WALNUT CREEK WATERSHED RESTORATION AND WATER QUALITY MONITORING PROJECT

WALNUT CREEK NATIONAL WILDLIFE REFUGE AND ENVIRONMENTAL LEARNING CENTER

JASPER COUNTY, IOWA

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The Walnut Creek Nonpoint Source Pollution Monitoring Project is supported by Region VII of the U.S. Environmental Protection Agency through a 319-Nonpoint Source Program Grant to the Iowa Department of Natural Resources. Analytical support is provided by the University Hygienic Laboratory in Iowa City and Des Moines. The design of this workplan is modeled after those developed for the Big Spring and Sny Magill Watershed Projects.

INTRODUCTION

Nonpoint Source Pollution (NPS) is considered to be the major cause of remaining impairment to water quality in the United States. In an agricultural state such as Iowa this is particularly true; recent assessments show that agricultural landuse is the source of diffuse, nonpoint source pollution affecting approximately 96% of Iowa's stream miles and the majority of impaired lakes and wetlands (Agena, Bryant, and Oswald, 1991). Numerous programs are being implemented in Iowa, by many agencies, to work to mitigate NPS pollution from agriculture. These programs provide evidence of considerable pollution prevention and source reduction benefits that will, over time, reduce NPS pollution. The ultimate test of the success of such efforts must be improved water quality, hence, there is a clear need for programs that can monitor water quality. Monitoring NPS water-quality impacts and improvements is not an easy task; the pollution results from runoff and infiltration across the landscape, in relation to varied land-management practices. The resultant impacts that can be measured in perennial streams or groundwater are typically a mix of effects from many different parcels of land, many different components of management, integrated over many time scales.

The primary objective of this project is to establish a nonpoint source monitoring program in relation to the watershed habitat restoration and agricultural management changes implemented by the Walnut Creek National Wildlife Refuge and Prairie Learning Center (WNT). The WNT watershed is being restored to native prairie and/or savanna; riparian zones and wetlands will be restored in context, with riparian zones grading from prairie waterways, to savanna, to timbered stream borders. It is not expected that large-scale restoration will ever be used as an NPS management practice. However, the conversion will allow an analysis of the effectiveness of placement of non-agricultural fields within the landscape. It will also allow assessment of the amount of non-agricultural land that might be needed to reach a given water quality objective. In addition, for the Refuge-owned lands remaining in row-crop production during the restoration period, improved agricultural management practices are mandatory, altering chemical inputs and ensuring soil-conservation compliance to the entire Refuge-controlled area. These mandatory practices are equivalent to conservation compliance measures to reduce erosion and runoff, and portions of the Iowa Water Quality Project Integrated Crop Management Options I and II for nutrient and pest management. Because the restoration work and these improved management measures are implemented under U.S. Fish and Wildlife Service (USFWS) control, they are implemented much more uniformly than most other projects, both in time and spatially across the watershed. Hence, they will constitute an important demonstration of the water-quality accomplishments that can be related to other nonpoint source projects.

The U.S. Environmental Protection Agency (USEPA) has authority and responsibility to control NPS pollution, under Section 319 of the Clean Water Act. USEPA has issued grants to the states to implement NPS control projects and related activities. A grant from the USEPA, Region VII, to the State of Iowa, Department of Natural Resources (IDNR), is providing support for the development and implementation of this monitoring program. This report outlines the design and initial workplan for a nonpoint-source, water-quality monitoring program for Walnut Creek and related areas, in Jasper County, central Iowa. It is a plan, and as such, it is subject to change as changing conditions dictate.

WATER-QUALITY MONITORING PROJECT OBJECTIVES

The general goal of this project is: to institute a comprehensive, long-term, 319-NPS protocol monitoring project in the Walnut Creek Watershed, Jasper County, Iowa; to quantitatively document over time the reduction in non-point source pollution and environmental improvements resulting from watershed habitat restoration and land management changes implemented by WNT. Several other component objectives can be expressed: 1) to evaluate the changes in agricultural practices that will occur as a result of a change in management; 2) to monitor and develop an understanding of the hydrologic changes that will accompany a large scale restoration program such as is occurring at WNT; 3) to quantitatively measure changes in flow and water quality and evaluate their impacts on biological habitat; 4) to use the water-quality and habitat monitoring data to increase our understanding of what implementation measures are successful and will be useful in similar areas, and for public education to expand awareness of the need for nonpoint source pollution-prevention implementation.

The project will be a coordinated inter-agency effort. This workplan outlines the initial development year of the project and its first four years of implementation for which funding has been provided.

WATER RESOURCE DESCRIPTION

Walnut Creek, a warm-water stream located in Jasper County, Iowa, drains 30.7 mi^2 (19,500 acres) and discharges into the Des Moines River at the upper end of the Red Rock Reservoir. The Walnut Creek National Wildlife Refuge and Prairie Learning Center (WNT) was established in this watershed by Congress to restore a significant preserve of tallgrass prairie. Ultimately over 8,000 acres in the WNT watershed will be restored to native prairie and/or savanna, the rarest of North America's major natural landscapes. Riparian zones and wetlands will be restored in context. The Refuge has an approved acquisition boundary of 8,654 acres (13.5 mi^2). Only the upper part of the watershed will be included in the monitoring project because of possible backwater effects from the reservoir. The project watershed includes 12,860 acres (20.1 mi^2) and includes the majority of the WNT Refuge area (Fig. 1); approximately 63% of the watershed is within the Refuge boundaries. Currently, about 5,000 acres (7.8 mi^2) are owned and controlled by the U.S. Fish and Wildlife Service (USFWS).

Walnut Creek drains into a segment of the Des Moines River that is classified as *Not Supporting* its designated uses in the Iowa Department of Natural Resources (IDNR) water-quality assessments; Squaw Creek and the Skunk River are classed as *Partially Supporting*. Assessments in this area cite agricultural nonpoint source (NPS) as the principal concern. It is anticipated that the ecosystem restoration, improved crop production and conservation practices, and other proposed efforts will lead to significant improvements in water quality and habitat in the Refuge, both for terrestrial and aquatic organisms.

