Table 4. Summary of EPA/ORD Research Program for Six High-Priority Research Topics (Continued)

Research Topics	Strategic Focus	Tasks	Products	Uses
Pollution Prevention and New Technologies for Environmental Protection (Continued)	How can we best identify, develop, and apply advanced measurement tools and enabling technologies to support environmental protection?	Develop working partnerships between technology developers and environmental policy makers and managers to enhance the use of policy drivers in the development and adoption of new technologies. Organize ongoing activities in EPA to focus them on applying and adopting advanced measurement and companion technologies to environmental protection needs. Work with organizations to leverage their investments in advanced technologies.	EPA Program Office and Regional Needs Inventories, NASA Technology Workshops, EPA/DOE Partnerships, internal research on remote sensing applications to environmental measurements, advanced monitoring pilot projects to evaluate currently feasible applications, research to address fundamental concepts of ecosystem rehabilitation, and identification of opportunities for developing domestic and international commercial markets for applying advanced technologies to environmental issues.	To establish partnerships for identifying specific monitoring technology needs and requirements, and subsequent matches with relevant environmental technologies. To sponsor a number of directed technology application projects and demonstrations. To facilitate the commercial adoption of advanced monitoring technologies to meet the needs of EPA, the regulated community, and the public. To facilitate the export of American technologies to international markets.

[a]FQPA = Food Quality Protection Act.
[b]SDWA = Safe Drinking Water Act.

Table 5a. Safe Drinking Water—Disinfection

Subtopic	Strategic Focus	Tasks	Products	Uses
Health Effects	What dose levels of pathogens cause illness in exposed populations?	Conduct dose-response studies on waterborne pathogens.	Data for risk assessment models to predict disease incidence.	To provide health effects data for risk assessments to support upcoming surface water and ground-water treatment rules.
	What are the endemic and epidemic illness rates for waterborne microbial disease?	Conduct epidemiology studies for pathogen-caused disease.	Indication of magnitude of risks and verification of risk models.	To provide health effects data for risk assessments to support upcoming surface water and ground-water treatment rules.
	What are the relative risks of disinfection by-products (DBPs) from different disinfection processes?	Conduct epidemiology studies on reproductive/developmental effects and, if feasible, on cancer.	Qualitative/quantitative data on cancer, reproductive effects, and other effects.	To assess the risks of different disinfection processes, combining epidemiology, toxicity, and mixtures information, to support DBP rules.
		Conduct toxicity studies on individual DBPs and mixtures if feasible.	Risk assessments for individual DBPs.	
Exposure	What levels of pathogens are people exposed to?	Develop analytical methods that detect viable/infective organisms.	Practical analytical methods for pathogens.	Survey tool for developing occurrence data; basis for compliance methods for water utilities.
		Identify sources of pathogens and factors affecting occurrence levels, transport, and fate in surface and ground waters.	Analyses of pathogen occurrence in source waters. Information on pathogen exposures in drinking water. Information on microbial pathogen survival, fate, and transport in subsurface environments.	To support exposure assessments to predict pathogen occurrence in drinking water under different treatment processes.

(Continued)

Table 5a. Safe Drinking Water—Disinfection (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure (continued)	What levels of DBPs are people exposed to?	Develop methods for measuring occurrence of DBPs in drinking water.	Improved practical field and research methods for DBPs in drinking water.	To support exposure assessments for DBPs from different treatment processes; provide basis for compliance methods for water utilities.
		Study the level of DBPs in drinking water supplies.	Identity of new DBPs under different disinfection practices. Data on DBP exposure from drinking water.	
Risk Assessment	What are the comparative risks from DBPs and microbes?	Develop appropriate risk assessment paradigm for microbes, including dose-response models.	Improved risk assessment procedures and risk estimates for microbes.	To provide a comparative risk framework for risk assessments for surface water treatment rules and DBP rules.
		Apply advances in cancer and noncancer risk assessment to individual DBPs and mixtures of DBPs.	Improved risk assessment procedures and risk estimates for DBPs.	
Risk Management	What risk management strategies can simultaneously control pathogens and DBPs?	Evaluate treatment processes for pathogen control, including identification of surrogate measures of treatment effectiveness, technologies for small systems, control of bacterial growth in distribution systems, and prevention of pathogen intrusion into the distribution system. Simultaneously evaluate processes for controlling DBPs (including chlorine vs. alternative disinfectants) and practices for removing DBP precursors (granular activated carbon, membrane filtration). Evaluate vulnerability to microbial pathogens of source waters used by public water supplies.	Data on the effectiveness of different processes. Source water protection protocols for public water supplies, including geohydrologic computer modeling and GIS mapping techniques.	To evaluate different treatment options and regulatory strategies for reducing DBP and microbial risks. To provide guidance for operation of treatment plants and distribution systems.

