U.S. Department of the Interior

Annual Report on Technology Transfer

FY 2013 Activities

January 2014

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I. Introduction

Technology transfer for the Department of the Interior (Department) includes a range of activities designed to disseminate scientific and technical information and knowledge between the Department and other Federal and non-Federal entities. It includes but is not limited to publications, exchange of scientific and technical information, protecting and licensing intellectual property rights, and sharing — or otherwise making available — for scientific or technical purposes the expertise and specialized scientific material and resources which the Department manages. In general, technology transfer activities within the Department are consistent with its mission to protect and manage the Nation's natural resources and cultural heritage; to make available scientific and other information about those resources; to honor trust responsibilities to Tribes; and to supply energy for the future.

This report describes the actions the Department took in FY 2013 to advance technology transfer. These range from developing techniques to diagnose avian botulism and potential next-generation technologies for water desalination to tracking hydrocarbon plumes in seawater to testing novel products to protect critical water infrastructure from invasive mussels. It also describes progress on meeting the objectives of the Department's Technology Transfer Plan, submitted to the Office of Management and Budget, to advance its technology transfer activities. These activities demonstrate the innovation, expertise and dedication of the Department's employees, including its many scientists and engineers.

II. Advancing Technology Transfer in the Department of the Interior

The FY 2013 enacted budget for the Department of the Interior included $789.0 million for research and development. Much of the funding was for applied research ($629.8 million), while basic research and development received $51.4 million and $107.8 million, respectively. The programs supported through these funds generate large amounts of knowledge, information, and technology, which help the Department meet its mission objectives and are transferred to resource managers, stakeholders, and the general public.

The Department's bureaus have varying levels of involvement with scientific and technical research and innovation, and technology transfer. In FY 2013, as in previous years, the majority of technology transfer activities being reported by the Department under the Federal Technology Transfer Act of 1986 (FTTA) was undertaken by the U.S. Geological Survey (USGS). It is the largest research and development (R&D) organization within the Department, both in terms of budget and personnel, and typically accounts for about 80% of the Department's R&D budget.

The Department's scientists, engineers and other technical personnel advance the state of knowledge related to the Department's resources, and ensure that this information is accessible to resource managers, private industry, and the general public. The vast majority of the Department's technology transfer activities use traditional technology transfer mechanisms such as publications of peer reviewed papers and reports, webpage postings, and presentations at meetings and conferences. In 2013, USGS and U.S. Fish and Wildlife Service (FWS) personnel, for example, authored or co-authored over 2,200 reports, books, fact sheets, and other

publications, including over 1,400 scientific journal articles. Bureaus also use other conventional approaches to share scientific and technical resources and expertise with each other, universities and other entities to address resource management issues. For example, several are active participants in the network of Cooperative Ecosystem Studies Units (CESUs), a collaboration among 13 Federal agencies (including six DOI bureaus) and over 300 non-Federal partners (including universities, Tribes and tribal organizations, State agencies, museums, aquariums, arboretums, and conservation organizations) organized into 17 CESUs, each hosted by a university.

Bureaus that are active in research and development, or have research capabilities that complement U.S. commercial interests, may also utilize technology transfer agreements authorized by the FTTA to join forces with non-Federal partners. Such agreements allow the Department's bureaus and private sector industries to pool their expertise and resources to jointly create and advance technologies that could help fulfill agency missions while helping U.S. industries innovate and commercialize technologies that can strengthen our national economy and create jobs. This report focuses primarily on the aspects of technology transfer related to the FTTA.

FY 2013 Accomplishments

In FY 2013, the Department continued to build on actions initiated in FY 2011, to institutionalize technology transfer programs within the Department and to enable all bureaus to more effectively and efficiently implement the FTTA and related legislation while maintaining focus on their missions. In addition to publishing over 2,200 reports, books, fact sheets, and other publications, the Department's scientific, technical and engineering personnel engaged in a broad range of cooperative activities to develop and disseminate innovative technologies, including:

- Collaborating on 476 Cooperative Research & Development Agreements (CRADAs), of which 376 were new that fiscal year. In addition, the Department was engaged in at least 322 other collaborative R&D relationships.

- Disclosure of nine new inventions. In addition, eight patents were filed and four patents were received.

- Managing 16 licenses for inventions and other intellectual property earning over $59,000.

- Drafting a new Departmental Manual chapter that will establish policy and procedures for implementing and administering technology transfer agreements.

- Developing a technology transfer website to provide information on relevant bureau programs and activities, as well as opportunities for other agencies, and private and non-profit institutions to cooperate with The Department's scientists, engineers and technical personnel.

Departmental Plan on Technology Transfer

In response to a Presidential Memorandum, the Department submitted a plan in 2012 that committed to a set of actions that would advance technology transfer activities within the Department. The following summarizes these commitments, and the progress toward fulfilling them:

- Developing a Departmental Manual chapter specifying general policies for implementing technology transfer (TT) activities authorized by the FTTA, and related legislation. The Departmental Working Group on Technology Transfer (DWGTT) has developed the relevant DM chapter. It is currently in the Department's clearance process.

- Revising the current DM chapter on patents and inventions which dates to the 1980s. Work on this is proceeding.

- Developing a unified website to improve public access to information related to inventions owned by the various bureaus, and other technology transfer activities. The DWGTT has developed the technology transfer web site. Its home page can be accessed at http://www.doi.gov/techtransfer/.

- Developing an online repository of documents and legal templates detailing best practices for TT agreements and activities from across the government and other organizations. The DWGTT has developed a repository that can be accessed via the DOI technology transfer home page.

- Submitting annually to OMB consolidated reports on technology transfer activities and achievements, including analysis of trends in these activities (due every January). Over the past two years, the Department has implemented a process for developing and submitting an annual report to OMB on its technology transfer activities. The current report is the third consecutive one produced using this process. Past reports can be accessed at http://www.doi.gov/techtransfer/annual-reports.cfm.

- Developing materials to train bureau R&D personnel in technology transfer activities, including training on relevant ethics and legal issues (target: September 30, 2013). Links to a variety of training resources related to technology transfer are available via the technology transfer home page. These links will be supplemented by additional resources as they become available. The Department's Ethics Office is developing materials specific to technology transfer for DOI employees in 2014.

III. Overview of Technology Transfer Activities

Table 1 indicates that The Department's bureaus use, or are contemplating using, a diverse range of mechanisms to transfer information, knowledge and technology within and outside their agencies.

Table 1: Principal Technology Transfer Mechanisms Identified by Each Bureau

	USGS	FWS	OSM	NPS	BSEE	Reclam-ation	BOEM	BLM
Technical/Scientific Publications	X	X	X	X	X	X	X	X
Workshops/Seminars	X	X	X	X	X	X	X	X
Educational Courses & Other Outreach		X	X		X	X	X	X
Cooperative Research and Development Agreements (CRADAs)	X	X		X		X		
Technical Assistance Agreements (TAAs)	X					X		
Facility Use/Service Agreements (FUSAs)	X					X		
Material Transfer Agreements	X			X		X		
Demonstration/Joint Projects					X	X		X
Patents	X	X		X		X		
Licenses	X	X		X		X		
Other Cooperative Ventures & Agreement Types		X	X	X	X	X		
Web and other mechanisms	X	X	X	X	X	X	X	X

IV. Technology Transfer Agreements

Table 2 provides a summary of new and active technology transfer agreements undertaken within the Department in FY 2013. There were a total of 476 active CRADAs in FY 2013, of which 376 were newly executed. In addition there were 322 other collaborative R&D arrangements with various parties, including 137 that were new in FY 2013.

Table 2: Collaborative Relationships for Research & Development (FY 2013)

	USGS	FWS	BSEE	Reclam-ation	Total
● **CRADAs**, total active in the FY[(1)]	464	4	0	8	476
- New, executed in the FY	376	0	0	0	376
▪ Traditional CRADAs,[(2)] total active in the FY	14	4	0	3	21
- New, executed in the FY	2	0	0	0	2
▪ Non-traditional CRADAs,[(3)] total active in FY	450	0	0	5	455
- New, executed in the FY	374	0	0	4	378
● **Other collaborative R&D relationships**[4]					
▪ (Collaborative Agreements), total active in the FY	314	n/a	8	0	322
- New, executed in the FY	130	n/a	7	0	137

CRADA = Cooperative Research and Development Agreement
(1) "Active" = legally in force at any time during the FY. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).
(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partner.
(3) CRADAs used for special purposes -- such as, material transfer or technical assistance that may result in protected information. For USGS, Technical Assistance Agreements (TAA) and Facility Use/Service Agreement (FUSA) fit this category.
(4) Based on available data.

Table 3 summarizes invention and patenting activity within the Department during FY 2013 broken out by bureau. This activity was limited to USGS and Reclamation. The table indicates that nine new inventions were disclosed, eight new patent applications were filed and four new patents were issued. The corresponding numbers for FY 2012 were ten inventions, three applications, and three patents issued.