For this monitoring project a paired-watershed design will be used. The Squaw Creek basin, adjacent to Walnut Creek, will be used as a control watershed (Fig. 1). Squaw Creek drains 25.2 mi^2 (16,130 acres) above its junction with the Skunk River. The watershed included in the monitoring project is 18.3 mi^2 (11,710 acres) and does not include the wide floodplain area near the intersection with the Skunk River. The very upper part of the watershed incudes part of the town of Prairie City, population of about 1,140. Sewage effluent from Prairie City is discharged to the south into a different watershed.

Watershed Characteristics

The Walnut Creek watershed and WNT Refuge is located in the Southern Iowa Drift Plain, characterized by areas of steeply rolling hills and well-developed drainage. Soils on the Refuge fall primarily within four soil associations: Tama-Killduff-Muscatine; Downs-Tama-Shelby; Otley-Mahaska; and Ladoga-Gara. Most of the soils are silty clay loams, silt loams, or clay loams formed in loess and till. Many of the soils are characterized by moderate to high erosion potential. The upper portion of the Walnut Creek watershed, above the WNT Refuge, is the more gently sloping headwaters portion of the

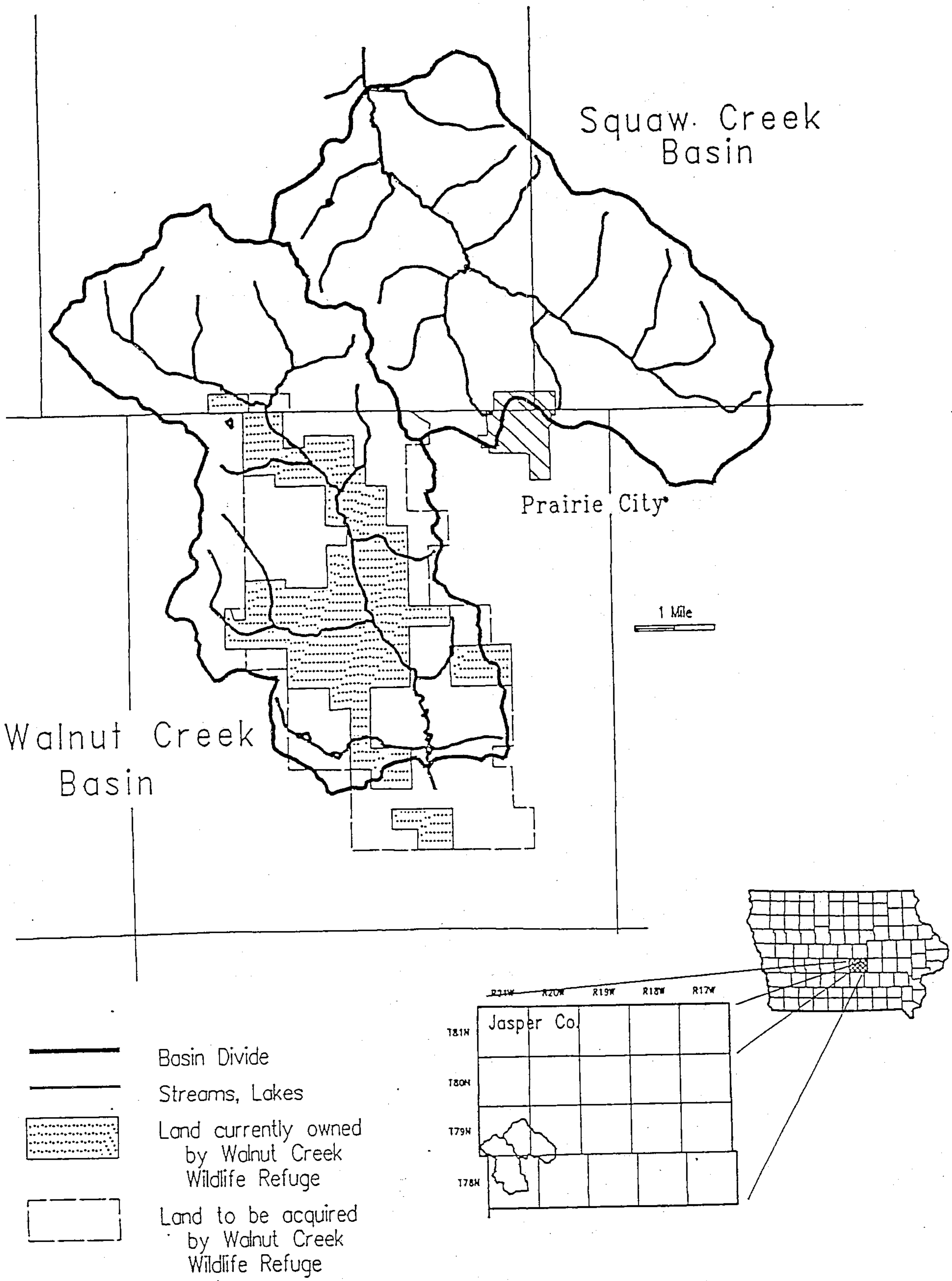

Figure 1. Location of Walnut Creek and Squaw Creek basins.

basin; the majority of highly-erodible land in the watershed occurs in the Refuge area. Pre-Illinoian till underlies most of the Refuge area and is 50 to 100 feet thick. Bedrock is at an approximate elevation of 850 to 700 feet above mean sea level and is primarily Pennsylvanian Cherokee Group shale, limestone, sandstone, and coal.

The entire watershed is agricultural with no industry or urban areas. Prior to the establishment of theRefuge, about 80% of the watershed was cropland (predominantly corn and soybeans), 13% grassland or pasture, 3% forest, and 4% roads, farmsteads, and other uses. Most farms include small livestock operations. Currently, only 37% of the area under Refuge control is in cropland (predominantly corn and soybeans), 33% is grassland, 5% CRP, and 25% woodland, wetlands, or prairie. There are currently seven individuals farming on Refuge owned lands under a cash rent, contract basis.