Table 5b. Safe Drinking Water—Arsenic

Subtopic	Strategic Focus	Tasks	Products	Uses
Health Effects	What are the health effects and dose-response associated with arsenic exposures?	Conduct epidemiologic studies on arsenic health effects. Conduct animal studies on important health endpoints (developmental, reproductive, cardiovascular, neurologic, etc.).	Data on the relationship (linear or nonlinear) between arsenic exposure and adverse health effects.	To provide health effects data for risk assessment/characterization to support the arsenic drinking water rulemaking.
	What are the dose-responses for various effects at low doses?	Develop biomarkers of effect and susceptibility and model systems to assess mechanisms of arsenic toxicity.	Biomarkers to assess effects and susceptibility, data on arsenic mechanisms of toxicity, and an improved PBPK[a] model.	To provide improved understanding of arsenic-induced adverse health effects in humans and to improve the risk assessments.
	What are the modifiers of susceptibility and dose-response?	Determine the factors that affect human susceptibility.	Assessments of the factors that influence arsenic dose-response and susceptibility in humans.	To provide an improved understanding of human susceptibility to arsenic exposure and to support improved risk assessments used in arsenic drinking water rulemaking.
Exposure	What arsenic species and concentrations are present in drinking water, diet, and biological tissues?	Develop validated analytical methods for speciating arsenic in drinking water, diet, and biological tissues. Develop a National Database on arsenic occurrence and concentrations in drinking water, soils, and dietary constituents.	Practical analytical methods for arsenic species in various media. National Database on arsenic.	To support developing occurence data compliance methods for water utilities, methods for mechanistic studies and for exposure risk assessments. To support exposure risk assessments necessary for the arsenic drinking water rulemakings, now and into the future.
	What are the biomarkers of arsenic exposure?	Develop biomarkers of exposure in biological media.	Standardized biomarkers to assess arsenic exposure from various media.	Standardized biomarkers protocols for assessing exposures in epidemiological studies and to improve the precision of risk assessments.
	What is the bioavailability of arsenic species from various media?	Conduct research to determine the bioavailability of arsenic species found in water, soils, and food constituents.	Empirically derived bioavailabililty (oral absorption) factors for each arsenic species in each media.	To support improved risk assessments necessary for the arsenic drinking water rulemaking.

(Continued)

Table 5b. Safe Drinking Water—Arsenic (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Risk Assessment	What additional risk assessment tools and models are needed to assess arsenic risks?	Develop dose-response predictive models for adverse effects and assessing interactions.	Improved risk assessment procedures and risk estimates for arsenic.	To provide the risk basis for arsenic drinking water rulemaking.
	What risk assessment/characterization guidance can be provided for arsenic exposure scenarios?	Develop guidances for states and EPA regions concerning arsenic exposures.	Interim guidances and reports characterizing human exposures.	To support states and EPA regions in developing regulations and permits and for refinement of risk estimates for EPA rulemaking.
Risk Management	What technologies are available for effective arsenic treatment of drinking water?	Conduct and evaluate laboratory and field tests on different arsenic control technologies.	Series of reports describing the technical performance of the different arsenic control technologies.	To demonstrate the capabilities and performance of arsenic control technologies for use in determining Best Available Technologies and in rulemaking.
	What are the technical and economic considerations of arsenic control for small drinking water systems?	Complete cost evaluations for all arsenic control technologies.	Series of reports describing the economic considerations associated with the operation of each arsenic treatment technology.	To provide data on any adverse economic considerations that may impact small systems and that can be taken into consideration during rulemaking and granting variances to compliance.
	How can arsenic-enhanced residuals be effectively managed from drinking water systems?	Conduct studies on the arsenic characterizations of the residual materials generated from different arsenic control technologies.	Series of reports outlining the composition of the residual arsenic and its mobility in treatment wastes.	To provide data on the recycle/disposal options for the residual material generated and for support in rulemaking decisions.

