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St. Johns River, Florida
Water Quality Feasibility Study
Phase I Interim Report

Volume VII

Summary of Workshop

U.S. Army Corps of Engineers
Jacksonville District
South Atlantic Division

St. Johns River Water Management District
Palatka, Florida

Table of Contents

A LOWER ST. JOHNS RIVER WORKSHOP SEDIMENTS, HYDRODYNAMICS, WATER QUALITY AND RELATED ISSUES

SUMMARY

Prepared by
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CONTENTS

A LOWER ST. JOHNS RIVER WORKSHOP
SEDIMENTS, HYDRODYNAMICS, WATER QUALITY AND RELATED ISSUES

Overview

BACKGROUND

In 1987, the Florida Legislature mandated that the water management districts in the state address problems with water quality and habitat in several "priority water bodies" as part of the Surface Water Improvement and Management (SWIM) Act. The lower St. Johns was included in this list. Since that time, the St. Johns River Water Management District (SJRWMD) has developed an evolving program based on the watershed concept. The program has now progressed to a point where several important issues need to be addressed. The level and type of technical support needed to make sound management decisions are the most notable, especially when time and cost factors are included in the equation. Emphasis has been placed on identifying viable alternatives in the technical areas covered as part of a feasibility level study under a cost-share/joint agreement between the SJRWMD and the U.S. Army Corps of Engineers (USACE) known as the "St. Johns River Water Quality Management Study." A Lower St. Johns River Workshop - Sediments, Hydrodynamics, Water Quality, and Related Issues was conducted from September 13-16, 1993, in Atlantic Beach, Florida. This workshop was the final task performed under the cost-share agreement. A brief overview of the workshop sessions is provided below.

Day 1 (Tuesday, September 14)

The morning session consisted of a series of presentations that included descriptions of the watershed, SWIM program, work completed under the SJRWMD/USACE cost-share agreement, and the proposed 5-year watershed management plan. A historical presentation and an informative boat tour rounded out the afternoon and evening activities. By the end of the day, even those panelists who had never visited or worked in this area developed a familiarity with the St. Johns, its problems, existing programs, and plans for future activities.

Day 2 (Wednesday, September 15)

Technical panel discussions were devoted to developing sound analytical practices that may be used by the SJRWMD as part of its technical support program that are based on scientific merit. The primary areas of focus were watershed processes, sediment quality, sediment physics, hydrodynamics, and water quality. Sediment physics and hydrodynamics were combined into one panel. Living resources and other related issues were addressed in an interdisciplinary manner in context with the area of focus for each panel. Some panelists served on more than one panel, as appropriate. Panelists were encouraged to attend other sessions and participate in general discussion toward the end of each session.

Day 3 (Thursday, September 16)

In the morning, recommendations from the previous day were reviewed and priorities for action were established based on technical/scientific merit. Successes and failures experienced when technical approaches have been applied to the management decision-making process were discussed and implications for technical programs were identified. In the afternoon, management needs for technical support were discussed as part of an intergovernmental panel and the roles of government, business, industry, educators, and citizens were examined. During the final hour of the workshop, the panel sessions were summarized and recommendations for change were discussed. Individuals serving on the technical panels were encouraged to take part in all activities, including the management related discussions on the final day.

A total of 70 individuals attended the workshop. The majority were either speakers or panelists with a specific goal of evaluating and recommending alternatives that could be implemented as part of ongoing technical program for the LSJRB. Information presented at the workshop is expected to be very useful for this purpose.

Position papers which were sent to panelists prior to the workshop summarized issues of importance to the LSJRB technical program. The position papers, panel summaries, a workshop synopsis, agenda, and a list of participants are provided below.

POSITION PAPERS

WATERSHED PROCESSES
Lower St. Johns River Basin
Watershed Modeling and External Load Assessment

Overall Objective

Water quality management of the Lower St. Johns necessitates the development of reasonable, cost effective approaches to abate pollution loads entering the river's main stem. Assessment of chemical contributions is necessary to develop the mix of point and non-point control strategies which can be invoked to provide quality necessary to attain "designated use".

Physiography/Precipitation

Tributaries entering the Lower St. Johns are of two types. On the river's east bank, short, low head (typical headwater elevations = 25 to 35 ft. msl) streams drain the Atlantic coast flatwoods. Watershed soils are predominantly poorly drained, and streams are associated with extensive wetland source areas. The typical annual rainfall pattern, which sees most precipitation from July through September, brings watertables to the surface through much of these watersheds, providing sustained baseflow through the fall. The combination of increased soil microbial activity via available moisture and higher temperature, and enhanced runoff potential, results in high allochthonous organic matter transport at this time.

On the river's west bank, several longer, medium head streams drain higher elevation (175 to 200 ft. msl) sandy ridges. The parent material of these ridges is extremely base cation poor, yielding low pH, soft, darkwater streams.

Pollution Sources

Nonpoint source pollution arises primarily through row crop agriculture in the southeast basin; medium density residential with septic tank on poorly drained soils, concentrated primarily on the river's east bank; and urban/industrial impervious surfaces at the river's mouth in Jacksonville. While the latter two land uses contribute loads primarily as a function of runoff (i.e., rainfall driven), the seasonal management practices of agriculture make modeling this activity more complex.

Nutrient constituents are the primary concern in agricultural runoff. Agricultural tributary stormflow concentrations vary from 0.7 to 1.6 mg/l total phosphorus, and from 4.0 to 11.0 mg/l total nitrogen. Jacksonville urban stormwater is relatively low in nutrients, but typical event mean concentrations for metals vary from 7 to 14 mcg/l for copper, 11 to 47 mcg/l for lead, and from 50 to 165 mcg/l for zinc.

Monitoring Activities

The bulk of historical water quality monitoring to date within the watershed tributaries has been performed under fixed interval ambient sampling programs. Samples with a wide constituent range (complete total nutrient forms, chlorophyll, trace metals) have been collected only since 1985. Work has recently begun on characterizing the components of tributary flow, stormflow and baseflow.

