National Science Foundation
Division of Ocean Sciences

Record of Decision

United States Implementing Organization's Participation in the Integrated Ocean Drilling Program

SUMMARY

The National Science Foundation (NSF) has decided to proceed with funding the United States Implementing Organization's (USIO) participation in the Integrated Ocean Drilling Program (IODP), an international research program that explores the history and structure of the earth as recorded in seafloor sediments, fluids, and rocks. The planned action will result in the United States providing and operating a light, riserless drilling vessel, the modernized and retrofitted *JOIDES Resolution,* also referred to as the Scientific Ocean Drilling Vessel (SODV). The Consortium for Ocean Leadership, Inc. (COL) and its partners, Lamont-Doherty Earth Observatory of Columbia University (LDEO) and Texas A&M University (TAMU) through the Texas A&M Research Foundation (TAMRF) have been selected by NSF to be the IODP-USIO for the light drilling vessel and related activities.

Alternative B has been selected as the preferred alternative. In reaching this decision, the Director of the NSF Ocean Drilling Program has considered the potential environmental impacts addressed in the Programmatic Environmental Impact Statement (PEIS) for proposed IODP-USIO activities. The National Marine Fisheries Service (NMFS), a part of the National Oceanic and Atmospheric Administration (NOAA), was a cooperating agency in the preparation of the PEIS. The Director has also sought input from federal agencies, research institutions, private organizations, and individuals. A Notice of Availability for public review of the draft PEIS was published in the Federal Register and copies of the document were made available for review to all interested parities including international and U.S. Federal agencies, research institutions, private organizations, and individuals. Two public meetings were conducted. No comments were received.

NSF will distribute this Record of Decision (ROD) to all known interested and affected persons and agencies and will publish a notice of its availability in the Federal Register.

DECISION

Background

The NSF proposes to fund the USIO's participation in the IODP which involves the operation of a light, riserless drilling vessel, the *JOIDES Resolution* (SODV) and the performance of related activities to support earth sciences research throughout the world's oceans where riserless drilling is optimally suited. Proposed activities to be conducted by the *JOIDES Resolution* include the mechanical operation of the vessel, riserless ocean drilling, core sampling, and onboard research activities.

The IODP is an integrated, multi-drilling platform scientific research program with objectives identified in the IODP Science Plan (ISP), which provides fundamental guidance as to the scientific and technical objectives. IODP studies will lead to a better understanding of the deep biosphere and the sub-seafloor ocean; environmental change, processes, and impacts; and solid earth cycles and geodynamics. The specific IODP initial drilling initiatives require the IODP to deploy closely linked drilling platform types simultaneously. A riserless drillship such as the *JOIDES Resolution* will enable the IODP to reach the ocean's greatest depths, more effectively than the other two available drilling IODP platforms. Additionally, the *JOIDES Resolution* will serve as a state-of-the-art riserless drilling research platform that is critical for achieving the program's scientific goals, particularly as IODP drilling progresses into harsher environments, where the challenge of recovering biologically, chemically and physically intact samples continues to increase.

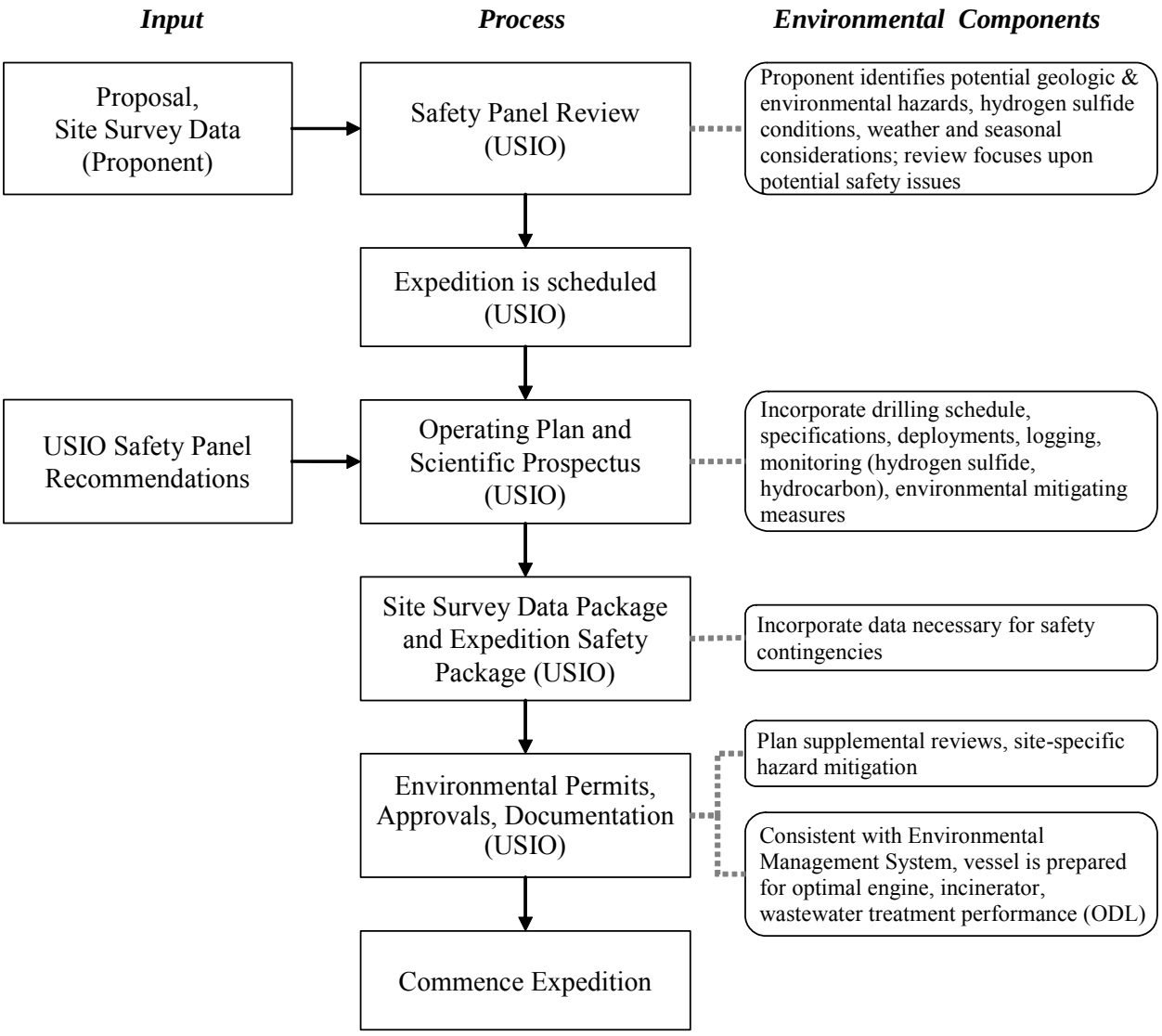
Alternatives Considered

The PEIS focused on the evaluation of all SODV operations and research activities independent of specific geographic locations and considered the following alternatives:

Alternative A – Conduct Riserless Ocean Drilling Based Solely on Scientific Research Needs

In Alternative A, riserless ocean drilling expeditions would be designed and conducted to meet site-specific scientific objectives as developed by the proponents of the research. In this alternative, the primary focus during the planning and implementation of riserless drilling expeditions would be on achieving the proposed scientific objectives and avoiding unsafe working conditions. Figure 1 identifies the process features and the environmental components of this alternative.