The soils and geology of the Squaw Creek watershed are similar to that in the Walnut Creek basin. Landuse is primarily agricultural, and essentially the same as the Walnut Creek basin prior to changes implemented by the establishment of the Refuge. As noted, the very upper part of the watershed incudes part of the town of Prairie City, but the municipal sewage effluent is discharged to the south into a different stream.

Average yearly rainfall is approximately 31 inches in the area. Groundwater discharge to similar Iowa streams in the region is generally between 40 and 60% of total flow. Thus, groundwater quality is also an important factor in management considerations for streams in the area.

MONITORING PROJECT DESCRIPTION

The intent of the design of the Walnut Creek Water Quality Monitoring Project is to meet USEPA's criteria for "Nonpoint Source Monitoring and Reporting Requirements for Watershed Implementation Projects." The Walnut Creek Watershed is well suited for such a project. The area is amenable to various comparative water-quality approaches, including paired-watershed design. Because of the intimate linkage of groundwater and surface water in the region, the watershed has a very responsive hydrologic system and should be relatively sensitive to the changes induced through the implementation programs. The restoration program is comprehensive and long-term and will affect 53% of the Walnut Creek Watershed. Restoration will proceed slowly, however during the interim, substantial improvements in land, nutrient, and chemical management will be implemented on the remaining agricultural land.

Restoration has begun at WNT as well as implementation of agricultural programs. However, the acreage affected by these measures is still minimal compared to basin size. Landuse will be altered extensively over the next 5-10 years.

Pre-Implementation Data

Water quality data has been collected as part of the U.S. Environmental Protection Agency (EPA) sponsored "Tri-State NPS Project" (personal communication, B. Menzel). In 1992, mean reactive phosphate (0.3 mg/l) and total dissolved solids (310 mg/l) were low to average, while nitrate-N (15 mg/l) and turbidity (73 NTU) were high compared to other streams. The maximum alachlor concentration was 10 μg/l and atrazine was 4 μg/l. These pesticide concentrations were very high compared to other streams in the study. Primary biological productivity was low and Walnut Creek had one of the most depauperate fish communities of all the streams under study in the three-state area. This study includes assessments of aquatic diversity and stream parameters as well as water quality. Detailed information is not yet available.

One USGS gaging station was installed on Walnut Creek near the lower end of the refuge in mid-summer 1994. Equipment problems prevented the collection of data until 9/1/94.

Two water-quality rain-event collections were made. Samples were collected on 6/21/94 and 9/26/94 at seven stations on Walnut Creek and at one site on Squaw Creek. This was a cooperative effort between the USFWS Environmental Contaminants Program and The University of Iowa Hygienic Laboratory. Nitrate-nitrogen concentrations ranged from <0.1 to 19 mg/l. Concentrations were lower in the fall than in the summer. Three pesticides and two pesticide metabolites were detected on Squaw Creek; atrazine and its metabolites- desethyl and deisopropyl, cyanazine, and metribuzin. Atrazine and cyanazine were present in both samples; metribuzin only in the fall. Two pesticides and two metabolites were found in Walnut Creek and tributaries; atrazine as well as desethyl and deisopropyl atrazine, and cyanazine. Concentrations were generally less than 1 µg/l except at tributary 4, where higher concentrations were noted. Tributary 4 drains into the lower part of Walnut Creek and much of its drainage area is not currently part of the refuge. Concentrations decreased and were mostly undetectable in the fall sampling. Fecal coliforms were detected in all samples at a wide range of concentrations. Highest concentrations were seen at the upper end of Walnut Creek where it enters refuge lands. A fall count of 7.6 million fecal coliforms was especially high. This also correlated with an increased ammonia-nitrogen concentration of 2.5 mg/l.

Monitoring Plan Design

The project will monitor water-quality parameters at ten surface water and four groundwater sites and will utilize a paired-watershed as well as upstream/downstream comparisons for analysis and tracking of trends. The Walnut Creek Watershed will be paired with Squaw Creek Watershed, which shares a common basin divide with Walnut Creek (Fig. 1). The pairing of these two adjacent watersheds will allow minimization of precipitation variation. The watersheds are ideally suited to such a design; Walnut Creek Watershed is 20.1 mi^2 in the project area; Squaw Creek Watershed has an area of 18.3 mi^2 in the project area. Their groundwater hydrogeology and known surface hydrologic characteristics are very similar. Complete gaging and monitoring stations, including precipitation measurement, will be established near the mouths of these watersheds, and upstream on Walnut Creek to further allow analysis of changes. These will form the two principle sites for paired watershed statistical comparisons.

Two locations on Walnut Creek and one on Squaw Creek will be monitored monthly. The upstream sampling point on Walnut Creek is above the refuge and will allow an evaluation of upper basin effects on water quality. It may be possible later in the project to effect changes in agricultural practices by a joint effort with the USFWS Open Lands Program and the USDA-Natural Resource Conservation Service (NRCS). Current land use practices in the upper Walnut Creek basin as well as in Squaw Creek will be determined by conversations with NRCS and will be tracked throughout the life of the project.

Smaller watersheds within Walnut Creek will also be monitored to allow comparisons of differential implementation over time, and for analyzing their incremental contributions to the overall basin response. Some of these basins are primarily within refuge lands; some contain a high percentage of cropland. The smaller streams in the area are ephemeral streams and therefore will be sampled during four runoff events. Supplemental measurements will be done on the smaller streams, flow permitting, to evaluate significant land alterations both before and after, and above and below the changes. Further, comparisons can include water-quality conditions, habitat, and aquatic biology.

Water Quality Parameters

Various agencies will be involved in the collection and analysis of data for this project. Below are descriptions of the major project elements and the agency involved. Figure 2 shows the sampling locations which have been selected to this point.

USGS Stream Gaging Stations

Stream gaging will be done to provide stage and discharge measurements for the monitoring effort. Stream discharge records will allow the assessment of changes in the hydrologic response of the watersheds, evaluation of groundwater effects through baseflow analysis, and estimation of basin mass losses, and balances when coupled with concentration data. Monitoring daily suspended solids is expensive and difficult, but if sediment loading and sediment yield are to be evaluated, such detail is necessary. Suspended sediment load is highly flow-dependent and highly variable. There would be little chance of measuring any significant changes without daily, and event-related records for computation of sediment yield over time. Gaging stations, while expensive, are essentially required by the EPA protocols, and enhance all other information.