A limited amount of stormflow data have been collected from Jacksonville urban watersheds. The Jacksonville watersheds are also currently undergoing a modelling effort aimed at predicting storm stages and pollutant loads, for the purpose of devising stormwater management systems.

Characterizing nonpoint agricultural pollutant loads has received the greatest attention in recent studies. Soon to be completed work has described field loads, and studies recently undertaken will expand these measurements to whole watersheds.

The existence of significant loading from low-lying residential areas is largely conjecture at this time, and no efforts have been made to characterize its impact.

In addition to nonpoint source loading to the river, point sources continue to contribute significant nutrient loads to the main stem. Approximately 38% of the total nitrogen load and 55% of the total phosphorus load are contributed by point sources, most located between the southern Duval County line (Jacksonville) and the ICWW.

Workshop Objectives

Identify the most reasonable approach to determining tributary watershed flux rates of the Lower St. Johns River to:

1) determine which watersheds contribute the greatest loads to the river main stem, as well as the constituent profile of these fluxes,

2) qualitatively describe the natural (physiographic and biotic) and human caused (land use development patterns, management practices, hydrologic modifications) factors driving constituent loads,

3) quantitatively describe the timing and magnitude of these flux rates to serve as boundary inputs to a river main stem water quality model.

SEDIMENT QUALITY
Lower St. Johns River Basin

Background

During the past 10 years, nine studies have evaluated the degree of contamination of LSJRB sediments. These studies are limited in scope. Sources of sediments within the river are, therefore, poorly understood, and information concerning the complex flow patterns and water chemistry that affect sediment deposition and distribution is virtually non-existent. The limited information that is available relies heavily on general knowledge of sediment characteristics and transport mechanisms, and very little upon empirical data gathered within the estuary.

That which is clear is that the primary physical and chemical properties affecting sediment formation and transport result from the unique characteristics of the basin. The sediments of the LSJRB are composed of very fine material (silts and clays) and are poorly sorted. The low gradient of the river basin results in the absence of strong downstream flow and in extended tidal effects. This combination allows more upstream transport of suspended load, as well as allowing a broad area to be affected by the mixing of salt and fresh water. The chemical differences between fresh and salt water cause flocculent material to form from the suspended silt and clays, and heavy metals to precipitate into the sediment at the interface between fresh and salt water.

The LSJRB sediments are high in organic content, particularly in the tributaries, making them perfect sinks for hydrophobic chemicals. Published data indicate that river sediments are contaminated significantly by a number of different classes of compounds including heavy metals, PCBs, PAHs, and chlorinated pesticides.

Discussion Objectives

- Considering contaminant storage and distribution in sediments, discuss the specific information needed from sediment transport models.

- Discuss the need for determining the temporal and spatial distribution of sediment types and toxic contaminants.

- Discuss the temporal and spatial characteristics of models needed to predict areas of probable deposition, erosion and resuspension of sediments and associated toxic contaminants.

- Discuss the need for modeling of sediment dynamics to predict areas of probable deposition and accumulation of sediments and associated toxic contaminants.

- Discuss the need for sediment sampling activities, and propose cost-effective methodologies.

- Discuss the need for research on relative toxicity and bioavailability of sediment-bound contaminants to resident species.

- Discuss the connection between, and mutual influence of, water column quality and sediment quality.

SEDIMENT PHYSICS
Lower St. Johns River Basin

Background

Sediment physics includes quantitative descriptions of sediment sources and sinks (erosion, deposition, resuspension), descriptions of the components of the sediment, and transport, mixing, and dispersion. Physical models for studies of shoaling have been developed for Jacksonville Harbor (Mill Cove), but no comprehensive sediment modeling study in the Lower St. Johns River has been reported. Sediment physics must be described before changes in sediment quality can be quantified. A schedule for gaining a comprehensive understanding of the magnitude and distribution of the sediment problem in the river has not yet been defined.

Assumptions

It is assumed that the quality of sediments in the LSJR is a problem and that the trend is toward decreasing quality. It is assumed that an understanding of hydrodynamics and sediment physics is required for any assessment of sediment quality. Also, it is assumed that, for management of sediment in the river, the SJRWMD first needs to decide on the extent to which sedimentation needs to be, and can be, controlled. This question may be answered after an assessment of existing conditions in the river, including sediment quality, a comparison of the available choices for sediment management, and an evaluation of the costs of monitoring and modeling vs. the chances for developing alternative assessment tools have been completed.

Specifically, existing conditions in the LSJR will be described by (1) quantifying the types, sizes, and structures of sediment assemblages, (2) locating and quantifying the magnitudes of sediment sources and sinks, (3) mapping the distribution and trends in sediment accumulation in each area of the river, and (4) attempting to establish long-term trends in sedimentation from observations and measurements.

Major Points to be Covered in the Workshop

The state-of-the-art in quantifying sediment transport processes should be discussed. The advantages and disadvantages of surveys, measurements, monitoring systems, data analysis, and modeling should be reviewed in the context of the needs of the District for sediment management.

The known choices for management of sediments should be reviewed, and the advantages and disadvantages described.

Typical Specific Questions to be Answered or Discussed

Considering the overall goal of developing a sediment management capability for the river, is it necessary to:

a. quantify sediment mass balances (inflows, outflows, and storages) for specific areas?

b. quantify sediment transport, erosion, deposition, and resuspension?

If it is necessary to quantify the above, is it practical and feasible to do so? What are the advantages and disadvantages of such an effort?

If it is practical and feasible to quantify the processes in sediment physics, is simulation modeling practical and feasible, considering that simulations may operate at short time steps over long time periods, with requirements for large amounts of data?

If it is practical and feasible to develop models as management tools, what models are available and what temporal and spatial parameters are recommended?

What kind of sampling plan should be used to support the need for sediment dynamics model calibration and verification data?

How should predictive water quality and sediment initial and boundary conditions be formulated?