[a]PBPK = physiologically based pharmacokinetic.

Table 6. Particulate Matter

Subtopic	Strategic Focus	Tasks	Products	Uses
Health Effects	What health effects are caused by particulate matter (PM) and its components? What is the role of copollutants in producing PM toxicity?	Conduct epidemiologic studies of mortality and morbidity coupled with improved exposure characterization. Conduct clinical studies of respiratory effects in controlled human studies.	Qualitative and quantitative data on mortality and/or respiratory diseases.	To provide health effects data for risk assessment (Criteria Document) to support PM National Ambient Air Quality Standards (NAAQS).
	What are the causal mechanisms/particles that explain/support epidemiologic observations?	Conduct animal and clinical studies of biochemical and physiologic events initiated by PM and its components.	Dose-response data describing biochemical and physiologic events induced by PM and their relationship to disease.	To provide health effects data for risk assessment (Criteria Document) to support PM NAAQS.
	What is the relationship between PM exposure and dose? What is the role of dose for effects in sensitive subpopulations?	Develop dosimetric model of particle deposition in the lungs under various exposure and population conditions.	Dosimetric model linking animals to humans and normal humans to sensitive subpopulations (e.g., children, individuals with preexisting disease).	To provide health effects data for risk assessment (Criteria Document) to support PM NAAQS.
Exposure	What species and concentration levels of PM, and important copollutants, are people exposed to?	Develop ambient PM measurement methodology capable of discriminating particles by size and species.	Methods for measuring fine-particle mass and characterizing species (e.g., acid aerosols, inorganic and organic species).	To serve as a Federal Reference Method for new fine-particle NAAQS. To provide PM methodology for atmospheric chemistry research and total exposure research.
		Conduct PM size and species characterization studies.	PM characterization data.	To assess PM size and concentration levels for regulatory development and epidemiologic study design. To identify sources of PM and address PM formation, transport, and fate. To help develop control strategies for implementing PM regulation(s).

(Continued)

Table 6. Particulate Matter (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure (Continued)	What PM species and concentration levels are people exposed to?	Conduct prospective epidemiologic and human exposure studies.	Verification of current epidemiologic observations. Improved estimates of human exposure to PM Reduced uncertainty regarding the size and physical properties of PM that may cause health effects.	To determine the effects of ambient fine and coarse PM on adults' lung function and daily mortality. To evaluate and extend findings on size-specific PM exposure and daily mortality.
Risk Assessment	How can we reduce uncertainties associated with estimates of the PM mortality/morbidity risks at low ambient levels?	Conduct statistical reanalyses of existing epidemiologic databases to further characterize: –The shape of exposure-response relationships (possible 'thresholds'). –The influence of synoptic weather patterns. –The size/chemical composition of key PM components.	Quantitative data analyses providing reduced uncertainties in PM risk estimates.	To provide health effects data for risk assessment (Criteria Document) to support PM NAAQS.
Risk Management	What are the emission rates and physical and chemical characteristics of fine particles and precursors from sources that pose the greatest risk to public health?	Characterize fine-particle emissions from sources of concern (e.g., heavy duty diesel trucks, fugitive sources, combustion systems, other stationary sources).	Technical reports and data on the size distribution, chemical composition, and quantity of fine-particle emissions from key mobile and stationary sources.	To provide emissions data to focus regulatory strategies on the most critical sources. To provide methods and models for states to develop fine-particle emissions inventories.