Table 3: Invention Disclosure and Patenting (FY 2013)

	USGS	NPS	Reclam-ation	Total
● New inventions disclosed in the FY[(1)]	6	1	2	9
● Patent applications filed in the FY[(2)]	7	0	1	8
● Patents issued in the FY	4	0	0	4

(1) Inventions arising at the bureau.
(2) Tally includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and Patent Cooperation Treaty (PCT) applications.

Table 4 provides a summary of the number of active licenses managed by The Department bureaus.

Table 4: Active and Income Bearing Licenses in FY 2013

	USGS	FWS	Reclam-ation	Total
● **All licenses**, number, total active in the FY	14	1	5	20
▫ New, executed in the FY	3	0	0	3
● **Income bearing licenses**	13	0	3	16

Additional data are contained in the Data Appendix to this report. These show that total income in FY 2013 from all licenses amounted to over $59,000 (from 16 income bearing licenses).

Table 5 provides a summary of the scope and nature of technology transfer activities and mechanisms that the various bureaus implement currently or might implement in the future.

Table 5: Scope of Activities and Plans Related to the FTTA, by Bureau

Mission	Technology Transfer
United States Geological Survey (USGS). The mission of the USGS is to serve the Nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life.	The USGS serves the Nation as an independent fact-finding agency that collects, monitors and analyzes scientific and technical information to provide scientific understanding about natural resource conditions, issues, and problems. The USGS makes this information and knowledge readily available to decision makers and the public. Thus, one of the USGS's main thrusts is broad and open dissemination of its knowledge and information. USGS also pursues technology transfer opportunities under the FTTA and the Stevenson-Wydler Act in a variety of ways (see Table 1).
U.S. Fish & Wildlife Service (FWS). The mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people.	FWS's Research and Development (R&D) is primarily focused on providing the basis for effective conservation in order to meet its mission. The agency's primary research nexus with the private sector centers on the Fisheries Program. FWS Fish Technology Centers were established in 1965 to develop and improve fish culture technology and to provide assistance to Federal and State agencies, Tribes and other nations interested in aquaculture research and solutions. Today there are seven such centers working with industry and government to improve aquaculture opportunities.
Office of Surface Mining Reclamation and Enforcement (OSM). OSM helps States develop and implement their own approved surface coal mining programs.	OSM advances it mission by providing technical assistance based on sound science, and training to its State and tribal partners to enhance their ability to maintain effective programs. Although OSM has no formal research and development activities, its Technology Development and Transfer program promotes and disseminates information on techno-logical innovations to better protect the environment during mining and in reclaiming and restoring active and abandoned mines. The program also provides training to ensure that States, Tribes, and OSM's other partners continue to administer their surface mining programs efficiently and effectively.
National Park Service (NPS). The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of current and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout	Consistent with the Final Benefits-Sharing Environmental Impact Statement (2009) and the Record of Decision (2010), the National Park Service drafted benefits-sharing policy and procedures that were reviewed service-wide in 2012. Public policy review and final NPS review occurred in 2013. The final policy addressing benefits-sharing and technology

Table 5: Scope of Activities and Plans Related to the FTTA, by Bureau

Mission	Technology Transfer
this country and the world.	transfer was issued in FY 2014 (on 12/19/2013).
Bureau of Safety and Environmental Enforcement (BSEE). The BSEE works to promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement.	The BSEE R&D program operates through the Emerging Technologies Branch (ETB) and the Oil Spill Response Research (OSRR) Programs. BSEE research is associated with operational safety, pollution prevention, and oil spill cleanup technology.
Bureau of Reclamation (Reclamation). The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.	Reclamation has the lead Federal responsibility for water management and hydropower in the 17 western States. Its research program is highly applied towards development of solutions that benefit its operations and infrastructure reliability. The research programs use technology transfer fundamentals to help speed field deployment of new innovations.
Bureau of Ocean Energy Management (BOEM). The Bureau of Ocean Energy Management manages the exploration and development of the nation's offshore resources. It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.	BOEM's Environmental Studies Program (ESP) develops, conducts and oversees scientific research specifically to inform policy decisions regarding development of Outer Continental Shelf (OCS) energy and mineral resources. Research covers physical oceanography, atmospheric sciences, biology, protected species, social sciences and economics, submerged cultural resources and environmental fates and effects.
Bureau of Land Management (BLM). The BLM mission is to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future generations. The Federal Land Policy and Management Act of 1976 (FLPMA) mandates that the BLM manage public land resources for a variety of uses, such as energy development, livestock grazing, recreation, and timber harvesting, while protecting natural, cultural, and historical resources.	BLM's science and technical focus has been on place-based applications to improve the management of public lands in accordance with FLPMA's multiple use mandate. In addition to its traditional technological transfer activities, BLM is exploring additional technology transfer opportunities under 15 U.S.C. 3710 and U.S.C. 205 and 207 that could be employed to help advance its multiple-use mandate and which can be used in the landscape approach as the BLM transitions to ecoregional-area land management.

Subsequent sections briefly describe each bureau's technology transfer program and a sample of their activities in FY 2013. The tabular data requested by OMB Circular A-11 are reported in the Data Appendix, to the extent data are available.

V. U.S. Geological Survey

The United States Geological Survey (USGS) is a scientific bureau within the Department of the Interior whose mission is to serve the Nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life. Under its science strategy outlined in "Facing Tomorrow's Challenges—U.S. Geological Survey Science in the Decade 2007-2017," USGS focuses on the following interdisciplinary mission areas: Ecosystems; Climate and Land Use Change; Energy, Minerals, and Environmental Health; Natural Hazards; Water Resources; Core Science Systems; Administration and Enterprise Information; and Facilities. These mission areas combine expertise from several Earth Science disciplines (e.g. hydrology, geochemistry, biology) working together to address relevant issues of concern to people and other living things on the planet. Organization around these mission areas allows the USGS to better address the needs of customers and partners.

Since delivery of science information is a primary purpose of the bureau, technology transfer activities with the public sector and the private sector, including academia and non-profits, typically support the collection and transference of scientific data (knowledge dissemination). In 2013 USGS personnel, for example, authored or co-authored over 1,900 reports, books, fact sheets, and other publications, including over 1,000 scientific journal articles. The USGS also cooperates with its public and private collaborators to help them maintain necessary services, better understand the environmental consequences of their commercial and non-commercial activities, and develop new products and services. The USGS has 35 major laboratories and several hundred field offices located around the country.

Within the USGS, technology transfer that extends beyond traditional publications, meetings and conferences and is related to the Stevenson-Wydler Innovation Act and the FTTA is managed through the Office of Policy and Analysis where staff service USGS Science Centers and offices throughout the country. In 2013, the USGS continued negotiating and drafting CRADAs, Technical Assistance Agreements, Facility Use Agreements, Material Transfer Agreements, and Patent Licenses. This office also manages the USGS intellectual property and inventions program; markets USGS technology opportunities and assistance to industry, non-profits, academic institutions, and State agencies; and provides training to USGS personnel on technology transfer and intellectual property protection. At the end of 2013, the USGS had a total of 14 active licenses. During 2013, USGS filed seven patent applications, and received four patents.

USGS science and research contributes to a broad range of valuable collaborative projects in the private and academic sector. Since the implementation of its facility use program in 2003, the USGS has increased to 28 the number of specialty analytical laboratory services providing unique capabilities to U.S., foreign partners and academia. At least 212 user agreements were executed during 2013.

Following are examples of current USGS technology transfer activities.

Assessing the Effects of Seismic Experiments on Marine Wildlife. The USGS Earthquake Hazards Program, under the auspices of the National Earthquake Hazards Reduction Program, undertakes a broad range of applied earthquake hazards research, data compilation and archiving, and distribution of earthquake information products and services. The Pacific Gas and Electric Company (PG&E), a publicly owned utility providing service within California, is engaged in a long-term, multi-faceted, action-based seismic risk management program to reduce the impact of future earthquakes on the performance of their gas and electric systems, and to maintain acceptable levels of customer service. To further their programs, PG&E and the USGS have been involved in a series of CRADAs since 1992. The PG&E CRADA, which complements the USGS Earthquake Hazards Program, is carried out using the capabilities of five USGS Science Centers (Earthquake; Geology, Minerals, Energy and Geophysics; Pacific Coastal and Marine; California Water; and Geologic Hazards).

Tagged sea otters were captured, bio-sampled, and equipped with implanted radio tags to locate each animal daily by triangulation using high frequency telemetry. Colored flipper tags were used for visual identification of each animal using high-powered telescopes. Data collected include precise GPS coordinates, habitat use, reproductive success (presence of pup), behavior, social interactions, diet (recorded during feeding bouts), and movements.

The current PG&E CRADA is scheduled to run through 2014. PG&E seeks (1) the development and rapid application of data, methods, and technologies that improve earthquake hazard assessments in the regions where its electric power and natural gas facilities, service centers, and office buildings are located and where its customers live and work; and (2) the improvement of emergency response to earthquake occurrence by incorporating real-time earthquake hazard information.

