02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.B. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: Robert B Waide

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☒ White

Disability Status: (Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☐ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☒

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

Ethnicity Definition:
Hispanic or Latino. A person of Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.

Race Definitions:
American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.
Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.
Black or African American. A person having origins in any of the black racial groups of Africa.
Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.
White. A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.

WHY THIS INFORMATION IS BEING REQUESTED:

The Federal Government has a continuing commitment to monitor the operation of its review and award processes to identify and address any inequities based on gender, race, ethnicity, or disability of its proposed PIs/PDs. To gather information needed for this important task, the proposer should submit a single copy of this form for each identified PI/PD with each proposal. Submission of the requested information is voluntary and will not affect the organization's eligibility for an award. However, information not submitted will seriously undermine the statistical validity, and therefore the usefulness, of information recieved from others. Any individual not wishing to submit some or all the information should check the box provided for this purpose. (The exceptions are the PI/PD name and the information about prior Federal support, the last question above.)

Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

02 INFORMATION ABOUT PRINCIPAL INVESTIGATORS/PROJECT DIRECTORS(PI/PD) and co-PRINCIPAL INVESTIGATORS/co-PROJECT DIRECTORS

Submit only ONE copy of this form **for each PI/PD and co-PI/PD** identified on the proposal. The form(s) should be attached to the original proposal as specified in GPG Section II.B. Submission of this information is voluntary and is not a precondition of award. This information will not be disclosed to external peer reviewers. ***DO NOT INCLUDE THIS FORM WITH ANY OF THE OTHER COPIES OF YOUR PROPOSAL AS THIS MAY COMPROMISE THE CONFIDENTIALITY OF THE INFORMATION.***

PI/PD Name: James W Brunt

Gender: ☒ Male ☐ Female

Ethnicity: (Choose one response) ☐ Hispanic or Latino ☒ Not Hispanic or Latino

Race: (Select one or more)
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Black or African American
- ☐ Native Hawaiian or Other Pacific Islander
- ☒ White

Disability Status: (Select one or more)
- ☐ Hearing Impairment
- ☐ Visual Impairment
- ☐ Mobility/Orthopedic Impairment
- ☐ Other
- ☒ None

Citizenship: (Choose one) ☒ U.S. Citizen ☐ Permanent Resident ☐ Other non-U.S. Citizen

Check here if you do not wish to provide any or all of the above information (excluding PI/PD name): ☐

REQUIRED: Check here if you are currently serving (or have previously served) as a PI, co-PI or PD on any federally funded project ☒

Ethnicity Definition:
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Collection of this information is authorized by the NSF Act of 1950, as amended, 42 U.S.C. 1861, et seq. Demographic data allows NSF to gauge whether our programs and other opportunities in science and technology are fairly reaching and benefiting everyone regardless of demographic category; to ensure that those in under-represented groups have the same knowledge of and access to programs and other research and educational oppurtunities; and to assess involvement of international investigators in work supported by NSF. The information may be disclosed to government contractors, experts, volunteers and researchers to complete assigned work; and to other government agencies in order to coordinate and assess programs. The information may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records", 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records", 63 Federal Register 268 (January 5, 1998).

List of Suggested Reviewers or Reviewers Not To Include (optional)

SUGGESTED REVIEWERS:
Not Listed

REVIEWERS NOT TO INCLUDE:
Not Listed

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE/if not in response to a program announcement/solicitation enter NSF 09-1

NSF 09-1

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)

DEB - Long-Term Ecological Research

FOR NSF USE ONLY

NSF PROPOSAL NUMBER

0936498

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	DUNS# (Data Universal Numbering System)	FILE LOCATION
03/26/2009	1	08010000 DEB	1195	868853094	03/26/2009 5:04pm

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)

856000642

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE

University of New Mexico

AWARDEE ORGANIZATION CODE (IF KNOWN)

0026633000

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE

University of New Mexico
1700 Lomas Blvd. NE
ALBUQUERQUE, NM. 871310001

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING 9 DIGIT ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply) (See GPG II.C For Definitions)
☐ SMALL BUSINESS ☐ MINORITY BUSINESS
☐ FOR-PROFIT ORGANIZATION ☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT **Science and Cyberinfrastructure in Support of the LTER Decadal Plan**

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 6,737,042	60 months	07/01/09	

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.G.2)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)
☐ HISTORIC PLACES (GPG II.C.2.j)
☐ EAGER* (GPG II.D.2) ☐ RAPID** (GPG II.D.1)
☐ VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date _____
PHS Animal Welfare Assurance Number _____

☐ HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number _____
Exemption Subsection _____ or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)
_____
☐ HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT
Biology

PI/PD FAX NUMBER
505-277-2541

PI/PD POSTAL ADDRESS
LTER Network Office

Albuquerque, NM 871311091
United States

NAMES (TYPED)	High Degree	Yr of Degree	Telephone Number	Electronic Mail Address
PI/PD NAME **Robert B Waide**	**PhD**	**1978**	**505-277-2649**	**rwaide@lternet.edu**
CO-PI/PD **James W Brunt**	**MS**	**1988**	**505-277-2535**	**jbrunt@lternet.edu**
CO-PI/PD				
CO-PI/PD				
CO-PI/PD				

Electronic Signature

CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 09-1). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be dislosed to NSF.

Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer "yes", please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency? Yes ☐ No ☒

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, ''Disclosure of Lobbying Activities,'' in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and
(2) for other NSF Grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME **Brenda Baker**	**Electronic Signature**	**Mar 26 2009 4:55PM**

TELEPHONE NUMBER	ELECTRONIC MAIL ADDRESS	FAX NUMBER
505-277-2341	**brbaker@unm.edu**	**505-277-4185**

* EAGER - EArly-concept Grants for Exploratory Research
** RAPID - Grants for Rapid Response Research

Directorate for Biological Sciences
Division of Environmental Biology
Long-term Ecological Research

Proposal Classification Form
PI: / Proposal Number: 0936498

CATEGORY I: INVESTIGATOR STATUS (Select ONE)

- ☐ Beginning Investigator - No previous Federal support as PI or Co-PI, excluding fellowships, dissertations, planning grants, etc.
- ☐ Prior Federal support only
- ☐ Current Federal support only
- ☑ Current & prior Federal support

CATEGORY II: FIELDS OF SCIENCE OTHER THAN BIOLOGY INVOLVED IN THIS RESEARCH (Select 1 to 3)

☐ Astronomy	☐ Engineering	☐ Psychology
☐ Chemistry	☐ Mathematics	☐ Social Sciences
☐ Computer Science	☐ Physics	☑ None of the Above
☐ Earth Science		

CATEGORY III: SUBSTANTIVE AREA (Select 1 to 4)

☐ BIOGEOGRAPHY	☐ Decomposition	☐ Molecular Evolution
☐ Island Biogeography	☐ Biogeochemistry	☐ Methodology/Theory
☐ Historical/ Evolutionary Biogeography	☐ Limnology/Hydrology	☐ Isozymes/ Electrophoresis
☐ Phylogeography	☐ Climate/Microclimate	☐ Nucleic Acid Analysis (general)
☐ Methods/Theory	☐ Whole-System Analysis	☐ Restriction Enzymes
☐ CHROMOSOME STUDIES	☐ Productivity/Biomass	☐ Nucleotide Sequencing
☐ Chromosome Evolution	☐ System Energetics	☐ Nuclear DNA
☐ Chromosome Number	☐ Landscape Dynamics	☐ Mitochondrial DNA
☐ Mutation	☐ Chemical & Biochemical Control	☐ Chloroplast DNA
☐ Mitosis and Meiosis	☐ Global Change	☐ RNA Analysis
☐ COMMUNITY ECOLOGY	☐ Climate Change	☐ DNA Hybridization
☐ Community Analysis	☐ Regional Studies	☐ Recombinant DNA
☐ Community Structure	☐ Global Studies	☐ Amino Acid Sequencing
☐ Community Stability	☐ Forestry	☐ Gene/Genome Mapping
☐ Succession	☐ Resource Management (Wildlife, Fisheries, Range, Other)	☐ Natural Products
☐ Experimental Microcosms/ Mesocosms	☐ Agricultural Ecology	☐ Serology/Immunology
☐ Disturbance	☐ EXTREMOPHILES	☐ PALEONTOLOGY
☐ Patch Dynamics	☐ GENOMICS (Genome sequence, organization, function)	☐ Floristic
☐ Food Webs/ Trophic Structure	☐ Viral	☐ Faunistic
☐ Keystone Species	☐ Microbial	☐ Paleoecology
☐ COMPUTATIONAL BIOLOGY	☐ Fungal	☐ Biostratigraphy
☐ CONSERVATION & RESTORATION BIOLOGY	☐ Plant	☐ Palynology
☑ DATABASES	☐ Animal	☐ Micropaleontology
☑ ECOSYSTEMS LEVEL	☐ MARINE MAMMALS	☐ Paleoclimatology
☐ Physical Structure	☐ MOLECULAR APPROACHES	☐ Archeozoic
		☐ Paleozoic
		☐ Mesozoic

- ☐ Cenozoic
- ☐ POPULATION DYNAMICS & LIFE HISTORY
- ☐ Demography/ Life History
- ☐ Population Cycles
- ☐ Distribution/Patchiness/ Marginal Populations
- ☐ Population Regulation
- ☐ Intraspecific Competition
- ☐ Reproductive Strategies
- ☐ Gender Allocation
- ☐ Metapopulations
- ☐ Extinction
- ☐ POPULATION GENETICS & BREEDING SYSTEMS
- ☐ Variation
- ☐ Microevolution
- ☐ Speciation
- ☐ Hybridization
- ☐ Inbreeding/Outbreeding
- ☐ Gene Flow Measurement
- ☐ Inheritance/Heritability
- ☐ Quantitative Genetics/ QTL Analysis
- ☐ Ecological Genetics
- ☐ Gender Ratios
- ☐ Apomixis/ Parthenogenesis
- ☐ Vegetative Reproduction
- ☐ SPECIES INTERACTIONS
- ☐ Predation
- ☐ Herbivory
- ☐ Omnivory
- ☐ Interspecific Competition
- ☐ Niche Relationships/ Resource Partititioning
- ☐ Pollination/ Seed Dispersal
- ☐ Parasitism
- ☐ Mutualism/ Commensalism
- ☐ Plant/Fungal/ Microbial Interactions
- ☐ Mimicry
- ☐ Animal Pathology
- ☐ Plant Pathology
- ☐ Coevolution
- ☐ Biological Control
- ☐ STATISTICS & MODELING
- ☐ Methods/ Instrumentation/ Software
- ☐ Modeling (general)
- ☐ Statistics (general)
  - ☐ Multivariate Methods
  - ☐ Spatial Statistics & Spatial Modeling
  - ☐ Sampling Design & Analysis
  - ☐ Experimental Design & Analysis
- ☐ SYSTEMATICS
- ☐ Taxonomy/Classification
- ☐ Nomenclature
- ☐ Monograph/Revision
- ☐ Phylogenetics
- ☐ Phenetics/Cladistics/ Numerical Taxonomy
- ☐ Macroevolution
- ☐ NONE OF THE ABOVE

CATEGORY IV: INFRASTRUCTURE (Select 1 to 3)

- COLLECTIONS/STOCK CULTURES
- ☐ Natural History Collections
- ☑ DATABASES
- FACILITIES
- ☐ Controlled Environment Facilities
- ☐ Field Stations
  - ☐ Field Facility Structure
  - ☐ Field Facility Equipment
- ☑ LTER Site
- ☐ INDUSTRY PARTICIPATION
- ☐ Technique Development
- TRACKING SYSTEMS
- ☐ Geographic Information Systems
- ☐ Remote Sensing
- ☐ NONE OF THE ABOVE

CATEGORY V: HABITAT (Select 1 to 2)

TERRESTRIAL HABITATS

- ☐ GENERAL TERRESTRIAL
- ☐ TUNDRA
- ☐ BOREAL FOREST
- ☐ TEMPERATE
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Rain Forest
  - ☐ Mixed Forest
  - ☐ Prairie/Grasslands
  - ☐ Desert
- ☐ SUBTROPICAL
  - ☐ Rain Forest
  - ☐ Seasonal Forest
  - ☐ Savanna
  - ☐ Thornwoods
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Desert
- ☐ TROPICAL
  - ☐ Rain Forest
  - ☐ Seasonal Forest
  - ☐ Savanna
  - ☐ Thornwoods
  - ☐ Deciduous Forest
  - ☐ Coniferous Forest
  - ☐ Desert
- ☐ CHAPPARAL/ SCLEROPHYLL/ SHRUBLANDS
- ☐ ALPINE
- ☐ MONTANE
- ☐ CLOUD FOREST
- ☐ RIPARIAN ZONES
- ☐ ISLANDS (except Barrier Islands)
- ☐ BEACHES/ DUNES/ SHORES/ BARRIER ISLANDS
- ☐ CAVES/ ROCK OUTCROPS/ CLIFFS
- ☐ CROPLANDS/ FALLOW FIELDS/ PASTURES
- ☐ URBAN/SUBURBAN
- ☐ SUBTERRANEAN/ SOIL/ SEDIMENTS
- ☐ EXTREME TERRESTRIAL ENVIRONMENT
- ☐ AERIAL

AQUATIC HABITATS

- ☐ GENERAL AQUATIC
- ☐ FRESHWATER
  - ☐ Wetlands/Bogs/Swamps
  - ☐ Lakes/Ponds
  - ☐ Rivers/Streams
  - ☐ Reservoirs
- ☐ MARINE
  - ☐ Open Ocean/Continental Shelf
  - ☐ Bathyal
  - ☐ Abyssal
  - ☐ Estuarine
  - ☐ Intertidal/Tidal/Coastal
  - ☐ Coral Reef
  - ☐ HYPERSALINE
- ☐ EXTREME AQUATIC ENVIRONMENT
- ☐ CAVES/ ROCK OUTCROPS/ CLIFFS
- ☐ MANGROVES
- ☐ SUBSURFACE WATERS/ SPRINGS
- ☐ EPHEMERAL POOLS & STREAMS
- ☐ MICROPOOLS (Pitcher Plants, Tree Holes, Other)

MAN-MADE ENVIRONMENTS

- ☐ LABORATORY
- ☐ THEORETICAL SYSTEMS
- ☐ OTHER ARTIFICIAL SYSTEMS

NOT APPLICABLE

- ☑ NOT APPLICABLE

CATEGORY VI: GEOGRAPHIC AREA OF THE RESEARCH (Select 1 to 2)

- ☐ WORLDWIDE
- ☐ NORTH AMERICA
  - ☐ United States
    - ☐ Northeast US (CT, MA, ME, NH, NJ, NY, PA, RI, VT)
    - ☐ Northcentral US (IA, IL, IN, MI, MN, ND, NE, OH, SD, WI)
    - ☐ Northwest US (ID, MT, OR, WA, WY)
    - ☐ Southeast US (DC, DE, FL, GA, MD, NC, SC, WV, VA)
    - ☐ Southcentral US (AL, AR, KS, KY, LA, MO, MS, OK, TN, TX)
    - ☐ Southwest US (AZ, CA, CO, NM, NV, UT)
    - ☐ Alaska
    - ☐ Hawaii
    - ☐ Puerto Rico
    - ☐ Canada
  - ☐ Mexico
- ☐ CENTRAL AMERICA (Mainland)
  - ☐ Caribbean Islands
  - ☐ Bermuda/Bahamas
- ☐ SOUTH AMERICA
  - ☐ Eastern South America (Guyana, Fr. Guiana, Suriname, Brazil)
  - ☐ Northern South America (Colombia, Venezuela)
  - ☐ Southern South America (Chile, Argentina, Uruguay, Paraguay)
  - ☐ Western South America (Ecuador, Peru, Bolivia)
- ☐ EUROPE
  - ☐ Eastern Europe
  - ☐ Russia
  - ☐ Scandinavia
  - ☐ Western Europe
- ☐ ASIA
  - ☐ Central Asia
  - ☐ Far East
  - ☐ Middle East
  - ☐ Siberia
  - ☐ South Asia
  - ☐ Southeast Asia
- ☐ AFRICA
  - ☐ North Africa
  - ☐ African South of the Sahara
    - ☐ East Africa
    - ☐ Madagascar
    - ☐ South Africa
    - ☐ West Africa
- ☐ AUSTRALASIA
  - ☐ Australia
  - ☐ New Zealand
  - ☐ Pacific Islands
- ☐ ANTARCTICA
- ☐ ARCTIC
- ☐ ATLANTIC OCEAN
- ☐ PACIFIC OCEAN
- ☐ INDIAN OCEAN
- ☐ OTHER REGIONS (Not defined)
- ☑ NOT APPLICABLE

CATEGORY VII: CLASSIFICATION OF ORGANISMS (Select 1 to 4)

- ☐ VIRUSES
  - ☐ Bacterial
  - ☐ Plant
  - ☐ Animal
- ☐ PROKARYOTES
  - ☐ Archaebacteria
  - ☐ Cyanobacteria
  - ☐ Eubacteria
- ☐ PROTISTA (PROTOZOA)
  - ☐ Amoebae
  - ☐ Apicomplexa
  - ☐ Ciliophora
  - ☐ Flagellates
  - ☐ Foraminifera
  - ☐ Microspora
  - ☐ Radiolaria
- ☐ FUNGI
  - ☐ Ascomycota
  - ☐ Basidiomycota
  - ☐ Chytridiomycota
  - ☐ Mitosporic Fungi
  - ☐ Oomycota
  - ☐ Zygomycota
- ☐ LICHENS
- ☐ SLIME MOLDS
- ☐ ALGAE
  - ☐ Bacillariophyta (Diatoms)
  - ☐ Charophyta
  - ☐ Chlorophyta
  - ☐ Chrysophyta
  - ☐ Dinoflagellata
  - ☐ Euglenoids
  - ☐ Phaeophyta
  - ☐ Rhodophyta
- ☐ PLANTS
  - ☐ N0N-VASCULAR PLANTS
    - ☐ BRYOPHYTA
      - ☐ Anthocerotae (Hornworts)
      - ☐ Hepaticae (Liverworts)
      - ☐ Musci (Mosses)
  - ☐ VASCULAR PLANTS
    - ☐ FERNS & FERN ALLIES
    - ☐ GYMNOSPERMS
      - ☐ Coniferales (Conifers)
      - ☐ Cycadales (Cycads)

- ☐ Ginkgoales (Ginkgo)
- ☐ Gnetales (Gnetophytes)
- ☐ ANGIOSPERMS
- ☐ Monocots
- ☐ Arecaceae (Palmae)
- ☐ Cyperaceae
- ☐ Liliaceae
- ☐ Orchidaceae
- ☐ Poaceae (Graminae)
- ☐ Dicots
- ☐ Apiaceae (Umbelliferae)
- ☐ Asteraceae (Compositae)
- ☐ Brassicaceae (Cruciferae)
- ☐ Fabaceae (Leguminosae)
- ☐ Lamiaceae (Labiatae)
- ☐ Rosaceae
- ☐ Solanaceae

☐ ANIMALS

- ☐ INVERTEBRATES
- ☐ MESOZOA/PLACOZOA
- ☐ PORIFERA (Sponges)
- ☐ CNIDARIA
- ☐ Hydrozoa (Hydra, etc.)
- ☐ Scyphozoa (Jellyfish)
- ☐ Anthozoa (Corals, Sea Anemones)
- ☐ CTENOPHORA (Comb Jellies)
- ☐ PLATYHELMINTHES (Flatworms)
- ☐ Turbellaria (Planarians)
- ☐ Trematoda (Flukes)
- ☐ Cestoda (Tapeworms)
- ☐ Monogenea (Flukes)
- ☐ GNATHOSTOMULIDA
- ☐ NEMERTINEA (Rynchocoela) (Ribbon Worms)
- ☐ ENTOPROCTA (Bryozoa) (Plant-like Animals)
- ☐ ASCHELMINTHES
- ☐ Gastrotricha
- ☐ Kinorhyncha
- ☐ Loricifera
- ☐ Nematoda (Roundworms)
- ☐ Nematomorpha (Horsehair Worms)
- ☐ Rotifera (Rotatoria)
- ☐ ACANTHOCEPHALA (Spiny-headed Worms)
- ☐ PRIAPULOIDEA
- ☐ BRYOZOA (Ectoprocta) (Plant-like Animals)
- ☐ PHORONIDEA (Lophophorates)
- ☐ BRACHIOPODA (Lamp Shells)
- ☐ MOLLUSCA
- ☐ Monoplacophora
- ☐ Aplacophora (Solenogasters)
- ☐ Polyplacophora (Chitons)
- ☐ Scaphopoda (Tooth Shells)
- ☐ Gastropoda (Snails, Slugs, Limpets)
- ☐ Pelecypoda (Bivalvia) (Clams, Mussels, Oysters, Scallops)
- ☐ Cephalopoda (Squid, Octopus, Nautilus)
- ☐ ANNELIDA (Segmented Worms)
- ☐ Polychaeta (Parapodial Worms)
- ☐ Oligochaeta (Earthworms)
- ☐ Hirudinida (Leeches)
- ☐ POGONOPHORA (Beard Worms)
- ☐ SIPUNCULOIDEA (Peanut Worms)
- ☐ ECHIUROIDEA (Spoon Worms)
- ☐ ARTHROPODA
- ☐ Cheliceriformes
- ☐ Merostomata (Horseshoe Crabs)
- ☐ Pycnogonida (Sea Spiders)
- ☐ Scorpionida (Scorpions)
- ☐ Araneae (True Spiders)
- ☐ Pseudoscorpionida (Pseudoscorpions)
- ☐ Acarina (Free-living Mites)
- ☐ Parasitiformes (Parasitic Ticks & Mites)
- ☐ Crustacea
- ☐ Branchiopoda (Fairy Shrimp, Water Flea)
- ☐ Ostracoda (Sea Lice)
- ☐ Copepoda
- ☐ Cirripedia (Barnacles)
- ☐ Amphipoda (Skeleton Shrimp, Whale Lice, Freshwater Shrimp)
- ☐ Isopoda (Wood Lice, Pillbugs)
- ☐ Decapoda (Lobster, Crayfish, Crabs, Shrimp)
- ☐ Hexapoda (Insecta) (Insects)
- ☐ Apterygota (Springtails, Silverfish, etc.)
- ☐ Odonata (Dragonflies, Damselflies)
- ☐ Ephemeroptera (Mayflies)
- ☐ Orthoptera (Grasshoppers, Crickets)
- ☐ Dictyoptera (Cockroaches, Mantids, Phasmids)
- ☐ Isoptera (Termites)
- ☐ Plecoptera (Stoneflies)
- ☐ Phthiraptera (Mallophaga & Anoplura) (Lice)
- ☐ Hemiptera (including Heteroptera) (True Bugs)
- ☐ Homoptera (Cicadas, Scale Insects, Leafhoppers)
- ☐ Thysanoptera (Thrips)
- ☐ Neuroptera (Lacewings, Dobsonflies, Snakeflies)
- ☐ Trichoptera (Caddisflies)
- ☐ Lepidoptera (Moths, Butterflies)
- ☐ Diptera (Flies, Mosquitoes)
- ☐ Siphonaptera (Fleas)
- ☐ Coleoptera (Beetles)
- ☐ Hymenoptera (Ants, Bees, Wasps, Sawflies)
- ☐ Chilopoda (Centipedes)
- ☐ Diplopoda (Millipedes)
- ☐ Pauropoda
- ☐ Symphyta (Symphyla)
- ☐ PENTASTOMIDA (Linguatulida) (Tongue Worms)
- ☐ TARDIGRADA (Tardigrades, Water Bears)
- ☐ ONYCHOPHORA (Peripatus)
- ☐ CHAETOGNATHA (Arrow Worms)
- ☐ ECHINODERMATA
- ☐ Crinoidea (Sea Lilies, Feather Stars)
- ☐ Asteroidea (Starfish, Sea Stars)
- ☐ Ophiuroidea (Brittle Stars, Serpent Stars)
- ☐ Echinoidea (Sea Urchins, Sand Dollars)
- ☐ Holothuroidea (Sea Cucumbers)
- ☐ HEMICHORDATA (Acorn Worms, Pterobranchs)
- ☐ UROCHORDATA (Tunicata) (Tunicates, Sea Squirts, Salps, Ascideans)
- ☐ CEPHALOCHORDATA (Amphioxus/Lancelet)
- ☐ VERTEBRATES
- ☐ AGNATHA (Hagfish, Lamprey)
- ☐ FISHES
- ☐ Chondrichthyes (Cartilaginous Fishes) (Sharks, Rays, Ratfish)
- ☐ Osteichthyes (Bony Fishes)
- ☐ AMPHIBIA
- ☐ Anura (Frogs, Toads)
- ☐ Urodela (Salamanders, Newts)
- ☐ Gymnophiona (Apoda) (Caecilians)
- ☐ REPTILIA
- ☐ Chelonia (Turtles, Tortoises)
- ☐ Serpentes (Snakes)
- ☐ Sauria (Lizards)
- ☐ Crocodylia (Crocodilians)
- ☐ AVES (Birds)
- ☐ Passeriformes (Passerines)
- ☐ MAMMALIA
- ☐ Monotremata (Platypus, Echidna)
- ☐ Marsupalia (Marsupials)
- ☐ Eutheria (Placentals)
- ☐ Insectivora (Hedgehogs, Moles, Shrews, Tenrec, etc.)
- ☐ Chiroptera (Bats)
- ☐ Primates
- ☐ Humans
- ☐ Rodentia
- ☐ Lagomorphs (Rabbits, Hares, Pikas)
- ☐ Carnivora (Bears, Canids, Felids, Mustelids, Viverrids, Hyena, Procyonids)
- ☐ Perissodactyla (Odd-toed Ungulates) (Horses, Rhinos, Tapirs, etc.)

