0	1.0	1.0-1.0	40	37-42	1.25	1.25
Mosquitofish	52	41.6	0.8	0.5-1.0	33	26-39	32.50	26.0
Bluegill	6	8.0	1.3	1.0-3.0	42	39-57	3.75	5.00
Largemouth bass	1	11.0	11.0	-	97	-	0.62	6.90
White crappie	1	7.0	7.0	-	90	-	0.62	4.37
Black crappie	2	300.0	150.0	86-214	197	86-214	1.25	187.50

Navasota River seine samples, September, 1976. Station IV.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/ 1,000 ft ² (no)	Catch/ 1,000 ft ² (gm)
Ribbon shiner	16	10.0	0.6	0.5-1.0	33	27-38	10.6	6.6
Red shiner	1	2.0	2.0	-	51	-	0.7	1.3
Mosquitofish	3	4.0	1.3	1.0-2.0	39	35-45	2.0	2.7
Blackstripe topminnow	2	2.0	1.0	1.0-1.0	37	36-38	1.3	1.3
Channel catfish	1	2.0	2.0	-	55	-	0.7	1.3

Navasota River seine samples, November, 1976. Station I.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/1,000 ft ² (no)	Catch/1,000 ft ² (gm)
Gizzard shad	2	39	19.5	14.0-25.0	125	110-139	2.2	43.3
Bullhead minnow	8	8	1.0	1.0-1.0	47	44-50	8.8	8.8
Red shiner	180	180	1.0	0.5-2.0	39	33-47	200.0	200.0
Mosquitofish	16	10	0.6	0.5-1.0	35	30-41	17.7	11.1
Green sunfish	1	3	3.0	-	55	-	1.1	3.3
Bluegill	12	8	0.7	0.5-1.0	31	26-38	13.3	8.8

Navasota River seine samples, November, 1976. Station II.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/1,000 ft ² (no)	Catch/1,000 ft ² (gm)
Bullhead minnow	16	18.0	4.5	0.5-2.0	46	39-58	13.3	15.0
Red shiner	72	96.0	1.3	0.5-2.0	43	34-52	60.0	80.0
Channel catfish	2	3.0	1.5	1.0-2.0	58	55-61	1.6	2.5
Dusky darter	1	2.0	2.0	-	62	-	0.8	1.6

Navasota River seine samples, November, 1976. Station III

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} length (mm)	Length range (mm)	Catch/1,000 ft ² (no)	Catch/1,000 ft ² (gm)
Bullhead minnow	6	3.5	1.1	0.5-2.0	43	37-51	6	3.5
Golden shiner	1	6.0	6.0	-	88	-	1	6.0
Blackspot shiner	6	6.0	1.0	1.0-1.0	48	-	6	6.0
Red shiner	24	27.0	1.1	0.5-3.0	44	30-59	24	27.0
Mosquitofish	12	3.5	0.5	0.5-1.0	32	22-44	12	3.5
Green sunfish	1	6.0	6.0	-	73	-	1	6.0
Warmouth	4	20.0	5.0	1.0-7.0	61	35-75	4	20.0
Bluegill	12	39.0	3.3	0.5-24.0	47	31-112	12	39.0
Longear sunfish	9	19.0	2.1	1.0-4.0	48	41-65	9	19.0
White crappie	2	56.0	28.0	5.0-51.0	120	81-159	2	56.0

Navasota River seine samples, November, 1976. Station IV.

Species	Total catch (no)	Total wt (gm)	\bar{X} wt (gm)	Wt range (gm)	\bar{X} Length (mm)	Length range (mm)	Catch/ 2 1,000 ft ² (no)	Catch/ 2 1,000 ft ² (gm)
White crappie	1	155	155	-	223	-	1.1	172

Appendix C
Gill Netting
Navasota River

(none this segment)

Appendix D

Standing Crop

Navasota River

(no data this segment)

Appendix E
Age and Growth
Navasota River

(no data this segment)