A spin-off from this CRADA is a study led by a team of wildlife biologists from the USGS Western Ecological Research Center to improve our understanding of the ecological impact of high energy seismic studies, including their impacts on sea otter population. Sea otters are a federally-listed threatened species that also serve as crucial indicators of the health of nearshore

waters and coastal resources, from kelp forests to fisheries. Results from this study will help managers in shaping recovery strategies for sea otters, and for enhancing ecological services provided by nearshore healthy ecosystems.

Initiated in FY 2012, the objectives of this 3-year study are 1) to investigate the general ecology and stressors/health threats affecting southern sea otters (*Enhydra lutris nereis*) in the central coast region, and 2) to determine the effects of high energy seismic experiments offshore on this population. The study involves collaboration between USGS, California Department of Fish and Wildlife, the Monterey Bay Aquarium, and veterinarians and scientists from a number of universities. The team of biologists, veterinarians, technicians, interns and volunteers have captured, tagged and collected tissue samples for health analyses from over 50 sea otters in the region, and then monitored these animals in the wild on a daily basis using radio telemetry and direct observation. Gene expression analysis is used to assess exposure to various stressors, and advanced bio-logging devices provide detailed information on dive behavior and metabolic rates. Data from thousands of observations of tagged animals are used to provide baseline data on the demography, behavior, diet, habitat use and movements of sea otters in the vicinity of Diablo Canyon Power Plant, for use in "before/during/after" comparison studies that would be conducted in the event of any future seismic testing/research activity.

Diagnosing Avian Botulism. Avian botulism, a paralytic disease caused by the toxins produced by the naturally occurring bacterium, *Clostridium botulinum*, in their food supply can kill thousands of birds each year. This bacterium produces seven distinct neurotoxins (called botulinum neurotoxins, or BoNTs), each designated by the letters A through G. These toxins are among the deadliest substances known to man.

The USGS through its National Wildlife Health Center Diagnostic Microbiology Laboratory, with support from the Great Lakes Restoration Initiative, has had a Cooperative Research and Development Agreement with BioSentinel, Inc., to develop a rapid method of detecting BoNT-type E which causes mortality in fish-eating birds. The current standard method for detecting BoNTs is to test them using live mice. This assay method, in addition to raising ethical concerns, is too labor intensive and time consuming to be of utility for analyzing the large number of samples required to conduct meaningful ecological studies.

The assay method developed under the CRADA, BoTest™ Matrix E, uses a fluorescence-based bioassay to detect BoNT type E activity in avian blood and other sample types. This method, which does not involve killing mice, is faster, cheaper and has been shown to be as sensitive as the live mouse bioassay. This new assay will be used to advance both the understanding of environmental factors that contribute to outbreaks of avian botulism, and ongoing research to develop strategies to mitigate its impacts. This method may also have applications for human health since Type E botulism can occur in humans following consumption of improperly prepared fish.

Understanding Greater Sage-Grouse Ecology for Population and Habitat Management in the Great Basin. The Greater Sage-Grouse (*Centrocercus urophasianus*), which inhabits the sagebrush-steppe ecosystem of the Great Basin, is a candidate species for Federal listing. It is at the intersection of public land-use planning, rangeland industries, mineral extraction, and renewable energy development. Scientists from the Western Ecological Research Center (WERC) of USGS are conducting a multi-year sage-grouse research program at several field study sites within the western U.S. The research program involves collaboration between multiple partners including the Bureau of Land Management (BLM), FWS, Nevada Department of Wildlife, California Department of Fish and Game, and numerous industries. The research is designed to improve understanding of sage-grouse ecology and factors affecting their demography. It would help land managers make decisions regarding habitat selection, space use dynamics and other conservation actions affecting sage-grouse populations. The research includes satellite and ground-based telemetry, monitoring and observations not only of sage-grouse but the sagebrush ecosystem as well as extensive vegetation surveys.

VI. U.S. Fish and Wildlife Service

The FWS is dedicated to the conservation, protection, and enhancement of fish, wildlife and plants, and their habitats. It is the only Federal agency whose primary responsibility is management of fish and wildlife resources for the American public. The agency manages the 96 million acre National Wildlife Refuge System, which receives over 40 million visitors each year who participate in hunting, fishing, wildlife observation and photography, environmental education and interpretation, and other outdoor recreation activities. The FWS also operates 70

National Fish Hatcheries which, in conjunction with Fish Health Centers and Fish Technology Centers, restore and help recover native aquatic populations, mitigate for fisheries lost as a result of Federal water projects, and support recreational fisheries throughout the United States.

FWS's R&D is primarily focused on providing the basis for effective conservation in order to meet its mission of working with others to conserve, protect and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. The majority of FWS's technology advancements are transferred through free public dissemination. FWS employees are actively involved in the larger scientific community, including participating in scientific societies, attending and presenting at meetings and conferences, and generating and publishing original research.

Rainbow trout: One of several native North American species that FWS does research on to advance science-based management concepts, strategies and technologies.

The FWS manages two online peer reviewed publications focused on the practical application and integration of applied science to wildlife conservation and management—the Journal of Fish and Wildlife Management and the North American Fauna monograph series. These journals are in the public domain and are completely electronic. In addition, the FWS continues to support and encourage its scientists to also publish in other peer reviewed journals. In FY 2013, FWS personnel published over 350 articles in peer reviewed science journals, many of which are available online via open access journals. The FWS National Digital Library, run by the National Conservation Training Center (NCTC), is a searchable collection of selected documents, images, historical artifacts, audio clips, publications, and video, most of which are in the public domain. The Service also makes internal publications, reports, and information available to the public through the FWS website which includes links the public can use to access specific publications. The NCTC Conservation Library also makes many collections of current and legacy publications available free to the public from its server and linked from the library catalog and websites.

The agency's primary research nexus with the private sector centers on the Fisheries Program and the science network consisting of nine Fish Health Centers, six Fish Technology Centers, the Conservation Genetics Laboratory, and the Aquatic Animal Drug Approval Program. These centers provide assistance and support to its conservation partners which include Federal, State, tribal, and non-government organizations covering a broad range of disciplines including biostatistics, population ecology, genetics, nutrition, and internationally recognized research on fish diseases and pathogens of fish and other aquatic organisms.

The transfer of FWS's technology and knowledge to the public and collaborators accelerates the adoption and use of agency research while improving the returns to society from its R&D investments and helping solve natural resource related problems. For example, FWS works

closely with the aquaculture feed industry in developing sustainable feed options utilizing plant-based ingredients and in refining understanding of species' nutritional needs while minimizing waste. FWS also uses its research to help inform a wide range of wildlife management decisions in the interest of the general public. For instance, the National Wildlife Refuge Inventory and Monitoring Program regularly monitors a range of biological data about the status, trends and responses to management of species and habitats within the Refuge System, in order to inform and improve management of natural resources.

Within the FWS, the technology transfer function is shared between individual FWS programs and the Office of the Science Advisor, the Division of Policy and Directives Management (PDM) (for patent questions), and the Office of the Solicitor. The vast majority of FWS's technology transfer is done via public dissemination through traditional avenues such as peer reviewed papers, reports and fact sheets but it also occasionally applies for and obtains patents when necessary. Such patents include one for calcein detection devices developed at the Northeast Fishery Center in Lamar, PA, to non-lethally mark and detect hatchery-reared Atlantic salmon for up to three years of age post-marking. Western Chemical of Ferndale, WA, was granted an exclusive license for the invention for a period of eight years. Other inventions include a rocker for refrigerated storage or transport of fish sperm, a fistula device to gather eggs from inside a fish, and a method for agglomerating fine powders for larval aquatic feed. The FWS is currently in the process of evaluating a report of invention.

The FWS Aquatic Animal Drug Approval Program, under the Fisheries and Aquatic Resource Conservation program, currently has four CRADAs in place. These agreements — with Merck Animal Health, Summit, NJ; Aquatic Life Sciences, Ferndale, WA; Frontier Scientific, Logan, UT; and PennField Animal Health, Omaha, NE — permit the parties to identify research opportunities that support development of new aquatic animal drugs, broaden the U.S. technology base, and support accomplishment of FWS scientific mission objectives. New aquatic animal drug approvals are critically needed to maintain the health and fitness of aquatic species and to provide similar benefit to both public and private sector aquaculture programs. For example, the CRADA with PennField Animal Health has been instrumental in the development of collaborative research activities generating the data necessary to support the approval of Pennox 343 as an immersion treatment to control mortality caused by bacterial pathogens in freshwater fish. If approved, Pennox 343 would be the first immersion antibiotic treatment available for use in aquatic species.

The FWS supports and operates several R&D facilities where its scientists can cooperate with non-FWS entities, as described below.

Fish Technology Centers. Fish Technology Centers (FTCs) were established in 1965 to develop and improve fish culture technology and provide assistance and advice on fish culture to National Fish Hatcheries, other Federal and State agencies, Tribes, other Nations, and the aquaculture industry. Today, FTCs conduct an array of research that advances the scientific basis for conservation actions and improves technology used as part of restoration and recovery activities. Results of studies are published in peer-review journals and management recommendations are communicated within the FWS and through conservation science partnerships.