☐ Artiodactyla (Even-toed Ungulates) (Cattle, Sheep, Deer, Pigs, etc.) ☐ Marine Mammals (Seals, Walrus, Whales, Otters, Dolphins, Porpoises)	☐ TRANSGENIC ORGANISMS ☐ FOSSIL OR EXTINCT ORGANISMS	☑ NO ORGANISMS

CATEGORY VIII: MODEL ORGANISM (Select ONE)

☑ NO MODEL ORGANISM MODEL ORGANISM (Choose from the list)	☐ Escherichia coli ☐ Mouse-Ear Cress (Arabidopsis thaliana)	☐ Fruitfly (Drosophila melanogaster)

Proposal Summary

Intellectual Merit — The Long Term Ecological Research (LTER) Network Office (LNO) provides critical services in support of the research and education goals of the LTER Network, represents the Network in its interactions with other scientific networks and centers, facilitates the operation of the Network as a cohesive research entity, and fosters new, broadly-based initiatives that extend LTER science, education, and cyberinfrastructure to new communities. The Decadal Plan for LTER, the result of an intensive three-year planning effort by the LTER Network, describes a broad vision for LTER science that encompasses substantial new levels of synthesis and transdisciplinary research. In this plan, the LTER Network envisions collaborations between ecologists and social scientists to create a new body of theory in social ecology that draws on and incorporates information technology and the most advanced educational approaches to amplify the societal impact of this vision.

The current Cooperative Agreement for the LNO, which began on March 1, 2009, reflects the significant changes in the vision for LTER Network science that have taken place since the last renewal of the LNO Cooperative Agreement in 2003. The current Cooperative Agreement supports Continuing Operations of the LNO including: organization of two All Scientists Meetings in 2009 and 2012; basic cyberinfrastructure support for the LTER Network; continued development of the Network Information System; facilitation of Network governance meetings; development of a strategic communication plan; communication of information about LTER to a variety of audiences; and creation and maintenance of strategic partnerships.

In consultation with the LTER Executive Board and the LTER Information Management Committee, the LNO identified needs for new funding to address Network research, education, and cyberinfrastructure goals defined in the LTER Decadal Plan ($6,737,042). Eight new positions and three retained positions will provide the LNO with increased capabilities to achieve the goals of the Decadal Plan. Activities addressing new science and education goals include expanded funding for research working groups, support for meetings to capitalize on the intellectual momentum developed in the planning process, and funds to support the activities of the LTER Science Council. Activities addressing new cyberinfrastructure goals include completion of the Network Information System, management of increased numbers of Network data bases created through the EcoTrends project, the creation of new synthetic databases, and increased training opportunities for LTER information managers and scientists. The proposal outlines new approaches to assessment and evaluation of the outcomes of proposed activities that will inform a flexible and responsive management strategy for the LNO.

Broader Impacts — The impact of the proposed work extends well beyond the bounds of the LTER Network to include the broader social-ecological and informatics communities. The LNO will stimulate the interdisciplinary interactions necessary to begin to address Decadal Plan goals. By supporting research working groups, the LNO will encourage interactions between ecologists and social scientists and will provide opportunities for increasing synthesis and expanding collaborations. These developing collaborations will encourage a broader-scale of transdisciplinary activity as envisioned in the Decadal Plan. Additional impacts will result from development of distributed data services and their use for new synthetic research, co-development of standards of practice for ecological information management, development of new cyberinfrastructure tools, increased access to data for education and underserved groups, and collaboration with other environmental observing networks to plan a robust and efficient national cyberinfrastructure for ecological research.

TABLE OF CONTENTS

For font size and page formatting specifications, see GPG section II.C.

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

1.0 Results from Prior Support from Cooperative Agreement
DEB 02-36154 — *A Proposal for the Network Office of the U.S. LTER Program*
March 1, 2003 — February 28, 2009; Principal Investigator: R. B. Waide

In 1983, the National Science Foundation (NSF) created the Long Term Ecological Research Network Office (LNO) to support and coordinate network and site activities of the U.S. Long Term Ecological Research (LTER) Network. In 1997, responsibility for operating and managing the LNO shifted from the University of Washington to the University of New Mexico (UNM) through a Cooperative Agreement (CA) with the NSF. A Scope of Work (SOW) within the CA defined the tasks of the LNO in detail and grouped them into ten categories of activities [1]. Sections 1.1 through 1.10 below report the most important accomplishments in each of these categories from the past six years of successful LNO operation. More detailed descriptions of accomplishments can be found in LNO annual reports [2]. Links to additional information appear as bracketed numbers in the text and refer to items in Section 7.0 of this proposal. Supplemental material submitted with this proposal includes a list of acronyms used in the text.

1.1 Network Office Administration and Service Activities

Interactions with external entities — LNO staff (Waide, Michener, Vande Castle) served as the principal point of contact and coordination between the LTER Network and NSF, other Federal agencies (e.g., U. S. Geological Survey (USGS), Forest Service, Agricultural Research Service, National Aeronautics and Space Administration (NASA)), other national and international networks (e.g., Organization of Biological Field Stations, National Ecological Observatory Network, Water and Environmental Research Systems Network, National Phenology Network (NPN), India Flux Network), non-governmental organizations (e.g., Internet2, American Distance Education Consortium), and individual sites and scientists.

Administration of funds — From 3/1/2003 to 3/1/2008, the LNO administered $10,973,280 in funds from the CA and supplements as well as funds from competitive proposals to address LTER Network objectives. Funds by source were: $8,099,998 in yearly increments for continuing activities, $1,711,236 in supplemental awards, $1,150,711 in cost share, and $11,335 in program income. Administration of funds (McConnell) included fiscal compliance with University, State, and Federal regulations, annual fiscal accounting and reporting, timely budget analysis, accurate projection rates, and managing day-to-day activities of project goals.

Proposal preparation (supplements and competitive proposals) — The LNO prepared ten supplement proposals to support specific activities of the LTER and International Long Term Ecological Network (ILTER) Networks. These included supplements: for the All Scientists Meetings (ASM) in 2003, 2006, and 2009; for maintenance of the ILTER databases and web page; for increases in LNO efforts resulting from LTER Network growth; for planning meetings to implement the Decadal Plan; for preparation of an ILTER Brochure; and for web applications development in support of the EcoTrends project [3]. In addition, the LNO prepared 11 competitive proposals to support and enhance core activities and to strengthen partnerships with the broader ecological and informatics communities and emerging networks such as the National Ecological Observatory Network (NEON) and the Water and Environmental Research Systems (WATERS) Network [4].

Meeting coordination — To increase the pace of synthesis and facilitate new research and governance initiatives, the LNO, in the span of six years, coordinated 248 research and governance meetings with more than 4,600 participants [5]. Meetings and workshops took place at a wide range of LTER sites and other locations around the country. LNO meeting coordination services included negotiating hotel contracts, direct payment of meeting and travel costs, reimbursements to participants, general logistics, invitations to international participants, and computer/software and audiovisual support.

1.2 Computational and Communication Infrastructure

Implementation and maintenance of network cyberinfrastructure — The LNO provided a critical service to the LTER community by maintaining basic computing, communication, and collaboration

infrastructure. Specifically, LNO staff maintained the servers required for hosting web sites, managing data, archiving documents, forwarding email, storing source code, tracking requests, and managing videoconferences. In addition, LNO staff (Brunt, Wyman) retooled the server infrastructure, making it more secure, modular, and redundant, and enabling it to host new applications such as virtualization. The retooled server infrastructure represents a major step towards participating in a service-oriented architecture (SOA).

Collaboration tools — The LNO greatly expanded collaboration capabilities within the LTER Network by implementing a high-quality, low-cost, video-teleconferencing (VTC) system. With funds obtained from UNM, the LNO (Brunt) purchased and installed a Polycom MGC50+ Communications Bridge valued at over $100K. The bridge enables multiple, simultaneous, multi-party conferences using internet protocols over existing connections. The LNO (Brunt) purchased and installed seven high-end VSX 3000 VTC units for Executive Board members and purchased two desktop VTC software licenses for each LTER site. LTER governance and research working groups have used the VTC system extensively (***Figure 1***). LNO staff, both independently and with synthesis working groups, evaluated a wide range of collaboration software products **[6]** to identify potential additional tools for LTER scientists.

Training laboratory — In cooperation with the project *Enabling the Science Environment for Ecological Knowledge* (SEEK; see ***Table 1***), the LNO designed and implemented a state-of-the-art information technology training facility (***Figure 2***) that prepares the LTER Network to meet the workforce training needs outlined in the Decadal Plan. LNO staff (Michener and Brunt) designed the facility's unique configuration to maximize interaction between instructors and participants.

1.3 Information Management and Methods Development

Promotion of metadata standards — The LNO worked with leaders of the informatics community, the Information Management Committee (IMC), the Network Information System Advisory Committee (NISAC), and one-on-one with site information managers to define best practices and implement Ecological Metadata Language (EML) after it was adopted as the Network standard by the LTER Coordinating Committee in 2004. All LTER sites now produce EML documented data sets and participate in the LTER Network data catalog. LNO staff (Brunt, Servilla, Costa, Michener, San Gil) collaborated with the National Center for Ecological Analysis and Synthesis (NCEAS) and LTER information managers to fix errors in and improve and enhance EML. The LNO is contributing to a corrected version of EML, thereby improving the ability of LTER sites to work with and generate compliant metadata. The LNO also fostered a relationship with the genomics standards community and promoted the use of EML for environmental genomics metadata **[7]**.

Curation, maintenance, and expansion of LTER Network databases — LNO staff (Brunt, White) maintained interfaces and access to the LTER personnel, bibliography, and site characteristics databases, and they expanded the bibliography to include unique accession and digital object identifier (DOI) numbers from each site. These improvements facilitated an analysis of changes in social networking within LTER over the last 20 years **[8]**.

Web services interface — LNO staff (Brunt, Servilla, Costa, San Gil) developed a prototype web services interface to LTER Network databases that are routinely updated by sites (personnel, site, and bibliography). This interface provides a mechanism for individual site information systems to have programmed synchronization with the LTER Network databases. Functionality includes secure "query", "insert", "update", and "delete" record commands for all centrally-managed databases. This year, the LNO will release to the community a request for comments on this interface along with example code and information on use case scenarios.

Remote sensing archive — LNO staff (Vande Castle) maintained and curated a historical archive of remote sensing data for the LTER Network. The archive consists of Landsat, SPOT, MODIS and AVIRIS data from LTER Network acquisitions starting in 1990 and from past NASA and USGS research projects **[9]**. The LNO provided links to other collaborators and agencies that acquire data useful to the LTER, including MODIS data from the Oak Ridge National Laboratory Distributed Active Archive Center, International Space Station (ISS) imagery acquired as part of the ISS science plan, and Global Fiducial Library Reconnaissance imagery. Access information for other types of data, such as LIDAR and more recent SPOT imagery, was made available, and collaboration with the Center for Rapid Environmental Assessment and Terrain Evaluation at UNM provided access to near real-time direct broadcast Terra and

Aqua MODIS data through automated acquisition and processing. Standard data products were acquired and archived for 22 of the 26 LTER sites [10].

1.4 Network Development, Community Outreach and Training

Network development and community outreach included an array of activities to benefit LTER scientists and educators as well as the broader community of environmental scientists and teachers. A consortium, the Partnership for Biodiversity Informatics (PBI), consisting of the LNO, NCEAS, the San Diego Supercomputer Center (SDSC), and the University of Kansas Center for Biodiversity Research, provided leadership for several of these activities (***Table 1***). The PBI continued their collaboration in 2008 to produce two additional cyberinfrastructure proposals: INTEROP and DataNet (see below).

Network development — The LNO (Michener, Brunt), the Organization of Biological Field Stations (OBFS), NCEAS, and numerous other institutions collaborated to facilitate storage, discovery, and access to the strategic environmental information resources collectively held at North American biological field stations through a Research Coordination Network (RCN). The LNO assisted in revamping the OBFS web site **[11, 12]**, in maintaining mailing lists, and in infusing informatics and geospatial technologies into field stations and marine laboratories.

Community outreach and Network linkages — LNO staff maintained and expanded synergistic communication, collaboration, or coordination with institutions, partnerships, networks and other groups. ***Table 1*** describes some of these collaborations and their outcomes.

LNO staff (Michener, Brunt, Waide) were key participants in SEEK, a six-year, multi-institutional, multi-national initiative designed to create cyberinfrastructure for ecological, environmental, and biodiversity research and to educate the ecological community (especially, under-represented groups) about ecoinformatics. This collaboration helped the LNO develop the training laboratory described in Section 1.2 above.

LNO staff (Michener) developed a strategic partnership with the National Biological Information Infrastructure (NBII) that led to NBII support for hiring a Senior Application Support Analyst (San Gil) at the LNO. This partnership focused on metadata standardization and led to several key LTER and community-wide outcomes (***Table 1***).

During 2003-2007, LNO staff (Michener, Waide) participated in design activities for several emerging U.S. environmental observatories (NEON, CLEANER, WATERS, NPN), environmental monitoring networks in India and Portugal, and related US planning activities and workshops. Michener was on assignment to NEON, Inc. from February 2006 through August 15th, 2007. In this capacity, he and Dr. Bruce Hayden (University of Virginia) completed the NEON Measurement Book for use in detailed network design and cost analysis. NEON stands to both complement and benefit LTER, especially those LTER sites selected as NEON sites.

In addition, Michener collaborated with Dr. Jan Poley of the American Distance Education Consortium and others in a proposed effort to enhance communications and networking for approximately one-third of the LTER sites as well as for several additional field stations and international research sites. Michener led a collaborative effort focused on enhancing the interoperability of data collected and archived by LTER, NBII, NASA, NCEAS, the National Evolutionary Synthesis Center (NESCent), and other research networks and centers. This effort resulted in submission of an NSF proposal entitled *INTEROP: Creation of a Virtual Data Center for the Biodiversity, Ecological and Environmental Sciences*. He also coordinated a collaborative effort to enhance data preservation and use across a broad array of biological and environmental research networks, including LTER, resulting in a proposal to the DataNet program at NSF.

Training — The LNO CA did not have funds specifically targeted for training LTER scientists and students. Nevertheless, funds associated with the SEEK, RCN, Mellon Foundation and NBII projects as well as supplement funds in 2007 supported training for many LTER scientists in ecoinformatics, geospatial analyses, wireless communication and advanced sensing technologies, web site development, metadata management, and cybersecurity.

1.5 Network Publications and Public Outreach

LNO publications – LNO staff (Thomas) facilitated the publication of two documents in the LNO numbered publication series, Integrative Science for Society and Environment [41] and The Decadal Plan

for LTER [42]. The LNO (Bonito) contributed support to several of the site volumes in the LTER Oxford book series [43]. Individual LNO staff members published journal papers, book chapters, and other articles related to the accomplishments of the LNO and the LTER Network (see attached list of publications).

Paper materials — Informational and promotional materials produced during the current award include: 23 site brochures, one LTER Network brochure, and 14 issues of the Network Newsletter. LNO staff (Thomas, Bonito) created additional brochures and programs for the triennial All Scientists Meeting and produced scientific fact sheets and other information and promotional material to convey LTER results to the general public.

World Wide Web — The LNO website and LTER Network web portal each underwent major re-designs based on usability studies and community input to enhance their effectiveness, and LNO staff scanned, catalogued, and archived hundreds of historical LTER documents on the LTER portal. Based on usability studies and user feedback, LNO staff redesigned the LTER document archive and considerably improved the site's overall organization and search functions to make navigation more intuitive and materials easier to locate.

Traveling exhibit — The LNO significantly upgraded the LTER multimedia traveling exhibit and displayed it at annual meetings of the Ecological Society of America (ESA) and SACNAS (Society for Advancement of Chicanos and Native Americans in Science), and periodically at the American Association for the Advancement of Science (AAAS), the American Society of Limnology and Oceanography, the LTER All Scientists' Meeting, and local science fairs. The LNO Public Information Officer and Senior Web Designer conveyed information about the LTER Network to a wide-ranging audience, including the general public, scientists and educators, and policy-makers.

Video — Using an external consultant, the LNO facilitated production of an informational DVD video that highlights research being conducted by LTER and a similar video focusing on the International LTER. The LTER video was subsequently reformatted for the web [44].

1.6 Synthesis

The LNO encouraged synthesis efforts across the LTER Network: by providing support and coordination for science theme meetings of the LTER Science Council; by organizing two LTER All Scientists Meetings (ASM) and planning a third; by funding 50 research working groups with over 400 participants; and by documenting products of these meetings and archiving results [45].

In support of synthesis, the LNO staff organized and implemented the triennial ASM. The 2003 meeting in Seattle, WA (711 participants, 66 working groups, 400 posters) and the 2006 meeting in Estes Park, CO (863 participants, 69 working groups, 439 posters; ***Figure 3***) involved more than a year of effort by LNO staff. These efforts included: securing supplemental and other funding for the ASM and related meetings; contracting meeting providers; organizing lodging, local transportation and meals; providing funding (including pre-payments and reimbursements) for meeting participants; managing registration fees; organizing the program of speakers; and coordinating the extensive working group meetings. Coordination by the LNO (Waide, Vande Castle) included working with the organizers to facilitate working groups, collecting abstracts and meeting notes, and providing support through web pages, email lists and follow-on activities of results and future plans for the working groups. The statement of appreciation passed unanimously by the LTER Science Council [46] documents the success of these meetings.

The research working groups supported by the LNO produced a wide range of products including reports, proposals, data sets, and publications [5]. One example of a synthesis product that was facilitated by a research working group supported by the LNO is the recent paper in *Nature* from the Lotic Intersite Nitrogen Experiment (LINX) **[47]**, which has been cited widely in the scientific and popular press **[48,49,50]**.

1.7 Network Information System Design and Development

Establishing the distributed data network — LNO staff (Brunt, Servilla, Costa, San Gil) made significant progress towards the development of the Network Information System (NIS) including the completion and approval of the NIS Strategic Plan [51] and the development and prototyping of an architectural framework. The modular architectural framework for the NIS, called PASTA (Provenance Aware Synthesis Tracking Architecture) [52], leverages the LTER metadata catalog [53] and site

investment in EML (***Figure 4***). PASTA is a conceptual model for dynamically harvesting and archiving site-based data and metadata used to generate and deliver derived data products. The NISAC, the IMC, and several community partners accepted the PASTA framework, and components of PASTA were prototyped in support of the EcoTrends collaboration (see below).

Community collaboration and standardization efforts — LNO staff (Servilla, Costa) collaborated with NCEAS and SEEK developers on the 'Data Manager' library for EML that provides automatic insertion of well-documented data sets into a standard database management system based solely on the metadata description. LNO staff collaborated with the IMC on: implementing EML and site participation in the LTER Network data catalog (***Figure 5***); developing an advanced search interface to enable discovery of data from the Network; creating metrics and proposed standards for data access and data auditing of online information access using a proxy server called Data Access Server **[54]**; designing an online registry of standard units for EML **[55];** and prototyping the first phase of development of an ecological vocabulary of controlled terms.

Promoting and supporting synthetic research collaboration — The EcoTrends project was the predominant synthesis effort undertaken by the LTER Network **[56]**. LNO staff (Brunt, Servilla, Costa, San Gil) worked directly with the EcoTrends editorial board and technical subcommittee, New Mexico State University staff, and an independent web design firm to implement a time-series data model and data delivery system tailored to the EcoTrends website design to complement the EcoTrends book due out this year (***Figure 6***). LNO staff contributed significantly to this high-profile and community-supported project while simultaneously gaining valuable implementation experience for components of the PASTA architecture model for the NIS.

1.8 International LTER

The LNO SOW emphasized a transition of the ILTER Network from an activity largely supported by the NSF through the LNO to an activity broadly supported through a consortium of ILTER Networks. The U.S. LTER Network created a new standing committee (International Committee) to manage interactions with the ILTER Network, eliminating most of the responsibilities of the LNO in this area. In 2003 and 2006, with supplemental support from NSF, the LNO (Vande Castle) helped coordinate ILTER Coordinating Committee meetings as part of the LTER ASM and assisted the ILTER in becoming more independent of the U.S. LTER Program.

1.9 Education

The SOW limits LNO support of education activities to maintenance of the Schoolyard LTER web page and several short-term activities that concluded in 2003. Since NSF did not conduct a proposed review of the LTER education program, LNO restricted its educational responsibilities to those listed in the SOW.

1.10 Strategic Planning for the LTER Network

The LNO played a key role in facilitating LTER Strategic Planning by providing logistical support for 30 face-to-face meetings (2004-2007) with 584 participants (as well as numerous video and phone conferences), developing email lists, and providing collaboration software support and office space. LNO senior personnel (Brunt, Vande Castle, Servilla, Waide) contributed intellectually to the various planning elements (Research, Education, Governance, and Cyberinfrastructure) and played a major role in drafting, writing, and editing the planning documents. The result of the strategic planning effort was the completion of two documents: *Integrated Science for Society and the Environment* and *The Decadal Plan for LTER* **[41,42]**.