Appendix F
Habitat and Vegetation
Navasota River

HABITAT IMPROVEMENT NEEDS

JAN 01 1976

Reservoir/Stream Navasota River
 County Limestone
 Date 1976
 Project F-30-R-2

	Over-Abundant	Adequate	Marginal	Absent
1. Spawning beds for fish:				
a. Brush				X
b. Rocky shoreline				X
c. Gravel			X	
d. Inflow		X		
e. Rip Rap				N/A
f. Others (list)				
2. Brush shelters or fish attractors:				
a. Brush shelter				X
b. Terrestrial vegetation				X
c. Rocky ledges				X
d. Cover near fishing pier				X
e. Aquatic vegetation				X
f. Air bubbles				X
g. Others (list)				X

3. Comments:

HABITAT IMPROVEMENT NEEDS

JAN 01 1976

Reservoir/Stream Navasota River
 County Leon/Robertson
 Date 1976
 Project F-30-R-2

	Over-Abundant	Adequate	Marginal	Absent
1. Spawning beds for fish:				
a. Brush			X	
b. Rocky shoreline				X
c. Gravel			X	
d. Inflow		X		
e. Rip Rap				N/A
f. Others (list)				
2. Brush shelters or fish attractors:				
a. Brush shelter				X
b. Terrestrial vegetation				X
c. Rocky ledges				X
d. Cover near fishing pier				X
e. Aquatic vegetation				X
f. Air bubbles				X
g. Others (list)				

3. Comments:

HABITAT IMPROVEMENT NEEDS

JAN 01 1976

Reservoir/Stream Navasota River
 County Robertson/Brazos
 Date 1976
 Project F-30-R-2

	Over-Abundant	Adequate	Marginal	Absent
1. Spawning beds for fish:				
a. Brush			X	
b. Rocky shoreline				X
c. Gravel			X	
d. Inflow		X		
e. Rip Rap				N/A
f. Others (list)				
2. Brush shelters or fish attractors:				
a. Brush shelter			X	
b. Terrestrial vegetation		X		
c. Rocky ledges				X
d. Cover near fishing pier				X
e. Aquatic vegetation			X	X
f. Air bubbles				X
g. Others (list)				

3. Comments:

Aquatic vegetation was marginal for the third quarter survey, but was absent during other quarterly surveys.

HABITAT IMPROVEMENT NEEDS

JAN 01 1976

Reservoir/Stream Navasota River
 County Brazos/Grimes
 Date 1976
 Project F-30-R-2

	Over-Abundant	Adequate	Marginal	Absent
1. Spawning beds for fish:				
a. Brush			X	
b. Rocky shoreline		X		
c. Gravel		X		
d. Inflow	X			
e. Rip Rap				N/A
f. Others (list)				
Boulders		X		
Rocks		X		
2. Brush shelters or fish attractors:				
a. Brush shelter		X		
b. Terrestrial vegetation			X	
c. Rocky ledges			X	
d. Cover near fishing pier				X
e. Aquatic vegetation				X
f. Air bubbles				X
g. Others (list)				

3. Comments:

Appendix G
Access and Facilities
Navasota River

Form 16

Reservoir or Stream <u>Navasota River</u>	1	2	3	4	5	6 7		8	9 10		11	12
		Improved*	Unimproved*	Private Ownership*	Public Ownership*	Public	Private	Number of Units	Public	Private	Public	Private
County <u>Leon/Robertson</u>												
Date <u>1976</u>												
Project <u>F-30-R-2</u>												
<u>FACTOR</u>												
A. ACCESS and FACILITY	?											
* Answer + or -												
1. Public Access	-											
2. Boat Ramps	-											
3. Picnic Areas	-											
4. Camping Areas	-											
5. Marinas	-											
6. Enclosed Fee Fishing Docks	-											
7. Fee Fishing Piers	-											
8. Free Fishing Piers	-											
9. Private Housing Developments	-											
10. Tailwater Public Access	-											

11. Comments and Notes:

No facilities for fishermen exist at this location.