Standard USGS gaging facilities will be constructed at the three major stream sites (WNT1, WNT2, and SQW1). Stage is monitored continuously with bubble-gage sensors (fluid gages) and recorded by data collection platforms (DCP) and analog recorders (Rantz and others, 1982). The DCPs digitally record rainfall and stream stage at 15-minute intervals. Stevens A-35 strip-chart recorders also register stage continuously. The recording instruments are housed in 5 by 5 foot metal buildings. The equipment is powered by 12 volt gel-cell batteries which are recharged by solar panels or battery chargers run by external power. Reference elevations for all USGS gage stations are established by standard surveys from USGS benchmarks. Stage recording instruments are referenced to outside staff plates placed in the streambeds, or to type-A wire-weights attached to the adjacent bridges. Rainfall is recorded using standard tipping bucket rain gages.

Stream discharge is computed from the rating developed for each site (Kennedy, 1983). The stream-gaging and calibration is performed by USGS personnel, using standard methods (Rantz and others, 1982; Kennedy, 1983). Current meters and portable flumes are used periodically to measure stream discharge and refine the station ratings.

Suspended Sediment

Suspended sediment samples are collected daily by local observers and weekly by water quality monitoring personnel. The observers collect depth integrated samples at one vertical section at one point in the stream using techniques described by Guy and Norman (1970). Samples are collected daily at all three stations. During storm events, suspended sediment samples will be collected with an automatic water-quality sampler installed by the USGS at the gaging stations. Sampling is initiated by the DCP when the stream rises to a pre-set stage, and terminates when the stream falls below this stage. Suspended sediment concentrations are determined by the U.S. Geological Survey Sediment Laboratory in Iowa City, Iowa, using standard filtration and evaporation methods (Guy, 1969). Discharge, rainfall, and sediment data are stored in the USGS Automatic Data Processing System (ADAPS) and published in the Iowa District Annual Water-Data Report.

Chemical and Physical Parameters

Surfacewater Sites.

Three primary sites (WNT1, WNT2, SQW1) will be sampled monthly and analyzed for nitrate, ammonia-nitrogen, a selected list of pesticides, anions, cations (quarterly), BOD, DO, turbidity, alkalinity, fecal coliform, conductivity, and temperature. Temperature, conductivity, DO, and alkalinity will be measured in the field; all other analyses will be performed by the University Hygienic Laboratory (UHL) using standard methods and an EPA-approved QA/QC plan. In addition to the paired watershed design, the two sites on WNT will allow upstream/downstream comparisons for analysis of on-and off-refuge practices. Additional samples from tributaries to Walnut Creek will be collected during four runoff events annually to evaluate their incremental nonpoint source contribution in relation to differential management and restoration implementation. Samples will be analyzed for pesticides, nitrogen forms, and fecal coliform as well as field parameters. Rainfall monitoring for pesticides will be done to allow an evaluation of loadings from this source to restored areas. The rainfall sampling station will be located at refuge headquarters to allow easy sampling by USFWS personnel. Figure 2 shows the location of all surface water sampling sites.

Table 1 lists the parameters (field and lab) monitored and sampling frequency at the sites. Table 2 lists the laboratory methods for the analytes and Table 3 lists the method detection limits.

Temperature, conductivity, dissolved oxygen, alkalinity, and turbidity are measured at all sites when sampling occurs. Equipment used for field measurements and methods are summarized in Table 4. To ensure quality of data being collected and uniformity of collection, all personnel involved in the sampling have been instructed in proper field measurement and sampling techniques. Samples periodically will need to be mailed to meet laboratory holding time quality assurance/quality control (QA/QC) criteria. Appropriate QA/QC protocols for collection, field measurements, and delivery of the water-quality samples have also been implemented and are outlined in Appendix 1.

Groundwater Sites

Locations for the groundwater sampling have not yet been determined. The sites will be chosen to complement other biological data collection activities at WNT and will help in evaluation of the results of the land management and landuse changes, as well as revegetation characteristics and habitat analysis. Permanent transects are being selected and the groundwater stations will be placed along these transects to monitor changes in groundwater hydrology and quality that result from landuse changes in the watershed. Each site will consist of two nested wells and one suction lysimeter. Wells will be monitored for both water level and water quality changes. Groundwater chemistry will be monitored quarterly at these sites. Water samples will be analyzed for nitrogen forms, pesticides, and common ions by the UHL. Alkalinity, pH, and conductivity will measured in the field. Modifications to the chemistry monitoring may be done in subsequent years of the project depending on results.

Biomonitoring

The purpose of the biomonitoring is to document the changes in the aquatic vegetation, fish and macroinvertebrate populations of Walnut Creek as a result of the land use and management changes implemented in the watershed.

One biomonitoring sampling location will be identified in each watershed. These locations will be selected to reflect the overall basin effect on water quality and coincide with the placement of the most