The LNO, with the help of a consultant funded by UNM, developed a strategic plan to align the goals of the LNO more closely with the goals of the LTER Network **[60]**. This plan provides operational goals for the LNO and guides decisions about priorities and resource allocation. The LNO is updating the goals of the Strategic Plan and an accompanying implementation plan to incorporate the objectives of the LTER Decadal Plan.

2.0 Introduction

The Long Term Ecological Research Network Office plays a critical role in the operation of the 26-site LTER Network (***Figure 7***). The LNO supports the research and education goals of the Network; represents the Network in its interactions with other scientific networks and centers; facilitates the operation of the Network as a cohesive research entity; and fosters new, broadly-based initiatives that extend LTER science, education, and cyberinfrastructure to new communities. Recognizing the importance of these functions, the NSF has funded the LNO since 1982, originally through an award to Kansas State University and subsequently to Oregon State University and the University of Washington. The present LNO was established at UNM in 1997. The LNO operates under a Cooperative Agreement between the National Science Foundation and the University of New Mexico, which provides $8,989,493 in funding for core operations for the period March 1, 2009-February 28, 2015. Additional funding from competitive sources complements and extends the activities of the LNO.

The Decadal Plan for LTER **[42]**, the result of an intensive three-year planning effort, describes a broad vision for LTER science that encompasses substantial new levels of synthesis and transdisciplinary research (***Figure 8***). In this plan, the LTER Network envisions new collaborations between ecologists and social scientists to create a new body of theory in social ecology that draws on and incorporates information technology and the most advanced educational approaches to amplify the societal impact of this vision. The scope and complexity of the ideas envisaged in the Decadal Plan will require greatly increased efforts to organize and coordinate the proposed transdisciplinary synthesis. The LNO has demonstrated by its past performance that it is ideally suited to be the catalyst for implementation of the vision of the Decadal Plan. The LNO will play a key role in organizing people, tools, and ideas to promote the synthesis science that will address the increasing need to understand social-ecological systems from local to global scales. The activities described in this proposal were selected by the LTER community because they represent important contributions that the LNO can make to stimulate the evolution of the LTER Network from a group of associated sites to a closely integrated research community with a new focus on synthesis and transdisciplinary research.

The Decadal Plan defines the role of the LNO in achieving new Network objectives in research and cyberinfrastructure. Bylaws for the LTER Network, adopted in 2003, describe specific responsibilities of the LNO **[59]**. The strategic plan for the LNO, revised in 2008 to incorporate the objectives of the Decadal Plan, provides additional operational guidance for LNO activities **[60]**. Together, these documents created a new context for LNO activities that structured much of the formulation of the new CA as well as this proposal. Thus, when NSF invited UNM to submit a renewal proposal for the LNO CA to cover the period 2009-2015, the LNO and the LTER Executive Board (EB) (as specified in the LTER Bylaws) had a clear basis for determining the scope and funding level of the renewal proposal. Subsequently, the EB reviewed each step of the proposal's preparation, recommended changes to more optimally align the proposal with Network objectives including fostering Network synthesis, and approved the proposed activities and budget.

The external Mid-term Review Panel encouraged the LNO to explore opportunities for facilitating evolution of the Network.

> *In this time of rapid change, there is need to articulate a shared vision and to work across the Network to implement the vision. The LNO should play a key role in both emergence and implementation of the shared vision. Proactive broad thinking fostered by the LNO can and should have a beneficial effect on the evolution of the LTER Network.*
>
> *As a specific example, there is need for broad thinking about how the synthesis goals can be achieved across a range of funding scenarios. The Network planning process has created enormous energy and enthusiasm across the Network, leading to a remarkable opportunity to advance Network science. We encourage the LNO to think about how to capitalize intellectually on this opportunity regardless of specific funding scenarios.*

….the LNO is in a strong position to encourage and support opportunities for groups of sites to self-organize to build Network science.

With this recommendation in mind, the current proposal requests $6,737,042 in new funding to initiate the development of infrastructure that will enable network science across the LTER Network and its partners. Funds will be used to create eight new positions and to retain three existing positions to provide expanded capabilities in software programming, information management, cyberinfrastructure maintenance, and data archiving. Science activities will include expanded funding for research working groups to capitalize on the intellectual momentum developed in the planning process. Additional planning meetings will provide specifics needed to implement the Decadal Plan. Cyberinfrastructure activities will include completion of the Network Information System, stewardship of increased numbers of Network databases, creation of new synthetic databases, and increased training opportunities for LTER information managers and scientists. The proposal further outlines: new approaches to assessment and evaluation of the outcomes of proposed activities that will inform a flexible and responsive management strategy for the LNO (Section 4.0); the broader impacts of the proposed activities (Section 5.0); and the management structure and lines of responsibility (Section 6.0). A description of the budget (Section 8.0) provides detailed information about the cost of activities proposed for Science, Education, and Cyberinfrastructure in the Decadal Plan, and it provides the justification upon which these costs are based.

3.0 Project Description

The current LNO Cooperative Agreement describes the tasks needed to implement a series of activities in four areas of function: Support for Research Synthesis; Development and Implementation of Cyberinfrastructure; Core Services; and Development/Outreach. The LNO proposes 10 complementary activities that will build on these areas of core function. New activities specifically target the science and cyberinfrastructure goals of the Decadal Plan, and, by providing additional human resources at the LNO, will make feasible advancement of these goals during the course of this proposal. Proposed activities will facilitate and enhance scientific synthesis at the Network level by providing support for synthesis working groups, enhancing key cyberinfrastructure needed to implement the Network Information System, expanding critical databases managed by the LNO for the Network, and training site information managers in the use of enhanced cyberinfrastructure. A description of each activity and justifications of individual and collective impacts of the activities on the LTER Network appear below. The budget justification (Section 8.0) links requested human resources with proposed activities.

The proposal employs a logic model approach **[61]** to document the relationship among impacts, outcomes, outputs, activities, and requested resources for each proposed activity **[62]**. Logic models link cause and effect statements such as “if these resources are available, then these activities can be conducted.” This approach facilitates close coordination among model elements and incorporates measurement and evaluation of outputs and outcomes at the appropriate stages in each model. Section 4.0 describes the assessment and evaluation plan for the activities in this proposal.

3.1 Support for Research Synthesis

A primary function of the LNO as articulated by the Mid-term Review Panel (see Section 2.0) is to capitalize on the intellectual investment made in developing the Decadal Plan by mobilizing support to advance its goals. One of the major goals of the Decadal Plan is to increase the pace and scope of scientific synthesis. The principal means by which the LTER Network addresses synthesis at the network level is through annual meetings of the Science Council (see below) and triennial All Scientists Meetings. All Scientists Meetings foster integration within and among Network sites and research projects. Key outcomes of past ASM include: formation of new collaborations; sharing of data and ideas; integration of graduate students, educators, and international collaborators into the LTER community; advancement of theory through comparison of conceptual models; identification of transformative research; and coordination of research strategies and standards across the LTER Network. ASM generate new ideas

and synthesis products and build new partnerships and collaborations that enhance the breadth and productivity of LTER research. The impact of periodic ASM is an increase in the cohesiveness of the LTER scientific enterprise.

The intellectual advances made at ASM and Science Council meetings are stimulated and nurtured by the availability of funding for research working groups. These working groups provide opportunities for LTER and other scientists to evaluate and assess new ideas and to incorporate these ideas into manuscripts, theories, and proposals.

3.1.1 Science Council. *Support annual meetings of the Science Council as well as related planning meetings.*

Background — One accomplishment of the Decadal Plan is a new governance structure for the LTER Network **[63]**. As part of this reorganization, the LTER Bylaws have been amended to create a new entity, the Science Council (SC), comprised of two members from each of the 26 LTER sites and the chairs of standing committees. The SC "has the responsibility to provide leadership and planning for cross-site research and education, to develop proposals for the conduct of Network-level science, to interact with existing and emerging networks, to develop products that synthesize Network-level data and information, and to otherwise manage the science affairs of the LTER Network" **[59]**. The Bylaws require an annual meeting of the SC, and the LNO is responsible for supporting this meeting. The intended long-term impact of SC activities is an increase in operational coordination of science, synthesis, and education across the LTER Network.

The Science Council was expanded to be more inclusive of the various disciplines identified as central to achieving the goals of the Decadal Plan. This interdisciplinary focus is critical to establishing the new science of social ecology, as described in the Decadal Plan. Because the number of members of the Science Council is more than double the size of the original governing body, the Coordinating Committee, additional resources ($188,817 total) are required for the annual meeting.

Specific activities supported — The LNO funds participant travel and lodging for 70 participants in the annual meeting of the SC as well as any additional required expenses (e. g., meeting rooms, audiovisual). The LNO also supports planning and visioning meetings associated with SC activities. The Executive Director and the Director for Synthesis Support help develop the agenda, supervise meeting preparations and logistics, prepare materials, participate in the meetings, and record the accomplishments of the meetings.

Products and outcomes — Synthesis activities of the SC produce Network-level science publications and synthesis volumes, lay the groundwork for proposals to conduct Network-level science and education, and result in updates to the Network research and education objectives. In addition, the SC performs several administrative functions, including resolution of issues from sites or the Executive Board, approval of Bylaw changes, and election of the Chair. The LNO supports the SC by producing a persistent record of its activities and decisions. Outcomes of the operations of the SC include enhanced Network-level synthesis, increased scientific coordination across and beyond the LTER Network, increased funding for synthesis, evolving strategic plans, and effective governance.

3.1.2 Research Working Groups. *Provide support for Network research goals by funding working groups and intensive research visits for project scientists.*

Background — The Decadal Plan focuses on long-term, social-ecological questions in three thematic areas: 1) land and water use change in urban, exurban, and working systems; 2) climate change, variability, and extreme events; and 3) nutrient mobilization and species introductions. The activities that produced the Decadal Plan also created new collaborations among LTER scientists and with scientists from other disciplines, especially the social sciences. These new collaborations need additional resources to encourage their further self-organization in the context of the research themes of the Decadal Plan. During the last CA, the LNO provided resources (up to $10,000 per group from a total annual budget of $50,000/yr) for this purpose. The working groups that received LNO support were highly productive **[5,45]** and support for them was repeatedly identified in the annual surveys of site needs **[64]** as a valuable LNO service.

Specific activities supported — The LNO requests $100,000/yr to support self-organizing groups of sites and scientists. The Executive Director and the Director for Synthesis Support will organize and maintain records of annual competitions to disburse these funds, with proposals evaluated by the EB or their delegated representatives. In addition, the LNO proposes new funding to support two LTER scientists per year to focus for one to two months on completing publications or plans emerging from these working groups. Surveys of LTER scientists show that obtaining support for such intensive efforts is a high priority and will significantly enhance the pace of synthesis. To advance the goals of the Decadal Plan, one criterion for providing funds for research working groups and research visits will be evidence of an interdisciplinary focus linking social sciences and ecology. The LNO will support self-organizing groups of sites and scientists by funding working group meetings to produce specific research products such as publications, experimental designs, new databases, or common standards. The LNO will provide salary support to allow LTER researchers to focus on short-term (one to two months) intensive research visits that support the Decadal Plan research objectives.

Three new undergraduate work study students will help facilitate the entire suite of synthesis activities (working groups, Science Council meetings, All Scientists Meetings). They will assist the LNO Office Manager in preparing travel reimbursements and other documents necessary for science meetings. In addition, they will work with the Director for Scientific Synthesis to capture and archive meeting notes, reports, images, audio, video, and other products to maintain a persistent record of the scientific accomplishments of the LTER Network.

Products and outcomes — Research working groups will establish new partnerships and collaborations that advance a new body of theory in social ecology as one element of a developing strategy to meet Decadal Plan objectives over a range of funding scenarios. The working groups will enhance the breadth of LTER research and increase the pace of synthesis by producing multidisciplinary, multi-site publications such as books, monographs, or special issues of journals.

3.1.3 Activities of the Decadal Research Plan

. *Provide support for Network research goals by facilitating planning and visioning meetings to address the objectives of the Decadal Plan.*

Background — The Decadal Plan presents the broad outlines of a research program in each thematic area, but additional specifics need to be developed. Network science workshops that ask participants to identify individual questions, observations, experiments, and modeling activities within thematic areas and to identify the corresponding education and cyberinfrastructure needs can help develop the details required to advance the Decadal Plan, and the Executive Board has requested the LNO to support these workshops.

Specific activities supported — The LNO requests new funding ($170,468) to provide support for six to eight additional planning meetings in the first two years of the CA. By the end of Year 2, the NSF and LTER will likely reach an agreement on long-term support for the science agenda in the Decadal Plan.

Products and outcomes — The proposed planning workshops will produce: detailed steps for achieving the science goals of the Decadal Plan; a timeline for the staged implementation of those steps; and interim objectives for LTER sites and scientists. The proposed workshops will lead to a better balance between support for site-based research and Network-level collaborative synthesis. The eventual outcome will be achievement of the goals of the Decadal Plan.

3.2 Development, Implementation, and Maintenance of Cyberinfrastructure

For over two decades, LTER science has been interconnected with developments in cyberinfrastructure (CI). The LNO has supported Network CI by offering services that both met the needs of the community and kept pace with evolving technology. As part of the Decadal Plan, the LTER Network developed a CI Strategic Plan that outlines an expanded vision to support the decadal science agenda. Through a broad process of gathering input from community collaborators, investigators, and information managers, the LNO has provided leadership and support in the development of this plan. The proposed LNO CI activities are supportive of and in harmony with the implementation of the CI Strategic Plan, and will provide critical services to the LTER community through four activities:

1. supporting improvement, operation, and maintenance of the LNO computing, communication, and collaboration infrastructure;

2. providing leadership in researching, developing, and implementing Network-wide information management procedures, policies, and practices;
3. completing the development and implementation of the LTER Network Information System (NIS) framework; and
4. offering on-site, group, and individualized consulting services for improving and maturing site information management practices.

3.2.1 Basic CI Support. *Provide basic CI support to the LTER Network to enable collaboration, communication, and security.*

Background — Staff of the LNO maintain and operate the hardware and software that provides basic computing services for management of Network databases, web sites, access to site databases, administrative functions, software development, archives, and training. In addition, they maintain collaboration and communication technologies. For example, the LNO supports high-quality, low-cost, standards-based videoteleconferencing (VTC) for the Network, including regular monthly VTCs for the LTER EB, thereby extending the level of interaction and substantially lowering costs as compared to traditional telephone conferencing. The increase in use of VTC technology and the need to enhance communication and collaboration across the Network cannot be accommodated with present LNO staff. Therefore, we request funds to 1) establish the permanent position of Systems Analyst; and 2) recruit a Professional Intern to assist in regular maintenance of the LTER Network web sites.

Specific activities supported — The LNO will support activities in four areas:

1. Collaboration — New funding for an LNO Systems Analyst will support the continued operation of VTC services for LTER committees and working groups. The LNO Systems Analyst will verify the details of each call, program the request into the teleconferencing software, confirm participation and connection accuracy for each participant, and monitor the call for quality. Experience shows that these steps have increased the quality of the process for handling regular VTC for the Executive Board, Information Management Executive Committee (IMEXEC), the NISAC, and numerous ad-hoc conferences for LTER working groups. New members to specific groups (e.g., EB) will be provided new conferencing units or software, along with installation and configuration support.
2. Collaboration — During the new CA, the existing LNO Application Support Analyst will augment the current web and email support for Network committees, working groups, and special interests with basic collaboration tools for hosting web-based conferencing and interactions through shared applications and virtual workspaces. The Application Support Analyst will evaluate and implement new collaboration technologies that meet user needs. In order to provide sufficient time from regular duties for the Application Support Analyst to perform these tasks, the LNO will recruit a new Professional Intern to conduct maintenance activities on the LNO web sites. These activities will include review of content for out of date information, regular and time critical updates to web content, tests of web site operation, and response to user requests for assistance.
3. Technology improvements — The LNO Systems Analyst will upgrade hardware and peripherals in the Informatics Training Laboratory (see Section 3.4.2 below) twice during the CA period. The Systems Analyst will also perform annual updates of desktop computing equipment on a phased schedule that provides complete replacements every three years. The LNO Chief Information Officer (CIO) and System Administrator will operate and maintain computing infrastructure to support Network database management and information services by upgrading server hardware and peripherals twice during the CA period.
4. Communication — The LNO Systems Analyst will acquire, deploy, and maintain “rich media” recorders to capture and stream presentations via the World Wide Web. Through an investment by UNM in this technology, the LNO will be able to leverage additional recorders for loan to working groups and committees as needed. The annual LTER mini-symposium at NSF and the triennial ASM are examples of events that should be preserved through recordings.

5. Security –The LNO Systems Analyst will support communications about security issues to site system administrators through web-seminars and podcasts developed for this purpose. Each year, the LNO will offer four security-oriented technology transfer web-seminars including "how to" and "best practice" guidelines on network and computer security.

Products and outcomes — The LNO will provide a secure, modern, and efficient computing and communication environment that will increase the pace and productivity of interactions among LTER scientists and educators. The new capacity to record and stream LTER presentations will improve outreach to the LTER and broader scientific and information management communities. The continued availability of VTC services will result in more frequent and more productive interactions for LTER committees and working groups. In addition, the activities described above will improve access to common collaboration tools for LTER scientists and increase awareness and understanding of security issues for LTER information managers.

3.2.2 Information Management. *Improve information management for the Network by supporting communication and coordination among site information managers, strategic data integration, data stewardship, curated data storage, and other data operations that promote Network synthesis and the creation of data legacies.*

Background — Since 1988, the LNO has actively promoted standards and standard approaches to information management, and it has actively managed LTER Network data sets since acquiring Network-wide satellite data and developing the first personnel database in the early 1990s. LNO support for the annual LTER Information Management Committee (IMC) meetings and workshops keeps LTER sites informed of developing information management practices and technologies. Lack of staff resources has limited the number of databases managed by LNO and the level of management while requests for such services have increased (e.g., EcoTrends, ClimDB). The recruitment of a new LNO Information Manager will address this problem. While the LNO currently manages the personnel directory, all-site bibliography, site directory, data catalog and several synthetic databases (e.g., Net Primary Production), involvement in this valuable Network activity will increase by dedicating new management and curatorial personnel to address the migration of existing site data sets and new synthesis-oriented data sets to the LNO data holdings via the NIS. One new challenge facing the LNO is stewardship of more than 22,000 derived data products from the current and growing EcoTrends (***Figure 6***) project database that is dependent on a largely manual process for updates. The planned NIS framework calls for automated updates in the future.

Specific activities supported — The LNO will support activities in five areas:

1. Information Management Executive Committee meetings — The LNO will support an additional meeting of the Information Management Executive Committee every third year, in coordination with the All Scientists Meeting. IMEXEC will meet to plan the joint LTER/ILTER workshop held at ASM. IMEXEC meetings will take place at the LNO to reduce costs and increase interactions with the expanded LNO staff. These meetings will identify and address Network information management challenges through the development of new information management approaches.

2. Working visits to the LNO by information managers — The LNO will increase support to information management (IM) by funding working visits to the LNO by one or two site information managers per year to develop and implement solutions for specific information management challenges affecting multiple sites. In addition, the LNO will support several product oriented workshops each year to address critical IM issues. For example, site database personnel will meet to determine functional requirements necessary to implement the water chemistry database requested by the SC.

3. Maintain Network databases — LNO staff will continue to manage the personnel, site characteristics, and bibliographic databases for the Network through web-based forms and requests to the LNO email-based support system (tech_support@LTERnet.edu). The new Information Manager will have primary responsibility for the management of these Network databases.

4. Migrate and create Network databases — The new LNO Information Manager will work with staff from the H.J. Andrews LTER to transition the management and curation of climate and hydrologic databases (ClimDB and HydroDB) to the LNO where these databases will be integrated into the Network Information System (NIS) architecture (see Section 3.2.3). As requested by the EB, the LNO Information Manager will also work with scientists and the IMC to develop new synthetic databases resulting from SC and Decadal Plan activities, along with interfaces to such databases, and integrate them into the NIS framework.

5. Manage and extend the EcoTrends database — Funding for the new LNO Information Manager will support the management and curation of existing EcoTrends data, and allow collaboration between NIS developers and site scientists and information managers to implement a dynamic process for the creation of new derived data products. The new LNO Information Manager will: 1) identify new data sets and validate them for quality of metadata and completeness of data using the "EML Data Manager" library; 2) develop program scripts or workflows to transform data from native formats to the EcoTrends time-series format, 3) oversee harvesting and loading data from site repositories into the NIS data "cache", and 4) confirm the transformation and loading of site data into the EcoTrends database.

Products and outcomes — These LNO information management activities will improve information management practices, increase the accessibility of existing Network databases, increase the number of synthetic data sets, and increase the quality and number of Network data sets accepted for management and curation by the LNO. New information management approaches will be embodied in new standard procedures and protocols that will be published as "best practices" documents. By improving information management at a Network level, the LTER Network will become a high quality data provider for scientists and educators and a repository of scientifically rigorous, richly documented data available for synthesis.

3.2.3 Network Information System. *Complete the design, development, and implementation of the LTER Network Information System in collaboration with NISAC, IMC, and strategic community partners.*

Background – In 2003, the LNO acquired its first funds for personnel dedicated to the development of the LTER Network Information System. This initial support led to the production of the LTER data catalog **[53]**, design of the forward-looking PASTA framework for the NIS ***(Figure 4***), and successful demonstration of key PASTA modules in the EcoTrends project (***Figure 6***). These successes laid the groundwork for completing the implementation of the LTER NIS framework in this proposal. Similarly, emphasis on large-scale data integration in the Decadal Plan for LTER and the specific call in the CI Strategic Plan for completion of the NIS in support of such data integration generated timely momentum for these efforts. However, current staff resources do not provide sufficient programming capability to advance the NIS in a timely manner. Therefore, the LNO requests funds to recruit two new positions: 1) Programmer/Analyst and 2) Professional Intern. These two new positions will enhance the ability of the LNO to complete implementation of the NIS during the next five years.

Specific activities supported –

1. Complete the LTER NIS — The LNO CIO, NIS Developer, senior Programmer/Analyst, a new Programmer/Analyst, and a new Professional Intern will complete the design, implementation, and deployment of the PASTA framework (***Figure 4***) in support of the LTER NIS, thereby providing access to all LTER site data sets for the advancement of Network-level science and data synthesis. Accomplishing this objective involves the following major steps.

    - Complete the Data Access Server (DAS, **[54])** to support LTER data access policy compliance for access to LTER site data repositories. The DAS will act as a proxy interface between requests for LTER data and the actual data source, thereby authenticating users who request data and confirming their acceptance of the LTER Data Policy. All requests will be logged for reporting purposes, and the data owner will receive notification of access to their data resource. Use of the DAS would be optional; sites may instead support proxy access for any public interface (e.g., the data URL in the EML) but allow direct access to their data for internal users.