Figure 1. Expedition Review and Planning Process for Alternative A



Legend
ODL Overseas Drilling Limited
USIO United States Implementing Organization

In this alternative, TAMU and LDEO, the IODP-USIO's science support contractors, would maintain a distinct, independent panel of safety experts (Safety Panel) to advise the USIO on safety issues and drilling hazards. The Safety Panel would review all site-specific data pertaining to each expedition and render a final decision regarding site safety. No additional review and advisory support would be provided such as guidance from the IODP.

Prior to each expedition, a detailed Scientific Prospectus would be prepared by key operations and research personnel which reflects the agreed upon priorities and implementation strategies

for each expedition. The Site Survey Package consisting of data required for an expedition would be published in the Scientific Prospectus. The Expedition Safety Package would then be prepared which would be a collection of all data and documentation (including the Site Survey Package) necessary to support a safe and environmentally compliant operation. Both the Site Safety and the Expedition Safety Packages would contain pertinent information on the potential geological or environmental hazards that would be used to determine appropriate contingencies during drilling.

Prior to the vessel departure, the IODP-USIO would obtain necessary approvals for the areas in which the vessel would operate including permits and other regulatory notifications. In parallel, the vessel operator (ODL/Transocean) would ensure that vessel systems such as engines, incinerators, and wastewater treatment devices are functioning properly per regulatory requirements (e.g., MARPOL).

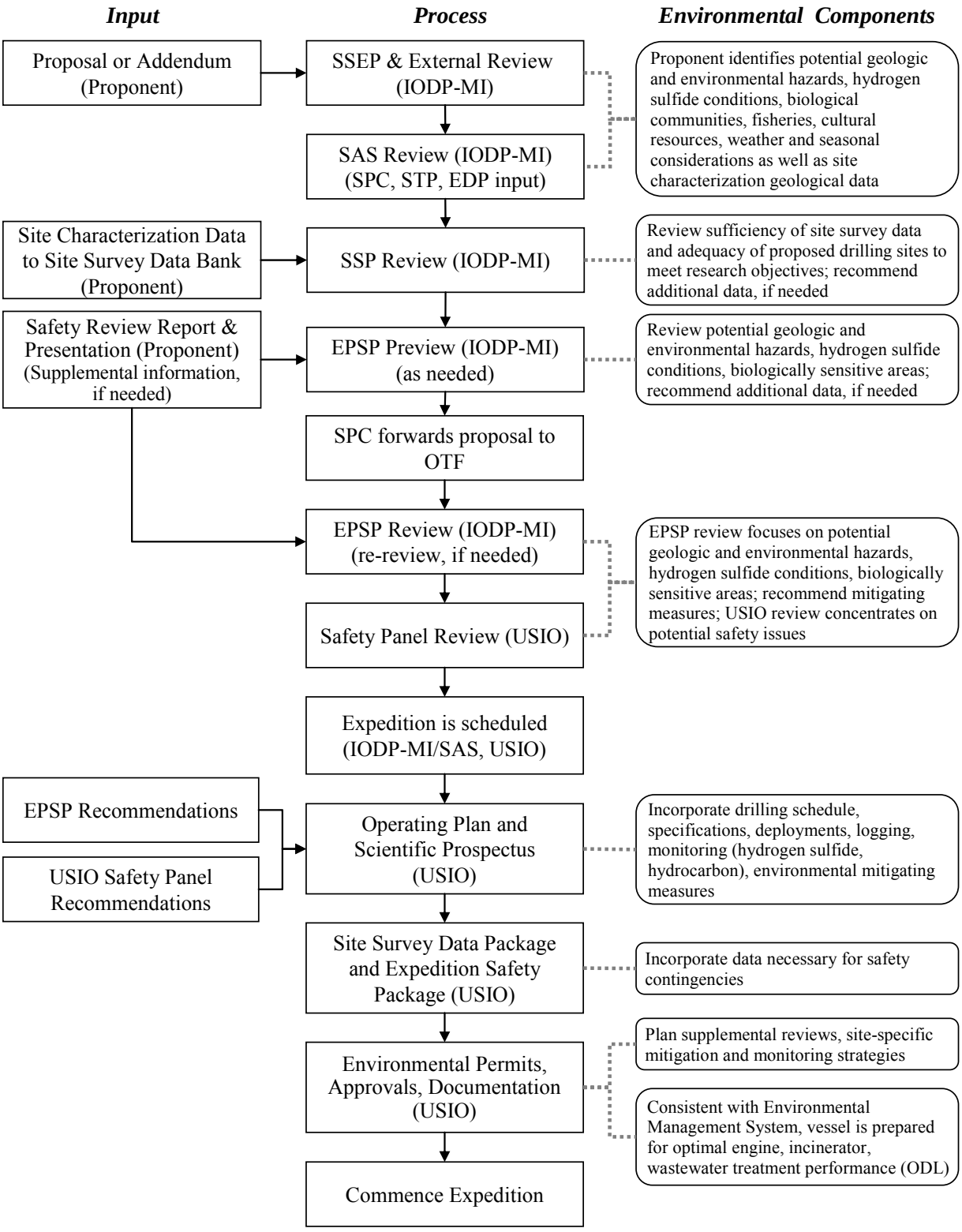
Alternative B - Conduct Riserless Ocean Drilling Based on Specific Scientific Research Needs and IODP Support

In Alternative B, riserless ocean drilling expeditions would be designed and conducted to meet site-specific scientific objectives as presented by the proponents of the research and would incorporate advisory input from the IODP as well as the USIO's Safety Panel guidance as described in Alternative A.

In this alternative, the value of the potential scientific results of any drilling proposal would be balanced against the possible hazards so that IODP-USIO riserless operations can achieve valuable scientific results without jeopardizing the health of individuals, the environment, or the future of the program. Figure 2 depicts the combined IODP and USIO review processes which would be used to select safe drilling locations and methods and identify site-specific environmental conditions that could be adversely affected by riserless drilling activities before an expedition is included in the drilling program.