HYDRODYNAMICS
Lower St. Johns River Basin

Background

The Lower St. Johns River is defined as that part of the river lying downstream of its confluence with the Ocklawaha River, approximately 100 miles south from the mouth at Jacksonville. The mean range of tide at the ocean entrance (Little Talbot Island) is 5.49 ft, and the spring range is 6.09 ft. The mean range of tide decreases to 4.51 ft at Mayport, and reaches a minimum of 0.71 ft at Julington Creek, south of Jacksonville. It then increases upstream to a secondary maximum of 1.09 ft at Palatka, again decreases to 0.35 ft at Welaka, and becomes negligable in Crescent Lake and at Georgetown.

Various characteristics of the St. Johns River have been measured and described since the late 1800s. Useful measurements of hydrodynamic features began in the 1930s. The U.S. Geological Survey (USGS), the National Ocean Service (NOS/NOAA), and the U.S. Army Corps of Engineers (USACE) have been the most active in obtaining basic hydrodynamic data on the river.

The river shorelines have been adequately mapped, but the bathymetric database is fragmented and is not recent. Outside of Jacksonville the set of raw depth data from hydrographic surveys, conducted between 1876 and 1959, has been digitized; in the Jacksonville area only charted depths are contained in the NGDC computer database. In general, except east of Jacksonville, only one bathymetric survey has been conducted in each area of the river.

The major hydrodynamic forcing functions have been identified. Tidal characteristics were partially described and quantified in the 1970s. However, there is only one long-term record of tide, at Mayport. Wind effects have been observed but not comprehensively related to stages and flows.

The hydrology of some basins has been described, and quantified to a limited extent. Detailed studies of some sub-basins have been conducted to describe flood protection and water quality loadings. However, no study has yet focused on either the effects of fresh water inflow on the river, or the effects of pollutant loadings.

Total river flows have been measured, but not reliably. Mean total flow at the confluence with the Ocklawaha River is estimated to be about 5,300 cfs. Cumulative monthly mean freshwater inflow at Jacksonville ranges from approximately 4,300 cfs (May) to 11,600 cfs (October). Total daily discharges at Jacksonville range from an estimated 64,000 cfs downstream to 62,700 cfs upstream. Until 1993, when some new flow-measurement systems have been installed, the estimates of flow have been based on stage/discharge and velocity measurements, Branch model calculations, and their associated rating curves.

A storm surge study by the Federal Emergency Management Agency (FEMA) has produced water level and flooding predictions and a series of flood plain maps. These have been supplemented by the Master Stormwater Management Plan for Duval County, which is still under development.

Longitudinal salinity profiles have been sampled a few times, but have not been related quantitatively to hydrology.

A few simple hydrodynamics and crude water quality models have been developed since the 1970s, but these are not detailed enough for the present needs of water managers.

Assumptions

It is assumed that, for management of water quality and restoration of the river, an understanding of hydrodynamics, sediment dynamics, and water quality dynamics in the river is required. Understanding of dynamics includes knowledge of trends in water and sediment quality and the responses of the river to inflows of fresh water and pollutants. It is assumed that it will be necessary to be able to predict the effects of specific changes in point and non-point loadings under certain hydrologic conditions, and to compare the effects of alternative management choices. Thus, it will be important to be able to assess the impacts of a change in input, to assess costs of alternative projects and measurement plans, and to be able to describe conditions, trends, and possible actions and consequences.

Major Points to be Covered in the Workshop

In the workshop it will be desirable to discuss the extent of hydrodynamic information needed by water quality managers to support predictions of water and sediment quality responses to changes in inflows. The spatial scales, i.e. the spatial extent, degree of resolution, and interfacing of both near-field and far-field models should be discussed. The time scales of hydrodynamic models, with regard to water quality and sediment components and the need for both relatively short-term (several week long) and relatively long-term (monthly or seasonal) predictive capabilities should be addressed. Techniques for coupling hydrodynamic models to sediment and water quality models are important. The extent and resolution of monitoring and measurement systems should be covered.

Typical Specific Questions to be Answered or Discussed

What hydrodynamic and salinity phenomena (processes) and level(s) of spatial and temporal detail are needed to adequately quantify hydrodynamics and salinity for management of St. Johns River water quality and river restoration?

Is it necessary, feasible, and cost-effective to model vertical phenomena such as stratification and mixing?

What monitoring and measurements are needed to support a planning-level understanding of river dynamics and responses?

How should predictive hydrologic, hydrodynamic, and salinity initial and boundary conditions be formulated?

For assessing retention times and flushing rates for tributary areas (assuming adequate data are available for calibration, verification, and setting initial and boundary conditions) what kind of model would be recommended, what features should it have, and how reliable could it be in a predictive mode?

WATER QUALITY
Lower St. Johns River Basin
River Main Stem Spatial and Temporal Water Quality Trends

Overall Objective

Devising reasonable and defendable load reductions to the St. Johns River main stem require a more thorough understanding of riverine processes. These processes include aquatic food chain bases, possible limiting factors to phytoplankton growth, sediment nutrient supply, and the role of macrophytes. Inter-relationships of these factors determine the quality of the river fishery, recreational potential and ecosystem health. The assessment of the maintenance, enhancement and management of the "river resource" will invariably rely on surface water sampling and chemical analysis, thus it is incumbent that we more completely describe water quality and its relationship to these resources.

Trends in River Main Stem Water Quality

A. Spatial Trends

Analysis of water quality data thus far has led to the distinction of three broad river segments, all tidally influenced, based on morphologic and hydrodynamic features: an open-water freshwater segment from the cities of Palatka to Green Cove Springs (mean annual conductance 1.0 to 0.9 mmhos/cm, respectively; < 0.5 ppt salinity); a open-water, oligohaline segment from the Duval County southern boundary north to the Ortega River mouth, where the river narrows (mean annual conductance 1.7 to 8.5 mmhos/cm; 0.5 to 5 ppt); and a rapidly flushed river/tidal inlet from Jacksonville to Mayport (the river's mouth)(mean annual conductance > 8.5 mmhos/cm; >5 ppt).