(Continued)

Table 6. Particulate Matter (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Risk Management (Continued)	What options (e.g., process changes, upgrades of existing controls, application of new technologies) are available that both reduce fine-particle and precursor emissions to acceptable levels and are cost-effective?	Investigate options for reducing fine-particle emissions: –Demonstrate the extent to which improved operation and maintenance of existing control equipment for combustion systems can further reduce emissions. –Develop advanced, more cost-effective technologies (e.g., improved electrostatic precipitators and fabric filters) to control fine particles from stationary sources. –Determine the effectiveness of indoor air cleaners for reducing personal exposure to fine particles. Compare the costs of these and other approaches.	Technical reports and data on the performance and cost-effectiveness of competing risk management approaches. User-friendly computer models and other technical assistance tools that transfer risk management information to key users.	To support evaluations of competing regulatory strategies, cost/benefit analyses, and development of guidance documents. To provide guidance to states and the regulated community on the performance and cost of competing fine-particle risk management approaches.

Table 7. Endocrine Disruptors

Subtopic	Strategic Focus	Tasks	Products	Uses
Biological Effects	Defining the classes of chemicals that act as EDCs[a] and their potencies.	Develop in vitro/in vivo methods and structure-activity models to screen for EDC action.	Methods to describe the hazard potential of EDCs and likely modes of action and potencies.	Hazard characterization to support implementation of the FQPA[b] and the SDWA.[c]
	Evaluating current testing guidelines and monitoring procedures for adequacy of assessment of EDCs.	Enhance ability of existing test methods (e.g., multigenerational studies in mammals and life-cycle tests in fish and wildlife) to evaluate manifestations of endocrine disruption and underlying modes of action.	Revised testing guidelines that are more indicative of the most sensitive lifestage, sex, and target tissue for chemicals that act through the endocrine system.	To improve regulatory testing requirements and data interpretation.
	Determining the shapes of dose-response curves for EDCs at relevant exposures and the tissue levels associated with adverse effects.	Assess effects of EDC exposure on neuroendocrine, immunological, and reproductive function in developing and adult animals in support of pharmacokinetic and biologically based dose-response models, with emphasis on animal models of EDC-induced diseases.	Animal models of EDC-induced health effects that provide increased understanding of the types and magnitudes of risks for exposure to EDCs during various phases of the life cycles.	To provide quantitative dose-response evaluation and reduced uncertainties for human health extrapolations.
	Describing the normal endocrine profiles in wildlife species.	Provide baseline endocrine information for wildlife populations and their laboratory surrogates, with emphasis on comparative endocrinology and developmental control of sex differentiation, especially for species with little historical attention.	Databases of endocrine profiles in species from multiple phylogenetic levels and improved understanding of the role of the endocrine system in sex differentiation.	To assess the impact of EDCs in wildlife populations.

(Continued)

Table 7. Endocrine Disruptors (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Biological Effects (Continued)	Extrapolating effects at the individual level to populations for fish and wildlife.	Translate results from measurement endpoints at lower levels of biological organization to impacts on populations and communities through use of microcosms and mesocosms. Identify appropriate sentinel species for environmental monitoring.	Models predicting population level effects from studies at lower levels of biological organization.	To facilitate ecological risk assessment based on effects in individuals.
	Characterizing the effects of exposure to multiple EDCs.	Systematically study the interactions of EDCs at low, relevant dose levels to understand potential for synergism.	Assessment of the validity of the additivity principal for EDCs and predictive models for synergistic interactions.	To reduce uncertainties associated with assessment of exposure to multiple EDCs.
Exposure Studies	Developing a framework to characterize and to diagnose and predict ecological and human exposure to EDCs.	Use physicochemical attributes to identify transport, transformation, and environmental fate characteristics associated with exposure scenarios of concern to biological organisms. Construct compartmental models to predict environmental behaviors.	Validated models to predict and assess transport, fate, and exposure to EDCs from source to receptor.	To conduct preliminary environmental exposure assessments and set priorities for additional focused research.
	Providing adequate tools to estimate exposure to EDCs.	Develop new methods and refine existing ones (e.g., analytical chemistry, sample extraction, biomarkers) to acquire data for compartmental models, with emphasis on the transport and transformation in sediments and tools for assessing exposure in individuals.	Field and laboratory tools to better quantitate EDCs in multimedia.	To improve characterization of exposure to EDCs.