Proposals and associated data packages would then be reviewed by the Environmental Protection and Safety Panel (EPSP), an advisory panel comprised of multi-disciplinary experts drawn from industry, government, and academia to provide independent advice to IODP regarding potential safety and environmental hazards that may exist because of general or specific geology of the seafloor, as a consequence of human activities, or the potential impact on the marine life and their environment. During the EPSP review process, a representative proponent would make a presentation consisting of a project overview followed by an appraisal of each proposed drill site and a description of the key safety and environmental issues. The purpose of the presentation would be to provide the panel with information on the proposed drilling activities, environmental conditions at each drill site, and other site-specific features that would allow the panel to identify operational hazards and potential environmental impacts.

Figure 2. Expedition Review and Planning Process for Alternative B



Legend

EDP	Engineering Development Panel
EMS	Environmental Management System
EPSP	Environmental Protection and Safety Panel
IODP-MI	Integrated Ocean Drilling Program - Management International
ODL	Overseas Drilling Limited
OTF	Operations Task Force
SAS	Science Advisory Structure
SPC	Science Planning Committee
SSEP	Science Steering and Evaluation Panel
SSP	Site Survey Panel
STP	Science and Technology Panel
USIO	United States Implementing Organization

Following their review, the EPSP would provide guidance on site selection and data processing to improve imaging of the sites, and on modification of site locations, so that the proposed sites would be safe to drill and will meet the scientific objectives. Final EPSP recommendations for each site may include approval as requested, approval with conditions regarding drill sites, drilling order, depths, associated monitoring requirements, or site-specific mitigating measures. In concert with EPSP advice, the IODP-USIO Safety Panel would review all site-specific data pertaining to a particular expedition and render a final decision regarding site safety.

Prior to each expedition, a detailed Scientific Prospectus would be prepared by key operations and research personnel which reflects the agreed upon priorities and implementation strategies for each expedition. The Site Survey Package consisting of data required for an expedition would be published in the Scientific Prospectus. The Expedition Safety Package would then be prepared which would be a collection of all data and documentation (including the Site Survey Package) necessary to support a safe and environmentally compliant operation. Both the Site Safety and the Expedition Safety Packages would contain pertinent information on the potential geological or environmental hazards that would be used to determine appropriate contingencies during drilling.

Prior to the vessel departure, the IODP-USIO would obtain necessary approvals for the areas in which the vessel would operate including permits and other regulatory notifications. In Alternative B, site-specific environmental assessments, Incidental Harassment Authorizations (IHA), mitigating measures, monitoring strategies, and contingencies for alternate drill sites, would be developed based on conditions or requirements identified during the comprehensive review process, reviewed by the appropriate authorities, and incorporated into the operating plan. In parallel, the vessel operator (ODL/Transocean) would ensure that vessel systems such as engines, incinerators, and wastewater treatment devices are functioning properly per regulatory requirements (e.g., MARPOL).

Alternative C - Do Not Conduct Ocean Drilling (No Action Alternative)

In Alternative C, the IODP-USIO would not operate the SODV and would not provide the riserless ocean drilling capability to the IODP. Unless the riserless drilling resources are realized from other sources, the IODP's goal to integrate multiple drilling platforms, exploratory tools, and diverse strategies to resolve outstanding research questions as identified in the ISP may not be achieved. The long-term U.S. commitment and expertise to support earth sciences research using riserless ocean drilling technologies would be lost.

Preferred Alternative

Alternative B has been selected as the preferred alternative. As shown in Figure 2, critical environmental components will be identified during the review process and necessary contingencies and site-specific mitigating measures planned accordingly. For example, some common environmental issues addressed during IODP reviews include:

- Potential for encountering a pressurized section of the sub-seafloor while drilling;
- Indications of active (or previously active) vent systems or hydrocarbon seeps in the area of proposed drilling;
- Probability of encountering H_2S (hydrogen sulfide) or hydrates during coring or core recovery activities;
- Presence of any biological communities within 100 meters of any proposed drill sites, their type (e.g., vents, deep-water reefs.), and evidence for their existence (e.g., sampling, visual);
- Presence of a nearby fishery (species, typical gear), known local breeding ground, consistent feeding area, migration route, or habitat to threatened or endangered species; and
- Availability of alternative sites in the event that weather, currents, ice, sensitive biological communities prevent drilling.

In addition, the site survey data required as a result of the comprehensive review process will characterize the area in the immediate vicinity (within 1 km) of each proposed drill site for the purpose of evaluating seafloor conditions (water depth, seafloor topography and stability) and identifying potential hazards and environmental concerns while allowing flexibility in the use of alternate drill sites if unexpected field conditions prevent drilling at primary locations. Benefits derived from the collaboration of USIO riserless drilling planning efforts and IODP SAS review processes will effectively contribute to minimizing adverse environmental impacts and include:

- Selecting the optimum drilling platform based upon site-specific conditions and research objectives;
- Ensuring that site characterization data is adequate to support the proposed research objectives and identify potentially sensitive environmental conditions for protection;
- Selecting the most appropriate drilling locations and minimal number of boreholes to be drilled based on research needs and local environmental conditions;

- Developing plans and procedures to limit vessel and drilling related discharges in environmentally sensitive areas to the minimum needed to support the intended research; and
- Minimizing the use of acoustic sources (e.g., transducer-based equipment, seismic sources) in environments containing organisms sensitive to outputs from these sources.

By contrast, the nominal planning and review process for riserless drilling expeditions that would be implemented by selecting Alternative A (i.e., to only meet proposed scientific objectives and avoiding unsafe working conditions) would not provide the mechanisms to identify sensitive environmental conditions and avoid potential impacts.

Impacts

The findings of the PEIS indicate that a majority of the outputs associated with the performance of the preferred alternative will have minor and transitory effects on the environment. This alternative incorporates the IODP SAS review and advisory process to identify potentially sensitive environments and recommends the use of best management practices (BMPs) and site-specific mitigating measures to reduce environmental outputs associated with drilling and coring operations.

A majority of the impacts resulting from the preferred alternative will be localized and will disappear once the vessel completes drilling activities at a particular site and leaves the area. Many of the outputs and resulting impacts associated with the operation of the SODV such as wastewater discharges, air emissions, and the propagation of underwater noise from propulsion equipment and transducer-based equipment are common to most merchant marine vessels. Some outputs associated with riserless drilling activities (seafloor disturbance, deposition of sediment drill cuttings, deployment of equipment or materials) may remain evident on the seafloor for extended periods of time after borehole drilling is complete; however, the effects on the benthic environment will be minor. Further details describing these impacts of the preferred alternative are provided below.

Marine Water Quality

The impacts to water quality resulting from the mechanical operation of the SODV will include:

- Localized, short-term impacts resulting from SODV discharges of treated wastewater, greywater, treated bilgewater, deck drainage, ballast water, and treated lab discharges; and
- Localized disturbances resulting from mixing of the water column surrounding the SODV during thruster operation.

Impacts to water quality associated with drilling and coring operations and borehole completion activities will include:

- Localized effects near a borehole resulting from the discharge of seawater drilling fluid, sediment displaced from the borehole, drilling mud, cement, and tracers.