Shortly after the entry of the St. Johns River to the Lower Basin, it broadens to the wide, tidally influenced (e.g., sea level) fresh open-water segment. Here the river takes on characteristics of both a river and a lake. Velocities are low enough to permit phytoplankton productivity; mean annual chlorophyll A concentrations range from 20 to 25 mcg/l, and mineral nutrient form are low relative to organic forms, suggesting continuous algal assimilation. Allochthonous organic carbon is also significant. Color (dissolved organic carbon data are not available) generally runs from 75 to 140 Pt-Co units within this segment. Black Creek, just north of the city of Green Cove Springs, provides the last large freshwater input to this river segment.

Shortly downstream of Black Creek, a turbidity maximum can be discerned between Doctor's Inlet and the Ortega River, effectively marking the end of the reach of high water column algal productivity and the beginning of the oligohaline open-water segment. Below this reach, the river again narrows, flowing with distinct and appreciable velocity, the direction of which is determined by the tide. Turbidity and turbulence remain high in this segment, hence phytoplankton productivity remains depressed despite high mineral nutrient concentrations. These nutrients are assumed to arise primarily from domestic waste treatment facilities, which discharge a cumulative, continuous 170 cfs at an average total nitrogen of 15.3 mg/l and total phosphorus of 4 mg/l.

While point source loads in the Jacksonville reach do not appear to have a deleterious effect on water quality via eutrophication, non-point source loads of toxic metals, aromatic hydrocarbons and chlorinated biphenols may be may be affecting biotic communities. Effects level concentrations have been measured in sediments and biota in all tributaries within this river segment, and stormflow from urbanized watersheds typically contains appreciable metals concentrations.

B. Annual Trends

In the "fresh open-water" portion of the river (Palatka to Green Cove Springs), phytoplankton productivity and rainfall/temperature patterns exert the greatest control over annual trends. Chlorophyll a data and very infrequent phytoplankton species identification suggest blue-green dominance and maximum biomass from April through August (chlorophyll a > 33 mcg/l). Allochthonous organic carbon peaks from September through December, as summer rain-flooded tributary source areas begin to shed organic matter.

In the estuarine river (Orange Park to Mayport), annual water quality trends are controlled by river discharge and tidal advance. Water quality data suggest a lag of as much as 6 months between maximum rainfall and discharge, which occurs in September, and arrival of headwater derived freshwater. Sustained weather patterns can significantly affect marine water advance and storage within the open river as far upstream as Palatka, and hence resultant water quality. Frontal storms with predominantly northeast winds occur from November through March, while southwesterly winds are typical through the summer.

C. Long Term Trends

Little long term water quality data exist for the Lower St. Johns River. Earliest data were collected in the late 1950's. The only discernable trend suggests (i.e., not rigorously proven) an increase in total phosphorus to the early 1980's, followed by a gradual decline to the present, which may be attributed to improvements in wastewater discharge quality. Nitrogen form concentrations show little change over the period of record, a trend which is explained by competing factors of wastewater quality improvement verses continued development and population increase.

D. Vertical Stratification

The estuarine portion of the St. Johns River is moderately stratified, with bottom and top salinity difference usually less that 5 ppt. No stratification is evident in the fresh open-water river in salinity, nutrient forms or metals.

Monitoring Activities

Ambient, fixed interval, surface water monitoring constitutes the bulk of agency water quality sampling to date. Recently initiated monitoring is focusing on describing transient water quality at shorter time steps. These include salinity transect sampling to define tidal advance/regression at the maxima and minima of the cycle, and diurnal monitoring to identify factors which deplete water column dissolved oxygen. Fixed interval ambient sampling is currently coordinated between three agencies. These agencies also participate in twice yearly synoptic surveys, a comprehensive, basin-wide synchronized sampling event.

Workshop Objectives

Devise strategies for the measurement and prediction of water quality which:

1) identify aquatic ecosystem compartments and their associated exchange and assimilation rates, for the purpose of enhancing the function of desirable components,

2) model mainstem water quality to predict trends past on present and future loading scenarios,

3) translate the factors necessary for the maintenance of desirable ecosystem function into water column concentrations for the establishment of standards.

TECHNICAL PANEL SUMMARIES

WATERSHED PROCESSES
Panel Summary

Mission Statement: Develop allôwable loads from land areas within the St. Johns River basin in order to properly identify management practices necessary to satisfy competing demands for adequate water quality.

Critical Success Factors:

- Critically evaluate competing goals for different levels of water quality and identify parameter levels for receiving waters.
- Quantify loads for the land uses within the basin in order to prioritize impacts from various land uses.
- Perform evaluations necessary to properly identify loading factors for priority land uses.
- Delineate appropriate best management practices that will decrease critical parameters from priority land uses.
- Estimate control costs for construction and maintenance of best management practices.
- Develop cost estimates for different land uses and best management practices to allow comparisons with specific pollutant parameter reductions.
- Assess the significance of these cost estimates through presentations and discussions with impacted communities within the basin.

SEDIMENT QUALITY
Panel Summary

Panel Participants: John D. Schell (Chairman), Michael Rozengurt, Steve Schropp, Fred Calder, Herb Windom, Jonathan Garber, Ramesh Reddy, Dana Morton.

INTRODUCTION

Dr. John D. Schell, Toxicologist with TERRA Inc. of Tallahassee, Florida presented a brief overview of the sediment contamination situation within the LSJRB. Included in the discussion was a description of the basin in terms of contaminants present, their distribution and those factors which complicate cost-effective remediation. Following this brief synopsis of the situation, the following questions were posed to the panel:

> Given the current situation, the limited data and the numerous contaminants known to exist within the LSJRB,
>
> 1) What are the key considerations relative to the development of a sediment assessment/remediation program;
>
> 2) How should the District develop and design its sampling program to determine the need for restoration and, ultimately, support restoration activities;
>
> 3) Once the problem is defined (qualitatively and quantitatively) what restoration techniques are available which may have application within the LSJRB.