(Continued)

Table 7. Endocrine Disruptors (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure Studies (Continued)	Determining total ecosystem and human exposures to EDCs of concern.	Examine multigenerational transfer of EDCs in ecosystems, including biomagnification processes important to higher vertebrates. Provide information on EDC exposure distribution in the general human population.	Exposure assessments for EDCs in key wildlife species and the general human population.	To monitor the environmenal signals of EDC exposure and effects.
Linkage of Effects, Exposure, and Risk Management	Integrating human and ecological effects research with exposure research within the risk assessment paradigm.	Construct framework to identify, characterize, and prioritize potential exposure to EDCs and provide database for preliminary risk characterization.	Coordinated process for identifying exposure and effects of concern for additional intensive characterization of risk.	To conduct preliminary risk assessments and assist research prioritization.
	Determining classes and concentrations of EDCs associated with observations of endocrine disruption.	Develop informational database for EDCs, including biological effects, environmental concentrations, and historical trends from existing monitoring programs. Conduct integrated toxicology and exposure studies in areas or human populations with suspected contamination or exposure to EDCs.	Database on EDC levels in the human environment and various ecosystems associated with biological effects of concern.	Centralized information source for environmental monitoring of EDCs.
	Establishing status and trends of human and wildlife endocrine disruption and EDC exposure.	Identify sites within geographic proximity to ORD laboratories for long-term intensive observation of potential EDC effects. Examine existing exposure and effect registries for indications of EDC effects.	Consolidated databases of status and trends relevant to EDC exposures and effects.	For environmental monitoring and comparison of effects with more intensive exposures.

(Continued)

Table 7. Endocrine Disruptors (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Linkage of Effects, Exposure, and Risk Management (Continued)	Developing risk management approaches to reduce or eliminate environmental exposure to EDCs.	Identify major sources of EDCs entering the environment. Develop tools for risk management, such as biodegradation processes or pollution prevention strategies.	Risk management tools for elimination or prevention of exposures to significant EDCs.	To develop remedial actions where adverse effects of EDCs have been documented.

[a]EDC = endocrine-disrupting chemical.
[b]FQPA = Food Quality Protection Act.
[c]SDWA = Safe Drinking Water Act.

Table 8. Research to Improve Ecosystem Risk Assessment

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure and Effects	What is the current condition of the environment?	Develop indicators of ecological condition.	National Land Cover Database for all Regions and indicators of landscape vulnerability and human stress at watershed and larger scales. Suites of new, field applicable biological indicators/criteria for measuring, understanding, and diagnosing ecosystem exposures and effects.	To assist researchers and stakeholders in identifying environmental hazards at multiple scales and evaluating relative condition. To serve as guidance on how to measure regulatory and management success.
	What stressors are most significant in affecting the condition? Where are they? How are they distributed?	Develop multiscale exposure profiles for important stressors.	Multimedia, multistress exposure models for defining the distribution of stresses, alone and in combination, at local, watershed, and larger scales.	To assist researchers and stakeholders in evaluating the magnitude and extent of environmental stressors at local, regional, and national scales. To serve as a tool for predicting the results of alternative source reduction regulations.
	What are the mechanisms of adverse effects? How sensitive are ecosystems to chemical and nonchemical exposures?	Conduct cause/effects research at multiple levels of biological organization.	Ecosystem models for predicting the response of ecosystems to multiple stressors, at multiple scales.	To assist researchers and stakeholders in developing risk management alternatives and predicting ecosystem responses to these alternatives.
Assessment	What is the relative risk posed by stressors, now and in the future? What is the sustainability and/or vulnerability of ecosystems?	Develop multiple scale, multistressor, multi-endpoint relative risk methods.	Assessment techniques and guidelines for defining ecosystem sensitivity, developing associated exposure profiles, and quantifying ecosystem vulnerability and sustainability.	To assist researchers and stakeholders at local, regional, and national scales make cost-effective management decisions on the protection of ecological resources by knowing what the most important problems are, how to get the desired result, how to verify/measure that result, and how to improve conditions now and in the future.