Sea Bottom and Sediment Quality

The impacts to the seafloor environment and sediment quality resulting from drilling and coring operations and borehole completion activities will include:

- Localized disturbances to the seafloor derived from the installation of boreholes and the introduction of naturally-occurring drilling muds and cement;
- Localized deposition of drill cuttings and drilling mud particles, and alteration of seafloor topography;
- Displacement or smothering of benthic organisms in the immediate vicinity of the borehole; and
- Localized disturbances to the seafloor derived from the installation of permanent structures.

Air Quality

The emissions resulting from SODV operations, including engine exhaust and incinerator combustion byproducts, are expected to be transitory and will not adversely impair local air quality. Fuel evaporative emissions resulting from SODV operations are not expected to be detectable or adversely affect local air quality. Similarly, emissions from volatile or gaseous chemicals used onboard the SODV for operations or in the laboratories are expected to be minimal. Because the chemicals are used on an intermittent basis and in small quantities, the resulting air emissions are expected to be minimal.

Acoustic Environment

During transit, sound and vibration produced by the SODV engines, propulsion systems, and transducer-based instruments may be noticeable to nearby marine organisms. It is expected that many potential receptors will perceive the continuous noise produced by the approaching vessel and will deviate from the path of the vessel thereby avoiding exposure to peak and potentially harmful noise levels. For several reasons, it is unlikely that the transducer-based equipment on the SODV would cause a marine organism to be exposed to sound levels greater than the 180 dB re 1 µPa (rms) level which NMFS considers to be potentially harmful. First, most sound sources emit energy in narrowly focused beams directed toward the seafloor and would only affect organisms directly beneath the vessel. Second, at a typical cruising speed of 11 knots (20 km/hr), it is expected that if an organism were exposed to noise from the vessel, it would only be for a short period of time. Finally, the short pulse duration from the transducer devices reduces the risk of hearing impairment or other injury to exposed organisms.

The noise created by the SODV while it is dynamically positioned over a drill site and the physical turbulence in the water caused by the vessel's thrusters are likely to deter many marine organisms from approaching the drillship and becoming exposed to potentially intense sound levels. Because most drill sites will be located in deep open ocean areas that are not densely populated by marine organisms, the potential that an individual or a population of animals may be exposed to continuous noise levels that could cause behavioral changes is very low.

Similarly, the short-term increase in the ambient noise created by vessel operations or drilling and coring may deter some organisms from a particular area, resulting in temporary displacement and possible disturbance to an animals' feeding or spawning behavior. In general, the SODV will only occupy a drill site for a relatively short period of time (i.e., hours or days) allowing displaced organisms to repopulate the area when drilling ceases and the vessel departs.

In most areas where the SODV is expected to operate, the range of potential effects to biological receptors resulting from riserless ocean drilling operations and related research activities are expected to be minimal. Generally, it is expected that expeditions will avoid sensitive marine environments such as native hunting areas, migratory routes, consistent feeding grounds, or local breeding grounds that concentrate cetaceans or other sensitive species in critical areas, thereby reducing the risk of exposure to acoustical outputs from the SODV operations. In the preferred alternative, mitigating measures may include modifying the schedule for an expedition, selecting alternate sites, or limiting the types of activities performed to avoid or minimize exposing sensitive marine organisms to potentially disturbing or harmful acoustic levels.

At drill sites where marine organisms that are potentially sensitive to acoustic sources may be densely populated or the proposed research activities may result in more intense or prolonged acoustic exposures, a supplemental environmental review may be prepared to evaluate the site-specific risks and develop recommendations for additional mitigating measures. Therefore, the extent of acoustical source impacts in the preferred alternative for all receptors including cetaceans and other sensitive organisms is expected to be minimal for IODP-USIO ocean drilling expeditions.

Seismic surveys or vertical seismic profiling may be periodically performed and will incorporate BMPs to prevent marine biota from being exposed to sound levels that could result in injury (≥ 180 dB re 1 μPa rms) or significant behavioral changes (≥ 160 dB re 1 μPa rms). Additional detail pertaining to the impact assessment of seismic sources is being prepared in a separate document, to be entitled the *Draft Programmatic Environmental Impact Statement/Overseas Environmental Impact Statement for National Science Foundation-Funded Marine Seismic Research*. This document will be released for comment in mid-2008.

Marine Biological Resources (Near-Coastal and Deep Sea)

Potential impacts to marine biological resources resulting from the operation of the SODV and riserless ocean drilling activities are discussed below. Because the scope of the PEIS provided a general assessment of IODP-USIO riserless drilling and related research activities independent of specific geographic locations and time periods, the impact assessment focused on a qualitative analysis regarding the potential range of effects on these biological resources and their anticipated significance. Using the preferred alternative, these activities would be planned and performed following advisory support provided by the IODP SAS taking into consideration biological resources present at each specific drill sites and potential impacts of the research.

Plankton

The intensity, extent, and duration of potential impacts to plankton communities resulting from the discharges from SODV operations are expected to include:

- Localized, short-term impacts to zooplankton respiration resulting from increased turbidity associated with SODV discharges of treated wastewater, greywater, and other liquid wastes;
- Localized, short-term impacts to phytoplankton and zooplankton community structure due to increased salinity from brinewater discharges;
- Localized, short term, and reversible redistribution of phytoplankton and zooplankton communities within 100 m of the SODV as a result of turbulence created by thruster operations; and
- Interference with shallow or deepwater zooplankton feeding and respiratory activities due to the increased suspended solids concentrations within several hundred meters of the borehole.

Fish

It is expected that most fish will avoid the area and the continuous output of noise generated by drilling and coring operations, the transponder beacon deployed near the drill site, and the turbulence created by the vessel's thrusters. The intensity, extent, and duration of potential impacts to fish communities resulting from the discharges from SODV operations and drilling activities include:

- Localized, short-term disturbances to fish resulting from turbulence created by the thrusters when the vessel is dynamically positioned at a drill site; and
- Localized, short-term disturbances to fish derived from the acoustic outputs generated by the vessel's thrusters, drilling/coring operations, and transponder beacons deployed near the drill site.

Overall, impacts to fish associated with IODP-USIO riserless drilling activities are expected to be minimal. Expeditions with longer durations will have the potential for greater cumulative noise and vibration impacts on fish species than those with shorter durations, but no significant

behavioral changes or long-term loss or degradation to biological populations or communities or functional habitat value is expected.

Cephalopods

It is expected that the discharge of liquids from the SODV will rapidly disperse minimizing contact and impact to cephalopods. No impacts are anticipated as a result of the release of the drill cuttings or drilling mud on most cephalopod species, due to their mobility and ability to temporarily leave an affected area. Significant impacts to cephalopod eggs, whether on substrates or suspended in the water column, are not expected, because of the limited dispersal area of material discharged focused around the borehole.