- Complete a single point-of-access portal for the NIS. A NIS portal would provide a single point-of-access to all NIS supported data sets for both LTER scientists and the broader community. Using a federated authentication system will simplify the user experience by allowing reuse of common "log-in" information across LTER sites and other affiliated networks (a similar approach is in use with the EcoTrends web site). The portal will provide a unified data discovery and access process for all NIS data sets, including EcoTrends, ClimDB, and HydroDB, along with comprehensive and complete metadata in the EML.
- Create an automated extraction and loading process to move site data into a centralized data archive. The PASTA interface to sites will automatically extract site data and then load it into a centralized data cache. The EML "Data Manager" library (see Section 1.0) and the complete documentation of site data in EML make this extraction possible. The cache acts as a replica and permanent archive of the site data, thereby preserving the site and LTER data assets into the future.
- Develop an interchangeable transformation engine for generating derived data. The PASTA transformation engine provides a seamless mechanism for creating derived data products used in synthesis projects (e.g., EcoTrends). The PASTA framework decouples the transformation engine interfaces (both input and output) from other PASTA components, thus allowing new engines to be deployed without disrupting the entire process.
- Implement an automated provenance tracking system for all LTER derived datasets. The PASTA framework employs the power of metadata documentation through EML. Currently, EML is fully capable of capturing provenance information that can describe the methods used to create derived data products as well as the originating data documentation. The metadata product emerging as a side-effect of generating derived data will contain this provenance information.

The NISAC will review and vet the major implementation and deployment steps described above. Their vetting takes different forms depending on the anticipated impact of the project but typically consists of a request-for-comment (RFC) process. The Network Developer will ensure that NISAC reviews and advises on all PASTA implementation milestones and deployments (see below).

2. Integrate Network databases in the LTER NIS Framework — Integrating existing Network data products is a primary function of the LTER NIS. Specific tasks are listed below.
    - The Network Developer will work with the new LNO Programmer/Analyst, Professional Intern, and Information Manager, as well as database designers, site information managers, and scientists at LTER sites and the broader community, to assess and build an integration path for the EcoTrends, ClimDB, and HydroDB databases into the PASTA framework for inclusion in the LTER NIS.
    - An RFC process will gather requirements for user query, sub-setting, and descriptive analysis of data residing in the LTER NIS. The Network Developer and new Programmer/Analyst will evaluate these requirements, determine a course of action for satisfying such requirements, and integrate desired functionality into the NIS.
    - The new Network Information Manager will work with LTER site information managers to prepare relevant site data for automated integration into the LTER NIS data modules, including EcoTrends, ClimDB, and HydroDB (See 3.2.2).
    - The Network Developer and the new LNO Programmer/Analyst will make derived data from the ClimDB and HydroDB databases available to the Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI) Hydrologic Information System through the CUAHSI web-service API.

3. NISAC Meetings – All NIS activities will be conducted with the oversight and guidance of the NISAC, which is responsible for evaluating and prioritizing all NIS activities. NISAC was established to support development of the NIS for facilitating collaborative and synthetic research efforts and improving the quality of LTER synthetic data products and databases. The NISAC consists of site lead PIs, information managers, and LNO personnel. Core funding already provides support for one NISAC meeting a year, but the work load of this committee is increasing and a second meeting is necessary. Funding in this proposal will provide support for NISAC to meet a second time each year in person to review and evaluate the outcome of planned projects and to help identify and prioritize critical tasks for NIS development. In addition to the two meetings in person, NISAC will meet frequently by VTC.

Products and outcomes **–** The PASTA framework will support automation of data extraction and loading from LTER sites through structured data integration and publication of such data through web-based applications and services. More flexible and interoperable access to LTER data provided by the NIS will stimulate and increase LTER science, improve the quality of LTER data and metadata, foster the use of data for synthetic projects, and thereby enhance both national and global research. The NIS, when fully realized, will provide an increasing volume of LTER data to scientists for years to come.

3.2.4 Information Technology, Database, and Web Consulting

. *Provide information technology (IT), database, and web consulting to LTER sites and synthesis working groups.*

Background — The LNO has, with resounding success, gained site participation in Network standards and synthesis activities through the use of individualized consultation and "hands on" technical help for issues ranging from web site design to EML implementation (***Figure 5***). One-on-one support provides an opportunity to accommodate site-specific needs in the development of Network standards. Individualized technical help provided to LTER sites will increase their capability and desire to participate in Network science and education goals defined in the Decadal Plan.

Specific activities supported —

1. Technical support — The new LNO Information Manager and Programmer/Analyst will provide information technology, database, and web application consulting services to sites and working groups.

2. Site visits — With funding for this activity, LNO staff may travel to each site twice during the site performance period to consult and work on site-specific issues related to information management and meeting Network standards for information management. A site preparing for review, working on renewal proposals, or improving its information system to meet increasing site requirements may request assistance for strategy planning and system development, and/or the site can confer with LNO staff to propose reciprocal site visits to update the site's information management plan. LNO personnel may visit the site to develop an understanding of the site's requirements and help evaluate the level of effort required to make needed improvements. In addition, the site information managers may be provided the opportunity to spend two weeks at the LNO to work with LNO staff on design or coding issues (see 3.2.2 above) and to prototype needed functionality where feasible. Collaboration software tools can help a site complete its information management plan when direct interaction is not possible.

Products and outcomes — Face-to-face interactions with site personnel are the most productive way to understand site needs and provide optimally crafted technical solutions. The outcome of LNO technical support and site visits will include improvements in information management plans and techniques across the LTER Network.

3.3 Core Services

Among the many services the LNO provides to LTER scientists, sites, and the Network **[65]**, the acquisition and maintenance of remotely-sensed data are particularly important. Without coordinated requests from the LTER Network, some data (e.g., Space Shuttle imagery) would not be collected. In recognition of this need, the ad hoc LTER Remote Sensing Committee recently recommended a series of service tasks to be carried out the LNO. These services require additional effort, and therefore require

more resources, as discussed below. While these services are varied, they have the common goal of enabling new synthesis activities across the LTER Network.

3.3.1 Acquisition of Data. *Facilitate the acquisition of commercial and public data products for site-based and Network synthesis activities.*

Background — The Network research and education goals developed in the Decadal Plan emphasize synthesis using comparable datasets over broad spatial scales. To address issues of land use, climate change, and invasive species, LTER scientists will require time series of remotely-sensed data. Specific examples of such data sets include: satellite data collected by mission-oriented agencies such as NASA, NOAA, or DOD; field data collected through networks of monitoring stations; and photographic images. The LNO facilitates collection of such data by interacting with LTER sites and the data providers to ensure accurate and complete geographic coverage of LTER sites.

Specific Activities Supported — The Director for Synthesis Science will be responsible for addressing the recommendations of the ad hoc Remote Sensing Committee. The DSS will evaluate each recommendation and develop a plan for implementation, which will be incorporated into the LTER Cyberinfrastructure Strategic and Implementation Plans. If additional resources are required for implementation, the DSS will identify possible sources for funding and facilitate the preparation of proposals. Committee recommendations include:

1. Develop a database of sources for historic and current aerial imagery for all sites and provide this on the LNO website.
2. Develop cooperative agreements to acquire LIDAR (NCALM) for all sites and arrange for Hyperspectral (NASA airplane) to acquire imagery for all sites on repeated interval and/or for special disturbance events. Maintain coordination with planned space-based LIDAR and Hyperspectral data missions of NASA, such as DESDynI and HYSPIRI.
3. Develop an archive of the best Landsat-5 imagery for each site.
4. Facilitate GIS/GPS capabilities and data exchange among sites.
5. Facilitate communication on spatial analysis between sites and between site investigators and key individuals in various agencies, and represent LTER interests with these agencies.

Products and outcomes — Central acquisition of data products reduces cost and improves interoperability while reducing redundant effort at each LTER site. The consistent acquisition of standard and new data products across the LTER Network provides opportunities for cross-site synthesis **[67-76]**. Direct collaborations with private companies and government agencies have reduced redundancy of effort by individual LTER sites and enhanced access to a variety of data including remote sensing data products.

3.4 Development and Outreach

The LNO's development, outreach, and training activities raise the profile of LTER; benefit the Network by creating collaborative research, cyberinfrastructure development, and education opportunities; and transfer requisite technological skills and knowledge to LTER scientists and information managers. Communication and outreach activities will be re-focused in 2009 as part of the development of the LTER Strategic Plan for Communication. This plan will define critical audiences for LTER information and the means to deliver that information. Training workshops have brought critical technologies and skills to LTER sites and groups such as members of the Information Management Committee. Proposed training activities aim to provide LTER scientists, information managers, and students with training in new technologies, standard methods and approaches that facilitate data acquisition, integration and synthesis, as well as communication of knowledge to the broader community of scientists, students, and the public.

3.4.1 Communication and Outreach — *Effectively communicate information about the LTER Network—purpose, activities, and achievements—through an array of proven, high-visibility mechanisms.*

Background — The Public Information Office communicates information about LTER to the public through a web portal (www.LTERnet.edu), video and PowerPoint presentations, a traveling multimedia exhibit that is regularly transported to key national meetings [e.g., annual meetings of the Ecological Society of America, Society for the Advancement of Chicanos and Native Americans (SACNAS)], and a variety of print materials—examples of which are illustrated in ***Figure 9***. Support for the Public Information Officer ends in 2010, and new funds are necessary to maintain the position and the vital services it provides to the LTER Network.

Specific activities supported — The LTER Network is currently developing a Strategic Communication Plan to guide activities at the LNO and throughout the Network. This new plan may lead to the modification of some existing communication and outreach activities as well as to the addition of new activities that are approved by the Executive Board. Nevertheless, core activities that presently form the foundation for the LNO communication and outreach program will continue. These core activities include: (1) publication of LTER Network Newsletters, site and Network brochures, and flyers and occasional publications; (2) maintenance and continued upgrading of the LTER Network and LNO web sites; (3) revamping of the LTER traveling multimedia exhibit, PowerPoint presentations, and posters; and (4) representation of the LTER Network (including staffing of the multimedia exhibit) at scientific meetings such as the AAAS, ESA, and SACNAS.

One new priority for the Public Information Office is to redesign the traveling multimedia exhibit. The exhibit currently consists of multiple panels that are heavy, difficult and time-consuming to assemble, and prone to damage during assembly. The new multimedia exhibit will consist of a high-definition display, space for books and brochures, and, importantly, a series of modular posters that roll-up from a floor base. The modular poster display, modeled after the exhibit adopted by the Ecological Society of America, can be designed so that each poster is tied to a specific theme—general introduction to LTER, scientific achievements, education, and information management. The individual posters are light-weight and because of their low cost can be revised more frequently. Furthermore, the modular design enables easy and inexpensive transport of only those modules needed at a particular meeting or LTER site.

Products and outcomes — Key products of the Public Information Office include:

- Publication of the Spring and Fall LTER Network Newsletter
- Production of two revised site brochures annually
- One or more revisions of the LTER Network brochure
- Regular updating of the LTER and LNO web sites
- Re-design of the traveling multimedia exhibit in Year 1 and the addition of one or two revised poster modules annually
- Production of flyers, posters, and occasional publications as requested by the Executive Board
- Outreach to annual meetings of ESA and SACNAS

Key outcomes include:

- Increased understanding of LTER capabilities, achievements, and contributions to science and society, especially with respect to understanding complex, long term phenomena and to informing decision-making on ecological issues
- Increased understanding within and outside LTER about how its scientific and educational enterprise is organized and managed
- An integrated suite of tools and strategies for disseminating information about LTER scientific achievements
- Identification of LTER as a center of excellence offering a network of experts on long term ecological research, education, and ecological informatics

3.4.2 Training — *Provide or coordinate training for LTER scientists and information specialists in support of Network science and CI development.*

Background — The dissemination of technical information throughout the LTER Network raises understanding to a common level, facilitating productive interactions and promoting the adoption of best practices. The LNO has facilitated various training exercises focusing on LNO partnerships with the Organization for Biological Field Stations and the SEEK project. While LTER scientists and information managers have enrolled in these training opportunities, this will be the first effort to develop a training program focused specifically on LTER. To accomplish this goal, the LNO will seek partnerships with other research networks and scientific enterprises to provide mutually beneficial training opportunities.

Specific activities supported — Each year, the LNO will organize and host one three-day training workshop that reaches scientists or information managers at the 26 LTER sites. As part of this exercise, the LNO will coordinate workshop planning and training activities, cover participant support costs, capture lectures and live demos on a rich media recorder, and produce formative and summative evaluation tools. With supplemental funds, the LNO conducted a prototype training in 2008 that was well received by LTER participants. Technology training for scientists could alternate with information technology training. At present, LTER information managers have proposed several possible IT training topics, including cybersecurity and advanced GIS analysis. Possible science technology training topics include: creating and running scientific workflows for complex analyses (e.g., Kepler) and establishing sensor networks for in situ measurement programs (e.g., communications, QA/QC, analysis).

Products and outcomes — This activity will result in annual training sessions that will increase the use and proficiency of use of advanced technologies across the LTER Network. This increased proficiency will lead to an increase in cross-disciplinary and cross-site publications based on use of new technologies or scientific approaches.

4.0 Assessment and Evaluation

The main goals of this proposal are to facilitate, enhance, and expand the research, education, and synthesis capabilities of the LTER Network through a set of seven activities, each with measurable outcomes. Specific areas for evaluation were selected by using logic models to analyze and illustrate the relationship among LNO goals, activities, and outcomes. A logic model graphically depicts how a program will work to achieve identified outcomes **[78]**. ***Figure 10*** shows one of these logic models.

LNO staff, the LTER Executive Board (see Section 6.0), and external evaluators will conduct formative and summative assessment of LNO programs at least annually by employing a mixture of qualitative and quantitative approaches. ***Figure 11*** shows assessment data previously collected by the LNO. The Senior Program Manager and her staff will expand and institutionalize this process during the next five years. The formative component will generate feedback about what works and what does not, thereby enabling the LNO and key stakeholders to modify plans or redesign activities to increase the likelihood of meeting LNO goals **[79]**. The summative component will use qualitative and quantitative measures to produce an objective analysis of LNO outcomes. In some cases, these metrics can be quantitative; in other cases, qualitative descriptions of the impacts of LNO activities on the LTER Network and the broader scientific community will best measure progress. In all cases, assessing the impact of LTER activities will be correlative, since no control data are available **[80]**.

Measures of progress will be similar within categories of proposed activities, but somewhat different among categories. The initial suite of measures is listed below. Annual evaluations of the LNO by the Executive Board may modify this list.

Goal: Facilitate Scientific Synthesis

- Are users of synthetic datasets satisfied with delivery mechanisms, quality, etc.?

- Are collaborations formed among sites that have not collaborated previously? Is the number of sites collaborating on individual projects increasing?
- Does the LNO organize or support at least 12 working groups designed to increase collaboration across sites per year?
- Are the number and quality of products arising from All Scientists Meetings, Science Council Meetings, and research working groups increasing over time?
- Is progress being made towards achievement of Decadal Plan objectives for research?

Goal: Develop, Implement, Operate, and Maintain Cyberinfrastructure to Support LTER Activities

- Are users of communication and collaboration services satisfied with ease of use, reliability, and functionality?
- Are users of the NIS satisfied with ease of use, reliability, and functionality?
- Are the volume of data and the number of data sets in the NIS increasing over time?
- Are the number and quality of products (reports, standards, best practices documents, publications, and presentations) from IM activities increasing over time?
- Is the number of data sets managed by LNO increasing over time?
- Is progress being made towards achievement of Decadal Plan objectives for cyberinfrastructure?

Goal: Provide Core Services

- Are users of the LTER document archive satisfied with ease of use, reliability, and completeness of the archive?
- Are the volume and diversity of data in the remote sensing archive increasing? Are the number of users and the number products generated from the use of the remote sensing archive increasing?

Goal: Enhance Development and Outreach

- Does the LNO conduct an annual training for LTER scientists and information specialists in support of Network science and cyberinfrastructure development? Are participants satisfied with the course structure and content?

The LNO staff will measure progress directly by collecting data and analyzing regular surveys of LTER investigators. Surveys of participants in ASM and training sessions will provide feedback on the satisfaction and success of those activities.

5.0 Scientific Merit and Broader Impacts

The impact of the proposed work extends well beyond the bounds of the LTER Network to include the broader social-ecological and informatics communities. A major accomplishment of the LTER Network during 2007-2008 was completion of two key planning documents, Integrated Science for Society and the Environment (ISSE) and the Decadal Plan for LTER **[42]**. Together, these documents lay out strategies for an integrated social and ecological science program for the LTER Network and broader scientific community. The scientific merit of this new science program lies in its potential to galvanize a new body of theory spanning the social and ecological sciences. The LNO will facilitate increased synthesis across disciplines, and in so doing stimulate the interactions necessary to begin to address Decadal Plan goals. Funds for research working groups requested in this proposal will encourage interactions between ecologists and social scientists and will provide opportunities for increasing synthesis and expanding collaborations through proposals to NSF programs that link human and natural systems. These

developing collaborations will encourage a broader-scale of transdisciplinary activity as envisioned in the ISSE and Decadal Plan documents.

Additional scientific and broader impacts will result from development of distributed data services and their use for new synthetic research, co-development of standards of practice for ecological information management, development of new cyberinfrastructure tools, increased access to data for education and underserved groups, and collaboration with other environmental observing networks to plan a robust and efficient national cyberinfrastructure for ecological research.

National High-quality Distributed Data Services — The distributed data repositories of the 26 LTER sites reflect the actual distribution of most ecological data, which are held in separate data management systems developed by field stations, museums, academic institutions, state and local governments, and individual scientists. The structure of these data often differs from repository to repository, making integration of semantically similar data a difficult task. The Network Information System being developed by the LNO and LTER sites using the PASTA architecture model will address the problem of delivering distributed ecological data. For example, the LTER NIS will leverage the value of metadata to facilitate the extraction, transformation, and loading of source data into a database system with a rich, shared lexicon, while supporting experimental data reproducibility and quality assessment through the capture of data provenance and quality metrics. The NIS will provide access to data from the 26 LTER sites through a single point of access and at the same time ensure long-term preservation of site data through centralized stewardship. In addition, the NIS will provide access to derived data products through targeted web-services and by enabling non-LTER sites to participate. The broader impact of completing this project in the next five years will be the dramatic expansion of access to the wealth of LTER data and information in a readily discovered and useful format that promotes learning and scientific discovery by scientists, students, and citizens.

Standards of Practice for Ecological Information Management — LTER Information managers have a history of leadership and partnership in informatics dating back to the inception of LTER. During the next five years, LNO will nurture partnerships with environmental observatories and federal agencies which share the goal of developing community standards and disseminating robust LTER IM practices widely. For example, the partnership between the LNO and the NBII will continue the LTER Metadata Standardization project to develop metadata standards of practice to optimize cross-site synthesis and the Metadata Crosswalk project that bridges two commonly-used metadata standards for the geospatial, biological and ecological disciplines. These efforts will provide the genesis for standard metadata management practices applicable to both LTER and non-LTER sites (e. g., field stations, international LTER sites) that frequently adopt LTER standards in lieu of developing solutions of their own.

Community Cyberinfrastructure Development — The LNO provides leadership and plays a key role in defining the importance of informatics in ecology and in disseminating knowledge about ecoinformatics throughout the ecological community. Partnerships with NBII, the San Diego Supercomputer Center (SDSC), NCEAS, the National Center for Supercomputer Applications (NCSA), and the University of Kansas are promoting the integration of informatics, computer science, and ecology through large-scale collaborative projects such as SEEK. During the next five years, the LNO plans to expand these partnerships to involve the Oak Ridge National Laboratory, NESCent, the California Digital Library, the Global Biodiversity Information Facility, and many individual scientists at a range of institutions through joint proposals to develop cyberinfrastructure that benefits the LTER Network and the broader scientific community. For example, projects involving many of these partners will develop interoperability standards via participation in the INTEROP and DataNet networks. The broader impacts of the effort include enhanced integration and synthesis of data, improved data sources for geo-statistical and modeling studies, and enhanced access to data for scientists not associated with large projects, large agencies, or major universities.

Increased Accessibility to Data — The LNO engages in a suite of CI activities to improve access to LTER data and information. Although the primary target of these activities is the research community, increased data accessibility also benefits other groups. Achievement of the education objectives of the Decadal Plan will be facilitated by improved data accessibility and enhanced tools to

manipulate and share data. Beyond LTER, the availability of LTER data for educational purposes will enhance instruction at all levels. Open access to LTER data and information through public web portals will benefit underserved groups that have limited access to academic data sources. The LTER Strategic Communication Plan under development has an explicit goal of identifying and implementing information technology to engage underserved groups in LTER science and education.

Coordination of Shared Cyberinfrastructure with Environmental Observing Networks — The LNO is committed to sharing large CI with other environmental observing networks. In the last six years, LNO staff have used their growing expertise and experience to facilitate the design and development of several national and international environmental observatory systems, including NEON, CUAHSI, WATERS, NPN, LTAR, the Collaborative Large-scale Engineering Analysis Network for Environmental Research (CLEANER), and the IndoFlux Network. The LNO will continue to collaborate with these networks as they develop and it will be an integral partner in efforts to leverage shared CI. For example, LNO staff members are part of an observatory working group convened by the NSF to coordinate development and use of CI. One of the group's initial goals is to provide shared access to a national data repository and indexing system. The LNO anticipates strong future interactions with these networks as well as with newly emerging national and international observing networks.

6.0 Management

The Principal Investigator of this proposal is also the Principal Investigator of the Cooperative Agreement for the LTER Network Office. The Principal Investigator is also Executive Director of the LNO. The position of Executive Director is defined in the LTER Bylaws:

> ***Article IX, Section 4. Executive Director:*** *The Executive Director of the Office is the Principal Investigator and scientific leader of the Cooperative Agreement. The Executive Director is an employee of the contracting institution, and operational supervision of the Executive Director resides with the contracting institution. The Executive Director is responsible for the day-to-day operation of the Office. The Executive Director will implement programmatic recommendations of the Executive Board, consistent with the Cooperative Agreement with the NSF.*

The current Executive Director holds the position of Research Professor in the Department of Biology. The general responsibilities of the Executive Director include cooperation with the EB to set priorities for the LNO, development and implementation of a strategic vision for the LNO, management and evaluation of staff, oversight of LNO efforts as outlined in the CA, and communication with the NSF, LTER, other agencies, and the general public. The Executive Director reports directly to the Chair of the EB (presently Phil Robertson of Michigan State University). Communication between the Chair and the Executive Director occurs through frequent telephone and video conferences. The Executive Director orients incoming chairs and EB members and provides organizational continuity for the LTER Network.

The LNO is located administratively at UNM in the Center for Research Excellence in Science and Technology (CREST) in the College of Arts and Sciences. In response to a recommendation in the last LNO renewal, the Dean of Arts and Sciences created CREST in 2004 to manage the CA and related grants and contracts under a separate administrative unit. CREST has two defined positions, a Director who reports to the Associate Dean for Research in Arts and Sciences, and a Senior Program Manager. At present, the Executive Director of LNO is also director of CREST. As stipulated in UNM rules, CREST receives an annual review by the College of Arts and Sciences, and the Associate Dean for Research conducts an annual performance review of the director. The Department of Biology provides support services to CREST for purchasing and personnel matters.

The Executive Director supervises four senior staff members: the Director for Synthesis Support, the Chief Information Officer, the Director for Development and Outreach, and the Senior Program Manager (***Figure 12***). The Executive Director conducts annual reviews of performance for members of the senior staff and meets with them several times each year to update and revise goals.