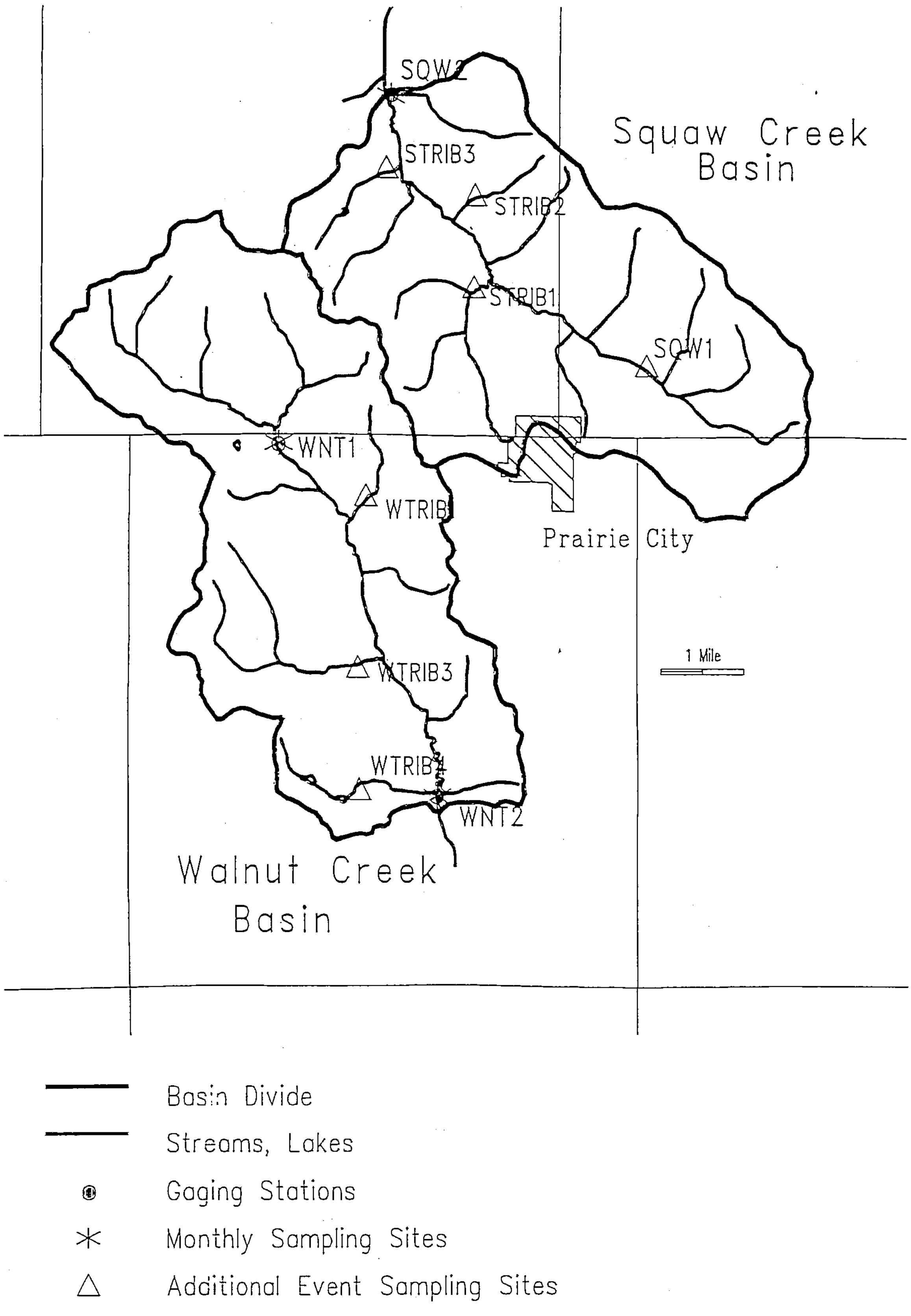

Figure 2. Monitoring Sites for Walnut and Squaw Creeks.

Table 1. Monitoring parameters and frequency of sampling for Walnut Creek and Squaw Creek.

Sampling Location	Parameters	Frequency
WNT1, WNT2, SQW2	Stage/Discharge, Suspended Sediment	Daily
	Temperature, Conductivity, Dissolved Oxygen, Turbidity, Alkalinity, pH	Monthly
	Fecal Coliform, Ammonia-nitrogen, BOD, Pesticides, Anions	Monthly
	Cations	Quarterly
WNT1, WNT2, WTRIB-1, WTRIB-3, WTRIB-4, SQW2, STRIB-1, STRIB-2, STRIB-3, SQW1	Temperature, Conductivity, Dissolved Oxygen, Turbidity, Alkalinity, pH Fecal Coliform, Pesticides, Partial N-series	Four runoff events
Rain gage station	Pesticides, IMA triazines when necessary	Precipitation events
Groundwater stations	Water levels	Daily
	Temperature, Conductivity, Alkalinity, pH	Quarterly
	Pesticides, Anions	Quarterly
	Cations	Bi-annually
Biomonitoring stations	Biomonitoring	Bi-monthly

Table 2. Laboratory methods used for analyzing Walnut and Squaw creek water-quality analytes.

1) fecal coliform bacteria: Based on Standard Methods for Water and Wastewater, Method 9222D (APHA, 1985) using media fecal coliform at 44.5°C.

2) nitrate and nitrite-nitrogen: automated, copper-cadmium reduction and colorimetric quantitation using a Technicon auto-analyzer system. The method is based on U.S. EPA Method 353.2 (USEPA, 1983 and revisions).

3) ammonia-nitrogen: automated phenate reaction, and colorimetric quantitation, using Technicon auto-analyzer IM 780-86T. Based on U.S. EPA Method 350.1 and 350.2 (USEPA, 1983 and revisions).

4) organic-nitrogen: total Kjedahl procedure with K_2SO_4, and $HgSO_4$ pre-treatment using Technicon IM 780-86T; semi-automated block digester, AAII, colorimetric quantitation. Organic-nitrogen is defined as the sum of ammonia-nitrogen and organic nitrogen compounds which are converted to ammonium sulfate, less the ammonia-N determined in procedure for ammonia-nitrogen (see above). Based on U.S. EPA Method 351.2 (USEPA, 1983 and revisions).

5) anions: ion chromatography using a Dionex ion chromatograph with ionic supression with conductivity detection. Based on U.S. EPA Method 300.0 (USEPA, 1983; 1991 revision).

6) cations: inductively-coupled plasma , atomic-emission spectroscopy using a Thermo-Jarrell Ash 61E simultaneous/sequential instrument. Based on U.S. EPA Method 200.7 (USEPA, 1983 and revisions).

7) 5-Day BOD: samples incubated in dark for 5 days at 20 °C, Standard Method 507 (APHA, 1985).

8) suspended sediment: standard filtration and evaporation methods (Guy, 1969).

9) common herbicides, multi-residues: methylene chloride extraction; extract partitioned, using silica gel, into two fractions for gas chromatograph-nitrogen-phosphorous capture detector and/or GC-NPD analysis, employing two-column confirmation. Based on U.S. EPA methods, EPA-600/8-80-038, Section 10, A (USEPA, 1980 and revisions).