In recent nutritional studies, FTC scientists made advances in understanding and improving the components of fish feed. These studies provide information that benefits both public and private aquaculture. For example, a study evaluating ethanol yeast as an alternative protein source for rainbow trout led to increased understanding of the amino acid needs of trout and an improved ability to produce cost effective feeds while maintaining fish growth, health and product quality. Similarly, scientists examined whether healthy steelhead can be grown using diets that contain low levels of phosphorus and vegetable oil, thereby avoiding excess phosphorus in hatchery effluent waters.

Fish Health Centers: The FWS's Fish Health Centers help integrate applied science and technical transfer. Their scientists are leaders both nationally and internationally in the diagnosis of wildlife diseases and in the science of aquatic animal health, developing and validating tests that benefit, and are adopted by, the aquaculture industry. Fish Health Centers work closely with Federal, State, tribal, academic, and other non-governmental organizations and commercial partners in efforts to further the management and science of fisheries and aquaculture in general, and wildlife pathogens in particular.

Fish Passage and Screening Laboratories: These laboratories support research into areas such as open-channel flume and swim tunnels and artificial streams, where researchers can simulate varied stream conditions for addressing a wide variety of questions on fish ecology, behavior, and life-history requirements relative to selected environmental factors.

Nutrition and Diet Development Laboratories: These facilities allow for the manufacturing of experimental larval, fingerling, and broodstock fish feeds and the testing of many different kinds of ingredients to improve fish performance and quality. This program also develops specialized diets for use in captive rearing of endangered fish species like woundfin, razorback sucker, June sucker and Rio-Grande silvery minnow. Recent work includes development of plant-based fish feeds to reduce reliance on ocean forage fish for fish feed protein. This type of research into fish diets supported innovations now used around the world, including the dry, long-lasting feeds that have revolutionized the fish-rearing industry.

Conservation Genetics Laboratories: These laboratories support related conservation and management needs to the FWS and its partners, including, but not limited to: 1) use of genetic DNA methods to meet real-time fishery needs to conserve and manage species; 2) assisting with Endangered Species Act status reviews and recovery planning via genetic monitoring and evaluation of listed populations and species; 3) establishing and maintaining genetic tissue/DNA repositories for imperiled species; and 4) characterizing diversity within and among wild populations.

Conservation Physiology and Ecology Laboratories: These laboratories focus on understanding the physiological requirements and tolerances of threatened and endangered species. Less-invasive or non-invasive tools, such as measurement of plasma sex steroid and ultrasound, are used to assess sex and stage of maturity and spawning readiness in both wild and captive populations of threatened and endangered species. Contract services available include blood chemistry, histology, proximate analysis, and radioimmunoassays.

Aquatic Invasive Species: The FWS Aquatic Invasive Species program works to prevent introductions of potentially harmful species and to develop early detection and rapid response capabilities. For example, through the Great Lakes Restoration Initiative (GLRI), an interagency effort involving several bureaus (including BIA, FWS, NPS and USGS) and other departments, the FWS is partnering with the University of Notre Dame to develop a surveillance program for invasive species at risk of invading the Great Lakes. This technology uses suspended DNA in the aquatic environment (environmental DNA or eDNA) using methods developed in collaboration with USGS and Army Corps of Engineers, to confirm the presence of organisms such as Asian carp in low numbers that might be "invisible" to traditional sampling methods. This new and innovative technology should be expected to significantly benefit both FWS programs and partners by allowing earlier detections of invasive species.

VII. Office of Surface Mining Reclamation and Enforcement

One of the purposes of the Surface Mining Control and R3eclamation Act of 1977 (SMCRA) is to help States develop and implement their own approved surface coal mining programs. The Office of Surface Mining Reclamation and Enforcement (OSM) achieves this in part by providing technical assistance based on sound science, and training to its State and tribal partners to enhance their ability to maintain effective programs.

Although OSM has no formal research and development activities, the Technology Development and Transfer program promotes and disseminates information on technological innovations to better protect the environment during mining and in reclaiming and restoring active and abandoned mines. The program also provides training to ensure that States, Tribes, and the bureau's other partners continue to administer their surface mining programs efficiently and effectively.

The principles that underlie OSM's Technology Development and Transfer program include: (a) increasing the technical knowledge of the reclamation of active and abandoned coal mines; (b) developing and enhancing working relationships among the bureau's partners in Federal, State, and tribal governments, and in industry and academia; and (c) leveraging its resources through partnerships.

OSM accomplishes these principles via three programs:

- Technical Innovation and Professional Services program
- Technical Training programs
- Technology Transfer program

Technical Innovation and Professional Services (TIPS). The goal of TIPS is to provide State, Tribal, and OSM personnel with a comprehensive set of analytical tools to aid in technical decision-making related to regulatory and reclamation processes. The services provided are centered on off-the-shelf scientific and engineering computer hardware and software. This technical assistance has grown from a few software applications available on a single specially-designed shared workstation, to a suite of software on each user's desktop computer.

TIPS is a national program that continues to research emerging technologies and their application to SMCRA. A fundamental premise of TIPS is that it enables every official responsible for the implementation and enforcement of SMCRA to use the same technological tools, thereby promoting consistent enforcement of SMCRA nationwide. This also means that personnel enforcing SMCRA can easily exchange data with one another, and since the tools that TIPS provides are predominantly the same as those used by coal mining companies and reclamation contractors, data is easily exchanged between mining and SMCRA officials.

The following examples are representative of the numerous OSM activities that took place under the TIPS program in FY 2013.

Appalachian Pilot Project Geographic Information System (GeoMine): During FY12-13 OSM partnered with the SMCRA regulatory programs in Kentucky, Tennessee, Virginia and West Virginia; and Federal agencies involved in SMCRA, Clean Water Act (CWA) and Endangered Species Act (ESA) regulation and consultation (EPA, FWS and the Army Corps of Engineers) to develop the GeoMine interactive digital map of coal mining and reclamation activities. This GeoMine Pilot Project has demonstrated the feasibility and value of sharing this mapping data between the partner agencies through the Internet. A final report of the Pilot Project findings and recommendation was reviewed and approved by all Federal, State and tribal agency executives, and published in December 2013. The report recommended that GeoMine be deployed nationwide to the SMCRA, CWA and ESA communities and the public.

Remote Sensing Pilot Project: OSM Remote Sensing Specialists in the TIPS program have been working since 2009 on a pilot project to, "determine the best satellite image data, products, and services that will support effective and efficient SMCRA solutions for the regulatory program." The project explored the processes and requirements involved in acquiring image data, products and services from the National Geospatial-Intelligence Agency (NGA) Office of Commercial Partnerships through the USGS. The President's Commercial Remote Sensing Space Policy (CRSSP), signed in 2003 and supported through President Obama's 2010 National Space Policy, tasked the NGA with sharing satellite imagery with Federal agencies. In 2009, OSM also entered into an official partnership with the NGA through the USGS to assist the goals of this pilot project. OSM is working with the Civil Applications Committee (CAC), for which USGS is the co-chair, to obtain satellite imagery.

The OSM Remote Sensing Pilot Project Final Report is to be released in early 2014, with a finding that satellite imagery is extremely useful for SMCRA applications and may be used for virtual inspections of mines, identification of key features for ground inspection, or to locate abandoned mines. The project also revealed that there is a significant cost savings associated with using remote sensing imagery for virtual inspections.

OSM will continue to work with the NGA to further improve products and services for the use of satellite imagery in SMCRA applications. In the interim, TIPS has established an annual imagery purchase process to provide images for mines where OSM is the regulatory authority and will assist States on a case-by-case basis.

University Partnerships - Minority Higher Education Program: OSM works to build mutually beneficial partnerships with minority serving colleges and universities under the OSM Minority Higher Education Program (MHEP). OSM provides guidance and direction on these projects to ensure that the intended results are achieved. OSM provided speakers for the Alabama A&M science symposium series during FY 2013 to address the Forestry Reclamation Approach and the protecting of bats at coal mines. OSM also collaborates with its MHEP partners on training and education programs. In addition to traditional training within the SMCRA community, the TIPS program has been involved in a collaborative partnership with MHEP Adams State University (ASU), a Hispanic Serving Institution in Alamosa, CO, since November 2009. This collaboration is expected to continue to advance the technical and scientific training of ASU students.

TIPS offers more than just software and hardware; the program also provides specialized training to use these tools in mining and reclamation. The TIPS Training Program is a collaborative effort among OSM, states, and tribes. Course developers and instructors are reclamation experts who use TIPS software to solve a wide-range of complex permitting, enforcement and abandoned mine land problems. Although most of these tools are off-the-shelf applications, TIPS training is unique in that it is tailored exclusively to mining and reclamation uses. TIPS courses are delivered on-site at the customer's request, and in specialized training centers in OSM's Regional Offices: Denver, Colorado; Alton, Illinois; and Pittsburgh, Pennsylvania. In FY 2013, the TIPS training program received a customer satisfaction rating of 98 percent, exceeding the annual GPRA goal by 5 percent. Seventeen instructor-led classes were held in 2013 with 210 students completing class sessions. Additionally, 118 students attended online training courses sponsored by TIPS, bringing the 2013 total to 328 students. Eight of the 17 training classes were facilitated "on-site" at locations to meet the specific training needs of particular offices or groups of students throughout the SMCRA community.