Senior Staff — The four senior staff members, along with the Executive Director, constitute the management team of the Network Office. They advise the Executive Director on matters pertaining to their areas of expertise and work with the Executive Director and other staff to further the goals of the LTER Network. They may assume the duties of the Executive Director in his absence. The Director for Synthesis Support, the Chief Information Officer, and the Director for Development and Outreach have appointments as research faculty in the Department of Biology. The Senior Program Manager is a regular staff member.

Under the overall supervision of the Executive Director, senior staff members have responsibility for the four categories of activities described in this proposal and supervise the staff assigned to these activities (***Figure 12)***.

Goals and Priorities — The SOW that is part of the LNO CA, the strategic plans of the LTER Network **[42]** and the LNO **[77]**, and the EB all define the goals and activities of the LNO. The LNO Strategic Plan contains the operational objectives of the LNO and the means to prioritize these objectives. The Executive Director annually reviews the LNO Strategic Plan, and the management team revises the plan every three years.

Evaluation — The NSF reviews the success of the LNO in meeting its goals through annual reports **[2]**, mid-term site visits **[81-82]**), and renewal proposals every six years. In addition, the Executive Director reports on activities to the LTER Program Officer frequently via videoconference and in person several times during the year. The LTER Bylaws stipulate an annual review of the LNO by the Executive Board:

> ***Article IX, Section 2. Review of Network Office Performance:*** *An annual review of Office performance shall be conducted by the Executive Board at its first meeting of the year. The review will be based on 1) the annual report of the Office, which will be circulated to LTER Sites on January 1 of each year, 2) a survey of Sites administered by the Office in October of each year, and 3) goals set in the LTER Strategic Plan. The Executive Board will recommend modifications to Office tasks. Those recommendations approved by the Executive Board will be submitted by* the Office to the NSF for possible incorporation into the Cooperative Agreement.

Linkages to the LTER Network — The SC and the EB are the governance bodies of the LTER Network (**Figure 13**). Under the ultimate authority of the SC, the EB is empowered to make decisions regarding the management of the LTER Network. The Executive Director is an ex-officio, non-voting member of the SC and the EB, and is thus involved in every LTER governance meeting. Other LNO staff members participate in these governance meetings as required and may also be members of standing committees. The LNO has two operational responsibilities within the LTER Network. Namely, the LNO works on both strategic and tactical planning with the SC and EB, LTER standing committees, the NAB, and the NSF. The LNO also has responsibility for implementing some of these plans by facilitating compliance by individual LTER sites and scientists.

National Advisory Board — The LTER Network has established a NAB **[83]** to provide regular review and advice regarding LTER programs. Members of the NAB are nationally recognized scientists chosen to encompass a wide range of disciplines and backgrounds. The NAB also provides independent review and advice to the LNO. The NAB meets annually and produces a report to NSF and the EB **[84]**.

Table 1. Selected key activities and outcomes supported through strategic partnerships and collaborations.

Strategic Partnership	Activities	Key Outcomes, Products, and Publications[#]
The Knowledge Network for Biocomplexity • LNO staff – Brunt, Waide • Collaborators – NCEAS, SDSC	• specified the Ecological Metadata Language content standard for ecological metadata • developed *Morpho* and *Metacat*—two software tools that support entry and management of ecological metadata records • held multi-institutional graduate training	1) EML adopted as the metadata standard by all sites in the LTER Network; 2) all databases documented using EML-compliant metadata; 3) Metacat is used nationally (LTER, etc.) and internationally for metadata management. http://knb.ecoinformatics.org [13]
Resource Discovery Initiative for Field Stations • LNO staff - Michener and Brunt • Collaborators – OBFS, NCEAS, SDSC, SEV/CAP/VCR LTER sites, California Natural Reserve System (CaNRS)	• created several new databases that are used by both OBFS field stations and LTER sites (e.g., summer courses, site descriptions, personnel, administration, bibliography) • revised the OBFS web site • implemented OBFS Data Registry • held two week-long training activities annually	1) EML-compliant Data Registry adopted by ESA, PISCO, CaNRS, and OBFS; 2) thousands of data sets now easily discoverable by scientists, students and educators; 3) 13 LTER sites are OBFS members and benefited from having new information managers trained in ecoinformatics and ArcGIS. http://www.obfs.org/ [12, 14-16]
Science Environment for Ecological Knowledge. • LNO staff - Michener, Brunt, Waide • Collaborators - NCEAS, SDSC, CAP LTER (ASU), U. North Carolina, U. Kansas, U. Vermont, UC-Davis, Napier University	• created cyberinfrastructure for ecological, environmental, and biodiversity research • provided education and outreach to the ecological community (especially, under-represented groups) about ecoinformatics • state-of-the-art ecoinformatics training lab developed	Created an integrated data grid (EarthGrid) for accessing a wide variety of ecological and biodiversity data and analytical tools (including Kepler—an open-source scientific workflow solution developed as part of SEEK; see http://seek.ecoinformatics.org/ and http://kepler-project.org/). [17-31]
USGS National Biological Information Infrastructure (NBII) • LNO staff - Michener, Brunt • Collaborators - NBII	• provided direct metadata and data management assistance to all 26 LTER sites • achieved interoperability between EML (the LTER metadata standard) and the USGS Biological Data Profile • participated in the new ISO standard working groups for the Biological Data Profile	1) Exposed 6,090 LTER metadata documents through the NBII & ORNL clearinghouses; over half contain information that enable automated data retrieval and integration; 2) co-developed a metadata entry tool that facilitates metadata creation and storage.
Environmental Observatory (EO) Design. • LNO staff – Michener, Waide • Collaborators: NEON, CLEANER, WATERS, NPN, IndoFlux	• served on teams involved in planning environmental observatories • completed planning activities for a continental scale-environmental science research agenda • completed a National Research Council publication focused on linking space-based and ground-based observing networks	1) Completed NEON design documents; 2) designed an environmental monitoring network in India; 3) organized a Special Session at ESA (Annual meeting in San Jose) focused on Decadal Science Planning for the Ecological Sciences. http://neoninc.org [32-40]

	FTE	3.1.1 Science Council	3.1.2 Research Working Groups	3.1.3 Activities of the Decadal Plan	3.2.1 Basic CI Support	3.2.2 Information Management	3.2.3 Network Information System	3.2.4 IT, Database, and Web Consulting	3.3.1 Acquisition of Data	3.4.1 Communication/Outreach	3.4.2 Training
Director Synthesis Support	0.60	0.05	0.10	0.05					0.40		
Public Information Officer	1.00									1.00	
Application Support Analyst	0.50				0.30			0.20			
NIS Programmer/Analyst	1.00						1.00				
Systems/Analyst	1.00				0.80						0.20
Information Manager	1.00					1.00					
Professional Intern 1	1.00				1.00						
Professional Intern 2	1.00						1.00				
Work study student 1	1.00		1.00								
Work study student 2	1.00		1.00								
Work study student 3	1.00		1.00								

Table 2. The LNO proposes to allocate staff effort to 10 activities in four thematic categories. Eight new positions (*italics)* and three retained positions (**bold**) will expand the capability of the LNO to achieve the goals of the LTER Decadal Plan.

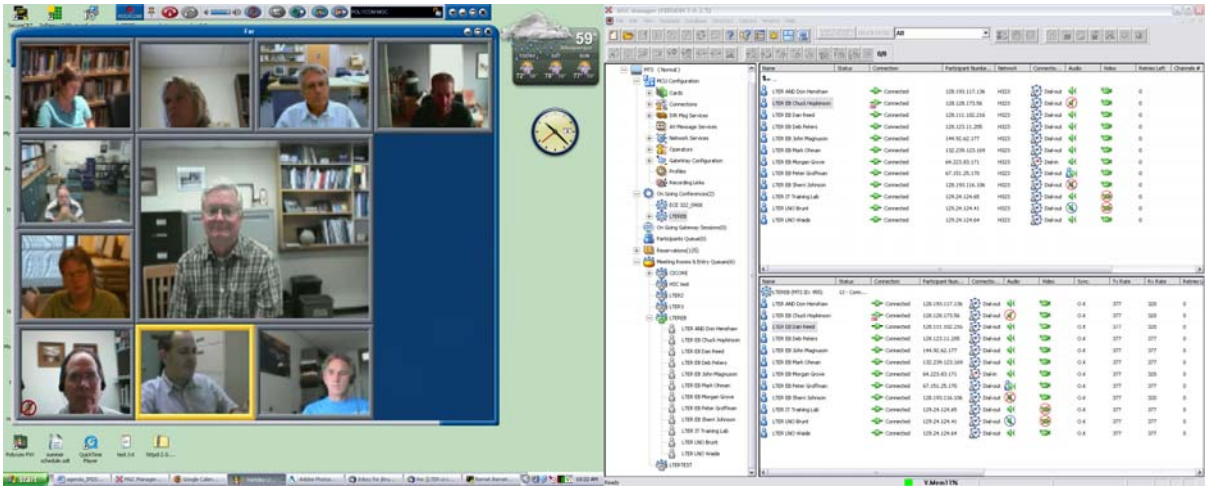


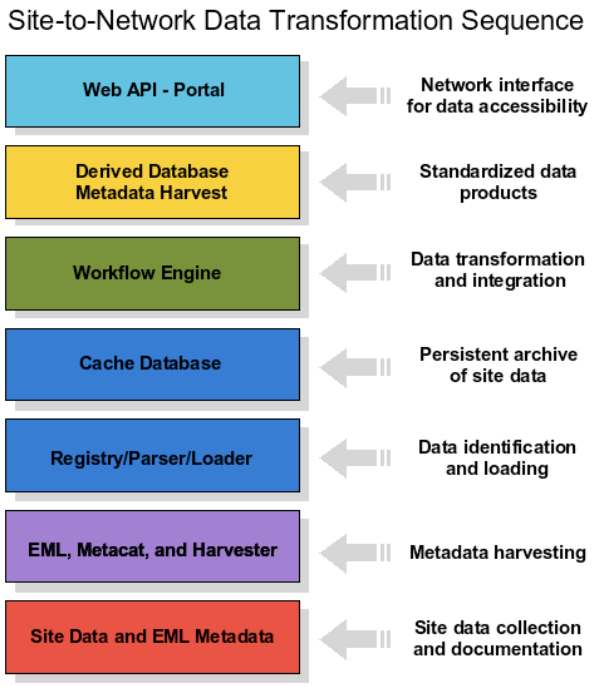
Figure 1. Video teleconferencing (VTC) is improving the way the LTER Network gets business done. The 2006 Executive Board, under the leadership of interim chair John Magnuson, began holding its monthly meetings by VTCs instead of by telephone conferences. The experiment has been a great success. The VTC system establishes connections using a variety of client technologies including desktop software (A), conference room units, and personal standalone VTC units. The Polycom MGC+ MCU bridge at the LNO harmonizes the connection idiosyncrasies and the LNO Systems Analyst will monitor VTCs for quality via a full-featured administrative interface (B).

Figure 2. The LTER Informatics Training Laboratory - Here participants receive hands-on instruction in Ecological Metadata Language creation and management. The LNO and the SEEK project co-developed a modern information technology training laboratory that is optimized for student-to-instructor communication, while remaining ergonomically comfortable for long periods of instruction.

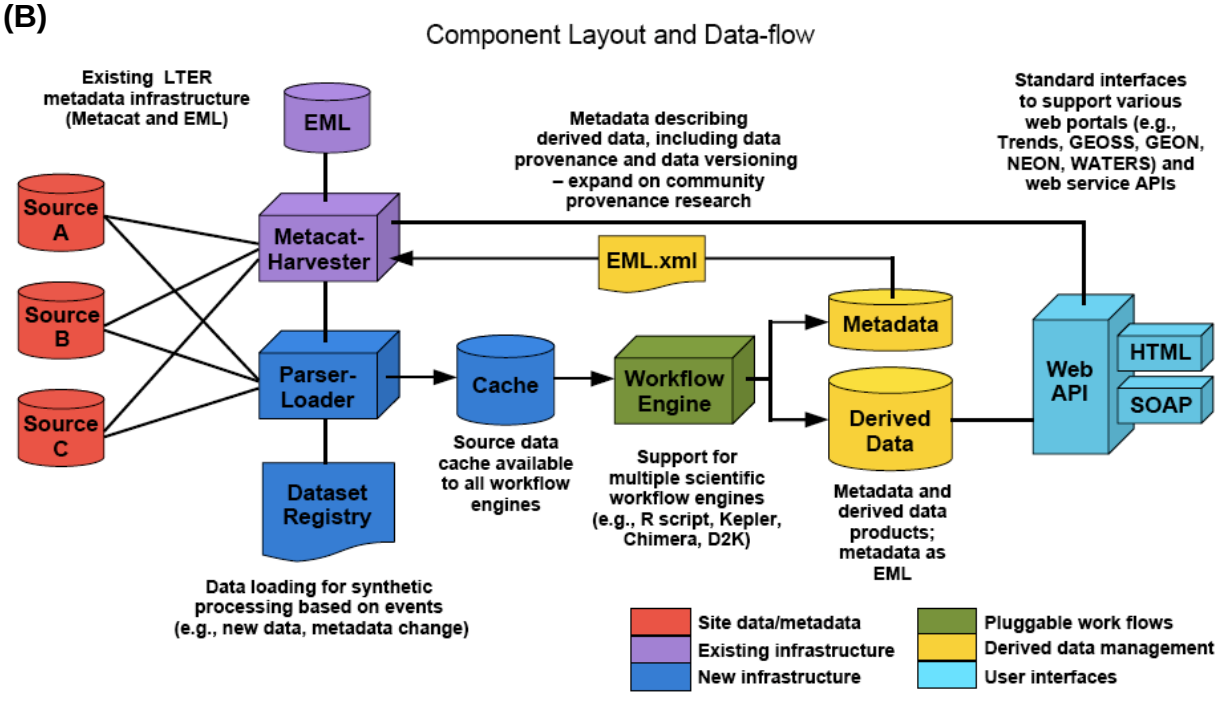
Figure 3. The 2006 LTER All Scientists Meeting in Estes Park, CO attracted 863 participants, including members of the LNO team (first row, left to right): Mark Servilla, David Farris, Jeanine McGann, Duane Costa, Steve Carpenter (NTL), Bob Waide, John Vande Castle, Bill Michener, George Garcia, Marshall White, James Brunt, and McOwiti Thomas.

Figure 4. The PASTA (Provenance Aware Synthesis Tracking Architecture) framework is a conceptual model for transforming LTER site-collected data into Network-ready derived products. Diagram (A) shows the sequence of steps used to transform the data and the respective PASTA components that perform the operations; Diagram (B) shows the component layout and data flow. The system uses interoperable components (B) based on existing standards and commonly accepted programming approaches, and it leverages investments in existing community-developed software tools like Metacat, Harvester, and the Ecological Metadata Langu **(A)** The PASTA model utilizes a dynamic data repository that automatically tracks the provenance of derived datasets. Interchangeable workflow engines can be used to produce specific synthetic data products. PASTA is based on an open-source philosophy where modular components that conform to standard specifications can be seamlessly interchanged to meet the needs of the community.

Site data are loaded into a common data "Cache" that serves as a permanent Network archive. The "Cache" makes the data available to analytical applications through a standard interface, enabling development of derived data products. Metadata created for all derived data become part of a Metacat repository, thereby providing resources for data discovery and access through various community accessible channels (e.g., browser, web services).



(B)



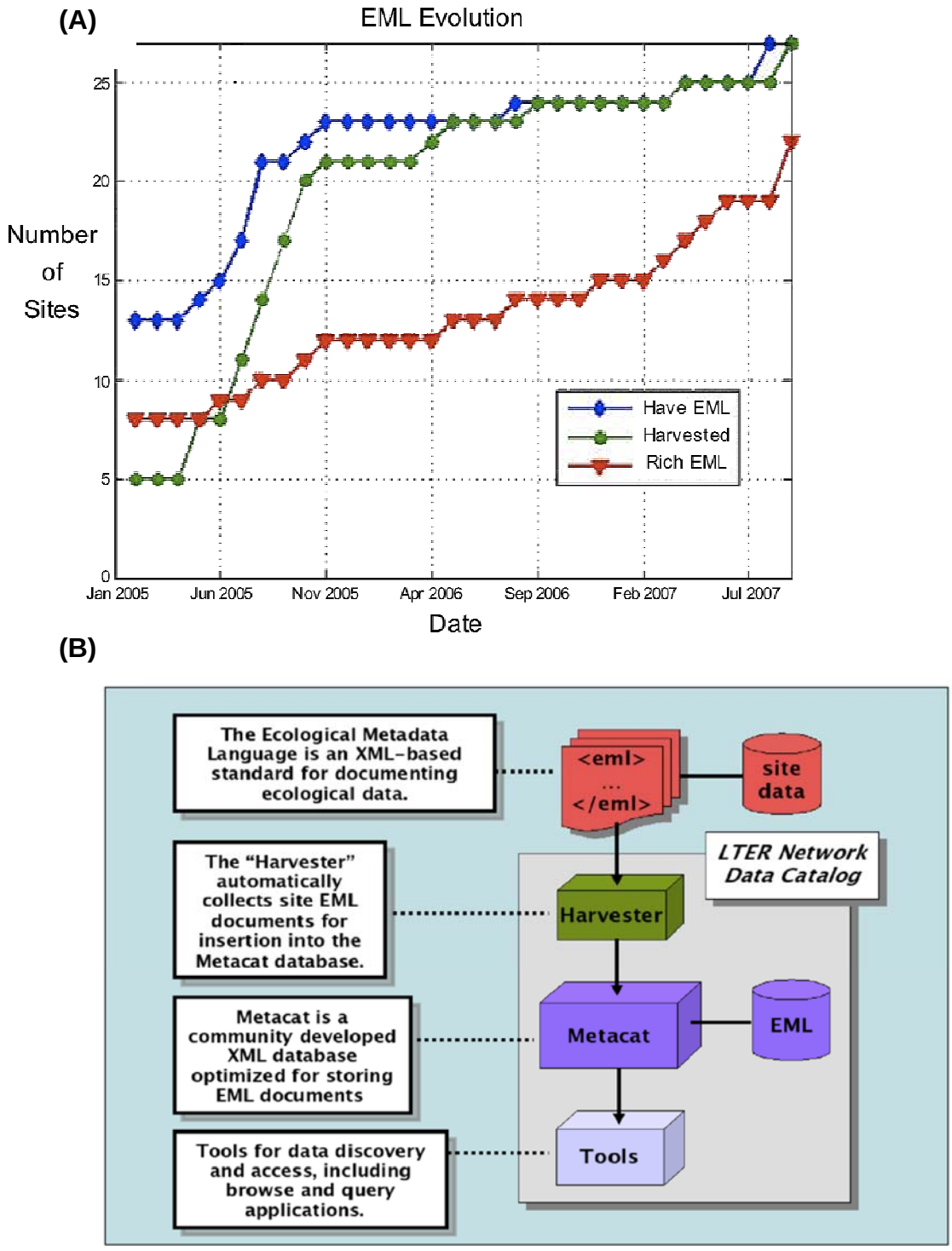


Figure 5. The LNO's aggressive outreach is increasing LTER site use of the Ecological Metadata Language and the LTER Network Data Catalog through automated harvesting of EML documents. Diagram (A) shows progress through July 2007. The quantity and quality of metadata documents available for harvesting from LTER sites continues to increase. Diagram (B) depicts the data harvesting infrastructure, which derives from the Knowledge Network for Biocomplexity project (a previous LNO collaboration), and serves as the metadata update mechanism and repository for the PASTA framework.

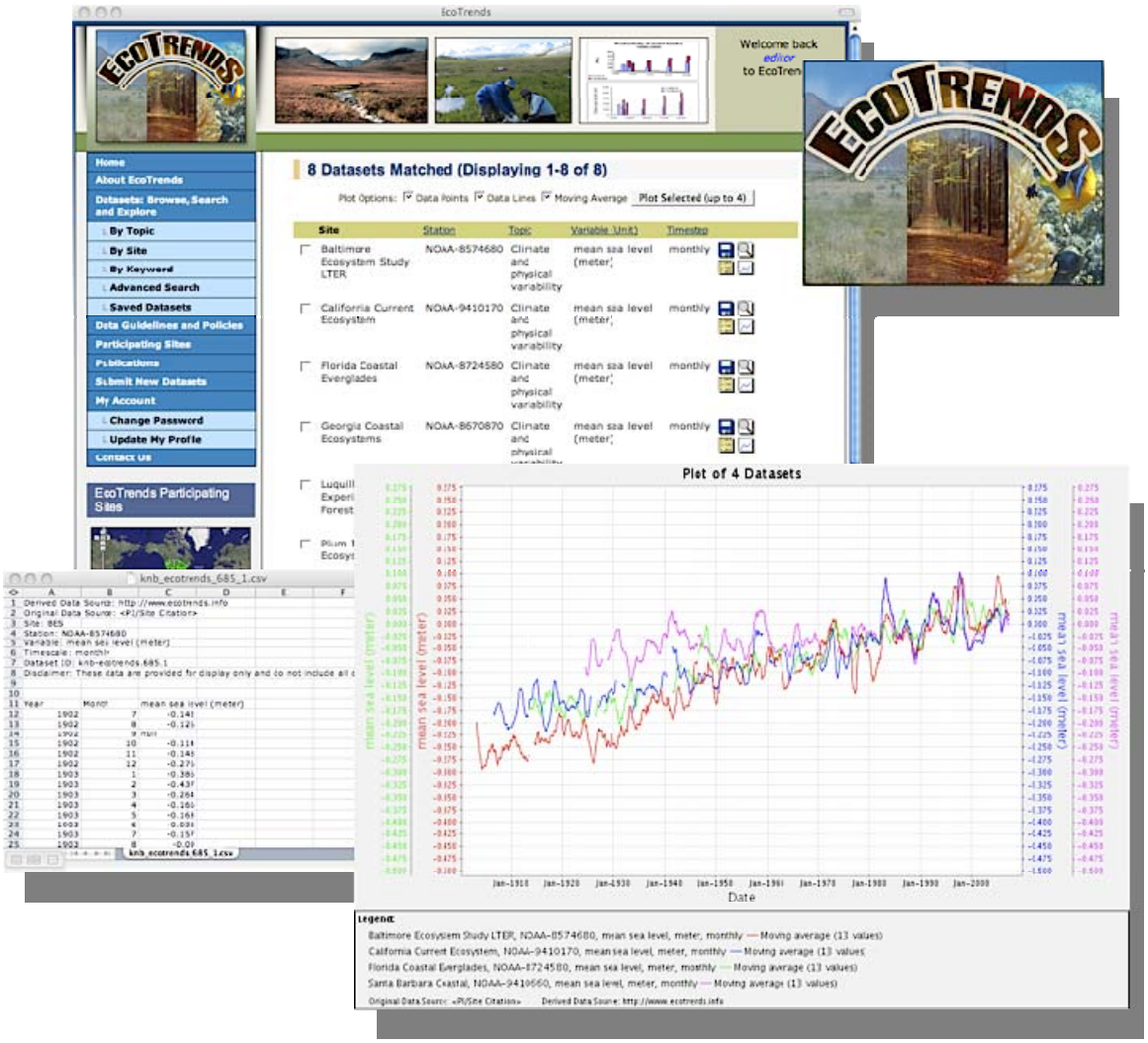


Figure 6. The EcoTrends project began in 2004 as an effort to organize and make available in a simple and common format data sets that exemplify the significant trends demonstrated in the collections of long-term ecological and environmental observations. The original project by Drs. Debra Peters and Ariel Lugo will produce a high-quality print volume of site descriptions and graphs of long-term trends for a variety of variables (due to be released in late 2009). The EcoTrends web site portal developed by LNO (**http://www.EcoTrends.info**) provides a dynamic data discovery and access interface capable of generating multivariate plots, data set persistence, and data use tracking for greater than 22,000 derived time-series data sets from the LTER Network and other research stations. An infrastructure goal of the EcoTrends project is to automatically update datasets as new data become available, thereby providing an ideal test environment for LNO developers to implement components of the PASTA framework model. To date, EcoTrends development by the LNO has focused on the "derived-data" management aspect of PASTA. Future work proposed under the "Cyberinfrastructure for the LTER Decadal Plan" will implement the Ecological Metadata Language "Data Manager" software library to dynamically parse and load source data from sites when updates are available. This process will test a variety of applications, including the Kepler workflow system, by providing data transformation and provenance information as part of its output. EcoTrends will incorporate the functionality and data from existing standalone value-added network data products like the LTER Climate and Hydrologic databases into its common data delivery framework.