Similar to fish, it is possible that some cephalopods may be deterred from an area by incidental noise from the SODV. The impacts associated with this deterrence may include a temporary disturbance in feeding and spawning behavior in the general vicinity of the vessel. Expeditions with longer durations at one particular drill site will have the potential for greater cumulative noise impacts on cephalopod species than those with shorter durations at each drill site. No significant long-term loss or degradation to biological populations or communities or functional habitat value is expected.

Benthos

In general, the resulting impacts to benthos from riserless drilling expeditions may include:

- Localized alteration of benthic communities caused by physical changes in the substrate;
- Localized interference with benthic organism feeding and respiration due to suspended particles of drill cuttings and drilling mud; and
- Localized impacts to the benthic community derived from smothering effects of drill cuttings and drilling mud particles deposited on the seafloor.

Overall, impacts to benthic organisms resulting from riserless drilling activities in the preferred alternative are not expected to be significant. Potentially sensitive benthic communities unique to a particular area will be identified during the IODP SAS planning and review process. As needed, drill site locations or particular operations may be modified to avoid significant adverse effects to these sensitive benthic organisms. For prospective drill sites where benthic organisms that are especially sensitive to the deposition of sediment from a borehole are densely populated, or the proposed research activities may result in more intense or prolonged exposure, a supplemental environmental review may be prepared to evaluate the site-specific impacts, if any, and, if necessary, develop recommendations for additional mitigating measures.

Marine Mammals

The presence of the drillship, whether in transit or at a drill site, is unlikely to interfere with the movement of marine mammals. Close approaches of the vessel to marine mammals (or vice versa) are expected to be rare, considering that the proposed action will only involve one vessel and that the average density of marine mammals in the open ocean is very low. When close approaches occur, the mobility of marine animals and their ability to detect the ship would permit them to easily avoid contact, especially since the cruise speed of the ship is generally 11 knots or less. Therefore, collisions between the drilling ship and marine mammals are not expected to occur. Detours made by marine animals to avoid the ship will be a temporary response.

Discharges from the drillship could potentially disturb marine mammals or their food sources. Effects on water quality from drillship discharges are expected to be minimal and localized near the ship. Because of rapid mixing and the assimilative capacity of the sea, marine mammals are not expected to be exposed to the discharges. Wake and disturbance effects such as turbulence created by the dynamic positioning thrusters are likely to deter most mammals from approaching the vessel, and instead will likely remain outside the small area where an adverse effect from discharges might occur. Direct physical or toxicological effects of various vessel discharges on marine mammals are therefore unlikely and few animals will be affected.

Acoustic outputs from SODV operations have the potential to affect marine mammals exposed to the underwater sounds. No significant physiological effects to individual animals or marine mammal populations are expected to result from noise produced by the SODV. As previously noted, the noise produced by SODV operations may result in temporary displacement or disturbance of some marine organisms, including marine mammals, but the organisms are expected to return to the area after the vessel departs. The single-channel seismic surveys or vertical seismic profiling, which may be occasionally performed by the SODV at selected sites, represent an additional noise source. These activities will generally involve small seismic sources (1 or 2 airguns) operated for short durations (less than 12 hours). Resulting effects to marine mammals, if any, will be minimal and temporary due to the consistent implementation of mitigating measures to prevent exposure to harmful sound levels or sound levels that may initiate adverse behavioral effects.

Though infrequent, helicopter operations represent another noise source that may occur during SODV operations. Helicopter overflights will temporarily affect the surface environment at a given location. The noise from helicopter operations can cause a startle response and interrupt whales and dolphins while resting, feeding, breeding, or migrating. Both the noise and shadow cast by the helicopter can elicit a response from nearby cetaceans. These occurrences will be temporary and will pass within seconds, having no long-term impact on cetaceans. The greatest potential effect from helicopters is disturbance of pinnipeds breeding rookeries although such overflights would be severely limited through the use of mitigating measures.

As prompted by the IODP SAS review and planning process for each expedition, the IODP-USIO will obtain necessary approvals for the areas in which the vessel will operate including permits and other regulatory notifications. As necessary, the IODP-USIO will consult with National Marine Fisheries Service with respect to rare or endangered species (e.g., North Atlantic right whale, Northeast Atlantic bowhead whale) listed in the Endangered Species Act to prevent harassment or interference to those species. In the event that a proposed expedition that has the potential to cause significant adverse behavioral effects or disturbances to marine mammals, the IODP-USIO will apply for an IHA as required by the Marine Mammal Protection Act. Mitigating measures and operating conditions developed in response to these requirements and notifications will be incorporated into the Operating Plan and Scientific Prospectus for the expedition accordingly.

Marine Reptiles

The potential for exposure of marine reptiles to SODV wastewater discharges is expected to be minimal since water column disturbances (e.g., turbulence) caused by the SODV's presence at a drill site is likely to deter the animals from approaching the vessel and coming in contact with discharged wastewater.

Although sea turtles are generally not sufficiently mobile to avoid a moving ship in case of an imminent collision, such situations are expected to be relatively rare because the density of turtles in the open ocean is very low. Therefore, very few, if any, sea turtles are likely to be involved in collisions with the drillship, and the resulting effects on turtle populations will be minimal. Sea snakes, because of their greater mobility, are unlikely to be victims of a collision.

Based on limited available data on sea turtles hearing abilities and effects relating to exposure to acoustical outputs, it is unlikely that sea turtles will exhibit behavioral changes as a result of acoustic outputs from SODV operations. If a sea turtle approaches the SODV during drilling, it is likely the animal will exhibit an avoidance reaction. Any effects on sea turtles will generally be short term, reversible, and are not expected to displace the animals from their preferred habitats, foraging, or breeding areas.

Unless the SODV is operating in a concentrated area used by sea turtles for breeding, it is unlikely that sea turtles will be encountered during riserless drilling expeditions. Based on IODP SAS advice and guidance, mitigating measures will be developed to prevent significant adverse effects to marine reptiles by addressing site-specific factors or seasonal variations that could affect the organisms near proposed drill sites. Overall, the resulting impacts to marine reptiles are expected to be minimal, with no significant loss or degradation of marine reptile communities or functional habitats, or seasonal migration patterns.

Birds

No impacts to birds are expected as a result of air emissions generated during SODV operations, including the continuous release of fuel combustion byproducts when the SODV is in transit and is present at drill sites, intermittent use of the SODV's incinerators and the periodic release of vapors and gases from the vessels laboratories. The emissions from all sources are expected to disperse rapidly in the surrounding atmosphere.

The SODV operations will result in discharge of wastewater and victual wastes each day the vessel is at sea. These discharges could potentially affect marine birds either directly while the birds are in the water or indirectly through the ingestion of fish or plankton. Since the points of discharge for liquid wastes from the drillship will occur very close to the vessel, there should be no significant direct physical or toxicological effects on marine bird populations.