National Technical Training Program (NTTP). Established in 1985, NTTP is an ongoing training program designed to aid the bureau's mission by increasing the technical competence and professionalism of State, tribal and OSM regulatory and reclamation staff. The NTTP provides comprehensive training in the skills needed to carry out the mandates of SMCRA. The entire program—from identification of training needs through course development and presentation—is a cooperative effort between State, tribal, and OSM offices. Course instructors are subject matter experts in the mining regulatory and reclamation practices and are primarily volunteers from approximately 43 State, tribal, and OSM offices. These partner instructors participate in course instruction, development, and content revisions. NTTP instructors keep abreast of changing technologies, evolving methodologies and policies to ensure the training reflects the best protection and land restoration practices.

In Fiscal Year 2013, NTTP trained 590 students from State, tribal and OSM programs. It offered 31 training sessions covering 29 technical, legal, and programmatic subjects ranging from best practices and technologies to protect society and the environment from the adverse effects of surface and underground mining to methods to restore land use capabilities. The course subjects are, where appropriate, tailored to conditions and characteristics specific to each mining region, and offered in or near those regions. Course subjects include a wide variety of technical areas including design of abandoned mine land restoration, proper inspection tools and techniques,

soils and revegetation, identification and handling of acid/toxic forming materials, water quality assessment, legal aspects of enforcement procedures, and preparation of evidence and testimony.

Overall the program achieved an effectiveness rating of 95 percent, based on student and supervisor responses regarding the value of the training in their current positions.

Technology Transfer Program. OSM's National Technology Transfer Team provides a forum for OSM, State, and tribal SMCRA programs to regularly meet and discuss common issues involved with the daily functions required by administration of SMCRA, allowing partners to collaborate in finding solutions to reclamation issues. This process included the funding of national studies related to reclamation of mined lands, via the **Applied Science Program**. Final reports and fact sheets resulting from these projects may be viewed at: http://www.techtransfer.osmre.gov/NTTMainSite/appliedscience/ASbySubject.shtm. Applied science projects supported studies by universities and other research institutions in the areas of coal mine reclamation, revegetation, blasting, hydrology, coal mine voids and fires, soil productivity, acid mine drainage and other topics relevant to environmentally responsible mining and reclamation. However, OSM was unable to provide funding for solicitations in FY 2013.

VIII. National Park Service

As part of its mission, the National Park Service (NPS) actively manages the natural, cultural and historical resources entrusted to it. This management includes preserving and maintaining these resources and, where necessary, preventing impairment, mitigating adverse impacts, or restoring these resources. The vast majority of these activities are undertaken at the level of each individual park unit, but servicewide networks, programs, and centers make related scientific contributions in areas such as inventory and monitoring, and preservation technology.

Scientific activities within NPS focus on improving the understanding and management of park natural and cultural resources, and in cooperation with partners, preserving and interpreting similar resources outside parks. The information generated by these activities is shared with park managers and stakeholders, including public and private land managers, as well as the broader public, largely through interpretive programs, exhibits, conferences, meetings, training, and standard publication media such as reports, newspapers, journals, magazines, fact sheets, and webpage postings.

In order to expand the range of expertise and tools available to it, NPS participates in many collaborative ventures with universities and other governmental and non-governmental organizations, including the Cooperative Ecosystem Studies Unit Network.

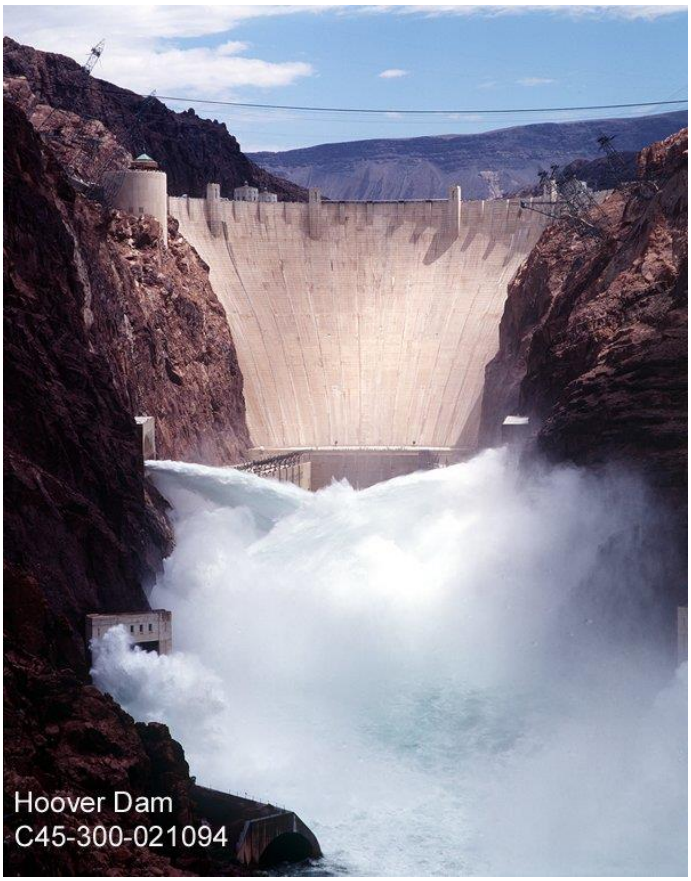
The NPS Cultural Programs include the National Center for Preservation Technology and Training (NCPTT), which was created by Congress to fill a fundamental need for research and technology transfer among Federal, State, and local historic preservation programs. NCPTT serves as a research and development laboratory for historic preservation and advances the application of science and technology to preservation problems. The NCPTT also supports applied research, partners with professional and scientific organizations, publishes technical

guidance for preservation professionals, and trains students and practitioners in the latest preservation techniques.

The NPS also encourages qualified scientists to undertake research on park physical, biological and other resources under the egis of park Scientific Research and Collecting Permits. Such permits are issued for scientific and educational purposes only. The specimens and components of specimens may not be used for commercial or other revenue-generating purposes. Parties proposing commercial use of research results must enter into an agreement to share benefits with NPS or an agreement in which NPS explicitly declines to share benefits. In accordance with the National Parks Omnibus Management Act of 1998, which authorizes the Secretary of the Interior to enter into negotiations with the research community and private industry for equitable, efficient benefits-sharing arrangements, NPS has developed policy and procedures to implement benefits-sharing. For each benefits-sharing agreement, NPS proposes to choose an applicable agreement type from among several available authorities. The CRADA, authorized by the FTTA, is one such option. NPS released the draft benefits-sharing policy for public review in December 2012. The policy was issued on December 19, 2013.

IX. Bureau of Reclamation

The Bureau of Reclamation (Reclamation) is a water management agency whose mission is to help provide water and power to the 17 Western States and numerous Tribes while protecting the environment and the public's investment in the infrastructure it has constructed and operates. It is the largest wholesaler of water in the country. It brings water to 31 million people, and to one out of five Western farmers, who produce 60% of the nation's vegetables and 25% of its fruit and nut crop. Reclamation is the second largest producer of hydroelectric power in the Western United States. Its 53 power plants annually provide more than 40 billion kilowatt hours of electricity, enough to power 6 million homes, generating $1 billion in revenues.


Hoover Dam
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Reclamation R&D – Reclamation's R&D is primarily focused on applications to identify and develop solutions related to the broad spectrum of water and hydropower related issues. Reclamation conducts both programmatic and project-specific R&D.

Programmatic R&D is managed by Reclamation's R&D Office and funded through the Science and Technology Program. Science and Technology Program projects are competitively selected based on the ability to meet priority needs that have broad application across Reclamation and the West. Project-specific research is typically driven by the necessity to improve solutions and processes at a particular Reclamation facility or project, and is done as part of the technical studies and engineering work associated with operating, updating, and maintaining a specific Reclamation facility or project operational responsibility. In either case, expert Reclamation engineers and scientists typically lead or are heavily involved in the effort.

Reclamation Collaborative R&D Activities – Management of water resources is a shared responsibility across Federal, State, and local agencies and the water user organizations. Collectively, these organizations possess a broad range of scientific and technical expertise and managerial perspectives that drive research used to inform decisions, produce solutions to real world problems and increase operational efficiency. Universities and non-governmental organizations also possess cutting edge technical and scientific expertise that can augment Reclamation's R&D activities. Collaborative endeavors are, thus, central to Reclamation R&D activities. Reclamation dedicates significant resources to foster and, where appropriate, lead collaborative R&D endeavors in order to bring together complementary capabilities, leverage resources, and avoid duplication of effort. The majority of these cooperative activities does not involve the need to protect intellectual property or exchange funds between parties, but instead involve cooperation without the need for formal agreements or use of authorities provided by the FTTA. In addition, cooperation involving the exchange of funds or a formal commitment of resources can be achieved via other non-FTTA related formal agreements (e.g., interagency agreements, cooperative agreements, and procurement contracts) authorized by other statutes.