AND – **H.J. Andrews Experimental Forest LTER, Oregon**

ARC – **Arctic Tundra LTER, Alaska**

BES – **Baltimore Ecosystem Study LTER, Maryland**

BNZ – **Bonanza Creek Experimental Forest LTER, Alaska**

CAP – **Central Arizona-Phoenix LTER, Arizona**

CCE – **California Current Ecosystem LTER, California**

CDR – **Cedar Creek Natural History Area LTER, Minnesota**

CWT – **Coweeta LTER, North Carolina**

FCE – **Florida Coastal Everglades LTER, Florida**

GCE – **Georgia Coastal Ecosystem LTER, Georgia**

HBR – **Hubbard Brook LTER, New Hampshire**

HFR – **Harvard Forest LTER, Massachusetts**

JRN – **Jornada Basin LTER, New Mexico**

LNO – **LTER Network Office, University of New Mexico, Albuquerque, NM**

KBS – **Kellogg Biological Station LTER, Michigan**

KNZ – **Konza Prairie LTER, Kansas**

LUQ – **Luquillo Experimental Forest LTER, Puerto Rico**

MCM – **McMurdo Dry Valleys LTER, Antarctica**

MCR – **Moorea Coral Reef LTER, French Polynesia**

NWT – **Niwot Ridge LTER, Colorado**

NTL – **North Temperate Lakes LTER, Wisconsin**

PAL – **Palmer Station LTER, Antarctica**

PIE – **Plum Island Ecosystem LTER, Massachusetts**

SBC – **Santa Barbara Coastal Ecosystem LTER, California**

SEV – **Sevilleta LTER, New Mexico**

SGS – **Shortgrass Steppe LTER, Colorado**

VCR – **Virginia Coast Reserve LTER, Virginia**

Figure 7. The LNO provides a central point of contact and collective expertise to support the objectives of the 26 research sites that constitute the LTER Network. These 26 sites include ecosystems spanning broad ranges of environmental conditions and degrees of human domination of the landscape. Geographically, sites range from Alaska to Antarctica and from the Caribbean to French Polynesia. The LTER Network includes agricultural lands, alpine tundra, barrier islands, coastal lagoons, deserts, coral reefs, estuaries, forests, freshwater wetlands, grasslands, kelp forests, lakes, open ocean, savannas, streams, and urban landscapes. Each site develops research programs in five core areas: pattern and control of primary production; spatial and temporal distribution of populations selected to represent trophic structure; pattern and control of organic matter accumulation in surface layers and sediments; patterns of inorganic inputs and movements of nutrients through soils, groundwater and surface waters; and patterns and frequency of site disturbances. Collectively, LTER sites have generated 17,198 publications and 6090 well-documented, publicly accessible data sets. Presently, 1663 scientists and 692 students are actively conducting research at LTER sites. Two of NSF's 50 most important research discoveries are based on research at LTER sites **[57]**. Thirty-eight countries around the world have created national research networks based on the LTER model **[58]**. Data sources: LTER personnel directory, bibliography, and data catalog.

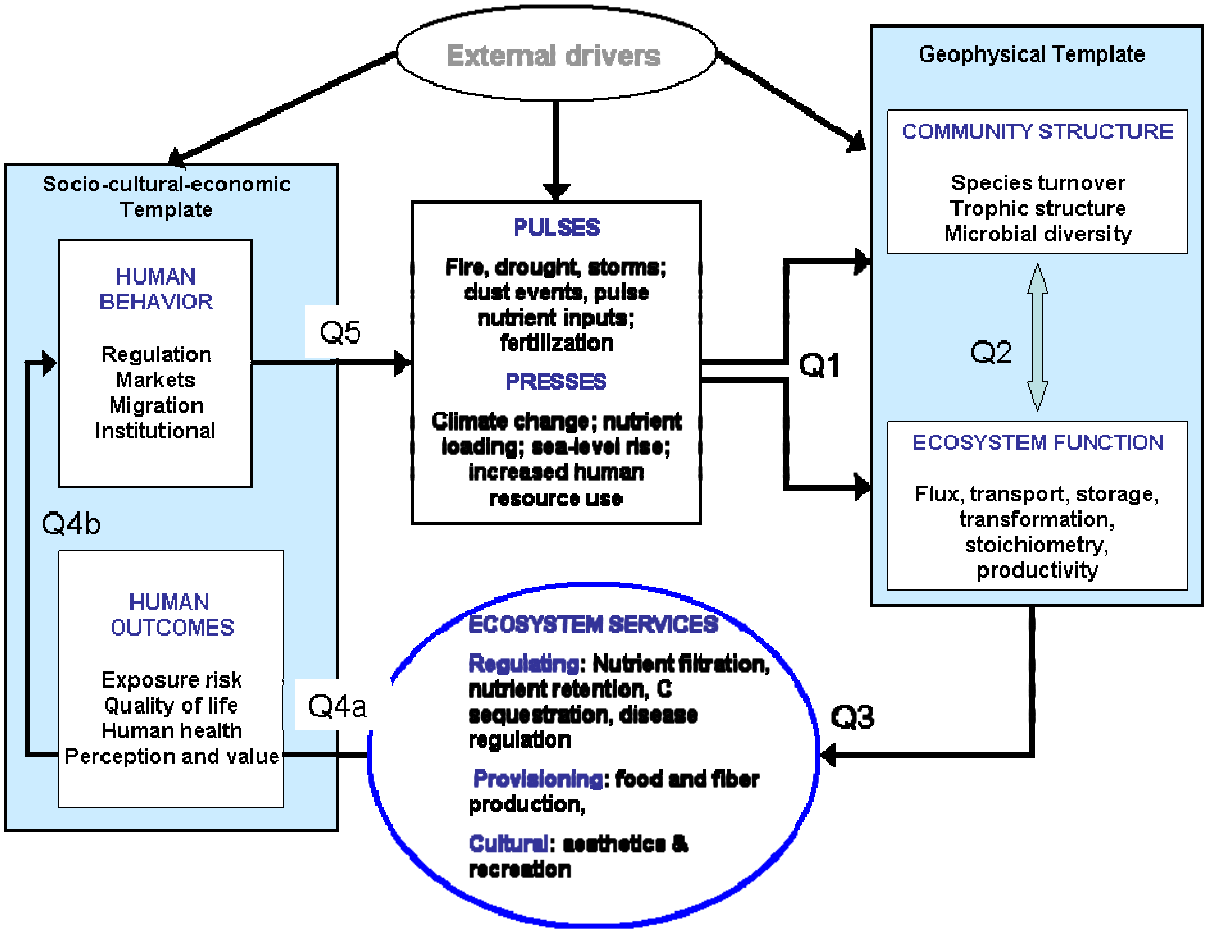


Figure 8. The Decadal Plan proposes a research framework that integrates the traditional domains of ecology and social science. The right side of the diagram represents traditional ecological research. The human dimensions of environmental change occupy the boxes on the left and are linked to ecological research through ecosystem services and press and pulse disturbances. Five questions (see below) provide a common focus for synthesis across sites and across domains.

Q1: How do long-term press disturbances and short-term pulse disturbances ***interact*** to alter ecosystem structure and function?

Q2: How can biotic structure be both a ***cause and consequence*** of ecological fluxes of energy & matter?

Q3: How do altered ecosystem dynamics affect ecosystem services?

Q4: How do changes in vital ecosystem services ***feed back*** to alter human behavior?

Q5: Which human actions influence the frequency, magnitude, or form of press and pulse disturbance regimes across ecosystems, and what determines these human actions?

Figure 9. One of the LNO's major roles is to promote the LTER Network's activities through publications and other promotional material. LNO produced, helped produce, or facilitated the production of several print and web publications, including (clockwise from upper left): *Network News*, the LTER Network newsletter; a sample of informational site brochures; the Bonanza Creek volume in the LTER/OUP synthesis series; the LTER Network Brochure; the Network News portal; the Coweeta LTER site brochure; an NSF brochure highlighting the broader impacts of the LTER program, produced with LNO assistance; and the LNO web site.

RESOURCES	ACTIVITIES	OUTPUTS	SHORT- AND LONG-TERM OUTCOMES	IMPACT
In order to accomplish our set of activities we will need the following infrastructure:	*In order to address our problem or asset we will accomplish the following activities:*	*We expect that once accomplished these activities will produce the following evidence of service delivery:*	*We expect that if accomplished these activities will lead to the following changes in 1-3 and then 4-6 years:*	*We expect that if accomplished these activities will lead to the following changes in 7-10 years:*
• Funding for Information Management Committee Meetings and workshops • Support for a dedicated LTER Network Data Manager to create, manage, and curate network data sets • Support for Application Support Analyst to develop and maintain interfaces to new network data sets	•Coordinate meetings of the Information Management Committee and IM steering committee • Manage existing network databases for accuracy and accessibility • Migrate climdb and hydrodb to LNO • Manage EcoTrends as part of the NIS • Develop new synthetic thematic databases	•1 information management committee and 1 steering committee meeting per year •Annually increasing # of long-term data sets curated •1 new synthetic data sets developed per year •Annually increasing # of long-term data sets delivered to scientists for synthesis •Interfaces to new network data sets	• Increase in the development of new synthetic data sets •Increased use of network information system for LTER synthesis activities •Increased efficiency for LTER site data managers and scientists in contributing to synthetic data sets. •LNO becomes data repository partner for community	• LTER information management becomes a CI 'standard of practice' for the community • LTER Network seen as the high quality data provider for scientists addressing grand environmental challenges •LTER Network provides friendly intuitive interface to data for scientists, educators, and the public

Figure 10. Logic Model 3.2.2 — Problem: Improve Information Management. An example of a logic model used to link a desired impact with the outcomes that will achieve that impact, the outputs leading to the required outcomes, and the activities and resources required for each output [61].

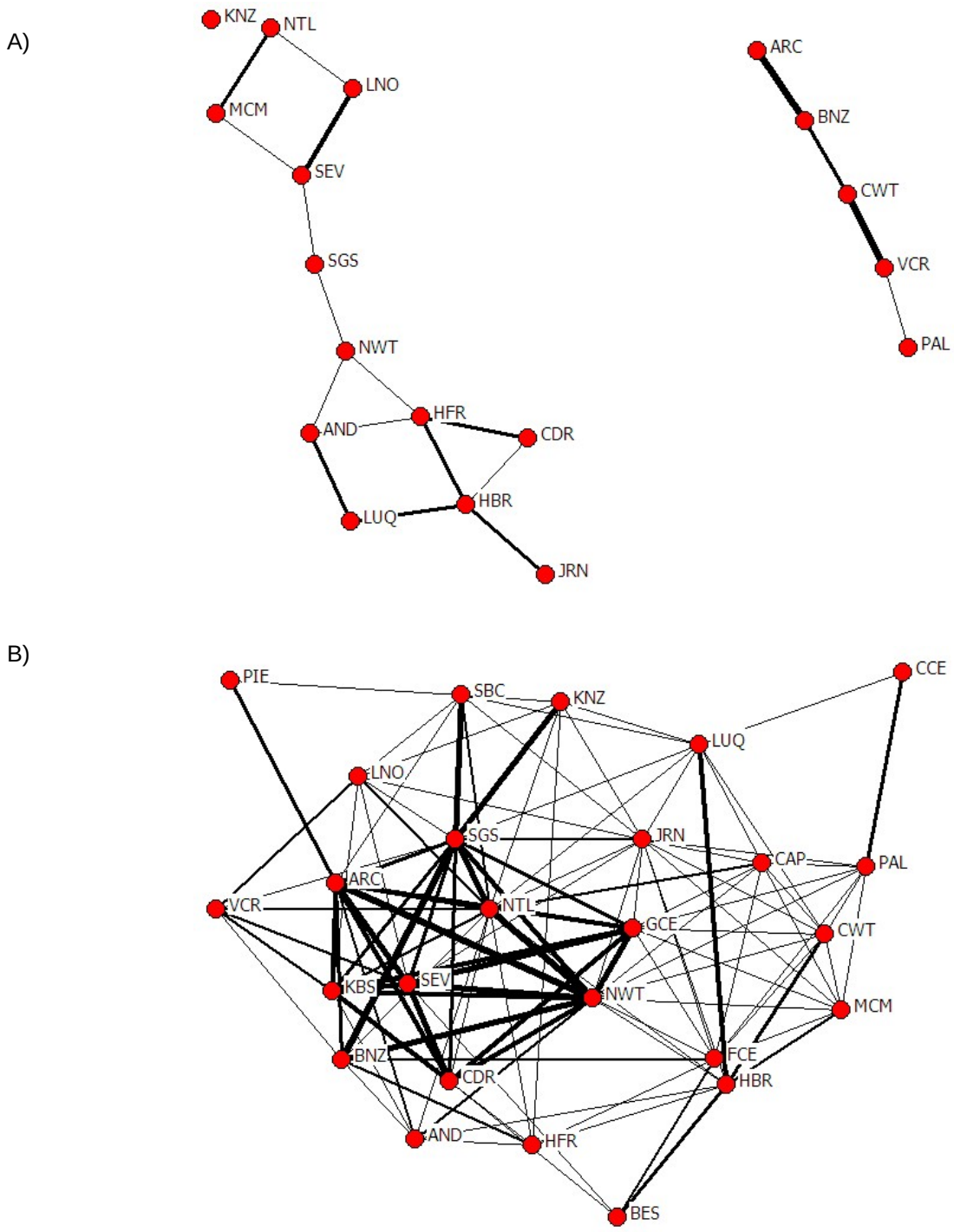


Figure 11. Christian et al. **[8]** used network analysis and data from the LTER bibliography to examine changes in co-authored publications among LTER sites over time. They determined the degree of Network engagement based on publications involving three or more sites. A) In 1995, the Network is only 50% engaged since two distinct interaction clusters occur. B) In 2005, the Network is completely engaged. Analysis of publication records from 1981-2006 demonstrates a trend towards increasing engagement, especially since 1998.

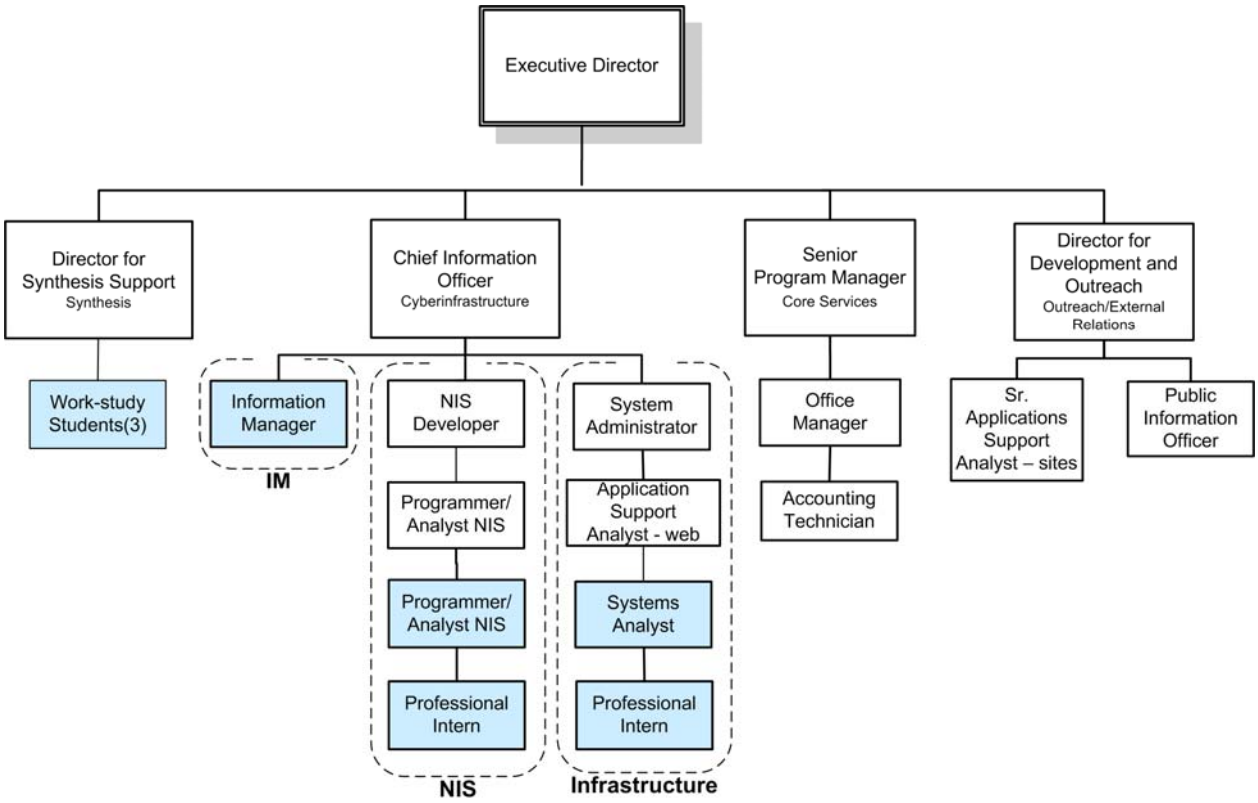


Figure 12. The LNO operates with a lean staff and simple organizational structure. Four senior staff members report to the Executive Director and supervise technical staff in the areas of Synthesis, Cyberinfrastructure, Core Services, and Development/Outreach. Note that the vertical organization of technical staff does not reflect reporting structure; all technical staff report directly to the indicated senior staff member. The synthesis science goals of the Decadal Plan will require a more robust cyberinfrastructure and additional technical competencies. To meet these requirements, the LNO is requesting funds to support eight new positions: Programmer/Analyst, Systems Analyst, Information Manager, two Professional Interns, and three work-study students. Requested new positions are shaded in blue.

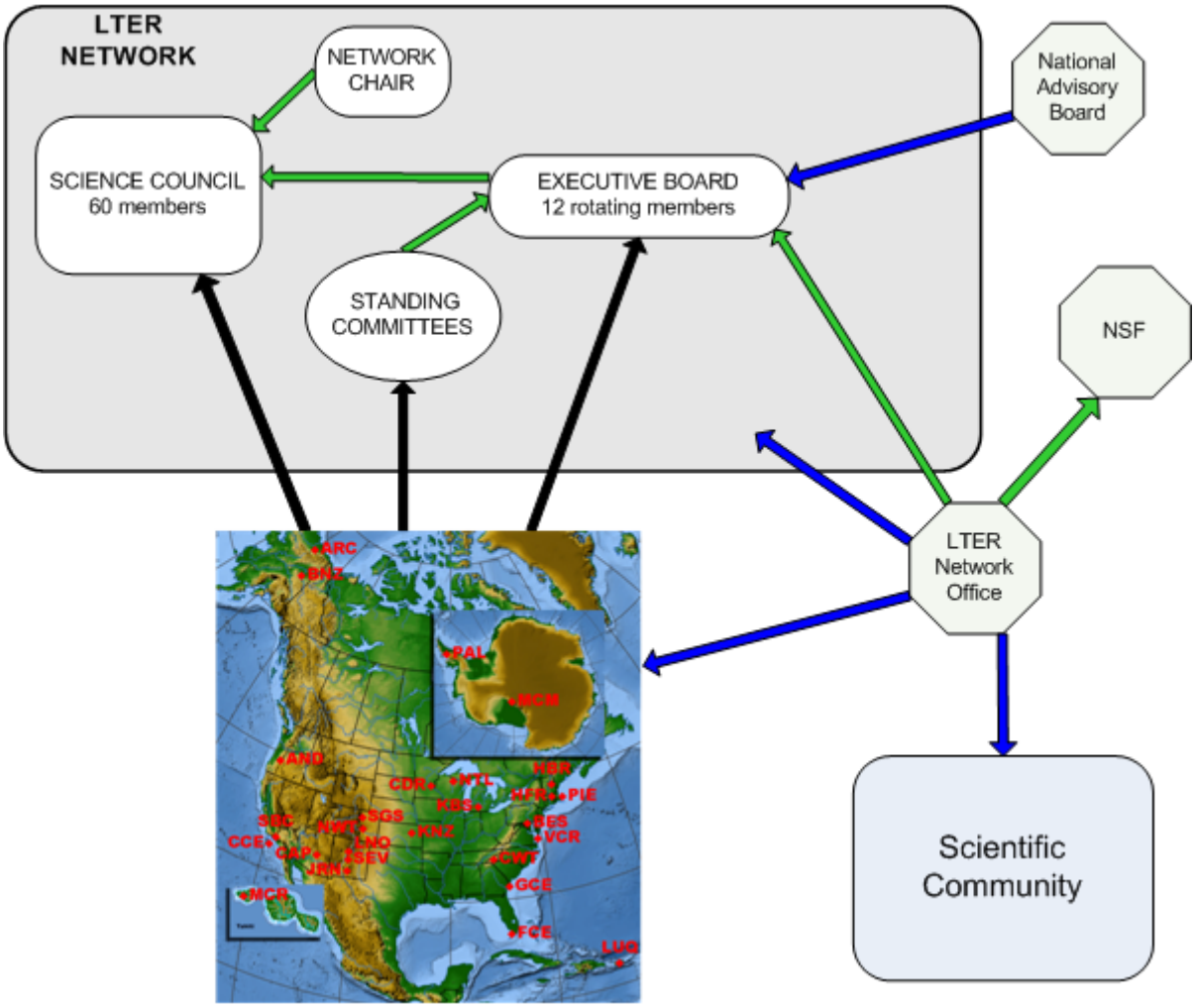


Figure 13. The Decadal Plan for LTER created a new governance and reporting structure for the LTER Network. Members of the Science Council, the Executive Board, and standing committees are drawn from the sites (black lines). The standing committees respond to the Executive Board and the Executive Board and Chair respond to the Science Council (green lines). The LNO responds to the Executive Board and NSF, and provides service and leadership to the Network, LTER sites, and the scientific community (blue lines). The LNO is a leader in the evaluation and implementation of Network-scale cyberinfrastructure and in the development of collaborations with other networks and centers. The dual roles of service and leadership can create conflicting expectations of the LNO.