10) IMA triazines: immuno-assay using spectrophptometric measurement and analysis; Millipore triazine kit.

Table 3. Summary of chemical parameters and method detection limits analyzed in Walnut and Squaw creek samples.

Analyte	LabMethod	Detection	Sample Holding Time
Fecal bacteria	UHL-IC	count	8 hours
Nitrate	UHL-IC	1.00 mg/L	48 hours
Ammonia-N	UHL-DM	0.10 mg/L	28 days
Bromide	UHL-DM	0.05 mg/l	28 days
Chloride	UHL-DM	1.0 mg/l	28 days
Fluoride	UHL-DM	0.1 mg/l	28 days
Nitrate-nitrogen	UHL-DM	0.1 mg/l	28 days
Phosphate	UHL-DM	0.1 mg/l	28 days
Sulfate	UHL-DM	1.0 mg/l	28 days
Calcium	UHL-DM	1.0 mg/l	28 days
Magnesium	UHL-DM	0.1 mg/l	28 days
Sodium	UHL-DM	0.5 mg/l	28 days
Potassium	UHL-DM	1.0 mg/l	28 days
5-Day BOD	UHL-DM	1.00 mg/L	48 hours
IMA triazines	UHL-IC	0.10 ug/L	14 days
Suspended sediment	USGS-IC	0.50 mg/L	
Common herbicides	UHL-IC	0.10 ug/L	7 days

UHL-DM: University Hygienic Laboratory, Des Moines

UHL-IC: University Hygienic Laboratory, Iowa City

USGS-IC: United States Geological Survey, Iowa City

Table 4. Methods for field water-quality measurements.

Analyte	Method	Units
Temperature	Conductivity meter	degrees C
Specific conductance	Conductivity meter	uS/cm @25°C
Dissolved oxygen	DO meter	mg/L
Turbidity	Turbidimeter	NTU
Alkalinity	pH meter and digital titrator	mg/l
pH	pH meter	pH units

downstream gage station in each basin. The biomonitoring involves sampling through a reach of the steam, which, in part, coincides with the point used for chemical and physical parameter water-quality sampling.

Each project year the aquatic macroinvertebrates will be collected bi-monthly during the period from April through October. Three Hester-Dendy artificial substrates will be deployed at each sampling location. After a six week colonization period the artificial substrates will be collected and returned to the laboratory for sorting and identification of organisms obtained. In the laboratory a 100 organism, random sub-sample will be taken from each sample for identification to the lowest taxonomic level (usually genus or species), as time and expertise permit. The remaining organisms and pickate will be preserved in 70% ethyl alcohol. At a later date, if quantitative analysis is deemed necessary, the remainder of the sample will be identified and enumerated. Date collected will be analyzed using appropriate metric indices outlined in the EPA Rapid Bioassessment Protocol III (USEPA, 1989). Other metrices may also be evaluated as results dictate. The biomonitoring will be conducted using the UHL Limnology Section Standard Operating Procedures (UHL, 1993) and Quality Assurance Plan (UHL, 1994) for Aquatic Biological Sampling. Three replicates will be collected at each station to ascertain community or population variability and provide statistical validity. From 10% of the samples collected an additional 100 organism sub-sample will be taken and analyzed. A reference collection will be maintained in which all organisms have been identified and the identification confirmed by experts.

The fisheries portion of the biomonitoring program is designed to provide population information on the resident fish species and document changes over time. Previous information (personal communication, B. Menzel-ISU) has indicated a very poor fish community in the Walnut Creek basin. As changes in land use and basin management occur the Walnut Creek fishery may also expect changes. Fish sample collection will be planned for late summer (August-September) to minimize water and fish population fluctuations. At each site, a stream segment of approximately 100 yards will be sampled. All sampling will be done using back-pack, variable-voltage stream electrofishing equipment set at or near 150 VDC. Upper and lower block nets may be used to reduce intrastream movement of fish. All fish species will be identified, enumerated, and released. A summary of the survey, including a species list and relative abundance will be compiled for annual reports.

During the fishery survey, observation of the aquatic vegetation in the same reach will be made. The submergent and emergent vegetation will be identified and its areal coverage estimated. The annual summary will discuss changes in aquatic vegetation. In addition, stream corridor habitat changes will also be recorded. All biomonitoring will be done by the UHL Limnology group, utilizing their Standard Operating Procedures (UHL, 1993) and quality assurance work plan (UHL, 1994).

Analytical Methods and Quality Assurance/Quality Control

The IDNR and UHL have USEPA approved QA/QC plans in place. The biomonitoring group will be using the UHL Limnology Section, Standard Operating Procedures for Quality Assurance for Aquatic Biological Sampling. The USGS follows their national standards for methods and procedures. Appendix I details the quality assurance/quality control plan for the water sample collection part of the project.

Demonstration and Education

The WNT's educational commitment and resources will allow for educational and demonstration activities far beyond the scope of those that could typically be accomplished by 319 projects. Of particular note, the linkages between landuse changes and water quality improvements will be an integral part of these educational efforts. In addition, existing curriculum creates opportunities for interested visitors to acquire, enter, and interpret hydrologic and water quality data from the watershed. Both streamside and visitor center-based activities and educational stations are planned. Information presentations could readily be tailored to school, environmental, or agricultural interest groups. It is anticipated that visitors to the WNT will number in the tens of thousands annually, offering a unique, wide exposure to the landuse changes and monitoring activities in the watershed.

USFWS will utilize the WNT as a demonstration area for landscape restoration projects. Information will be disseminated to visitors and invited groups, the public, and to the news media using published reports, presentations, and news releases. Of broader interest, the project is also serving as a demonstration site for riparian restoration and small wetland restoration. Having a linked water-quality evaluation program makes these demonstrations more effective for general use and translation to broader audience.

Geological Survey Bureau (GSB) activities will be integrated into the demonstration and education aspects as appropriate. GSB personnel will be available for presentations to groups or for field days on the refuge. Other activities will be discussed as the project proceeds and other opportunities arise.

Project Coordination

This workplan, and the work elements to be carried out, are a coordinated inter-agency effort. The participating agencies will meet in work groups as needed to review coordination needs and problems. The monitoring results and plan will be reviewed annually by an inter-agency coordinating committee to assess needed changes.