Reclamation Technology Transfer – Although Reclamation's R&D focus is on water issues specific to the arid and variable climates characteristic of the Western U.S., the new solutions, tools, and information developed can have broad applicability regardless of location. The transfer of Reclamation's technology and knowledge across the national and international communities of practice maximizes public benefits of Reclamation's R&D investments.

The majority of Reclamation's technology advancements are transferred through public dissemination, while others require the capabilities and know-how of the private sector to mature, mass produce and otherwise commercialize the technology into market-ready products. Reclamation's research nexus with industry is typically in the area of hydroelectric power generation, water infrastructure, water conservation, and desalination/water purification technologies.

If an industry partner is needed to ultimately transfer the technology into a market-ready product, Reclamation utilizes the authorities available under Federal technology transfer legislation to protect intellectual property, as needed, and from research and licensing partnerships with U.S. manufacturing industries. Reclamation's R&D Office implements these authorities on behalf of Reclamation. It also serves as a surrogate for an Office of Research and Technology Application (ORTA) as required by 15 USC 3710(b). The R&D Office also utilizes a funded interagency agreement with the USDA Agricultural Research Service (ARS) Office of Technology Transfer to have access to the full range of expert skills needed to implement technology transfer

authorities (e.g. experienced technology transfer specialists, patent advisors, license specialists, CRADA specialists) on a project-by-project basis. This arrangement benefits the government since it avoids the need to build similar capabilities within Reclamation or the Department. In FY 2011, Reclamation also began utilizing partnership intermediaries as authorized by 15 USC 3715, to facilitate and broker research partnerships with industry via its interagency agreement with USDA-ARS.

Reclamation also plans to create more awareness across U.S. industries and other non-government organizations about the specialized research resources (people, lands, and facilities) that they can access through technology transfer agreements authorized by 15 USC 3710a. In addition to physical research laboratories, Reclamation's R&D assets include engineering and scientific expertise, and extensive water storage, water delivery and hydropower facilities that offer unsurpassed real-world laboratories for field tests, evaluations, and demonstrations of new technologies and processes related to water and hydropower. Although the majority of Reclamation R&D activities do not involve development of patents or industry involvement to mature technologies into viable products, the technology transfer activities that Reclamation conducts under the authorities of the FTTA are an important subset of its technology transfer responsibilities. Examples of active projects in 2013 authorized under the FTTA are summarized below.

Reclamation's Award-Winning High Impact Research on Advancing Mussel Detection. Mussels can attach to and clog pipes, pumps, trash racks, cooling water systems, fire protection systems and virtually any water related infrastructure surface, thereby reducing the reliability and efficiency of water and hydropower systems while simultaneously increasing maintenance costs. Zebra and quagga mussels have recently invaded the Colorado River and other western water bodies. Detecting and preventing the spread of these mussels is, therefore, critical to Reclamation's primary mission of water and hydropower delivery. To advance the capabilities to monitor water bodies for the presence of mussels, Reclamation has entered into a CRADA with Fluid Imaging Technologies to conduct research for improving automated detection and quantification of invasive mussel larvae (also known as "veliger"). Larvae are 70 to 200 microns in size (about half the size of the period at the end of this paragraph). Detection and monitoring invasive mussel larvae is the cornerstone of an effective strategy to manage these invasive nuisances.

Reclamation has pioneered new methods to aid early detection of quagga and zebra mussels before they become a major nuisance for water infrastructure.

Reclamation has developed a Mussel Detection and Monitoring Program to help better understand the spread of mussels. This program cooperates with States and other partners to come up with proactive measures to provide the earliest detection possible for any new mussel introductions that can reduce the need to remove mussels or interrupt Reclamation's facilities

and structures. Reclamation has entered into a CRADA with a partner who specializes in developing particle analysis instruments using digital imaging technology that could help monitor mussel larvae. Under the CRADA, both parties bring together their joint interests and capabilities to effectively monitor larvae for various water types. Reclamation's contributions include research expertise and know-how from botanists, engineers, and biologists; and the use of Reclamation's field test site and Research Laboratory. The CRADA partner's contributions include the FlowCAM® technology, research resources, and capabilities to improve its technology to better count samples with abundant organisms. The major advantage of the FlowCAM over traditional cross-polarized microscopy is that is has the potential to process samples more systematically than manual methods and provides automated photography of individual particles if additional analysis is necessary.

Under the CRADA, both parties jointly improved the FlowCAM into a specialized *VeligerCAM* to accurately count abundant organisms including mussel larvae, and monitor physical larvae damage. The hardware to the FlowCAM has also been upgraded to include dual cameras which can display images of the same organism in both regular light and cross-polarized light that helps with identifying and accelerating the analysis. So far, research results conducted under the CRADA indicate the images recovered from the *VeligerCAM* are much brighter and sharper when compared to the standard FlowCAM. The *VeligerCAM* reports more accurate high number larvae counts than cross polarized microscopy and current testing indicates that accuracy remains above 95% recovery. *VeligerCAM* photos are also used as a tool for evaluating the effectiveness of various mussel control interventions by photographing the pretreatment and post-treatment condition of mussel shell health.

Both parties have benefited from the CRADA. The CRADA partner has improved and validated the performance of their FlowCAM while adding the newly developed *VeligerCAM* capabilities into their line of product offerings for other users. Reclamation now has a specialized technology that can accurately and efficiently count abundant mussel samples. In part due to the newly developed *VeligerCAM* capability, Reclamation's Mussel Detection Laboratory, located in the Technical Service Center in Denver, Colorado, received the Colorado Governor's Award for High Impact Research in 2012 for its work in advancing methods to monitor for the presence of invasive quagga and zebra mussels in water bodies.

CRADA to Develop New Coating Technologies to Protect Water Infrastructure.
Reclamation is also conducting research across a broad portfolio of technologies and methods to reduce fouling of infrastructure by mussels. This includes research into durable, "foul-release" coatings that would negate mussels' ability to attach to the infrastructure. In 2013, Reclamation entered into material transfer agreements to test commercially available coatings with several U.S. companies and universities to determine the capability of existing coatings products for preventing mussel attachment and durability protection needed for Reclamation's water infrastructure. These tests indicated that commercially available coatings did not meet the desired performance standards, and that a new coating formulation is needed. Thus, in FY 2013, Reclamation launched an effort to explore a CRADA with a U.S. coating manufacturer to create new commercially available, durable, foul-release coating to protect water infrastructures.

Under the CRADA, both parties will bring together the joint interests and the complementary capabilities that are necessary to effectively achieve the research results that neither party is capable of producing on its own. Reclamation's contributions include background intellectual property, research expertise and know-how from material engineers, chemists, and biologists; the use of Reclamation's Parker Dam field test site and Materials Engineering and Research Laboratory. The CRADA partner's contributions also include background intellectual property, supplemented by research staff with extensive experience in formulating foul release coatings for marine environments, specialized research facilities; extensive coating scale-up and manufacturing know-how and related production facilities, and in-kind resources.

Early Stage Research Collaboration across Federal Agencies and Non-Federal Organizations. Pooling the know-how and research capacity of Federal agencies and U.S. private sector companies is vital to maintaining and growing the U.S.'s world-wide leadership positions, and meeting the growing needs for water in the U.S. and abroad. In FY 2013 Reclamation started exploring an effort to create and implement Communities of Practice in areas of water resources research where industry involvement is vital to create innovations, and develop and manufacture new tools, solutions, and products that will secure water for generations to come. Communities envisioned include desalination, hydropower, water conservation, and water infrastructure technologies. During FY 2014, Reclamation plans to further develop and pilot test the concept in collaboration with the EPA and other Federal agencies before implementing a Community in partnership with the private sector. Depending on progress, capabilities, and interests, Communities would be pursued in other subject matter areas.

The Communities of Practice concept is similar to the call in the October 28, 2011, Presidential Memorandum on *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Business* to better utilize technology innovation clusters to foster effective collaborations with industry and economic development consortia, and other entities. Developing Communities of Practice is also consistent with the Presidential Memorandum by providing new ways to better engage U.S. industry at the early stages of Federal discovery. Communities would serve as forums to foster industry-Federal partnerships to inspire and pull discoveries toward mutual federal-industry goals at the earliest possible time. This would allow the commercial value for discoveries to be identified early in the research process. Communities of Practice will also create more awareness across U.S. industries and other non-government organizations about the specialized Federal research resources (people, lands, and facilities) that they can access through technology transfer agreements authorized by the FTTA (15 USC 3710a). Once the Communities are developed and implemented, it is envisioned that ongoing administration would become a shared responsibility of industry trade associations or similar organizations.

X. Bureau of Safety and Environmental Enforcement

The Bureau of Safety and Environmental Enforcement (BSEE) works to promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement.