The SODV contains numerous sources of noise including the ship's diesel-electric engines, mechanical equipment, and various transducer-based devices. The sounds from these sources will propagate in air and be transmitted through the vessel and into the water. It is anticipated that the impacts to bird communities as a result of the drillship and associated equipment operation will be minimal. SODV activities could affect marine birds through disturbances caused by helicopter overflights. However, these disturbances are expected to be very infrequent and temporary. Therefore, only minimal, short-term impacts on bird populations and their flying patterns are expected.

Based on IODP SAS advice and guidance, mitigating measures will be developed to prevent significant adverse effects to sensitive bird species that may be present at specific drill sites. Overall, the resulting impacts to birds in the preferred alternative are expected to be minimal.

Threatened and Endangered Species

As indicated above, activities associated with the proposed action will have minimal impacts on marine organisms including plankton, cephalopods, fish, marine mammals, marine reptiles, and birds. This conclusion also generally applies to endangered and threatened species of those groups; however, any impacts to diminished populations or limited ranges of threatened or endangered species will be greater than impacts to non-endangered species.

The SODV will comply with all regulatory requirements pertaining to threatened species such as the Endangered Species Act. The IODP SAS review process will ensure that sufficient data is available to identify critical species near the proposed drill sites and recommends for implementation measures to mitigate potentially adverse impacts. If a riserless drilling expedition is planned in an area where endangered or threatened species may be adversely impacted or harmed, a supplemental site-specific environmental review will be performed to evaluate the risks of proceeding with the proposed action and to develop recommendations to mitigate unacceptable risks.

SODV activities are generally not expected to result in substantial loss or degradation of the functional habitats that may be used by threatened and endangered species, nor are IODP riserless drilling activities expected to result in the impedance of fish or wildlife migration routes. Because of the sensitivity of some endangered populations to the loss of even just one individual, if endangered species, habitats or other critical breeding, feeding, or migratory areas are not identified in advance, some impacts resulting from the riserless drilling expeditions may have the potential to be significant. Therefore, drilling will be avoided at locations where outputs such as wastewater discharges, seafloor alteration, or acoustical outputs have a greater potential to adversely impact local biota, habitats, or disrupt behavior.

Biologically Sensitive Areas

Despite the deep locations that the SODV will operate, a majority of the outputs associated with the operation of the vessels will occur near the surface and hundreds of meters away from sensitive communities and structures on the seafloor, such as coral reefs, hydrothermal vent (chemosynthetic) communities, and seamounts. Therefore, these types of outputs are not expected to result in significant impacts to these resources. Noise and vibrations generated by the operation of the SODV are expected to attenuate sufficiently with distance from the source to prevent most aquatic organisms from being exposed to noise levels that would result in adverse physiological effects. Although noise produced by the SODV during riserless drilling activities has the potential to displace sensitive marine organisms from their community, it is anticipated that these effects would only be realized during the relatively short period of time the vessel is on-site and drilling. Because affected organisms in biologically sensitive areas are expected to return once the vessel leaves the area, the resulting behavioral effects are considered minimal and short term in duration.

Similar to threatened or endangered species, the IODP SAS review process will ensure that sufficient data is available to identify biological resources in sensitive ecosystems that may be adversely affected by the proposed drilling activities and will recommend appropriate site-specific restrictions or best management practices accordingly. For example, chemosynthetic communities may be unlikely to recover rapidly from drilling mud deposition, increased turbidity, or changes to substrates in the localized area surrounding the borehole. If the appropriate restrictions are not implemented, long-term impacts to these deepwater communities may potentially occur, with recovery times as long as 200 years for mature tube worm communities. Similarly, prolonged exposure of coral reefs to sediment build-up, at any depth, would have a negative impact on growth and long-term survival.

Due to the diverse characteristics associated with seamounts, the potential impacts from the drilling operation in or near these structures could vary quite widely. Certain portions of the seamount would likely be less susceptible to severe impacts from the drilling of a borehole. The potential impacts associated with drilling on or near seamounts are very similar to those described for benthic organisms. Nonetheless, because seamounts represent such a diverse and

in many cases slow growing ecosystem, the drilling impacts could be significant if they result in substantial alteration or destruction of habitat that prevents re-establishment of biologically significant communities.

If a riserless drilling expedition is planned in an area where biologically sensitive organisms may be adversely impacted or harmed, a supplemental site-specific environmental review will be performed to evaluate the risks of proceeding with the proposed action and recommendations to mitigate unacceptable risks or select alternate sites will be developed.

Commercial and Native Fisheries and Aquaculture

To the extent that impacts to marine fish species resulting from the proposed riserless drilling operations affect the subsistence value of fish used by individuals as a food source or the commercial harvesting of important species, there will be an impact to fisheries and aquaculture. However, the potential for impacts to open ocean and coastal marine fish resulting from both the presence of the SODV and the riserless drilling activities are not expected to be significant regardless of location.

Due to the mobility of fish and thus their ability to avoid disturbances in their habits, impact to fisheries will be limited primarily to impacts such as disturbances to schooling fish or the smothering of food sources (e.g. plankton) or demersal eggs with drilling sediments. Considering the temporary nature of the drilling activity and the small area of the sea affected, overall impacts to marine fisheries and aquaculture are expected to be minimal.

Appropriate best management practices will be implemented to protect fishery resources. For example, permanent structures installed on the seafloor such as observatories will be designed to be trawl-resistant to prevent damage to fishing nets in areas where extensive bottom trawling occurs. If a riserless drilling expedition is planned in an area where fisheries or aquaculture may be adversely impacted or harmed, a supplemental site-specific environmental review will be performed to evaluate the risks and develop recommendations to mitigate unacceptable risks or select alternate sites.

Marine Vessel Transport & Trade Routes

Because ship traffic within a geographic area is generally related to the region's proximity to trade routes between the world's major ports, the potential impacts associated with SODV operations will be variable and dependent on the drilling location.

Through normal expedition planning or vessel operations, potential interferences with marine transportation at any given site are expected to be minimal. When transiting or stationary at a drill site, the SODV will comply with all international conventions and regulations pertaining to navigational safety. When dynamically positioned at a drill site, the SODV, by nature of the

activity, will be required to remain stationary and essentially "tethered" to the seafloor by the drilling equipment. All approaching large maritime vessels will be able to establish radar and/or visual contact with the SODV well in advance of any potential collision. When the SODV is positioned at a drill site, it will be the responsibility of the approaching vessel to choose a course which avoids a collision. However, the SODV will maintain visual and radar vigilance of pending traffic conflicts and communicate accordingly via radio and other means. In addition, the SODV will display universally-recognized maritime signal flags while drilling, indicating the vessel has restricted ability to maneuver.

Cultural Resources

A majority of IODP-USIO riserless drilling activities will be conducted in water depths greater than 500 m. Therefore, most of the mapped historical and cultural resources, which are generally located in relatively shallow coastal waters, will in all likelihood not be affected by the proposed activity. However, there are undoubtedly untold numbers of undiscovered shipwrecks and other culturally significant artifacts lying at great depth throughout the world's oceans, particularly along historic trade routes.