(Continued)

Table 8. Research to Improve Ecosystem Risk Assessment (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Risk Management	What options are available to manage the risk?	Evaluate alternative management options.	Risk managment strategies that take advantage of pollution prevention and the self-purifying potential of natural systems.	To assist researchers and stakeholders in identifying cost-effective risk management options and to provide guidance on how best to maintain or improve conditions now, and in the future.
	How are degraded systems best restored?	Conduct ecosystem restoration studies.	Document techniques for restoring valued ecosystems.	

Table 9. Research to Improve Health Risk Assessment

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure	What is the source-exposure relationship?	Develop verified models that trace the prospective and retrospective relationship between sources and total exposure.	Verified source-exposure models that incorporate fate and transport processes.	To identify the most effective risk management targets.
	What is the population distribution of exposures from all media?	Develop quantitative total human exposure models based on sound theoretical and experimental information.	Improved methods for exposure measurements: - Activity pattern database. - Microenvironmental exposure measurements. - Field studies of populations with a variety of exposure risk factors. - Computer-based exposure model platform.	To support health risk assessments; to measure effectiveness of risk management decisions.
	What are the determinants of exposure?	Determine which behavioral, socioeconomic, or lifestyle factors increase exposure to pollutants; determine the relationship of age (young and old) and preexisting disease to exposure.	Multimedia/pathway exposure data for disadvantaged populations, children, the elderly, and persons living near selected sources (e.g., pesticide use). Exposure models for highly exposed subpopulations.	To identify at-risk subpopulations for risk assessment and to ensure adequacy of rules/regulations.
Dose Estimation	What is the exposure-dose relationship for pollutants from each pathway?	For pollutants having multiple pathways, determine the quantitative contribution of each pathway to total exposure and target-site dose.	Models of relative intakes of persistent chemicals from inhalation, oral, and dermal routes based on measurement data.	To identify the pathways that contribute most to risk and hence require mitigation.
	How can we improve dose estimations across species and exposure scenarios?	Develop methods and models for estimating dose to target tissues (i.e., physiologically based pharmacokinetic models).	Models for predicting disposition of chemicals in the body from all routes.	To improve the scientific basis for cancer and noncancer risk assessments. To reduce uncertainty in risk assessment and risk management decisions.

(Continued)

Table 9. Research to Improve Health Risk Assessment (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Hazard Identification and Characterization	How can we improve our ability to detect hazards?	Develop screening methods to set testing priorities.	Validated screening protocols using, for example, in vivo, in vitro, and structural activity relationship (SAR) methods.	To identify and rank existing pesticides and industrial chemicals in terms of potential toxicity. To screen new chemicals as they enter the regulatory system; to assess relative toxicity.
		Develop cost-effective methods for toxicity data collection.	New and revised standard toxicity testing protocols.	To develop Agency test guidelines. To support regulatory activities (e.g., TSCA[a] test rules and consent agreements, FIFRA[b] data call-ins).
	How can we better interpret toxicity data to predict and define hazards?	Develop improved methods for data interpretation. For example, identify biomarkers of exposure and effect and validate the use of biomarkers in human populations.	Guidance document on interpretation of toxicity data.	For incorporation into risk assessment guidelines.
Dose-Response Relationship	How can we reduce uncertainty in extrapolations (e.g., from high doses in animals to environmental exposures in humans)?	Develop quantitative models for predicting tissue and organism response to target tissue dose (i.e., biologically based dose-response models).	Models for predicting toxicity due to chemical exposures, which can be modified and applied in chemical-specific risk assessments.	To provide critical examples of development and use of mechanistic models; to evaluate the potential of these models for replacing default approaches for cancer and noncancer risk assessment. To provide a state-of-the-science basis for replacing default, primarily empirical risk assessment approaches.
		Develop improved empirical dose-response models (e.g., benchmark dose models).	Validated benchmark dose models and guidelines for applications.	To improve reference dose concentration procedures and thereby improve the basis for risk management decisions.