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4. List of LNO Competitive Proposals. <http://lno.lternet.edu/renewal/proposals/>

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Professional Preparation:

University of Illinois	Biology	B.S.	1969
University of Wisconsin	Zoology	M.S.	1973
University of Wisconsin	Zoology	Ph.D.	1978
Carnegie Museum	Ornithology	Post-Doc.	1978 – 1980

Appointments:

1997 – Present Executive Director, Long-Term Ecological Research Network Office
Professor, Department of Biology, University of New Mexico
1995 – 1999 Professor, Department of Biology, University of Puerto Rico
1995 – 1997 Director, Puerto Rico Minority Research Center of Excellence
1982 – 1997 Director, Terrestrial Ecology Division/Institute for Tropical Ecosystem Studies (University of Puerto Rico-Rio Piedras)
1982 – 1995 Senior Scientist I, Center for Energy and Environment Research, University of Puerto Rico.

Publications:

(i) Publications Most Relevant to Proposal

Michener, W.K. and R.B. Waide. 2008. The Evolution of Collaboration in Ecology: Lessons from the United States Long Term Ecological Research Program. In Scientific Collaboration on the Internet. G.M. Olson, A. Zimmerman, and N. Bos (eds). (in press). MIT Press, Cambridge, MA.

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(ii) Five Other Significant Publications

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D. P. Reagan and R. B. Waide, eds. 1996. The Food Web of a Tropical Rain Forest, University of Chicago Press.

Synergistic Activities:

- Program co-chair LTER All Scientists Meeting 2000, 2003, 2006
- Member, development committees for NEON, CLEANER, National Phenological Network
- Member, Science Task Force for the LTER Planning Project

Collaborators & Other Affiliations:

Collaborators and Co-editors

Allen, V. G. (Texas Tech U.)
Andelman, S.J. (Conservation International)
Boody, G. (Land Stewardship Project)
Boose, E. R. (Harvard U.)
Brokaw, N. (U. of Puerto Rico)
Camilo, G. (St. Louis U.)
Comarazamy, D. (U. of Puerto Rico)
Creamer, N. G. (North Carolina State U.)
Crowl, T. (Utah State)
Drinkwater, L. E. (Cornell U.)
Ezcurra, E. (San Diego Natural History Museum)
González, J.E. (Santa Clara U.)
Gosz, J. R. (U. of Idaho)
Groffman, P.M. (Institute for Ecosystem Studies)
Harmsen, E.H. (U. of Puerto Rico)
Havlin, J. L. (North Carolina State U.)
Jackson, L. E. (U. of California-Davis)
Lodge, D.J. (USDA Forest Service)
Lugo, A.E. (USDA Forest Service)
Lynch, L. (U. of Maryland)
Maass, J.M. (National U. of Mexico)
Magnuson, J.J. (U. of Wisconsin)
McDowell, W. H. (U. of New Hampshire)
Michener, W.K. (U. of New Mexico)
Parsiani, H. (U. of Puerto Rico)
Pickett, S. T. A. (Institute for Ecosystem Studies)
Picón, A. (U. of Puerto Rico)
Pitelka, L. (U. of Maryland)
Pringle, C.M. (U. of Georgia)
Ramírez, N. (U. of Puerto Rico)
Randall, A. (Ohio State U.)
Reed, A. S. (Oregon State U.)
Richardson, B.A. (U. of Edinburgh)
Richardson, M.J. (U. of Edinburgh)
Robertson, G. P. (Michigan State U.)
Scatena, F.N. (U. of Pennsylvania)
Schaefer, D. (No affiliation)
Seastedt, T. R. (University of Colorado)
Silver, W.L. (University of California)
Tepley, C.A. (U. of Puerto Rico)
Thompson, J. (U. of Puerto Rico)
Vásquez, R. (U. of Puerto Rico)
Vaughan, H.H. (Environment Canada)
Vogt, D. (U. of Washington)
Vogt, K. (U. of Washington)
Wall, D. H. (Colorado State U)
Willig, M. (U. of Connecticut)
Zimmerman, J. (U. of Puerto Rico)

Graduate Advisors and Postdoctoral Sponsors

Beals, Edward, retired, Major Professor
Parkes, Kenneth, Carnegie Museum of Natural History, Pittsburgh, post-doctoral advisor

Thesis Advisor

Li, Y. (Unknown)
Thompson, J. (U. of Georgia)
Tossas, A. (U. of Puerto Rico)

Post-graduate Sponsor

Eastman, J. (U. of Maryland)
Lu, L. (Unknown)
Williams, J. (U. of Minnesota)

JAMES W. BRUNT
Chief Information Officer
LTER Network Office
Research Associate Professor
Department of Biology MSC03 2020
1 University of New Mexico
Albuquerque, New Mexico 87131-1091

PROFESSIONAL PREPARATION

B.A.	New Mexico State University 1986	Biology
B.S.	New Mexico State University 1986	Botany/Chemistry
M.S.	New Mexico State University 1988	Computational Ecology/Experimental Statistics

ACADEMIC AND PROFESSIONAL APPOINTMENTS

July 2007 – Present: **University of New Mexico**. Title: **Research Associate Professor**, Position**: Chief Information Officer**. Responsible for LTER cyberinfrastructure, including development implementation and maintenance of computing and communication infrastructure; improving LTER information management practice; development of LTER Network information system and coordinating and planning cyberinfrastructure development activities with LTER network partners and environmental observatories. Acts as Executive Director in his absence.

November 1997 – June 2007: **University of New Mexico**. Title: **Research Assistant Professor**, Position**: Associate Director for Information Management**. Responsible for computing and communication infrastructure, coordination and planning development of LTER Network information system and coordinating the information system development activities with LTER network partners.

February 1997-October 1997**: Photon Research Associates, Inc.** Title**: Staff Scientist,** Position**: Senior Systems Engineer.** Responsible for setting direction, policies, and guidelines for all aspects communication and information technology for a company of 100+ with a budget of 1,000.000 + / year. Including, collaborating with 5 divisions management, users, and system administrators to insure timely implementation and maintenance of specified enterprise and desktop solutions.

January 1989 – February 1997: **University of New Mexico**. Title: **Analyst/Programmer II**, Position: **Director of Sevilleta Information Management System** - Responsible for: the design, implementation and administration of the research information management computer system for the Sevilleta Long-Term Ecological Research (LTER) Program - supervising technicians, training project students, technicians, and investigators, and providing liaison with information management groups from the LTER Network and other national and international agencies.

1986 - 1988: **New Mexico State University** - **Computing Research Lab**. Title: GRA Position: **Science Workbench Project**. Worked with programmers and scientists in the development of research data management and analysis tools.

PUBLICATIONS

(i) 5 PUBLICATIONS MOST RELEVANT TO THIS PROPOSAL

Brunt, James W. and William K Michener (In Press, 2008). **The Resource Discovery Initiative for Field Stations: Enhancing Data Management at North American Biological Field Stations.** BioScience.

Brunt, James W. and Mark S. Servilla. (submitted). **Defining and Assessing Data Quality in Online Ecological Information Systems.** Ecological Informatics.

Brunt, James W., Peter McCartney, Karen Baker, and Susan G. Stafford. 2002. **The Future Of Ecoinformatics In Long Term Ecological Research**. In Proceedings of 2002 Systemics, Cybernetics, and Informatics Symposium. July 14-18, 2002 Orlando, Florida.

Michener, William K. and James W. Brunt. 2000. **Ecological Data**: **Design, Management, and Processing.** Blackwell Scientific, Ltd., London. 180 pages

Michener, William K., James W. Brunt, John Helly, Thomas B. Kirchner, and Susan G. Stafford. 1997. **Non-GeoSpatial Metadata for the Ecological Sciences**. Ecological Applications. 7(1):330-342.

(ii) 5 OTHER SIGNIFICANT PUBLICATIONS

Cushing, Judith, Vanderbilt, Kristin, Brunt, James, Jones, Matt, Gupta, Amarnath, McCartney, Peter. 2005. **NSF Long Term Ecological Research Sites: Praxis et Theoria – LTER Information Management and CS Research.** In, Proceedings of the 17th International Conference on Scientific and Statistical Database Management, pp 303-307, Jim Frew (Editor). 17th International Conference on Scientific and Statistical Database Management. University of California, Santa Barbara, June 2005.

Baker, Karen S., James W Brunt, and David Blankman. 2002. **Organizational Informatics: Site Description for a Research Network.** In Proceedings of 2002 Systemics, Cybernetics, and Informatics Symposium. July 14-18, 2002 Orlando, Florida

Brunt, J. W., and R. Nottrott. 1996. **The LTER Network Information System for the 21st Century**. Eco-Informa '96, Lake Buena Vista, Florida, 4-7 November 1996. 10:104.

Michener, W. K., J. W. Brunt, and S. G. Stafford (Eds.). 1994. **Environmental Information Management and Analysis: Ecosystem to Global Scales.** Taylor & Francis, London. 555 pages.

Brunt, James W. 1994. **Research Data Management in Ecology: A Practical Approach for Long-term Projects**. Pages 272-275 in Proceedings of the Seventh International Working Conference on Scientific and Statistical Databases. IEEE Computer Society Press.

SYNERGISTIC ACTIVITIES

1. James has focused his professional life on facilitating and advancing ecological science through the use of information technology. His activities range from sponsoring workshops, software development projects, and standards development projects, to the production of training materials, and the establishment of a community-of-practice in ecological informatics.
2. James has actively worked to broaden the inclusion of underrepresented groups in ecological science. As a PI on an NSF funded UMEB – Undergraduate Minorities in Environmental Biology – project he introduced students to the exciting field of informatics and gave them experience that they could use in furthering their scientific careers. He now actively recruits staff from underrepresented groups to the LTER Network Office.
3. James is a champion of quality in all aspects his work but particularly in data quality and the maintenance of scientific integrity. James works within the community to develop solutions to data quality and scientific integrity issues particularly in the areas of quality assessment, metadata, and data provenance for new data-intensive technologies.

COLLABORATORS AND OTHER AFFILIATIONS

i) Collaborators: James Beach (U of Kansas), Chad Berkley (NCEAS at UCSB), Shawn Bowers (UC-Davis), Susan Gauch (U Kansas), Daniel Higgins (NCEAS at UCSB), Matthew B. Jones (NCEAS at UCSB), Jessie Kennedy (U of Edinburgh), Serguei Krivov (U of Vermont), Bertram Ludaescher (UC-Davis), Joshua Madin (NCEAS at UCSB), A.T. Peterson (U of Kansas), Arcot Rajasekar (SDSC at UCSD), Mark Schildhauer (NCEAS at UCSB), David Stockwell (SDSC at UCSD), Jing Tao (NCEAS at UCSB), Dave Vieglais (U of Kansas), Ferdinando Villa (U of Vermont), Richard Williams (UCSB)

ii) Thesis Advisors: Walt Conley, retired, Bill Boecklin, NMSU, Don Doerner, NMSU

John R. Vande Castle
University of New Mexico, Department of Biology - Long Term Ecological Research - Network Office
Albuquerque, NM 87131-1001
Phone 505 277 2643 / 269-6957 Fax: 505 277 2541 Email: jvc@lternet.edu

Professional Preparation:

University of Wisconsin	Biological Aspects of Conservation	BS.	1976
University of Wisconsin	Zoology	MS.	1979
University of Wisconsin	Aquatic Biology, Computer Science	Ph.D.	1985
University of Wisconsin	Aquatic Applications of GIS & Remote Sensing	Post-Doc.	1985-1986
University of Wisconsin	GIS, and Remote Sensing	Post-Doc.	1986-1989

Appointments:

1997 – Present Research Associate Professor, Department of Biology, University of New Mexico, Associate Director, Center for Rapid Environmental Assessment and Terrain Evaluation, and Associate Director, Long-Term Ecological Research Network-Network Office

1997 – 2002 Affiliate Research Associate Professor, College of Forest Resources, University of Washington

1990 – 1997 Research Assistant Professor, College of Forest Resources, University of Washington and Network Manager, Long-Term Ecological Research Network

1986 – 1989 Assistant Scientist, Research Associate, and Lecturer, Environmental Remote Sensing Center, University WI-Madison

1986 Professional Staff, Project Associate and Research Associate and Research Scientist, Great Lakes Water Institute, University WI-Milwaukee

1982 – 1985 Professional Staff, Project Associate and Research Associate and Research Scientist, Great Lakes Water Institute, University WI-Milwaukee

1980 – 1982 Research Associate, National Water Research Institute, West Vancouver, BC.

1976 – 1979 Professional Staff, Project Associate and Research Associate and Research Scientist, Great Lakes Water Institute, University WI-Milwaukee

Publications:

(i) Publications Most Relevant to Proposal

Pregenzer, A, R. Parmenter, H. Passell, J. Vande Castle, K. Budge, G. Bonito 2005. Sustainability in Arid Grasslands: New Technology Applications for Management In: Biodiversity in Drylands: Toward a Unified Framework. Shachak, M., J. Gosz, S Picket and A. Perovolotsky eds. Oxford University Press

Vande Castle, J.R. 2003. Vegetation Change Observations of Long-Term Ecological Research Sites Using Remote Sensing Data. Proceedings - 30th Symposium of the International Society on Remote Sensing of the Environment: TS-42.4

Yates T.L., J.N. Mills, C.A. Parmenter, T.G. Ksiazek, R.R. Parmenter, J. Vande Castle, C.H.Calisher, S.T.Nichol, K.D. Abbott, J.C. Young, M.L.Morrison, B.J.Beaty, J.L.Dunnum, R.J.Baker, J. Salazar-Bravo and C.J. Peters. 2002 – Ecology and Evolutionary History of and Emergent Disease: Hantavirus Pulmonary Syndrome. Bioscience 52:11;989,998

Pennington, D., Fountain, T., Wang, G. and Vande Castle, J., 2002, Spatio-temporal Data Mining of Remotely Sensed Imagery for Ecology, Proceedings of GIScience 2002, Second International Conference on Geographic Information Science, September 25-28, 2002, Boulder, Colorado.

Riera, J, J. Magnuson, J.Vande Castle and M.MacKenzie 1998. Analysis of Large-Scale Spatial Heterogeneity in Vegetation Indices among North American Landscapes. Ecosystems 1:268-282

(ii) Five Other Significant Publications

Vande Castle, Pennington, Fountain and Pancake. 2002. A Spatial Data Workbench for Data Mining, Analyses, and Synthesis, Proceedings, SCI2002 ISBN:980-07-8150-1(420-424)

Vande Castle, J.R 1999 Remote sensing applications in ecosystem analysis. In: Scale Issues in Ecology. 13:271-288. D. Peterson and V.T. Parker Eds. Columbia University Press.

Chopping, M., T. Schmugge, A. Rango, J. Ritchie, B. Kustas, and J. Vande Castle 2001. The impact of the structure and composition of shrub-coppice dune landscapes on MASTER reflectance anisotropy IAHS Proceedings on Remote Sensing and Hydrology 2000, Owe, M, K. Brubaker, J. Ritchie & Albert Rango, Editors. IAHS Publication #267, ISBN 1-901502-46-5

Holben B.N., D.Tanre, A.Smirnov, T.Eck, I.Slutsker, A.Setzer, B.Markham, J.Vande Castle, D.Ward,

Y.Kaufman, T.Nakajima, and N.T.O'Neill, 2001. Aerosol climatology measured from the globally distributed ground-based AERONET system, Proceedings: Fifth Scientific Conference of the International Global Atmospheric Chemistry, Seattle, Washington, USA, August 19-25, 1998.

Vande Castle, J. R. and E.F. Vermote, 1996. Operational Remote Sensing Data for Comparative Ecological Research: Applications of Atmospheric Correction Using Automated Sunphotometers. Proceedings of Eco-Informa '96: Global Networks for Environmental Information pp. 791-796

Synergistic Activities:

- Part of “Core” LTER Cyberinfrastructure Planning team and coordinator for the LTER Cyberinfrastructure supplemental planning grant
- Member, LTER Network Information System Advisory Committee
- Development of the Long Term Ecological Research Network "Technology" Web pages to disseminate information and data access related to historical, current and planned LTER activities related to technological issues, data access and information management (http://www.lternet.edu/technology)
- With collaborators at UNM, OSU, and UC-San Diego/SDSC, co-developed the "LTER Spatial Data Workbench", for access, analysis and synthesis of geospatial datasets, including hyperspectral remote sensing data
- Lecturer for GIS, remote sensing and wireless networking for NSF funded SEEK and OBSF/RDI training courses

Current Collaborators and Other Affiliations (COI):

Collaborators and Co-Editors
Robert Waide (U. of New Mexico)
William Michener (U. of New Mexico)
James Gosz (U. of New Mexico)
James Brunt (U. of New Mexico)
Louis Scuderi (U. of New Mexico)
Robert Parmenter (U. of New Mexico)
Deanna Pennington (U. of New Mexico)
Timothy Thomas (U. of New Mexico)
Mark Chopping (Montclair State U.)
Tony Fountain (U. of California)
Brent Holben (NASA-Goddard)
Eric Vermote (NASA-Goddard)
Jerry Franklin (U. of Washington)
David Peterson (U. of Washington)
Thomas Parker (U. of Washington)
John Porter (U. of Virginia)
Joan Riera (U. of Wisconsin)
Mark MacKenzie (Aurburn U.)
Graduate Advisors and Postdoctoral Sponsors
Arthur Brooks (U. of Wisconsin)
Tony Remson (U. of Wisconsin)
Thomas Lillesand (U. of Wisconsin)
John Magnuson (U. of Wisconsin)
Thesis Advisor and Postgraduate-Scholar Sponsor
Richard Lathrop (Rutgers U.)
Randolph Wynne (Virginia Tech)
Paul Bolstad (U. of Minnesota)
Mathew Clark (U. of California)
Howard Passel (U. of New Mexico)
Martha Innis (U. of New Mexico)

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	0.00	0.00	0.00	**0**	
3. **John Vande Castle - Senior Personnel**	0.00	7.20	0.00	**68,202**	
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	7.20	0.00	**68,202**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**4**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	42.00	0.00	0.00	**183,328**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**3**) UNDERGRADUATE STUDENTS				**33,030**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**2**) OTHER				**65,338**	
TOTAL SALARIES AND WAGES (A + B)				**349,898**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**135,355**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**485,253**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
Media recorders and server $ **60,000**					
TOTAL EQUIPMENT				**60,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**44,880**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **322,633**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**293**) TOTAL PARTICIPANT COSTS				**322,633**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**126,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**6,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**132,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,045,366**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
50% MTDC (Rate: 50.0000, Base: 662733)					
TOTAL INDIRECT COSTS (F&A)				**331,367**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**1,376,733**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **1,376,733**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Brenda Baker

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	0.00	0.00	0.00	**0**	
3. **John Vande Castle - Senior Personnel**	0.00	7.20	0.00	**69,876**	
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	7.20	0.00	**69,876**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**4**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	42.00	0.00	0.00	**188,229**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**3**) UNDERGRADUATE STUDENTS				**33,030**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**2**) OTHER				**66,929**	
TOTAL SALARIES AND WAGES (A + B)				**358,064**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**146,822**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**504,886**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
server replacements $ **15,000**					
TOTAL EQUIPMENT				**15,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**44,880**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **338,425**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**307**) TOTAL PARTICIPANT COSTS				**338,425**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**81,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**4,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**85,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**988,791**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
50% MTDC (Rate: 50.0000, Base: 635366)					
TOTAL INDIRECT COSTS (F&A)				**317,683**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**1,306,474**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **1,306,474**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Brenda Baker

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 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 3

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PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	0.00	0.00	0.00	**0**	
3. **John Vande Castle - Senior Personnel**	0.00	7.20	0.00	**71,600**	
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	7.20	0.00	**71,600**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	54.00	0.00	0.00	**236,877**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**3**) UNDERGRADUATE STUDENTS				**33,030**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**2**) OTHER				**68,568**	
TOTAL SALARIES AND WAGES (A + B)				**410,075**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**171,563**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**581,638**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**44,880**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **244,622**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**222**) TOTAL PARTICIPANT COSTS				**244,622**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**91,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**0**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**91,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**962,740**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (Rate: 50.0000, Base: 718118)**					
TOTAL INDIRECT COSTS (F&A)				**359,059**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**1,321,799**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **1,321,799**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Brenda Baker

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Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 4

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	0.00	0.00	0.00	**0**	
3. **John Vande Castle - Senior Personnel**	0.00	7.20	0.00	**73,376**	
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	7.20	0.00	**73,376**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	54.00	0.00	0.00	**242,694**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**3**) UNDERGRADUATE STUDENTS				**33,030**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**2**) OTHER				**70,256**	
TOTAL SALARIES AND WAGES (A + B)				**419,356**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**175,788**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**595,144**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**44,880**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **251,669**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**228**) TOTAL PARTICIPANT COSTS				**251,669**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**106,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**2,320**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**108,920**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,000,613**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (Rate: 50.0000, Base: 748944)**					
TOTAL INDIRECT COSTS (F&A)				**374,472**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**1,375,085**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **1,375,085**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Brenda Baker

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

YEAR 5

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	0.00	0.00	0.00	**0**	
3. **John Vande Castle - Senior Personnel**	0.00	7.20	0.00	**75,205**	
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	7.20	0.00	**75,205**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**5**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	51.00	0.00	0.00	**231,396**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**3**) UNDERGRADUATE STUDENTS				**33,030**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**2**) OTHER				**71,995**	
TOTAL SALARIES AND WAGES (A + B)				**411,626**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**168,257**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**579,883**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **server replacements** $ **15,000**					
TOTAL EQUIPMENT				**15,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**44,880**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **246,406**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**224**) TOTAL PARTICIPANT COSTS				**246,406**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**101,600**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**4,000**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**105,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**991,769**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (Rate: 50.0000, Base: 730363)**					
TOTAL INDIRECT COSTS (F&A)				**365,182**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**1,356,951**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **1,356,951**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Brenda Baker

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Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of New Mexico**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Robert B Waide**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	0.00	0.00	0.00	**0**	
3. **John Vande Castle - Senior Personnel**	0.00	36.00	0.00	**358,259**	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	0.00	36.00	0.00	**358,259**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**23**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	243.00	0.00	0.00	**1,082,524**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**15**) UNDERGRADUATE STUDENTS				**165,150**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**10**) OTHER				**343,086**	
TOTAL SALARIES AND WAGES (A + B)				**1,949,019**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**797,785**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**2,746,804**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) $ **90,000**					
TOTAL EQUIPMENT				**90,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**224,400**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **1,403,755**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**1,274**) TOTAL PARTICIPANT COSTS				**1,403,755**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**508,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**16,320**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**0**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**524,320**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**4,989,279**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**1,747,763**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**6,737,042**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **6,737,042**	$

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Robert B Waide**

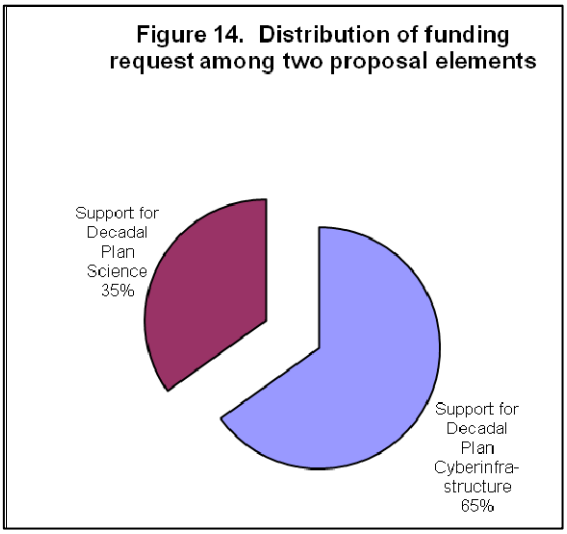
ORG. REP. NAME*: **Brenda Baker**

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

C ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

8.0 Budget Description and Justification

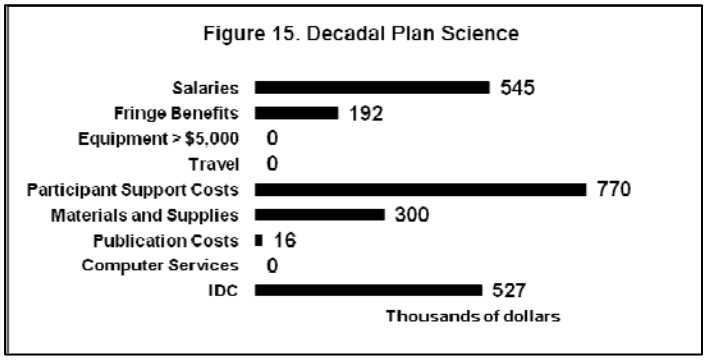
The LTER Network Office (LNO) requests funds to develop the infrastructure needed to advance the research and education goals of the Network as stated in The Decadal Plan for LTER. The proposed five-year budget of $**6,737,042** includes funds to support science goals of the Decadal Plan and to implement preliminary objectives of the LTER Cyberinfrastructure Strategic Plan. The LNO, in consultation with the Executive Board and other LTER committees, identified 10 distinct activities that address these goals and objectives. The body of this proposal links each activity with anticipated outcomes and needed resources using a logic model approach. The budget explanation specifies resources needed for each activity, thus providing a clear link between requested funds, resulting activities, and eventual outcomes. ***Figure 14*** shows the cost of the two major categories of activities as a share of the total budget.