The comprehensive review and planning process involving the IODP SAS, the EPSP, and other review panels will evaluate each proposed riserless drilling expedition. The site characterization data in the site survey data packages will include information on known (mapped) cultural resources. If proposed drill sites are located near known or suspected cultural resource sites, recommendations will be made to either select alternate drill sites or implement mitigating measures to prevent damaging or destroying these resources.

Catastrophic Events

The primary output resulting from a catastrophic event related to the SODV itself or drilling into a geological source would be the uncontrolled release of petroleum hydrocarbons to the marine environment. Based on IODP-USIO riserless drilling experience, the probability of a major spill or catastrophic release of petroleum from the SODV or a geological source is very low. This is readily demonstrated by 21 years of ODP/IODP experience involving riserless drilling of more than 1,900 boreholes without a major spill of fuel from the vessel or accidental release of hydrocarbons from a geologic source.

Building further upon this experience, it is anticipated that this record of preventing catastrophic releases will continue with future SODV expeditions. The IODP SAS comprehensive review and advisory process combined with the stringent program of continuous real-time monitoring of hydrocarbon potential while drilling will further reduce the risk of an uncontrolled release of hydrocarbons from a geologic source to an extremely low level. Input from the IODP SAS review process may also include recommendations for site-specific mitigating measures such as additional detection tools (e.g., logging while drilling, measurement while drilling) and the

availability of resources to respond to signs of geologic hazards. For example, the IODP SAS may recommend the availability of heavy drilling mud at certain drills sites which could quickly be deployed to abandon a borehole or seal specific stratigraphic intervals, thereby ensuring a maximum level of protection from potential petroleum releases.

Severe weather represents a significant condition that could threaten vessel operations and contribute to a catastrophic release of petroleum. For example, if the ship were to be blown off a drill site during a severe storm without ample time to retrieve the drill string, the drill string could be lost and the ship may be severely damaged if it grounded in shallow water or onshore. Through best management practices including the operational planning process for each expedition and continuously monitoring ever-changing weather conditions, the SODV will be able to avoid environmental conditions which could contribute to the catastrophic release of petroleum from the vessel.

During drilling, if conditions suggesting the possible release of petroleum hydrocarbons or other gasses (e.g., hydrogen sulfide) are detected during SODV operations, drilling will immediately cease and a series of pre-defined control measures will be implemented to stabilize and seal the borehole thereby avoiding an uncontrolled release to the marine environment. It is possible, though unlikely, that riserless drilling may penetrate a thin, relatively undetectable petroleum layer, resulting in its release from the borehole to the marine environment. In this instance, the amount of material released would be minimal.

Impact Summary

The majority of identified potential environmental impacts are short term in duration, of local extent, and minimal intensity, with most impacts unlikely to occur. Unavoidable impacts focus around the effects of the drilling activity itself, and include drill cuttings deposited on the seafloor around the borehole and fine grained particles suspended in the water column or deposited on the seafloor in the borehole vicinity. Drilling locations will be sited so as to minimize these unavoidable impacts. Impacts with the most severe consequences- oil and gas releases from either a fuel spill from the drilling vessel or from a blowout caused by drilling into a pressurized geological sources- have not occurred in 40 years of DSDP, ODP, or IODP operations (1968-2008), and are judged highly unlikely to occur. Table 1 identifies the outputs associated with the preferred alternative and summarizes the significance of each potential impact.

Impact Mitigation

During each riserless drilling expedition, Best Management Practices (BMPs) and site-specific mitigating measures will be implemented that are intended to effectively reduce or avoid impacts to the environment. The IODP-USIO will be responsible for implementing these measures and assuring compliance by all applicable IODP-USIO participants (e.g., contractors, field personnel,

researchers). Additionally, using 30 years of riserless drilling experience, the IODP-USIO will continue to refine and implement various BMPs and mitigating measures to reduce or avoid adverse impacts to marine organisms and the physical environment.

BMPs represent routine actions that may be performed during riserless drilling expeditions including measures that involve every phase of IODP-USIO operations. Many of the BMPs have already been incorporated into the operating procedures that will be used by the IODP-USIO, and have been designed to complement the IODP's core environmental principles to 1) protect marine life and environment, 2) dispose waste materials consistent with applicable standards, 3) store and transport samples in such a way as to prevent contamination of the environment, and 4) keeping the public informed such as through the dissemination of the PEIS.

Table 1. Summary of Potential Impacts from IODP-USIO Riserless Ocean Drilling

Process/Activity	Output	Affected Environment	Environmental Impacts				
			Duration	**Extent**	**Intensity**	**Probability of an Impact**	**Severity Rating**
Operate the SODV (vessel in transit and at a drill site using thrusters for dynamic positioning; note: impacts associated with drilling and coring activities are summarized below)	Discharges (treated wastewater, greywater, treated bilgewater, deck drainage, ballast water, treated lab discharges)	Water Quality	Short term	Local	Minimal	Unlikely	1
		Seafloor	No environmental impacts				0
		Biological Resources					
		Typical	Short term	Local	Minimal	Unlikely	2
		Sensitive Areas	Short term	Local	Minimal	Unlikely	2
		Fisheries	Short term	Local	Minimal	Unlikely	1
	Physical Disturbances	Water Quality	Short term	Local	Minimal	Unlikely	1
		Seafloor	No environmental impacts				0
		Marine Traffic	Short term	Local	Minimal	Unlikely	1
	Underwater Noise (operation of vessel engines, generators, thrusters, mechanical systems, instruments, transponder beacons)	Acoustical Environment	Short term	Local	Minimal	Unlikely	2
		Biological Resources					
		Typical	Short term	Local	Minimal	Unlikely	1
		Sensitive Areas	Short term	Local	Minimal	Unlikely	1
		Fisheries	Short term	Local	Minimal	Unlikely	1
	Air Emissions • Exhaust & vapors	Air Quality	Short term	Local	Minimal	Unlikely	1
	• Laboratory	Air Quality	Short term	Local	Minimal	Unlikely	1
	Hazardous Materials (storage & use)	Vessel Crew & Resources	Continuous	(Not Applicable)	Minimal	Unlikely	0