PANEL DISCUSSION

The panel discussion identified various assessment needs. Assessment needs included physical, chemical and biological parameters. Following the panel's identification of assessment needs, some general comments and suggestions concerning restoration were offered. Below is an outline of the panel discussion and the salient observations provided by the panelists and audience.

I. Assessment Needs

A. Physical

There is a need for physical assessment of the sediments within the LSJRB. The physical assessment should:

1) Define Sediment Distribution
Bottom Maps are in invaluable tool in the definition of sediment distribution within the basin.

2) Sediment Budget
Sources of sediments should be identified and the *movement* of sediments within the river should be described.

3) Cores
Sediment core samples are useful in revealing *temporal trends* and in identifying sources of sediment load, especially useful in establishing status and trends.

B. Chemical

There is a need for chemical assessment of sediments within the basin. The chemical assessment should:

1) Identify contaminants
Any assessment should include a determination of which contaminants are present within the basin.

2) Identify contaminant sources

3) Determine contaminant levels

4) Determine the significance of contaminants
It was suggested that *background levels* could be used as reference points, and that levels of 10% above background should be cause for concern. It was suggested that *published indices*, such as PELs, NOELs were a good reference to use in determining significance. *Existing standards*, such as those contained within state law and policy were good reference points.

5) Are Sediments Sources or Sinks for contaminants
The interaction of toxic substances with sediments is complex and governed by a number of physical and chemical factors.

Under certain circumstances sediments attract and bind toxic substances, making them unavailable to the water column and resident biota. Under other circumstances, they can release stored toxics creating potential for environmental hazard. Determination of the ***behavior of sediments*** and associated toxics is an important component of any assessment.

6) Quality Assurance/Quality Control QA/QC
Any analysis of the chemical composition of sediments must have adequate if the results are to be used to determine the need for remediation. Comparability of data spatially and temporally is very important in determining priorities for and evaluating effectiveness of clean up activities.

C. **Biological**

There should be a biological component in any sediment assessment program. Biological assessment should include:

1) Number of species

The number of species present at a given location should be determined, and compared to the number of species present in similar or *reference sites*. Decrease in number of species present should signal the need for further assessment.

2) Effect of sediments on benthic organisms

It is important to understand the impact of contaminated sediments on resident organisms. The types of assessments which were suggested included *bioassays* and determinations of *bioavailability*. It was stated that often contaminants produce very *subtle effects.* The panel cautioned against relying on mortality as the only indicator of biological health, Ulcerative Disease Syndrome was used as an example of possible, non-lethal contaminant effects.

3) Use bioeffects to help establish priorities

Biological effects can, and should, be used to help establish priorities for remediation. The public responds well to measures which will improve biological health.

II. General

A number of general comments regarding clean-up and understanding of sediments were offered by the panel and the audience. These included:

A) Modeling

There are a number of sediment models which are available. These include models for evaluating *toxicity*, evaluation in preparation for *dredge spoil removal*, and for sediment *movement*. Some are economical in terms of time and money and may have application within the LSJRB. Given the paucity of good physical and hydrological data within the LSJRB, modeling may be *premature*. Whatever tools are used to assess sediments, the must be *practical and useful* to resource managers.

B) Prioritization

Given 1) extent of the LSJRB, 2) the extent of the sediment contamination problem and 3) the limited resources available, there is a need to *prioritize* sediment assessment and remediation activities within the basin. There is sufficient information for prioritization of areas for future work.

C) Immediate action

There are sufficient data available to justify *immediate action* in some areas. Many are not dependent on the results of expensive modeling or extensive assessment. Immediate action activities may include *sediment traps* and *vegetated buffer zones.*

D) Allow the need to determine the approach

E) GIS

Geographic Information Systems can be used to support the whole gambit of assessment activities. The value of these efforts, when tied together with GIS is greater than the individual parts.

F) Data availability

The data, when collected, must be made available to those resource managers who are responsible for every day decisions regarding the resource. Agency permitting (regulatory) personnel are often the last to be made aware of the work of research done in support of regulatory activities. Make sure *information flows* to these people.

G) **Tributaries**

Within the LSJRB, sediment evaluations have been centered in the mainstem and in the downstream areas of tributaries where impacts are cumulative. There is a need to move further *upstream in the tributaries* to define the extent of contamination in these areas.

H) **Publicity**

Agency programs rely on *public support* for continued funding of clean-up activities. As a clearer understanding of contamination and its effects is achieved, the results should be publicized to ensure that the public which is the ultimate beneficiary, continues to support clean-up projects.

SEDIMENT PHYSICS AND HYDRODYNAMICS
Panel Summary

INTRODUCTION: SEDIMENT PHYSICS AND HYDRODYNAMICS

At the beginning of the panel discussion on Sediment Physics and Hydrodynamics, the moderator offered the following guidelines or issues for the panel to address.

1. Discussion of Models

One of the participants had stated that there could be confusion about the meaning of the word "model," since it has different meanings in different fields. The moderator defined a model as a numerical representation used for simulating processes in estuaries. In order to limit the possibility of wide-ranging discussion on all varieties of models, the moderator described the uses of models from the WMD's present viewpoint. A model:

- is a tool used to develop an understanding of estuarine system dynamics
- could assist in designing monitoring networks
- could support water quality and sediment dynamics, at the appropriate time in a study, to:
  - evaluate the effects of inflows
  - evaluate the effects of modifications to the system
- could support future management decision-making

2. Focus of Discussion

The moderator tried to focus discussion by stating the following general characteristics of a desirable model of the LSJRB:

- WMD will likely need a set of models with varying space and time scales:
  - Watershed - mainstream - intermediate (spatial)
  - Short-term and long-term
  - Fine resolution and wide area
- Develop one model at a time with continuous upgrade

The moderator also asked the panel not to spend much time comparing specific available models.

3. Users of Models

The moderator described the potential model-user community to include scientists, project managers, and resource managers in the St. Johns River Water Management District and in other agencies.