[a]TSCA = Toxic Substances Control Act.
[b]FIFRA = Federal Insecticide, Fungicide, and Rodenticide Act.

Table 10. Pollution Prevention and New Technologies for Environmental Protection

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure	What are the environmental monitoring needs of the EPA Program and Regional Offices?	Develop a monitoring information needs assessment inventory.	Inventory of specific monitoring technology needs and requirements.	To serve as a starting point for discussion with Federal and commercial technology developers to explore possible matches between information needs and technology capabilities.
		Match environmental monitoring needs with relevant environmental technologies.	Inventory of environmental monitoring needs matched with relevant technologies.	To focus research on those technologies that best meet the needs of EPA and the public.
	How can we best leverage the research, technologies, and information of others?	Stage a series of workshops with NASA[a] Mission to Planet Earth.	Joint pilot projects, demonstrations, and collaborative research and development opportunities.	To match the monitoring technolgoy needs of the EPA Program Offices and Regions with the technology capabilities of NASA.
		Sponsor a joint EPA/DOE[b] workshop.	Demonstrations of advanced monitoring technologies and their potential applications.	To identify and showcase new and innovative environmental monitoring technologies that can better meet the nation's needs for ensuring protection of the environment.
	How can we better focus on remote sensing applications research applied to characterizing landscape composition and pattern?	Establish an internal research program.	An interagency (EPA, USGS,[c] NOAA) program (called the Multi-Resolution Landscape Characterization, or MRLC), which is producing land cover information for the United States in accordance with Federal Geographic Data Committee standards for vegetation classification and documentation. (The MRLC has completed mapping of Standard Federal Region 2 and 3. Mapping of Regions 4 and 5 is planned to be completed in 1997.) Assessment tools for analyzing and interpretating landscape composition and pattern at a number of scales, ranging from local communities to Standard Federal Regions.	To provide more comprehensive information about ecological resources to be used for environmental planning purposes. To assess the conditions of watersheds (water quality, terrestrial wildlife habitat suitability and terrestrial ecosystem condition) across the mid-Atlantic region of the U.S., using the landscape tools.

(Continued)

Table 10. Pollution Prevention and New Technologies for Environmental Protection (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Exposure (Continued)		Initiate pilot projects.	Demonstrations of the use of remote sensing in a range of environmental applications such as air and water quality monitoring, ecosystem evaluation, and site assessment.	To evaluate currently feasible applications leading to broader implemenation involving key stakeholders.
		Establish joint EPA/NASA research program.	Scientific framework to allow the application of remote sensing technologies to diagnose existing ecosystems, establish the basis to prioritize ecosystems that should be restored, describe effectiveness criteria for improvements, and describe desirable endpoints for ecosystem restoration and rehabilitation.	To address fundamental concepts of ecosystem rehabilitation.
	What other advanced measurement technologies are available for real-time monitoring?	Establish an internal research program.	Development of cost-effective, real-time monitoring technologies.	To provide regulators and the public with timely and relevant environmental information.
Risk Assessment	How can we use monitoring information to better assess the risks to human health and ecological resources, and how can we better characterize and communicate these risks?	Develop techniques to characterize monitoring information and communicate this information to the public.	Easily accessible and understandable information about environmental conditions for the public and communities.	To provide better, more consistent environmental information to the public, enabling more informed decision-making.
Risk Management	How can pollution prevention strategies be integrated into federal, state, and private sector decision-making?	Develop life-cycle assessment (LCA) tools and models.	LCA tools that can address high-priority health and environmental problems.	To demonstrate how LCA can evaluate options for multimedia pollution prevention and risk management that are keyed to the greatest risks. To provide objective, scientifically credible LCA procedures for regulatory and private sector use.

