

Non-Technical Summary

Introduction, Purpose and Need

The United States has conducted scientific and educational programs in Antarctica continuously since the International Geophysical Year of 1957-1958 and is dedicated to continuing this mission as a matter of national policy¹ and to foster international cooperation. Over the last 60 years of United States research in Antarctica, science has increased in complexity and extent, requiring greater support over time.

McMurdo Station was established in 1955 on Ross Island in the southwestern Ross Sea, in the southernmost area of Antarctica accessible by ship. The station serves as a gateway to Antarctica for most United States scientific field teams and as a hub for most United States scientific activities on the continent. Much of the infrastructure at McMurdo Station supporting these programs dates back several decades and is nearing or has exceeded its intended life expectancy. Today, many components of the McMurdo Station infrastructure need to be upgraded to ensure that United States activities in Antarctica can continue uninterrupted. The National Science Foundation (NSF) proposes to modernize McMurdo Station while continuing the United States Antarctic Program (USAP) science and operational activities at McMurdo Station and at field sites and associated facilities the station supports.

The purpose of the proposed activity is to ensure that the USAP's resources at McMurdo Station continue to serve as viable and flexible platforms to support evolving scientific research efficiently and effectively. The proposed activity would implement modernization projects under the McMurdo Master Plan, including the subset of McMurdo Master Plan projects in the Antarctic Infrastructure Modernization for Science (AIMS) project, by replacing or substantially upgrading assets at McMurdo Station that are nearing or have exceeded their life expectancy. Proposed modernization activities would provide facilities and equipment that meet energy efficiency standards, logistical requirements, and environmental stewardship goals. In addition, the proposed activity would continue the USAP's science and operations at McMurdo Station and the facilities supported by the station at or near current levels.

Based on a preliminary environmental review, NSF determined that the proposed activity is likely to have a more than minor or transitory impact on the Antarctic environment. In response to this determination, NSF has conducted an in-depth environmental impact assessment (EIA), termed a Comprehensive Environmental Evaluation (CEE), to evaluate the potential impacts of implementing the proposed activity.

This CEE has been prepared in accordance with applicable provisions of Annex I, Article 3 of the *Protocol on Environmental Protection to the Antarctic Treaty*² (the Protocol); the *Guidelines for Environmental Impact Assessment in Antarctica*³ (2016); the Antarctic Conservation Act, as amended by the *Antarctic Science Tourism and Conservation Act of 1996*, 16 United States Code (U.S.C.) § 2401 *et seq.* (ACA); and implementing regulations set forth in *Environmental Assessment Procedures for National Science Foundation Actions in Antarctica*, 45 Code of Federal Regulations (C.F.R.) § 641.

¹ Presidential Memorandum 6646 (1982) and Presidential Decision Directive/NSC-26 (1994).

² *The Protocol on Environmental Protection to the Antarctic Treaty* (1991); <http://www.ats.aq/e/ep.htm>.

³ Antarctic Treaty Secretariat (ATS), *Guidelines for Environmental Impact Assessment in Antarctica* (2016); http://ats.aq/documents/recatt/Att266_e.pdf.

Using the EIA process, the USAP has assessed and continues to assess the potential environmental impacts of specific, proposed projects while other assessments evaluate the impacts of recurring activities (e.g., deployment of remote equipment and automatic weather stations, establishment of field camps, building maintenance, and use of explosives). Informed by the EIA process, and with a focus on environmental stewardship in Antarctica, the USAP mitigates impacts from common sources, preventing and/or minimizing

- spills or other accidental releases;
- the introduction or distribution of non-native species;
- the release of materials or wastes to terrestrial or marine resources;
- physical disturbance of terrestrial areas;
- disturbance or contamination of sensitive environments (e.g., McMurdo Dry Valleys, subglacial lakes, geothermal resources);
- disturbance or injury to Antarctic flora and fauna wildlife;
- the release of emissions to the atmosphere;
- alteration to the terrain, either through expanding existing facilities or occupying new sites; and
- alteration to the visual landscape, wilderness, and aesthetic value of the Antarctic environment.

Proposed Activity and Alternatives

The proposed activity (Alternative A) would implement modernization projects under the McMurdo Master Plan (including AIMS), while continuing the USAP's science and operations at McMurdo Station and locations supported by the station. Proposed modernization projects would involve demolishing, constructing, renovating, and operating buildings and structures at McMurdo Station. Ongoing science and operations at McMurdo Station (and locations supported by the station) would be maintained at or near current levels throughout the approximately 15-20 year construction phase of modernization projects. Proposed modernization projects address

- construction and operational features to enhance safety and health for the USAP's participants and visitors;
- building placement to increase operational efficiency and function;
- energy conservation to increase efficiency and the incorporation of renewable energy sources;
- support functions, such as fire protection, materials storage and distribution, and electrical distribution to optimize infrastructure in support of research and operational activities;
- support for a population that should not exceed 1000 people during the austral summer;
- logistics management to optimize warehousing and delivery processes; and
- quality of life upgrades to improve the living and working experience of McMurdo Station residents.