SUMMARY: SEDIMENT PHYSICS and HYDRODYNAMICS

The panel debate and recommendations could be grouped into four separate areas: watershed modeling, monitoring, modeling, and problems encountered by others. There was a fair amount of lively discussion about model dimensions (1-D vs 2-D vs 3-D), which is, in reality, about levels of resolution, degrees of accuracy, actual types and characteristics of different models, and costs. The following statements summarize the principal outcomes from, and topics that were not resolved in, the panel discussion.

1. Watershed Modeling

It was agreed that watershed modeling is needed to describe inflows of fresh water and corresponding pollutant loadings. The District:

- must account for diversions of fresh water from system
- must develop hydrologic models for describing inflows
- must assure that watershed mass balances are complete
- may want to consider including the Middle and Upper Basins for comprehensive management of the water resources of the system

2. Monitoring

There was no consensus on when monitoring should begin. The cautious approach suggests that the details regarding the variables to be monitored, the processes and time and space intervals to be used in the model, and thus the sampling frequencies and the total monitoring period, need to be fully defined ahead of time, to assure that the monitoring program will be minimal and cost-effective. Another approach argues that, by comparison with other similar projects, and a preliminary review of modeling objectives, the variables and sampling intervals can be easily defined and there is significant benefit to beginning as soon as possible. The intermediate approach is probably favored: define the scope of the model, implement a basic monitoring program, develop the model and use it to define any existing gaps in the monitoring program, and complete final calibration and verification of the model after enough data have been collected.

3. Modeling

There was no question as to the need for a hydrodynamics and salinity model. It was agreed that there is also a need to locate deposition and resuspension areas in estuary, but the panel did not suggest that a sediment model was required. They recommended that model objectives be clearly specified before selecting a specific model. They stated that planning and development of the model must be performed carefully to minimize unproductive efforts and produce a useful tool in a reasonable time.

It was suggested that the costs to develop all types of models are lower than at any previous time. Fully 3-D models have been tested on a number of waterbodies and are available and cost-effective, and a supercomputer is no longer needed to run such a model; for example, one panelist stated that a 1-year 3-D simulation using a model with several thousand cells can be run in about 48 hours on a PC or a Sun Sparc 2.

4. Problems Encountered by Others

Various miscellaneous problems that have occurred in similar projects in the past were reported by both panelists and persons in the audience. In one application, a grid that was developed to describe hydrodynamics turned out to be useless for water quality. In another model, losses of water in the system were not correctly accounted for. In still another, boundary conditions were not measured completely, and therefore calibration could not be adequately achieved. In a fourth project, a channel deepening effect was successfully calculated by hand to show the effect of saltwater intrusion and the model was not needed to solve the problem. The message of the latter example was that sometimes we don't need models to solve a problem, and that we should think first and analyze the methodology and expected results before developing a modeling program.

5. Topics Not Resolved

Various topics, besides the question about when to begin monitoring discussed above, were not resolved during the workshop. The type of model needed for the LSJR depends on the problems to be solved, which apparently had not been adequately defined for the panel. The advantages and disadvantages of developing a 1-D model before a 3-D model were discussed. The advantages and disadvantages of modeling tributaries before the main stem in the LSJR were discussed. Statements that 3-D models are easier to build and calibrate than 1-D and 2-D models were made, but not explored.

WATER QUALITY
Panel Summary

QUESTIONS POSED TO PANELISTS

1. What strategies would you recommend to better measure and assess water quality and the health of the aquatic community?

   Are there certain sampling schemes that should be modified based upon different domains in the lower basin?

   Have certain components of communities or water quality variables served well as key indicators?

2. What techniques would you recommend to evaluate improvement in water quality or the aquatic community as a result of management decisions?

3. There may be a need to set standards or goals to achieve the stated objectives. Would concentration or loading limits be a reasonable way to achieve these objectives?

4. What role do models play in assessing management decisions?

HIGHLIGHTS OF PANEL DISCUSSION

1. Thoroughly analyze the water quality and biological data, then design a sampling program to reflect a specific use. Reasons to monitor:

   a. Learn more about the system.

   b. Assess results of management actions.

2. Sampling program should be sensitive to the specific water quality issues, types of sources, and circulation pattern. Clearly define the objective of sampling, variables of interest, and level of resolution necessary.

3. GIS could be used to assist in revising the sampling scheme.

4. It is important to be able to separate man's impact from natural variation. Identify relative over-enrichment areas and the sources of that over-enrichment.

5. Some specific sampling suggestions.

    a. algal assays - be aware of species composition and use the appropriate species in the lab.

    b. macrophyte mapping

    c. statistical monitoring - could be useful, particularly for the benthos.

    d. sediment flux data

    e. silicates

    f. man made organics

    g. estuarine areas - perhaps make stations more mobile and sample along salinity gradients.

6. Look at resource based indices. Consider habitat suitability and deviations in index values. For example, NOAA considers changes in algal communities, nutrient concentrations, and long term species composition.

7. Models can prove useful to help assess some specific concerns in the basin. Models are good for measuring a change of state or addressing part of nature's influence under specific hydrologic conditions. The complexity of the model depends upon the particular concern, the resolution necessary to make management decisions, and the available resources. The previous panel discussed models and modeling in great detail. The following examples of model applications were provided by this panel:

    a. A hydrodynamic model for salinity and freshwater balance in the basin.

    b. A transport model that would address movement of toxicants or possible spills in the basin.

    c. A model to address sediment balance and potential impacts from channel dredging activities.

    d. Development of a nutrient budget using a box model segmentation approach.

8. Biological sampling should proceed in conjunction with water quality sampling.

WORKSHOP SYNOPSIS

SYNOPSIS OF THE WORKSHOP

Recommendations resulting from the technical panel sessions on watershed processes, sediment quality, sediment physics and hydrodynamics, and water quality fell into five general categories: goals and objectives, measurements, data analysis, modeling, and management. Highlights of discussions for each of these categories are presented below.

GOALS AND OBJECTIVES

The general goals and objectives for the Surface Water Improvement and Management program for the lower St. Johns River basin (LSJRB) were briefly summarized by St. Johns River Water Management District staff. Participants strongly recommended establishing specific goals and objectives and setting priorities for individual components of the program.