(Continued)

Table 10. Pollution Prevention and New Technologies for Environmental Protection (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Risk Management (Continued)		Develop pollution prevention modules for industrial plant, product, and process design procedures.	Generic and specific LCA case studies with private and public sector partners. Mathematical models and computer-based simulators for process design.	To establish partnerships to demonstrate risk-based pollution prevention design and a process simulation opportunities. For commercial plant and process design methods, models, and procedures. To provide technology transfer to the private sectors through Cooperative Research and Development Agreements and licensing agreements.
		Develop pollution prevention measurement and audit tools for small businesses.	Pollution prevention accounting methods and models. Audit procedures for pollution prevention.	To provide tools for measuring and estimating "pollution prevented" in small businesses. To provide technical guidance for regulatory programs and private sector needs.
	How can pollution be prevented using innovative approaches?	Develop precompetitive and enabling pollution prevention approaches for major industrial sectors.	Pollution prevention approaches for Common Sense Initiative-related industrial sectors and high-risk problems, including information on technology costs.	To improve technical and cost data and designs for pollution prevention approaches keyed on Common Sense Initiative industries and other high-risk problems. To encourage the use of pollution prevention approaches for a wide array of U. S. industrial sectors and high-risk problem areas.
		Evaluate and verify these approaches for technical performance and cost-effectiveness.	Technology verification protocols, third-party verification organizations, and outreach to technology enablers and users. Performance and cost data for pollution prevention approaches.	To provide credible information that informs decision-makers about pollution prevention options emphasizing both performance and cost. To create a basis for developing scientifically credible and commercially available pollution prevention approaches in both U.S. and foreign markets.

(Continued)

Table 10. Pollution Prevention and New Technologies for Environmental Protection (Continued)

Subtopic	Strategic Focus	Tasks	Products	Uses
Risk Management (Continued)	How can reliable and appropriate cost data be generated for pollution prevention approaches?	Develop process cost models for pollution prevention approaches. Develop cost data reporting standards and protocols for improved cost comparability.	Cost-estimating and reporting protocols and standards.	To improve cost-estimating tools for use in cost-effectiveness and cost-benefit methods development and analysis. To provide reliable, scientifically credible cost-estimation packages for environmentally preferable approaches to preventing pollution.
		Develop engineering and performance costs for pollution prevention approaches.	Cost data for pollution prevention approaches.	To improve cost-benefit assessments by EPA and other regulatory and nonregulatory decision-makers.
	How can pollution prevention results and information be disseminated to affect a reduction in environmental risk worldwide?	Identify specific industry and government audiences worldwide, their needs for information, and appropriate products to meet those needs (e.g., seminars, bulletins, demonstrations).	A variety of technology transfer products disseminated via the Internet, teleconferencing, electronic bulletin board, and other more conventional means (e.g., reports, workshops).	To increase the awareness and knowledge of environmental professionals and others about the validity and benefits of pollution prevention, thereby leading to its increased application and broader use. To improve decision-making among pollution prevention practitioners and permitting officials. To support widespread use of applicable pollution prevention approaches that maximize risk reduction.
			Industry-targeted information dissemination that includes technical and cost data and performance analyses.	To improve environmental compliance and reduce compliance costs. To encourage the private sector to value and routinely use pollution prevention as the first or only preference for environmental protection and compliance.
	How can we encourage private sector development of advanced technologies?	The Small Business Innovative Research Program was established for this purpose.	Private sector development of advanced monitoring sensors, instruments, and data systems.	To support private sector developers of innovative technologies.

(Continued)