Table 1. Summary of Potential Impacts from IODP-USIO Riserless Ocean Drilling

Process/Activity	Output	Affected Environment	Environmental Impacts				
			Duration	**Extent**	**Intensity**	**Probability of an Impact**	**Severity Rating**
	Solid & Hazardous Waste (handle, store, incinerate)	Vessel Crew & Resources	Continuous	(Not Applicable)	Minimal	Unlikely	0
Conduct Riserless Drilling and Coring (in addition to impacts associated with the operation of the SODV)	Discharges (seawater drilling fluid, sediment displaced from the borehole, drilling mud, cement, tracers)	Water Quality	Short term	Local; seawater drilling fluid injected into the borehole at ≤ 1,900 L/min; fine grain particles suspended in the water column may extend 100+ m from the borehole	Minimal	Certain	2
		Seafloor	Short term	Local; fine grain particles deposited within 100+ m of the borehole	Minimal	Certain	2
		Biological Resources					
		Typical	Moderate	Local; benthos & fish eggs/larva may be displaced	Minimal	Possible	2
		Sensitive Areas	Long term	Local; habit may be disturbed	Moderate	Unlikely	3
		Fisheries	Short term	Local; fish may be displaced	Minimal	Unlikely	2
		Cultural Resources	Long term	Local; deposition of sediment	Minimal	Highly Unlikely	3
	Physical Disturbances	Water Quality	No environmental impacts				0
		Seafloor	Long term	Local; drill cuttings mound within ~5 m of borehole	Minimal	Certain	3
		Biological Resources					
		Typical	Moderate	Local; benthos may be displaced or smothered	Minimal	Possible	3
		Sensitive Areas	Moderate	Local; benthos may be displaced or smothered	Moderate	Unlikely	3
		Fisheries	Moderate	Local	Minimal	Unlikely	3
		Marine Traffic	Short term	Local	Minimal	Unlikely	1

Table 1. Summary of Potential Impacts from IODP-USIO Riserless Ocean Drilling

Process/Activity	Output	Affected Environment	Environmental Impacts				
			Duration	**Extent**	**Intensity**	**Probability of an Impact**	**Severity Rating**
		Cultural Resources	Long term	Local; damage or alteration	Minimal	Highly Unlikely	3
	Underwater Noise (operation of vessel engines, generators, thrusters, mechanical systems, instruments, transponder beacons, drilling/coring)	Acoustical Environment	Short term	Local	Minimal	Unlikely	2
		Biological Resources					
		Typical	Short term	Local	Minimal	Unlikely	1
		Sensitive Areas	Short term	Local	Minimal	Unlikely	1
		Fisheries	Short term	Local	Minimal	Unlikely	1
Conduct Research Activities (geophysical logging, downhole measurements)	Discharges (none)	Water Quality	No environmental impacts				0
		Seafloor	No environmental impacts				0
		Biological Resources					
		Typical	No environmental impacts				0
		Sensitive Areas	No environmental impacts				0
		Fisheries	No environmental impacts				0
	Underwater Noise (small seismic sources)	Acoustical Environment	Short term	Local	Minimal	Unlikely	2
		Biological Resources					
		Typical	Short term	Local	Minimal	Possible	1
		Sensitive Areas	Short term	Local	Minimal	Unlikely	1
		Fisheries	Short term	Local	Minimal	Unlikely	1

Table 1. Summary of Potential Impacts from IODP-USIO Riserless Ocean Drilling

Process/Activity	Output	Affected Environment	Environmental Impacts				
			Duration	Extent	Intensity	Probability of an Impact	Severity Rating
Complete Boreholes and Install Equipment	Releases/Discharges (heavy drilling mud for borehole closure, cement for casings and borehole seal, deployment of reentry devices, observatories and instruments)	Water Quality	Short term	Local	Minimal	Unlikely	2
		Seafloor	Long term	Local	Minimal	Likely	3
		Biological Resources					
		Typical	No environmental impacts				0
		Sensitive Areas	No environmental impacts				0
		Fisheries	No environmental impacts				0
Accidental Events	Discharges (petroleum hydrocarbons from major fuel spill from the vessel; liquids and/or gases from blowout caused by drilling into geological source)	Air Quality	Short term	Local (petroleum vapors, gasses)	Severe	Highly Unlikely	2
		Water Quality	Long term	Major	Severe	Highly Unlikely	4
		Seafloor	Long term	Major	Severe	Highly Unlikely	4
		Acoustical Environment	No environmental impacts				0
		Biological Resources					
		Typical	Long term	Major	Severe	Highly Unlikely	4
		Sensitive Areas	Long term	Major	Severe	Highly Unlikely	4
		Fisheries	Long term	Major	Severe	Highly Unlikely	4
		Marine Traffic	Long term	Major	Severe	Highly Unlikely	4

Notes: **Severity Ratings: 0** = no impact; **1** = minimal local effect that ceases immediately after the vessel leaves a particular drill site; **2** = minimal local effect that continues for a limited period of time after the vessel has left a particular drill site; **3** = minimal local long-term effect; **4** = substantial effects that may be realized on a major (regional) and long-term basis.

Current Status of the IODP-USIO Activities and Schedule

The *JOIDES Resolution* is in the process of being modernized and is expected to be completed in fall 2008 (see http://www.joiscience.org/sodv). The first expedition using the modernized *JOIDES Resolution* is scheduled to begin in November 2008. Table 2 summarizes the expedition schedule as of April 2008 (see http://iodp.tamu.edu/scienceops) and provides links to specific pre-cruise information such as expedition proposal, Scientific Prospectus, location, and other data.

Table 2. USIO Riserless Vessel Expedition Schedule

Expedition Name	Exp #	Port of origin	Dates[1,2]	Total days (port/sea)	Days at sea[3] (transit /ops)	Co-Chief Scientists	USIO contact
Canterbury Basin [more information]	317	TBD	Nov'08–Jan'09	TBD	TBD	C. Fulthorpe, K. Hoyanagi	J. Geldmacher
Wilkes Land[3] [more information]	320	TBD	Jan–Mar'09	TBD	TBD	C. Escutia, H. Brinkhuis	A. Klaus
Pacific Equatorial Age Transect[4] [more information]/ Juan de Fuca [more information]	TBD	TBD	TBD	TBD	TBD	N. Ahagon, H. Pälike, M. Lyle, I. Raffi	K. Gamage

Notes:
[1] **Dates for expeditions may be adjusted pending final vessel delivery date from shipyard.**
[2] The start date reflects the initial port call day. The vessel will sail when ready.
[3] Wilkes Land activities include completion of the Adelie Drift APL.
[4] The schedule after Wilkes Land is dependent upon available funding and logistical possibilities.

Conclusion

Alternative B has been selected as the preferred alternative, judged as providing the most scientific return while being most effective at minimizing environmental, health, and safety risks. Importantly, this Alternative provides two separate reviews of scientific drilling proposals, independent of the drillship operator, that examine not only drilling safety but also environmental impacts and mitigation measures. Review of safety issues and drilling hazards of drilling proposals by the IODP-USIO's Safety Panel occurs in parallel with review by the IODP Environmental Protection and Safety Panel (EPSP). The EPSP examines potential environmental hazards in addition to those of drilling safety, and, importantly, recommends mitigation procedures to reduce environmental impact.

On behalf of NSF, I hereby authorize the decision to move forward with funding the United States Implementing Organization's participation in the Integrated Ocean Drilling Program.

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Dr. Julie Morris — Date
Director, Division of Ocean Sciences
National Science Foundation

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