Critically evaluating competing goals for achieving different levels of water quality, and identifying water quality criteria to be applied to each receiving water body were considered to be necessary prior to determining the approach to evaluating watershed processes. To fully address watershed processes, participants agreed that it is essential to account for all significant diversions of fresh water from the system and to assure that watershed mass balances are complete.

Most panelists agreed that there are sufficient data available to set priorities for actions relative to sediment quality and to justify immediate action in some areas. It was suggested that initial goals could include the construction of sediment traps or creation of vegetated buffer zones. Clean-up activities, once initiated, should be publicized so as to cultivate public support and enhance the likelihood of continued funding.

Achieving an understanding of basic hydrodynamics for the system was considered essential.

MEASUREMENTS (SAMPLING AND MONITORING)

Panelists in several areas commented that there are at least three important reasons for monitoring: (1) to learn more about how the system operates, (2) to collect data for calibrating and verifying models, and (3) to assess the results of management actions. Sampling programs should be sensitive to the specific water quality issues, types of sources, and circulation patterns.

No consensus on monitoring of sediment physics and hydrodynamics processes was reached. Both the view that monitoring should not begin until the objectives have been fully developed, and the view that monitoring should begin as soon as possible, were expressed. A compromise approach was proposed. This approach would be designed to define the scope of the model, implement a basic monitoring program, develop the model, use the model to define any existing gaps in the monitoring program, and complete final calibration and verification of the model after enough data have been collected.

The water quality sampling program should be designed to meet specific uses after the existing data have been analyzed. Some specific water quality sampling suggestions included algal assays, macrophyte mapping, statistical monitoring, sediment flux, silicates, man-made organic compounds, and sampling stations in estuarine areas. GIS could be used to assist in revising the water quality sampling scheme.

It was the consensus of the panel that any sediment assessment program should include physical, chemical, and biological monitoring components. Physical assessment should include the development of bottom maps, identification of sediment sources and the movement of sediments. Sediment core samples were identified as a means of revealing temporal sediment quality and quantity trends. Chemical assessment is necessary to identify specific contaminants, their sources and their concentrations. The significance of contaminants is determined by their potential for impact on biological components of the environment. In this regard, biological assessment is a critical component of any assessment program.

DATA ANALYSIS

Panelists stated that watershed modeling can be used to quantify loads for the land uses within a basin. Results can then be used to evaluate impacts from various land uses and set priorities for action. The District should perform the evaluations necessary to properly identify loading factors for priority land uses. Costs for construction and maintenance of BMPs should be estimated. Also, cost estimates related to changes in land uses and implementation of BMPs should be developed to determine costs per unit of pollutant load reductions for each scenario. These projected costs and environmental benefits should be presented to local officials and citizens of impacted communities within the basin.

Separating environmental changes resulting from anthropogenic sources or as a result of natural variation was identified as an important objective. Over-enrichment areas and the sources of the over-enrichment should be identified. Resource-based indices should be investigated and utilized where applicable. Habitat suitability and deviations in index values should be considered. For example, NOAA considers changes in algal communities, nutrient concentrations, and long-term species composition in their assessment of environmental quality. Biological sampling should proceed in conjunction with water quality sampling.

The significance of chemical pollutants within the sediments can be determined by comparisons of assessed levels to published indices, background levels, or regulatory standards. Contaminants which are present at levels which are considered sublethal may still be cause for concern. Often contaminants produce subtle effects which can best be observed through bioassays or assessments of species diversity. The biological effects of contaminant laden sediments should help resource managers establish priorities for remediation.

MODELING

Panelists agreed that hydrologic models for defining inflows to the river are necessary. The objectives of a model development effort must be defined before a model is selected.

Hydrodynamic and sediment physics models are needed for assessing impacts of inflows on the system and locating deposition and resuspension areas. The resolutions, the dimensions, and the processes included in the main stem and tributary models must be determined by the intended application of the model. Some participants suggested a phased development of models in terms of complexity, while others recommended that the District plan to acquire whatever model is considered necessary for meeting ultimate goals. Participants agreed that the costs for development of all types of models are lower than they were several years ago, and low-end work stations and PCs are becoming capable of running more complex simulations.

Water quality models can prove useful to help assess some specific concerns in the basin. Models are good for measuring a change of state or addressing part of nature's influence under specific hydrologic conditions. The complexity of the model depends upon the specific concern, the resolution necessary to make management decisions, and the available resources. Examples of models that would be useful for water quality assessments were presented. The objective(s) of sampling, variables of interest, and level of resolution that is required must be clearly defined.

Sediment modeling can be used to identify areas of deposition and scouring, evaluate toxicity, and provide valuable information regarding sediment movement. Although sediment models are generally expensive and require vast amounts of data, there are some which are more economical, in terms of time and money, which may have application within the LSJRB. The analytical tools that are used to assess sediments must be practical and useful to resource managers. Given the paucity of good physical and hydrological data, the development of an extensive sediment model for the basin may be premature at this time.

MANAGEMENT

The District should delineate appropriate BMPs that will decrease impacts from priority land uses on critical chemical and biological components of the system. The Middle and Upper Basins of the St. Johns River should be included in the management decision-making process. Given the extent of the LSJRB, the sediment contamination problem, and the limited resources available, the need to set priorities for assessment and remediation activities is paramount.

AGENDA

A LOWER ST. JOHNS RIVER WORKSHOP
Sediments, Hydrodynamics, Water Quality & Related Issues

MONDAY, SEPTEMBER 13 Registration 6 - 9 p.m.