Form 16

Reservoir or Stream	1	2	3	4	5	6		7	8	9		10	11		12
Navasota River															
County															
Limestone															
Date															
1976															
Project															
F-30-R-2															
<u>FACTOR</u>															
A. ACCESS and FACILITY															
* Answer + or -	?	Improved*	Unimproved*	Private Ownership*	Public Ownership*	Public	Private	Number of Sites	Number of Units	Public	Private	Cost/Person/Day	Public	Private	Cost/Person/Season
1. Public Access	-														
2. Boat Ramps	-														
3. Picnic Areas	-														
4. Camping Areas	-														
5. Marinas	-														
6. Enclosed Fee Fishing Docks	-														
7. Fee Fishing Piers	-														
8. Free Fishing Piers	-														
9. Private Housing Developments	-														
10. Tailwater Public Access	-														

11. Comments and Notes:

No facilities for fishermen exist at this location.

Form 16

Reservoir or Stream <u>Navasota River</u>		1	2	3	4	5	6		7	8	9		10	11		12
County <u>Robertson/Brazos</u>							Number of Sites				Cost/Person/Day			Cost/Person/Season		
Date <u>1976</u>																
Project <u>F-30-R-2</u>																
<u>FACTOR</u>																
A. ACCESS and FACILITY																
* Answer + or -		?	Improved*	Unimproved*	Private Ownership*	Public Ownership*	Public	Private	Number of Units	Public	Private	Public	Private	Public	Private	
1. Public Access		+	-	+		+	1		1	0	0			0	0	
2. Boat Ramps		-														
3. Picnic Areas		-														
4. Camping Areas		-														
5. Marinas		-														
6. Enclosed Fee Fishing Docks		-														
7. Fee Fishing Piers		-														
8. Free Fishing Piers		-														
9. Private Housing Developments		-														
10. Tailwater Public Access		-														

11. Comments and Notes:

Highway right-of-way provides fishermen with access to the river at bridge crossing. No facilities for fishermen exist.

Form 16

Reservoir or Stream <u>Navasota River</u>	1	2	3	4	5	6		7	8	9		10	11		12
	?	Improved*	Unimproved*	Private Ownership*	Public Ownership*	Number of Sites		Number of Units	Cost/Person/Day		Cost/Person/Season				
						Public	Private		Public	Private	Public	Private			
County <u>Brazos/Grimes</u>															
Date <u>1976</u>															
Project <u>F-30-R-2</u>															
<u>FACTOR</u>															
A. ACCESS and FACILITY															
* Answer + or -															
1. Public Access	+	-	+	-	+	1	0	1	0	0	0	0	0	0	0
2. Boat Ramps	-														
3. Picnic Areas	-														
4. Camping Areas	-														
5. Marinas	-														
6. Enclosed Fee Fishing Docks	-														
7. Fee Fishing Piers	-														
8. Free Fishing Piers	-														
9. Private Housing Developments	-														
10. Tailwater Public Access	-														

11. Comments and Notes:

Highway right-of-way provides fishermen with access to the river at bridge crossing. No facilities for fishermen exist.

Appendix H
Physicochemical Data
Navasota River

RESERVOIR PHYSIOCHEMICAL
SUMMARY FORM

Reservoir or Stream Navasota River
 County Limestone
 Date 1976
 Project F-30-R-2

		1 *	2 Specify Units
PHYSIOCHEMICAL			
1. Average Surface Area (Acres)	N/A		
2. Average Annual Fluctuation (Ft.)	N/A		
3. Mean Depth (Ft.)	2		ft.
4. Maximum Depth (Ft.)	3		ft.
5. Shoreline Length (Mi.)	N/A		
6. Shore Development	N/A		
7. Storage Ratio	N/A		
8. Thermocline?		2	
9. Duration of Thermocline (Mos.)	N/A		
10. Mean Depth to Top of Thermocline	N/A		
11. Constant Tailwater Discharge?	N/A		
12. Range of T (°F) Tailwater Dischg.?	N/A		
13. Range of Reservoir T (°F)	66.2-87.8		F°
14. % of Reservoir Surface with Submerged Cover	< 1%		%
15. Reservoir Steep-sided? (stream)		1	
16. Age of Reservoir (Yrs.)	N/A		
17. Area of Shoal	N/A		
18. Transparency (Secchi) Ft.	6.0-14.0		in.