This request emphasizes development of the human resources needed to conduct activities to advance Network science and education goals. Thus, LNO staff salaries, fringe benefits, and associated indirect costs constitute the majority of the requested budget. ***Table 2*** shows how salaried staff effort will be allocated to each proposed activity. Funds for five new staff positions (Programmer/Analyst NIS, Systems Analyst, Information Manager, two Professional Interns) are part of the request for support of the LTER Cyberinfrastructure plan. Funds for the Director for Synthesis Support (0.60 FTE), Public Information Officer (1.0 FTE), and Applications Support Analyst (0.50 FTE) will allow retention of those existing positions. In addition, funds for three new student positions will provide opportunities for workforce training for 9-12 students over the course of the Cooperative Agreement (CA).

8.1 Science and Education in the Decadal Plan

As a result of concerted effort over the last three years, the LTER Network now has a strategic science, education, and cyberinfrastructure plan (The Decadal Plan for LTER). In addition to establishing a series of science, education, and cyberinfrastructure goals, the Decadal Plan provides a blueprint for funding to achieve these goals. The strategy to obtain needed funding is broad-based, incorporating submission of new proposals to existing programs at NSF and other agencies, targeted use of supplement requests, redirection of existing resources, and the development of new, large-scale research initiatives. Part of this strategy involves the expansion of resources at the LNO to facilitate realization of the new research and education goals outlined in the Decadal Plan. The LNO, as requested by the LTER EB, incorporates funds for these activities (totaling **$2,350,146**; ***Figure 15***) in the proposed budget. New funds requested to address new scientific and education goals directly respond to recommendations made in the report from the mid-term review of the LNO.



8.1.1 New Science and Education Goals. Synthesizing new and existing data (**Sections 3.1.1** and **3.1.2**) will require scientific working groups to pursue research questions stemming from the Decadal Plan

and research themes arising from interactions among LTER scientists. The previous CA provided $50,000 per year for these working groups. The LNO used most of these funds to encourage collaborations emerging from triennial All Scientists Meetings (ASM). However, LNO surveys of LTER sites identified a need for additional funds for research working groups; therefore, the LNO proposes to increase the amount available annually to **$117,694**, which will support 12-15 working groups per year. These working groups will plan and coordinate cross-site and network-wide synthesis efforts, standards development, development of value-added data sets, and interactions with other agency efforts. The LTER EB will allocate funds to working groups based on proposals submitted through the LNO.

Surveys also identified the importance of support for short-term, focused efforts by LTER scientists to complete synthesis studies arising from cross-site collaboration. Discussions with LTER scientists indicate that one or two months of salary would significantly enhance the pace of LTER synthesis. The LNO requests **$60,000** annually to support two such research efforts per year. Because each transaction will be small, the request appears under Materials and Supplies rather than as Sub-awards, in accordance with NSF Grants and Contracts guidelines.

The new governance plan for the LTER Network increases the size of the Science Council (**Section 3.1.1**) to 60 members. To support the annual meeting of the Science Council requires an additional **$188,817** total in Participant Support Costs.

Specifying experiments and measurements that can achieve the new science and education goals (**Section 3.1.3**) will require additional planning meetings. The LTER EB estimates an annual cost of **$85,234** to conduct three meetings of all 26 sites plus outside collaborators. The proposed budget includes this amount in Years 1 and 2. By Year 2 of the new CA, NSF's response to the plan will determine subsequent steps.

8.1.2 Facilitation of Network Synthesis. The Director for Synthesis Support (DSS) works with the Science Council (SC), the EB, and LTER sites and scientists to facilitate synthesis activities such as annual meetings of the SC (**Section 3.1.1**), triennial ASM, research working groups sponsored by the LNO (**Section 3.1.2**), and LTER planning meetings(**Section 3.1.3**). The DSS helps to determine the goals and products of each meeting and to identify the support necessary to achieve stated goals. Working with the LNO Office Manager, the DSS establishes benchmarks and timelines for organizing each meeting. The DSS works with the EB to determine priorities for disbursement of LNO support for research working groups, coordinate requests for proposals for these working groups, summarize evaluations of these proposals, and accumulate reports and other products from each working group. He works with the SC to plan and document science theme meetings and meetings to implement the Decadal Plan. When required, the DSS prepares supplement proposals for funding to support ASM, planning meetings, and research working groups. At the request of the EB, the DSS, in conjunction with collaborating partners such as NASA and the USGS, organizes and carries out Network-level acquisition and management of remotely-sensed data and provides access to these data via the Internet (**Section 3.3.1)**. He provides expertise to document and guide acquisition of new technology and cyberinfrastructure for the LNO and LTER sites, participates in preparing reports on LNO activities, and serves on the NISAC. The DSS will supervise three work study students in support of synthesis activities. This proposal includes 0.60 FTE in salary and fringe benefits for the DSS; the remaining salary for this position will be drawn from other sources.

8.1.3 Communication and Outreach. The LNO provides a variety of outlets for information to scientists, educators, students, policy makers, and the general public, including print, video and audio, and web-based sources. A Public Information Officer (1.0 FTE) plans and implements strategies for disseminating information about the LTER Network through public information products and tools. The Public Information Officer is responsible for public and media relations, produces LTER brochures and newsletters, and provides content for the LTER web sites. Support for this position concludes in 2010; this proposal requests funds to retain the position.

Travel – We request travel funds for 1) communication of the results of LTER research to the scientific community , 2) outreach from the LNO to LTER sites, and 3) discussions with NSF program officers about the activities described in this proposal. Specifically:

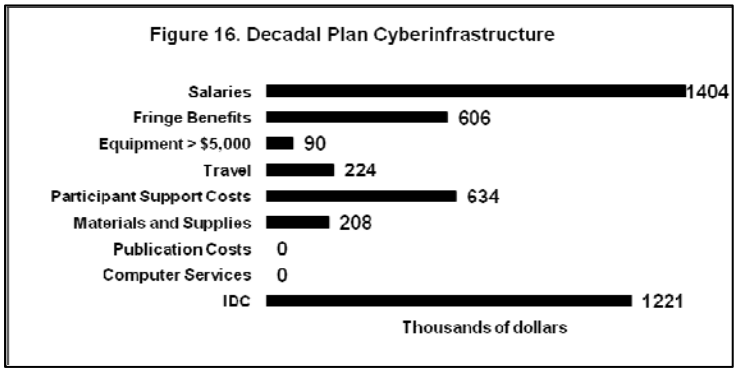
- One-two professional meetings (ESA, AAAS) a year for community outreach (Executive Director, Public Information Officer, Applications Support Analyst, Director for Synthesis Support) – 37 trips @ $1100 = **$40,700**
- One meeting for dissemination of scientific results (Executive Director, Chief Information Officer, Director for Development and Outreach, Director for Synthesis Support, Sr. Program Manager) – 25 trips @ $1100 = **$27,500**;
- Visits to four LTER sites per year to assess needs, discuss site priorities, and arrange technical assistance (Executive Director) – 20 trips @ $1100 = **$22,000**;
- Two trips per year to Arlington, VA for the Executive Director, and one trip per year each for the Director for Synthesis Studies and the Chief Information Officer. 20 trips X $1100 = **$22,000**;

Materials and Supplies – We request a total of **$16,320** for print materials in connection with LNO Communication and Outreach

8.2 Cyberinfrastructure in the Decadal Plan

The Decadal Plan includes a Strategic Plan for Cyberinfrastructure for the LTER Network, which defines cyberinfrastructure needs for sites and the Network to carry out the new science and education agenda. In preparing this proposal, the LNO asked the LTER EB and IMC to identify specific cyberinfrastructure needs for inclusion. The following budget recommendations (totaling **$4,386,896**; ***Figure 16***) emerged from these discussions.

8.2.1 Salaries and Fringe Benefits. New cyberinfrastructure goals described in the Strategic Plan require additional technical support staff at sites and at the LNO. Support staff at the LNO will provide expertise and effort needed to complete the NIS, manage increasing numbers of Network databases, and expand training for LTER scientists and data managers. Progress in these key areas will strengthen the ability of the LTER Network to advance ongoing discussions on common cyberinfrastructure needs in ecological observing networks. The proposed budget for Cyberinfrastructure includes funds for five new positions, which are:



- A junior Programmer/Analyst (1.0 FTE) will be recruited to support the development of the Network Information System (**Section 3.2.3**). This person will work with the existing senior Programmer/Analyst to accelerate the development of the NIS. The specific functions of this position are to develop software solutions to link site databases and applications to the NIS and to develop tools to better allow sites to implement Ecological Metadata Language. Creating this position is a high priority for completing the NIS. Moreover, the IM Committee has identified the need for additional programming support to advance and complete site level activities supporting the NIS. To address this need, the LNO requests funds to hire a Professional Intern (1.0 FTE) to provide additional capability for software programming in support of the NIS.
- A Systems Analyst (1.0 FTE) will support VTC, rich media capture and management, and desktop computing and manage the LNO training laboratory (**Sections 3.2.1 and 3.4.1**). UNM provided space for this state-of-the-art laboratory, and the SEEK project and LNO staff equipped the laboratory. The lab houses the site-based and distance training activities for LTER, and is an important resource for future LTER activities arising from the Decadal Plan. NSF support for this position will ensure the continued operation of the training lab and the training activities described in this proposal. Without NSF support, the LNO will have to decommission the training lab.

- The proposed budget requests a new position of Information Manager (1.0 FTE) to address management of existing Network databases and the creation and management of new data modules for the Network Information System. The EB strongly recommended adding capability in information management (**Sections 3.2.2**) to improve the utility of Network databases for future synthesis. In making this recommendation, the EB expected that managing, updating, and disseminating the > 22,000 LTER EcoTrends data sets would be part of the Network Information System responsibilities.
- A second Professional Intern (1.0 FTE) will support the existing Application Support Analyst, who provides expertise in and support for web-based applications and designs, develops, and maintains LTER Network web sites including the public site (http://www.lternet.edu), the Intranet (http://intranet.lternet.edu), and the LNO site (http://lno.lternet.edu), and who assists and consults with sites as needed. The new position will assume much of the routine work presently carried out by the Applications Support Analyst (e.g., updating content, maintaining mailing lists, checking for broken links), allowing that person to focus more time on critical web applications that support the NIS.

In addition to the staff positions described above, the proposed budget includes funds for three undergraduate work-study students a year. Undergraduate students will support science and cyberinfrastructure activities through a wide range of technical and non-technical duties. These duties will prepare the students to join the workforce once they graduate. Based on normal turnover of these positions, we expect the requested funds to benefit 9-12 undergraduates during the course of the CA. In addition, the Professional Intern positions described above are designed specifically for persons who have completed their undergraduate degrees and require additional experience before joining the workforce. We anticipate that the two requested Professional Intern positions will benefit 8-10 individuals over the course of the CA.

8.2.2 Equipment. The LNO requests funds for the initial purchase of fixed and traveling rich media recorders and a server to capture, archive, and stream scientific and educational presentations over the web ($60,000; **Section 3.2.1**). The cost of server upgrades in years 2 and 5 (**Section 3.2.1**) will be $30,000.

8.2.3 Travel. To address the goals of the CI Strategic Plan, LNO staff need travel funds to attend meetings and to assist site information management.

- Attend one meeting of NISAC per year (**Section 3.2.3**; CIO, DDO, DSS, Executive Director, Network Developer, Information Manager) — 30 trips @$1100 = **$33,000**;
- Visit each LTER site twice to assess needs, discuss site priorities, and provide technical assistance (**Section 3.2.4**; CIO and Senior Application Support Analyst or Information Manager) — 48 trips @ $1100 = **$52,800**;
- Two-three LNO staff members attend IM production meetings each year (**Section 3.2.2**; 24 trips @ $1100 = **$26,400**).

8.2.4 Participant Support. Site information managers require travel support for production and training meetings.

- The IMC requests funds for two production meetings each year to address specific technical aspects of LTER information management. The expectation for each meeting will be the resolution of a pressing IM issue (**Section 3.2.2**; 95 trips @$1100 = **$104,500** total for five years).
- Training (**Section 3.4.1**) is an important activity requiring increased LNO support. The LNO expects that as a result of the goals of the Decadal Plan, information managers and scientists will need training in the latest scientific and cyberinfrastructure technologies. Therefore, the LNO requests funds for two training activities per year ($51,600 per year including travel for 36 people and stipends for the trainers X 5 years = **$258,000** total).

- The LNO requests funds for two trips per year for short working visits by site information managers to the LNO or other sites (**Section 3.2.2**; 10 trips @ $1320 = **$13,200** total for five years).
- The LNO requests funds for one meeting of the NISAC per year (**Section 3.2.3**) – 55 trips @ $1100 = **$60,500**.
- The LNO will support an additional meeting of the Information Management Executive Committee every third year, in coordination with the All Scientists Meeting. 18 trips @ $1100 = **$19,800**.

8.2.5 Materials and Supplies. The LNO requests compensation to sites for time spent by information managers on Network activities and periodic replacement of computers in the LNO training lab.

- The IMC requests support for short (one month) working visits by information managers to other sites or to the LNO. Two visits per year will target information technology solutions to specific data management problems related to participation in Network synthesis activities. The proposed budget requests travel funds and compensation for time that information managers spend on these projects. Compensation is particularly important to make participation in Network projects more feasible by providing sites the means to replace the information managers' time dedicated to these projects (**Section 3.2.2**; **$90,000** total).
- The LNO will refresh 24 training lab computers in Year 1 and Year 4. Note: the LNO is replacing only CPU's, not monitors. (**Section 3.2.1**; **$50,000** total)
- Annual training exercise will require copies of instructional materials (**Section 3.4.1**; **$18,000** total).

8.3 Cost Share

Without charge, UNM provides space for the LNO in the newly-constructed CERIA building. The space consists of offices for LNO employees and associated projects (eight single or double offices, a reception area with three desks, a large space with 11 cubicles, climate-controlled server room, and the state-of-the-art LTER Training Laboratory). Located on the main campus of UNM, the LNO is near the Department of Biology, the Student Union, the campus bookstore, and UNM administration.

8.4 Facilities and Administrative Costs

Facilities and Administrative Costs are calculated at 50% Modified Total Direct Costs as specified in the UNM agreement with Health and Human Services dated April 14, 2005. Fringe benefits on salaries for the positions described above are UNM estimates of future costs. Fringe benefits on undergraduate stipends are 1%. Salaries after Year 1 show a projected 3% annual increase.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Robert Waide	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: A Proposal for the Network Office of the US Long Term Ecological Network

Source of Support: National Science Foundation
Total Award Amount: $ 8,100,000 Total Award Period Covered: 03/01/03 - 02/28/10
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 10.50 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long-Term Ecological Research in the Luquillo Experimental Forest IV

Source of Support: National Science Foundation
Total Award Amount: $ 4,920,000 Total Award Period Covered: 12/01/06 - 11/30/12
Location of Project: University of Puerto Rico
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Science on Demand - An M-Learning System Exploring the Rio Grande

Source of Support: National Science Foundation
Total Award Amount: $ 74,947 Total Award Period Covered: 01/01/00 - 01/01/00
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.50 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long Term Ecological Research Network Office FY 09-15

Source of Support: National Science Foundation
Total Award Amount: $ 8,925,000 Total Award Period Covered: 03/01/09 - 02/28/15
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 7.87 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Science and Cyberinfrastructure in Support of the LTER Decadal Plan

Source of Support: National Science Foundation
Total Award Amount: $ 6,737,042 Total Award Period Covered: 07/01/09 - 06/30/14
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 2.63 Acad: 0.00 Summ: 0.00

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: James Brunt	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Long Term Ecological Research Network Office 09-15

Source of Support: National Science Foundation
Total Award Amount: $ 8,925,000 Total Award Period Covered: 03/01/09 - 02/28/15
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 12.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Science and Cyberinfrastructure in Support of the LTER Decadal Plan

Source of Support: National Science Foundation
Total Award Amount: $ 6,737,042 Total Award Period Covered: 07/01/09 - 06/30/14
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: John Vande Castle	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: A Proposal for the Network Office of the US Long Term Ecological Research Network

Source of Support: National Science Foundation
Total Award Amount: $ 8,100,000 Total Award Period Covered: 03/01/03 - 02/28/10
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 9.00 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Environmental Public Health Tracking Implementation FY 08-09 Project

Source of Support: New Mexico Department of Health
Total Award Amount: $ 31,650 Total Award Period Covered: 07/01/08 - 06/30/09
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 3.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long Term Ecological Research Network Office 09-15

Source of Support: National Science Foundation
Total Award Amount: $ 8,925,000 Total Award Period Covered: 03/01/09 - 02/28/15
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 4.50 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Science and Cyberinfrastructure in Support of the LTER Decadal Plan

Source of Support: National Science Foundation
Total Award Amount: $ 6,737,042 Total Award Period Covered: 07/01/09 - 06/30/14
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 4.50 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

LTER Network Office - University of New Mexico

Facilities to Support Staff, Conferencing, and Working Groups

The Long Term Ecological Research Network Office (LNO) occupies a 2,700 square-foot suite comprising seven offices, an 8 person technical workspace, and two 40-person conference rooms in the CERIA building on the main campus of University of New Mexico. This space is ideally positioned to support the activities and research proposed. For collaborative technology, the LNO supports a Polycom MGC50+ IP video conferencing bridge that can support video conferences up to 48 persons. In addition, there are Polycom units that can be easily relocated.

The LNO maintains a dedicated a modern information technology training laboratory that compliments the above facilities. This training laboratory is optimized for student-to-instructor communication, while remaining ergonomically comfortable for long periods of instruction. The center piece of this laboratory is a fire-wall protected, 24-student pod facility with the Dell duo-core Pentium desktop computers for each student, including dual 20 inch flat-screen monitors that can be shared through the instructor's computer and multimedia/video system. In addition, this facility can support code development and data analysis projects.

Computing Facilities to Support Research

The LTER Network Office hosts computer facilities for the LTER Network Information System Infrastructure; the backbone of which is the Network Office Data Center. This climate-controlled center has scalable servers and enhanced network bandwidth to better serve the LTER Network and its partners in the ecological community. 12 Dell Quad-Core PowerEdge servers with over 12 Terabytes of disk storage, redundant power supplies and UPS) serve as the core communication, collaboration, and data processing, storage, and delivery components of the LTERnet.edu domain. In addition, there are modern multi-processor development and test machines. The combination of Linux and Windows operating systems on the Intel platform allows for maximum flexibility in incorporating new developments and technology. The Center standardizes on both PostgresSQL and MySQL relational database management systems, although Microsoft SQL Server is available for special purposes. In addition, the Center has a number of large format color output devices and a variety of scanning data input devices.

The UNM campus is wired with a 10 Gigabit redundant fiber backbone for optimal intra-campus networking needs. The CERIA building, which houses the LNO, have both fiber and copper Gigabit ethernet networking capability. Research activities at UNM enjoy OC-3 fiber connection to the Internet II via Denver that is connected directly to national Gigabit backbone infrastructures. In addition, the UNM is a full member of the National LambdaRail consortium. National LambdaRail (NLR) is a major initiative of U.S. research universities and private sector technology companies to provide a national scale infrastructure for research and experimentation in networking technologies and applications.

List of acronyms used in this proposal

AAAS – American Association for the Advancement of Science
ASM - All Scientists Meetings
AVIRIS - Airborne Visible/Infrared Imaging Spectrometer
CI – Cyberinfrastructure
ClimDB - network climate database
CUAHSI - Consortium of Universities for the Advancement of Hydrologic Science
DAS – Distributed Access Server
DOD – Department of Defense
EB – LTER Executive Board
EML – Ecological Metadata Language
ESA - Ecological Society of America
FS – Forest Service
FTE – full-time equivalent
GBIF - Global Biodiversity Information Facility
HydroDB - network hydrological database
ILTER – International Long Term Ecological Research
IM – information management
IMC - Information Management Committee
IMEXEC - Information Management Executive Committee
IndoFLUX – India Flux Network
ISO – International Standards Organization
IT - information technology
LIDAR - Light Detection and Ranging
LNO – LTER Network Office
LTER – Long Term Ecological Research
MODIS - Moderate Resolution Imaging Spectroradiometer
NAB - National Advisory Board
NASA – National Aeronautics and Space Administration
NBII - National Biological Information Infrastructure
NCAR – National Center for Atmospheric Research
NCEAS – National Center for Ecological Analysis and Synthesis
NCSA – National Center for Supercomputing Applications
NEON – National Ecological Observatory Network
NESCent - National Evolutionary Synthesis Center
NIS – Network Information System
NISAC – LTER Network Information System Advisory Committee
NOAA – National Oceanographic and Atmospheric Administration
NSF – National Science Foundation
OBFS – Organization of Biological Field Stations
OOI – Ocean Observatories Initiative
ORNL – Oak Ridge National Lab
PASTA – Provenance Aware Synthesis Tracking Architecture
PBI - Partnership for Biodiversity Informatics
RCN – Research Coordination Network
RFC - request-for-comment
SACNAS - Society for Advancement of Chicanos and Native Americans in Science
SC – LTER Science Council
SDSC – San Diego Supercomputer Center
SEEK - Science Environment for Ecological Knowledge
SOA - Service Oriented Architecture
UNM - University of New Mexico
USDA – U.S. Department of Agriculture
USGS – U.S. Geological Survey
WATERS - Water and Environmental Research Systems Network

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