TUESDAY, SEPTEMBER 14

8:00 a.m. **Registration**

8:30 **Welcome - St. Johns River Water Management District Governing Board** ***(Denise Prescod) (10)***

8:40 **Lower St. Johns River Basin (LSJRB) Surface Water Improvement and Management (SWIM) Program**

1. Program Background and Goals - *(5 min.) - Bill Watkins*
2. Description of Watershed *(20) - Bob Brody*
   a. Physical Characteristics
   b. Living Resources
3. Description of Existing Data Base *(10) - John Hendrickson*
4. SJRWMD/U.S. Army Corps of Engineers (USACE) St. Johns River Water Quality Management Study - Goals and Objectives *(5) - Fred Morris*

9:20 **Presentations on Recent USACE and SJRWMD Assessments - Overview**

1. Water Levels and Tides - *National Ocean Service (NOS)/National Oceanic and Atmospheric Administration (NOAA) (10) - Stephen Gill*
2. Survey Controls & Benchmarks - *Department of Environmental Protection (DEP)/NOS (10) - Douglas Thompson*
3. Sediments - *Dunn & Associates (15) - Panagiotis Scarlatos*
4. Groundwater - *U.S. Geological Survey (USGS) (15) - Rick Spechler*
5. USACE Historical Data Base and Data Base Management - USACE-JAX *(10) - Steve Sutterfield*

10:20 **Break** ***(20)***

10:40 **Presentations on Recent USACE and SJRWMD Assessments (continued)**

6. Watershed Hydrology - *SJRWMD (10) - Martien Bergman*
7. Hydrodynamics - Waterways Experiment Station *(WES)/USACE - Vicksburg (20) - Lisa Roig*
8. Water Quality - *WES/USACE - Vicksburg (20) - Tom Cole*

11:30 **Overview of LSJRB SWIM Projects - Past, Present, and Future** ***(30)***

1. Summary and Status of Completed and Ongoing Projects *- Dean Campbell*
2. Description of New Projects - FY '93 and FY '94
   a. Biological Investigations - *Bob Brody*
   b. Assessments of Agricultural BMPs - *Pam Livingston-Way*
   c. Integrated Watershed Management - *Bill Watkins*
3. The SJRWMD 5-Year Plan (Proposed) - a brief overview of project plans for the near future that will enable the SJRWMD to meet goals and objectives of the LSJRB SWIM Program - *Dean Campbell*

12:00 p.m. **Lunch** ***(75) - Introduce Panelists***

1:15 **The St. Johns River - A Historical Tour through Photographic Archives** ***(70) (Bill Dreggors)***

2:30	**Travel to Naval Air Station (NAS) - Jacksonville** *(60)*
3:30	**NAS-JAX "Mini" Tour - Hazardous Waste Treatment Facility** *(45)*
4:30	**Boat Tour** ***(est. 4 hrs. 30 min.) (Port Authority & Navy Guest Speakers)*** **-** ***Neal Ganzel & Kevin Gartland***
9:00	**Travel (from Blount Island → Atlantic Beach)**
9:30	**Arrive Motel**

WEDNESDAY, SEPTEMBER 15

8:00 a.m.	**Initiate Panel Discussions - Determine Analytical Alternatives to Meet Goals** *(5-10)*
8:15	**Watershed Processes** *(90) - Moderator, Steve Sedgewick*
9:45	**Break** *(30)*
10:15	**Sediment Quality** *(90) - Moderator, John Schell*
11:45	**Lunch** ***(75) (on your own)***
1:00 p.m.	**Sediment Physics & Hydrodynamics** *(90) - Fred Morris*
2:30	**Break** *(30)*
3:00	**Water Quality** *(90) - Wayne Magley*
4:30	**Adjourn**

THURSDAY, SEPTEMBER 16

8:00 a.m.	**Finalize Alternative Approaches for each Technical Category** *(60)* 1. Watershed Processes 2. Sediment Quality 3. Sediment Physics & Hydrodynamics 4. Water Quality
9:00	**Interdisciplinary Discussion - Set priorities for action based on technical merit** *(90)*
10:30	**Break** *(15)*
10:45	**Experiences and Implications for Management Decision Making** *(60)* 1. Successes and Failures Affecting Management Decisions 2. Implications for Technical Support Programs
11:45	**Lunch** *(75) - USACE (Guest Speaker) - Mike Ornella*
1:00 p.m.	**Intergovernmental Discission - set priorities for technical support programs based on management needs (panel)** *(45)*

1:45	**Identify Roles - discuss involvement in the decision-making processes for governments, businesses, educational institutions, citizens, etc.** ***(45)***
2:30	**Summarize the Proposed 5-Year LSJRB Watershed Management Plan** ***(15)*** **1. Technical Support Program** **2. Interagency Coordination & Public Awareness/Education**
3:30	**Adjourn**

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Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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Panels (key):

WP - Watershed Processes
SQ - Sediment Quality
SP/HY - Sediment Physics/Hydrodynamics
WQ - Water Quality
M - Management

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

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ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

Lower St. Johns River Basin Workshop

Participants

September 13-16, 1993

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Vavra, Timothy	U.S. Army Corps of Engineers P. O. Box 4970 Jacksonville, FL 32232-0019	P# (904) 232-1600 F# (904) 232-3442		
Walsh, Margaret	City of Jacksonville Dept. of Public Utilities Wastewater Division 2221 Buckman Street Jacksonville, FL 32206	P# (904) 630-4236	yes M	
Walton, Raymond	Ebasco Environmental 10900 NE 8th Street Bellevue, WA 98004-4405	P# (206) 451-4553 F# (206) 451-4187	yes HY	

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
Lower St. Johns River Basin Workshop
Participants
September 13-16, 1993

Watkins, Bill	SJRWMD SWIM Division P. O. Box 1429 Palatka, FL 32178-1429	P# (904) 329-4345 F# (904) 329-4329 SC 860-4345	yes (moderator) M	yes
Windom, Herbert	Skidaway Institute of Oceanography P.O. Box 13687 Savannah, GA 31416	P# (912) 598-2490 F# (912) 598-2310 H# (912) 598-1368	yes SQ, WQ	
Worley, David R.	Stormwater/Nonpoint Source Management Sec. DEP 2600 Blair Stone Rd. Tallahassee, FL 32399-2400	P# (904) 488-0782 F# (904) 488-6579 SC 278-0782		