Within BSEE, the Office of Offshore Regulatory Program (OORP) develops standards and regulations to enhance operational safety and environmental protection for the exploration and development of offshore oil and natural gas on the U.S. Outer Continental Shelf (OCS). OORP is also responsible for developing and implementing a comprehensive offshore inspection program in accordance with the provisions of the OSC Lands Act (OCSLA), ensuring that OCS oil and gas operators and contractors implement a robust safety and environmental management system (SEMS), and coordinating the agency's civil penalties program.

The Oil Spill Response Division (OSRD) is responsible for developing standards and guidelines to ensure that offshore operators are prepared to respond to an offshore oil spill. It also ensures their Oil Spill Response Plans comply with regulatory requirements. OSRD plays a critical role in the review and creation of policy, guidance, direction and oversight of activities related to the agency's role in ensuring industry's preparedness for oil spill response. The Division oversees the Oil Spill Response Research program, and works closely with sister agencies such as the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, and Environmental Protection Agency to continually enhance response technologies and capabilities.

BSEE operates the National Offshore Training and Learning Center (NOTLC) with specially developed curricula focusing on keeping experienced inspectors current on new technologies and processes and ensuring that new inspectors are given the proper foundation for carrying out their duties rigorously and effectively. The NOTLC works cooperatively with industry and academia to provide the specialized training needed.

The Bureau also operates Ohmsett in Leonardo, N.J., which serves as the National Oil Spill Response Research and Renewable Energy Test Facility. Although not classified as a Federal laboratory, Ohmsett is available for use by industry and government. Advances made by research conducted at the Ohmsett facility are vital to the oil spill response industry.

BSEE R&D operates through the Emerging Technologies Branch (ETB) and the Oil Spill Response Research (OSRR) program. The former supports research associated with operational safety and pollution prevention (including renewable energy). The ETB was established in 2012 to replace the Technology Assessment and Research (TA&R) group to be the agency's focal point on operational safety and pollution prevention research as well as ensuring that industry operations on the Outer Continental Shelf incorporate the use of Best Available and Safest Technologies (BAST) as required in the 1978 OCSLA amendments. The OSRR program was established through the Oil Pollution Act of 1990 to research oil spill response technology. Its Ohmsett facility is available to provide independent and objective performance testing of full-scale oil spill response equipment and marine renewable energy devices, and improving technologies through research and development.

BSEE's R&D focus is on offshore operational oil/gas and renewable energy issues. The majority of the bureau's technology advancements are transferred through public dissemination. BSEE's primary research synergy is with international government organizations and the oil/gas and renewable energy industry. It is typically in the area of ensuring that the best available and safest technology is used in the US Outer Continental Shelf. Additional information and research deliverables are available at:

http://www.bsee.gov/Research-and-Training/Technology-Assessment-and-Research.aspx and http://www.bsee.gov/Research-and-Training/Oil-Spill-Response-Research/index/.

BSEE is also a member of the International Committee on Regulatory Authority Research and Development (ICRARD), which focuses on transferring knowledge worldwide between governmental entities in the area of health, safety and environment in the petroleum sector. Although membership is only available to government entities, ICRARD cooperates with industry to coordinate and transfer technology.

BSEE is currently the Vice Chair of the Interagency Coordinating Committee on Oil Pollution Research (ICCOPR). This Committee, composed of 15 member Federal agencies, was mandated by the Oil Pollution Act of 1990 to: (1) prepare a comprehensive, coordinated Federal oil pollution research and development plan; and (2) promote cooperation with industry, universities, research institutions, State governments, and other nations through information sharing, coordinated planning, and joint funding of projects.

In addition to making the final reports of research projects publicly available on the BSEE website, BSEE also makes its research results available via conferences, and other forums, e.g., the annual Clean Gulf Conference; the Pacific States-British Columbia Oil Spill Task Force Annual Meeting; and the Coastal Response Research Center's Oil Spill Dispersant Research Forum.

Following are examples of technology transfer activities undertaken in FY 2013.

Best Available and Safest Technology. BSEE is developing a program to identify and ensure the deployment of Best Available and Safest Technology (BAST) for use in offshore facilities. As part of this exercise, BSEE entered into an agreement with Argonne National Labs (ANL) in FY 2012 under which the latter would provide its engineering expertise to assist the ETB establish test procedures, protocols and methodologies to identify and evaluate BAST. This agreement with ANL has continued into FY 2013 through various Statements of Work not only to assist BSEE with the identification of BAST, but to investigate risk based inspection policies, Safety and Environmental Management Programs (SEMP), conservation issues, and systems reliability concerns.

Assessment of Blowout Preventers and Related Technologies. A blowout preventer (BOP) is a device used to seal and control oil and gas wells to ensure safety and limit environmental harm from accidental losses of well control during operation. BSEE entered into a study with researchers from industry to investigate new designs for blind shear rams on BOP stacks, methods to detect high pressures in the well bore during the drilling process, the effects of water depth on detection, and new methods for detecting failure of BOP components. This project is expected to be completed in FY 2014.

Management of Hydrocarbon Hydrates During Production. Hydrocarbons (e.g., methane and ethane) at low temperatures and high pressures can, in the presence of water, form quasi-stable solid crystals called hydrocarbon hydrates. These hydrates can block pipes, flowlines, valves and other equipment used for offshore drilling and production activities. Moreover, if

disturbed or warmed sufficiently, these hydrates can "explode" as the hydrocarbons escape from the hydrate. Thus, they can be a safety hazard for offshore oil and gas drilling and production operations. An ongoing joint industry project with over a dozen oil and gas operating companies is investigating how hydrocarbon hydrates can be managed during the life of a producing oil and gas field and how anti-freeze and various other chemicals affect hydrate plugging. The project will also evaluate high pressure jumper pipe design, and help develop new technologies to monitor hydrates, and hydrate simulation tools. It is expected that this joint industry project will be completed in FY 2014.

XI. Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management (BOEM) manages the exploration and development of the Nation's offshore resources. It seeks to appropriately balance economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.

It is responsible for the development of the Five Year Outer Continental Shelf (OCS) Oil and Natural Gas Leasing Program and assessments of the potential of oil, gas and other mineral resources, and renewable energy in the OCS. It develops inventories of reserves of these resources and develops production projections, and conducts economic evaluations to ensure that U.S. taxpayers get fair market value for its OCS leases.

BOEM handles the actual lease sales, grants and agreements in the OCS for the exploration and/or development of minerals and renewable and non-renewable energy. It also develops official maps and GIS data for the OCS.

BOEM's Office of Environmental Programs conducts environmental reviews, including *National Environmental Policy Act* (NEPA) analyses and compliance documents for each major stage of energy development planning. These analyses inform the bureau's decisions on the Five Year Program, and conventional and renewable energy leasing and development activities. Additionally, BOEM's scientists conduct and oversee environmental studies to inform policy decisions relating to the management of energy and marine mineral resources on the OCS through its Environmental Studies Program. BOEM has three regional offices in New Orleans, Louisiana, Camarillo, California, and Anchorage, Alaska, that manage oil and gas resource evaluations, environmental studies and assessments, and leasing activities, including the review of Exploration Plans and Development Operations and Coordination Documents, fair market value determinations, and geological and geophysical permitting.

BOEM Science. The BOEM's Environmental Studies Program (ESP) plans, conducts and oversees world-class scientific research to inform policy decisions regarding leasing and development of OCS energy and mineral resources. BOEM works to manage the exploration and development of the Nation's offshore resources in a way that appropriately balances economic growth, energy development, and environmental protection through oil and gas leases, renewable energy development, and environmental reviews and studies.

BOEM's environmental studies cover a broad range of disciplines including physical oceanography, atmospheric sciences, biology, protected species, social sciences and economics, submerged cultural resources and the environmental effects of energy development. BOEM is a leading contributor to the growing body of scientific knowledge about the Nation's marine and coastal environment.

BOEM oversees scientific research conducted through contracts, cooperative agreements with State institutions or universities and interagency agreements. These arrangements enable the bureau to leverage resources, meet national priorities and satisfy common needs for robust scientific information. Many of the bureau's studies are collaborations with partners under the umbrella of the National Oceanographic Partnership Program.

BOEM Technology Transfer. BOEM's technology transfer activities include dissemination of information, knowledge and technologies to the various regions, and to commercial entities and other stakeholders with interests in the OCS.

Studies that have been undertaken by or through funding from BOEM are available to the public through the Environmental Studies Program Information System (ESPIS), and technical summaries of more than 700 BOEM-sponsored environmental research projects, as well as copies of more than 2,000 research reports, are available for online full text search. To learn more about BOEM's ongoing work to further environmental studies, go to: http://www.boem.gov/studies.

BOEM's Environmental Studies Program typically conducts or supports approximately 10 scientific meetings, Information Transfer Meetings, symposia, and its Federal Advisory Act Committee meetings (OCS Scientific Committee). BOEM-funded research has also supported and directly led to the publication of hundreds of peer-reviewed scientific articles including research papers from master's and doctoral students and post-doctoral fellows.