Monthly sampling of sites will be done by IDNR-GSB.

Data transfer procedures are already established between USGS, UHL and IDNR-GSB. Coordination will also be established with USFWS-WNT for reporting on land management changes as they proceed. WNT is in the process of implementing a Geographic Information System (GIS) tracking system and such information will be made available.

Partnerships

This project will be an inter-agency, collaborative effort. The agencies noted below have participated in the development of this project design. Their continued roles in the development and operations of the monitoring program are briefly outlined below:

IDNR-Environmental Protection Division (EPD) provides overall coordination and oversight for 319 programs.

IDNR-GSB will provide the overall monitoring project coordination and management, data management and data reporting to the EPA, including an annual narrative project report and data synthesis. Personnel will conduct the water-quality monitoring.

UHL will provide laboratory analytical work, and lab QA/QC, and conduct the macroinvertebrate monitoring of the streams. UHL will provide annual reports on the biomonitoring.

USFWS-WNT will be responsible for implementation of all landuse and/or land conversion changes on refuge lands. Tracking of land use changes will be done and provided to the GSB. They will assist in some aspects of water sample collection, particularly for precipitation as well as help in determining appropriate sampling times for event collection. They will also furnish opportunities for information dissemination and educational programs to refuge visitors.

USGS will install and operate surface water gage sites, precipitation collectors, parameter monitors, and suspended solids measurements. The USGS will provide cooperative expertise for interpretation and analysis of monitoring data and provide annual reports on streamflow, suspended solids loading, and other parameters as appropriate.

Data Management and Reporting

Project data management and reporting will be handled by the IDNR-GSB. Comprehensive narrative and interpretive reports will be issued on a water year basis (Oct-Sep) by IDNR-GSB. UHL will issue annual reports on biomonitoring. USGS monitoring and gaging will be summarized in their annual review of water-resources records for the state; these data will be included and summarized in the annual project report. This report will also be provided to IDNR-EPD for inclusion as part of Iowa's annual state section 319 report. For annual reports, data will be evaluated and summarized on a water-year basis; monthly and seasonal summaries will be presented as well. Statistical analysis and comparisons will be performed as warranted using standard statistical techniques. Paired-watershed analysis will begin after sufficient data is collected. The reality of the time required for data analysis and report generation suggests that the summary report for a given water year will likely be submitted in September of the following year.

All USGS data will also be entered in WATSTORE, the USGS national data base. Data transfer procedures are already established between USGS, UHL and IDNR-GSB.

All data will also be stored at WNT and will be available to other researchers there. The exact format for data storage at WNT is still to be determined. The final disposition of biomonitoring samples is also still to be decided. IDNR-GSB is establishing a coordinated process for tracking the implementation of land treatment measures with WNT. WNT will be tracking landuse changes with a GIS system using EPPL 7 software. This information will be available to IDNR-GSB where it will be transferred to an ARC/INFO software format for analysis and integration with data collection locations and geologic descriptions. All coverages will be stored at both IDNR-GSB and WNT in both GIS formats.

Measures of success will be the documentation of statistically significant improvements in water quality and aquatic habitat over time. These improvements will be determined through habitat monitoring, water chemistry monitoring, and biological monitoring. Other measures may include qualitative observations on habitat improvement.

SCHEDULE OF ACTIVITIES

Activity	Agency	Completion Date
Develop complete workplan	DNR-GSB	January 1995
Initiate water quality sampling	DNR-GSB	March 1995
Conduct surveys and plan for gage installation	USGS	April 1995
Install stream gages	USGS	May 1995
Install sediment samplers	USGS	June 1995
Choose locations for well installation	DNR-GSB	April 1995
Initiate biomonitoring	UHL	April 1995
Install wells and monitoring equipment	DNR-GSB	May 1995
Prepare annual report	DNR-GSB, USGS, USFWS	October 1995
Annual Activities		
Collect and maintain gaging and sediment data	USGS	
Monthly water quality sampling	DNR-GSB, UHL	
Rain event sampling	DNR-GSB, UHL, USFWS	
Conduct bi-monthly and annual biomonitoring	UHL	
Monitor implementation activities, land use changes	DNR-GSB, USFWS	
Prepare annual report	DNR-GSB, USGS, UHL	

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APPENDIX I

Walnut Creek Nonpoint Source Pollution Monitoring Project:

Surfacewater Monitoring Component Quality Assurance/Quality Control Workplan

The following quality assurance/quality control plan was developed for the field sampling component of the Walnut Creek Nonpoint Source Pollution Monitoring Project. This QA/QC plan was developed from the QA/QC plan for the Sny Magill Watershed Nonpoint Source Pollution Monitoring Project.

I. Training

All personnel conducting sampling will have undergone training by the project manager on proper sample collection and field techniques.

II. Schedule for Field Staff Conducting Sampling

Normally field sampling will occur on the second Wednesday of each month, except for conflicts with holidays (e.g., Christmas). Runoff sampling is unpredictable, however, it is desirable that samples be collected in spring, pre-and post planting, summer, and fall periods.

III. Field Measurement Form

The field measurement form lists the various sampling sites, parameters to be measured on site, and samples to be collected. All sites require field measurements of temperature, specific conductance, pH, dissolved oxygen, alkalinity, and turbidity. Any problems encountered during sampling are to be recorded on the Field Measurement Form. Field Measurement Forms for monthly and event surfacewater sampling are attached. Sample forms for groundwater monitoring will be developed once locations are chosen and transducers installed.

IV. Sample Bottles

Table A-1 and A-2 lists the number of sample bottles to be collected per month and the type of bottles used. Precleaned or sterilized sample containers will be provided by each laboratory for use in the field. The manner of preparation of all sample containers will be done in accordance with standard operating procedures of the University Hygienic Laboratory. UHL has an approved QA/QC plan on file with EPA and is a Safe Drinking Water Act certified laboratory.

V. Bottle Labeling

All bottles need to be labeled with the project name, site identification, date, time sample collected, and the initials of the person who collected the sample.