*1 - Yes
 2 - No

**RESERVOIR PHYSICO-CHEMICAL
SUMMARY FORM**

Reservoir or Stream Navasota River
 County Leon/Robertson
 Date 1976
 Project F-30-R-2

		1 *	2 Specify Units
PHYSICO-CHEMICAL			
1. Average Surface Area (Acres)	N/A		
2. Average Annual Fluctuation (Ft.)	N/A		
3. Mean Depth (Ft.)	3		ft.
4. Maximum Depth (Ft.)	4.5		ft.
5. Shoreline Length (Mi.)	N/A		
6. Shore Development			
7. Storage Ratio	N/A	2	
8. Thermocline?		2	
9. Duration of Thermocline (Mos.)	N/A		
10. Mean Depth to Top of Thermocline	N/A		
11. Constant Tailwater Discharge?	N/A		
12. Range of T (°F) Tailwater Dischg.?	N/A		
13. Range of Reservoir T (°F)	60.8-82.4		F°
14. % of Reservoir Surface with Submerged Cover	1%		%
15. Reservoir Steep-sided? (stream)		1	
16. Age of Reservoir (Yrs.)	N/A		
17. Area of Shoal	N/A		
18. Transparency (Secchi) Ft.	3.5-11.0		in.

*1 - Yes

2 - No

**RESERVOIR PHYSICO-CHEMICAL
SUMMARY FORM**

Reservoir or Stream Navasota River
 County Robertson/Brazos
 Date 1976
 Project F-30-R-2

		1	2
		*	Specify Units
PHYSICO-CHEMICAL			
1. Average Surface Area (Acres)	N/A		
2. Average Annual Fluctuation (Ft.)	N/A		
3. Mean Depth (Ft.)			ft.
4. Maximum Depth (Ft.)			ft.
5. Shoreline Length (Mi.)	N/A		
6. Shore Development	N/A		
7. Storage Ratio	N/A		
8. Thermocline?			
9. Duration of Thermocline (Mos.)	N/A	2	
10. Mean Depth to Top of Thermocline	N/A		
11. Constant Tailwater Discharge?	N/A		
12. Range of T (°F) Tailwater Dischg.?	N/A		
13. Range of Reservoir T (°F)	60.8-80.0		F°
14. % of Reservoir Surface with Submerged Cover	5%		%
15. Reservoir Steep-sided? (stream)		1	
16. Age of Reservoir (Yrs.)	N/A		
17. Area of Shoal	N/A		
18. Transparency (Secchi) Ft.	3.0-10.0		in.

*1 - Yes

2 - No

RESERVOIR PHYSICO-CHEMICAL
SUMMARY FORM

Reservoir or Stream Navasota River
 County Brazos/Grimes
 Date 1976
 Project F-30-R-2

PHYSICO-CHEMICAL		1	2
		?	Specify Units
1. Average Surface Area (Acres)	N/A		
2. Average Annual Fluctuation (Ft.)	N/A		
3. Mean Depth (Ft.)	4.2		ft.
4. Maximum Depth (Ft.)	5.8		ft.
5. Shoreline Length (Mi.)	N/A		
6. Shore Development	N/A		
7. Storage Ratio	N/A		
8. Thermocline?		2	
9. Duration of Thermocline (Mos.)	N/A		
10. Mean Depth to Top of Thermocline	N/A		
11. Constant Tailwater Discharge?	N/A		
12. Range of T (°F) Tailwater Dischg.?			
13. Range of Reservoir T (°F)	62.6 - 86.0		F°
14. % of Reservoir Surface with Submerged Cover	7%		%
15. Reservoir Steep-sided?		1	
16. Age of Reservoir (Yrs.)	N/A		
17. Area of Shoal	N/A		
18. Transparency (Secchi) Ft.	4.0-7.0		in.

*1 - Yes
 2 - No

Appendix I

Frame Netting

Navasota River

(none this segment)

Appendix J

Electrofishing

Navasota River

(none this segment)

Appendix K

Trawling

Navasota River

(none this segment)