Many large interdisciplinary projects with funding from BOEM have included partnerships with other Federal agencies and academic institutions as well as private companies directed towards offshore ecosystem studies that utilize state-of-the-art technologies such as autonomous underwater vehicles surveys, deep-water human-occupied submersibles and remotely operated vehicles. Many projects have developed innovative imaging technologies and digital analysis techniques for establishing long-term biological monitoring stations in deepwater. These partnership studies have leveraged expertise and technologies to meet common management goals.

One notable transfer of technology-derived information to the research community as well as the general public has been in mapping of seafloor features in the northern Gulf of Mexico (GoM) derived from 3-dimensional seismic surveys performed by the energy industry. BOEM scientists have mapped over 28,000 seafloor seismic amplitude anomalies since their efforts began in 1997. The resulting database, available on a BOEM webpage at http://www.boem.gov/Oil-and-Gas-Energy-Program/Mapping-and-Data/Map-Gallery/Seismic-Water-Bottom-Anomalies-Map-Gallery.aspx, represents a roadmap to the relatively rare exposed hard substrate in the deep GoM created by the natural seepage of hydrocarbons. The mapping of these features has proved

invaluable in the selection of sites for the study of deep-water corals and chemosynthetic communities in the GoM as well as damage assessment surveys after the *Deepwater Horizon* accident. Bottom features are now divided into several varieties and also include verified locations of natural oil seeps and some major types of biological communities.

BOEM occasionally also funds technology development studies. Two studies underway in FY 2013 are described below. These studies, which are complementary, were undertaken specifically to deal with offshore environmental issues but they could have applications onshore and provide significant benefits beyond BOEM's immediate mission needs both onshore and offshore.

Some BOEM studies, particularly in the emerging realm of offshore renewable energy are focused on the assessment of the best currently available technology to apply to management decisions. The use of newer technologies will yield improvements in the quality and character of the observations (for example, higher resolution profiling and mapping, or real-time measurements for control) that will feed back into improvements in the design and perhaps operating envelope of power extraction devices. One currently ongoing study is titled, *Roadmap: Technologies for Cost Effective, Spatial Resource Assessments for Offshore Renewable Energy*. Another example of an evaluation-themed study is represented by a project related to hydrokinetic energy device impacts titled, *Evaluating acoustic technologies to monitor aquatic organisms at renewable energy sites.* Extreme velocities at potential sites (desirable for energy extraction) can increase water turbidity and reduce optical imagery ranges. Robust technologies that can effectively survey large ranges over wide apertures are required for impact monitoring. This project will evaluate abilities and weaknesses of different technologies and result in management recommendations for deployment and data acquisition procedures at tidal and wave energy projects.

Use of new DNA analysis techniques has expanded in recent years affecting everything from species taxonomy to the mechanisms of human diseases. As an addition to the invertebrate archiving program BOEM has had with the Smithsonian Institution's National Museum of Natural History, the bureau has initiated the archiving of tissue samples taken from specimens collected through the BOEM Environmental Studies Program. This further enhances a long-term relationship BOEM has had with the Smithsonian since 1979 recognizing that extensive biological samples collected during BOEM environmental studies were invaluable not only to the relevant studies, but also to science in general. More than 400 new species to science have been identified from new tissue sample submissions that came from BOEM study collections from the Arctic, Pacific, Gulf of Mexico, and Atlantic. Similar to the continuing archiving and curation of invertebrate samples, these tissue/DNA samples will be available from the Smithsonian's new Biorepository for the use by scientists from all over the world into the future. See http://invertebrates.si.edu/boem/boem.htm.

XII. Bureau of Land Management

The Bureau of Land Management (BLM) mission is to sustain the health, diversity, and productivity of America's public lands for the use and enjoyment of present and future

generations. It administers more public land – over 245 million surface acres – than any other Federal agency in the United States. Most of this land is located in the 12 Western States, including Alaska. The BLM also manages 700 million acres of sub-surface mineral estate throughout the Nation.

The BLM's multiple-use mission, set forth in the Federal Land Policy and Management Act of 1976, mandates that it manage public land resources for a variety of uses, such as energy development, livestock grazing, recreation, and timber harvesting, while protecting a wide array of natural, cultural, and historical resources, many of which are found in the BLM's 27 million-acre National Landscape Conservation System. The conservation system includes 221 Wilderness Areas totaling 8.7 million acres, as well as 16 National Monuments comprising 4.8 million acres. There are opportunities for technology transfer projects related to the management of these areas.

The BLM invests approximately $16-18 million/year in research and development, and is working towards identifying the amount of funding invested in applied research projects. It defines applied research as systematic study, with on-the-ground validation, to gain knowledge or understanding necessary to inform management questions. A BLM research project provides fundamental knowledge required for the solution of social, economic, biological, political, technical, or physical problems. Projects are focused to address specific 'researchable' problems recognized by the BLM. They usually have applicability beyond a particular place (site) and time and are usually directed at development of new methodologies and technologies.

Development is defined in the BLM as a systematic process of identifying, adopting, and utilizing knowledge and understanding gained from research, directed toward the production of useful materials, devices, systems, or methods, including design and construction of prototypes and processes. Currently, the BLM's focus is toward developing basic foundational policy (e.g., scientific integrity, peer review, etc.) and evaluating the feasibility and benefits of additional technology transfer opportunities authorized under 15 U.S.C. 3710 and 35 U.S.C. 207 and 209. Technology transfer in the BLM includes, but is not limited to, information dissemination. An example is an in-depth manual explaining how a new technology (e.g., geospatial) is to be incorporated into existing procedures, techniques, and training (e.g., the landscape approach).

The BLM also emphasizes and has begun to apply a "landscape approach." Accordingly, the agency has been funding Rapid Ecoregional Assessments (REAs). The REAs will provide geospatial base data for future projects, which would include technology transfer. Climate change will move the bureau towards new conceptual models, innovative methods and new practices that more fully integrate science into its everyday work processes. The landscape approach will become the basis for encouraging technology transfer in the BLM.

XIII. Conclusion

Over the past year the Department has made substantial progress towards meeting its commitments made in the October 2012 Technology Transfer Plan to institutionalize technology transfer as a routine part of its science, engineering and other technical activities.

In the coming years, the Departmental Working Group on Technology Transfer hopes to increase, through education and training, the awareness of the Department's scientific, engineering and technical personnel about the scope and opportunities associated with technology transfer in terms of advancing both their professional careers and their bureaus' mission.

DATA APPENDIX

Data are provided if they are collected and readily available. Note that a blank cell or N/A indicates either zero, the data is not collected or it is otherwise unavailable.

FY 2013 DATA

Table 1: Invention Disclosures and Patents

		USGS	FWS	NPS	Reclamation	TOTAL
	Invention Disclosures					
1	Number of new inventions disclosed	6		1	2	9
	Patents					
2	Number of patent applications filed	7		0	1	8
3	Number of patents received	4		0	0	4

Table 2: Income Bearing Licenses

		USGS	Reclamation	TOTAL
	Income Bearing Licenses			
4	Number of income bearing licenses	13	3	16
5	Exclusive licenses	4	0	4
6	Partially exclusive licenses	0	0	0
7	Non-exclusive licenses	9	3	12
	Elapsed Amount of Time for Granting Licenses			
8	Average (months)	12		
9	Minimum (months)	12		
10	Maximum (months)	12		

Table 3: Licensing Income

		USGS	Reclamation	TOTAL
	Earned Royalty Income			
11	Earned Royalty Income from top 1% of licenses	$11,815	$5,600	$17,415
12	Earned Royalty Income from top 5% of licenses	$11,815		$11,815
13	Earned Royalty Income from top 20% of licenses	$11,815		$11,815
14	Minimum Earned Royalty Income	$500	$2,900	$3,400
15	Maximum Earned Royalty Income	$11,815	$5,600	$17,415
16	Median Earned Royalty Income	$3,502	$4,500	$8,002
	Disposition of Earned Royalty Income			
17	Total amount of Earned Royalty Income received	$45,531	$13,496	$59,027
18	Percent of Earned Royalty Income distributed to inventors	68	67	
19	Percent of Earned Royalty Income distributed to the agency or laboratory	32	33	
20	Licenses terminated for cause	0	0	0

	Total Income			
20 A		$45,531	$13,496	$59,027

Table 4: CRADAs

		USGS	FWS	Reclamation	TOTAL
	CRADAs				
21	Number of active CRADAs	464	4	8	476
22	Number of newly executed CRADAs	376	0	0	376
23	Active CRADAs with small business involvement	n/a			
24	Number of small businesses involved in active CRADAs	n/a			
	Traditional CRADAs				
25	Active traditional CRADAs	14	4	3	21
26	Newly executed traditional CRADAs	2	0	0	2
	Non-traditional CRADAs				
27	Active non-traditional CRADAs	450	0	5	455
28	Newly executed non-traditional CRADAs	374	0	4	378

Table 5: Other Performance Measures Deemed Important by the Agency

		USGS	BSEE	TOTAL
	(Add agency specific metrics)			
	Collaborative Agreements, total active	314	8	322
	Collaborative Agreements, new	130	7	137

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