VI. On-Site Field Measurements

Temperature, specific conductance, dissolved oxygen, pH, alkalinity, and turbidity are the field parameters measured at each site. This discussion of techniques is for equipment in current use at GSB. If new equipment is obtained, procedures will be updated.

A. Temperature:

A precision thermistor built into the conductivity probe will be used to record the temperature of the stream water and groundwater. In-stream measurement of temperature will be collected within 3 meters of the stream bank. Groundwater temperature will be measured in the well bore after purging, but prior to sample collection. The thermistor has a range of -5 to 50°C in 1°C increments with an error of +/- 0.4°C. Temperature, to the nearest degree C, will be recorded on the Field Measurement Form.

B. Specific Conductance:

Specific conductance will be measured with a YSI model 3000 T-L-C meter. Two platinized electrodes measure conductivity and will accurately measure changes in 10 seconds. Calibration is done at the factory and will be checked monthly using a standard conductivity solution.

Measurement:

1.-.To measure temperature compensated conductivity set the function switch to 2 mS/cm TC to 25°C.
2. - Completely submerge the probe and wait 40-60 seconds for probe to stabilize.
3. - Read the value from the appropriate scale.

Maintenance:

The probe will be stored in deionized water between uses.
The O-rings will be replaced annually

C. Dissolved Oxygen:

Dissolved oxygen will be measured using a YSI Model 58 dissolved oxygen meter.

Calibration:

1. - The oxygen probe should be in a partially filled BOD bottle
2. - Set the function switch to ZERO and adjust O2 ZERO until display reads 00.0
3. - Turn function switch to %; Wait 15 min for probe to stabilize
4. - Adjust the O2 CALIB knob until the meter reads the proper calibration value from the chart on the back of the meter

Measurement:

1. - Completely fill a BOD bottle under water
2. - Place the probe in the bottle and turn the stirrer on
3. - Set salinity control
4. - Switch to desired accuracy (0.1 or 0.01 mg/l) and read the dissolved oxygen value in mg/l

D. Turbidity:

Turbidity will be measured using a HACH turbidimeter.

Calibration:

1. - Check battery prior to going to the field.
2. - Insert focusing template into cell holder. Press 1.0 range switch and adjust "ZERO" control for reading of zero Nephelometric Turbidity Units (NTU). Press 10 range switch and verify that meter indicates zero NTU. Readjust "ZERO" control if necessary.
3. - Remove focusing template and place 10 NTU standard into cell holder. Cover with light shield. Adjust "SPAN" knob for a reading of 10 NTU.

Measurement:
1. - Collect sample in 1/2 gallon wide-mouthed polyethylene container with plastic threaded cap. Invert sample in container and then fill clean sample tube to the white line. Place sample tube into cell holder.
2. - Cover sample cell with light shield.
3. - Press appropriate range switch.
4. - Allow meter to stabilize.
5. - If sample reads value greater than 10 on 10 scale, insert cell riser below sample tube, cover with light shield and change range switch to 100 and read value.
6. - Record value on Field Measurement Form.

E. pH

pH will be measured using a Hach pH meter.

Calibration:
1. - Place probe in beaker of pH 4
2. - Press PH and then STANDARD; the display should read 4.01. If reading is not 4.01 repeat
3. - Rinse probe, then place in pH 10
4. - Press STANDARD, display should read 10.01
5. - If unable to calibrate, do not measure, substitute meters if possible.
6. - Rinse probe and place in pH 7
7. - Press PH, display should be within 0.05 of 7 depending on temperature of sample, record calibration value

Measurement:
1. - Place probe in sample
2. - Press PH and read result, press PH again and compare numbers, if close then record result on field form.

F. Alkalinity

Alkalinity will be measured using a Hach pH meter and a digital titrator.

Calibration will have been done for the pH measurement.

Measurement:
1. - Place 50 ml of sample in a beaker. Add a stirring bar and place on the battery-operated magnetic stirrer platform.
2. - Titrate to 4.5.
3. - Multiply the number on the titrator by two which is the conversion factor for 50 ml of sample. Record as mg/l.
4. - If the endpoint was overrun, add 50 ml of sample and retitrate to 4.5.
5. - Record the result as shown on the titrator, no conversion is necessary for 100 ml sample.

VII. Delivery of Samples to Labs

GSB personnel will deliver samples collected each week to appropriate labs within 24 hours of sample collection. Once samples are collected they will be stored in Coleman coolers until delivered to the labs. Ice will be used to cool samples if the air temperature is greater than 0^oC.

VIII. Data Management Form

A data management form will be completed by GSB personnel and delivered with samples to the University Hygienic Lab. This form will include analyses desired, samples collected, date, time, and bottle identification numbers and allows the logging and tracking of sample possession and transmittal.

IX. Equipment Problems/Supply Needs

All equipment problems or supply needs will be addressed to Carol Thompson, GSB.

Table A-1. Type of bottles to be used for the Walnut Creek Monitoring Project.

Analyte	Type of bottle	# of bottles monthly	# of bottles event sampling
Fecal coliform bacteria	100 ml sterile amber glass bottle with black plastic lid	3	10
Ammonia-N	250 ml disposable plastic bottle with plastic lid, contains sulfuric acid preservative	3	
Partial N-series	250 ml disposable plastic bottle with plastic lid, contains sulfuric acid preservative		10
Anions	1 quart plastic bottle with plastic lid	3	
Cations	250 ml disposable plastic bottle with plastic lid, contains sulfuric acid preservative	3 (quarterly)	
BOD	1 quart plastic bottle with plastic lid	3	
Pesticides	1 quart glass jar with teflon-lined lid	3	10

Table A-2. Samples bottles for groundwater sampling for the Walnut Creek Monitoring Project

Analyte	Type of bottle	# of bottles quarterly
Pesticides	1 quart glass jar with teflon-lined lid	8
IMA-triazines	50 ml glass tube with septum lid	4
Anions	1 quart plastic bottle with plastic lid	8
Cations	250 ml disposable plastic bottle with plastic lid, contains sulfuric acid preservative	8 (bi-annual)
Nitrate	50 ml amber-colored glass bottle wit plastic lid	4