The proposed new facilities and infrastructure would be built within the current footprint of McMurdo Station. Some facilities and functions at the station would be consolidated into new, centralized buildings to meet modernization objectives. When complete, it is estimated that the proposed improvements would

result in enhanced safety, greater fuel use efficiency, lower air emissions, reduced power and heat requirements, fewer vehicle operation hours, and fewer support and maintenance personnel. For example, McMurdo Station modernization projects would yield an estimated 35% reduction in diesel fuel consumption (for heat, power, and water) compared to current levels, due to facility consolidation and reductions in terrestrial fleet vehicle use.

It is anticipated that science and operational activities at McMurdo Station and outlying facilities supported by the station would continue at or near current levels during the construction phase of modernization projects. It is also anticipated that baseline impact levels would remain relatively constant when implementing these modernization projects. In some cases, efficiencies gained through implementing modernization projects may extend to existing facilities, once construction is completed.

In Alternative B, no infrastructure modernization would be implemented and McMurdo Station would continue science support and operational activities. Alternatives Considered but not Carried Forward included building design and configuration options.

Initial Environmental Reference

The affected environment where the proposed activity would be implemented includes McMurdo Station and surrounding areas where remote facilities and activities are supported from McMurdo Station, including

- Ross Island;
- McMurdo Sound and the Ross Sea;
- McMurdo Dry Valleys; and
- deep-field sites across the Polar Plateau, the Transantarctic Mountains, glaciers, basins, and ice shelves.

McMurdo Station is located on Ross Island, at the southern tip of the Hut Point peninsula and within Antarctic Conservation Biogeographic Region 9 and Environment S of the Environmental Domains Analysis. McMurdo Station, which encompasses approximately 2.5 km² (1 mi²), and its surrounding area are characterized as heavily disturbed. Ross Island holds many important ecological resources, such as algae, fungi, lichen, mosses, small invertebrates, seal colonies, and seabird colonies. Emperor penguins (*Aptenodytes forsteri*), Adélie penguins (*Pygoscelis adeliae*), and south polar skua (*Catharacta maccormicki*) breed at Antarctic Specially Protected Areas (ASPA) on Ross Island, including ASPA No. 124, Cape Crozier and ASPA No. 121, Cape Royds. The McMurdo Dry Valleys, within Antarctic Conservation Biogeographic Region 9, encompasses approximately 15,000 km² (5792 mi²), comprises the largest relatively ice-free area on the Antarctic continent, and Antarctic Specially Managed Area (ASMA) No. 2, the largest ASMA in Antarctica. The McMurdo Dry Valleys are a cold desert ecosystem that contains important microbiological communities, including colonies of moss, algae, cyanobacteria, and nematodes. ASMA No. 2 also includes special geological features and minerals. Lakes within the McMurdo Dry Valleys support abundant, widespread growth of benthic cyanobacteria-dominated mats, which influence overall lake geochemistry.

The Ross Sea, including McMurdo Sound, is one of the most biologically productive regions in the Southern Ocean and includes a variety of benthic communities, marine mammals, penguins, fish, and

invertebrates. Snow- and ice-covered deep-field sites in the Antarctic interior are generally devoid of flora or fauna. Numerous protected areas are present in the affected environment, including 20 ASPAs and five historic sites and monuments near McMurdo Station.

Identification and Prediction of Impacts

Potential impacts were evaluated by considering the context in which they would occur, as well as their extent, duration, intensity, and probability. Impacts from construction activities were evaluated, including building demolition, site preparation, soil fill and fines management, explosives use, importation of materials (as a potential introduction of non-native species), building construction, vehicle/heavy equipment use, traverse operations, and aircraft operations. Impacts were evaluated with respect to

- wildlife disturbance;
- air quality;
- noise;
- altered land contours;
- quality of terrestrial or marine environments;
- introduced non-native species;
- waste management;
- historic or aesthetic resources; and
- cumulative impacts resulting from relevant past, present, or reasonably foreseeable future projects.

Impacts resulting from the proposed activities could potentially be less than the impacts analyzed in this CEE. Impacts would be spread across the approximately 15-20 year construction phase of modernization projects. As a result of efficiency gains from modernization projects, impacts from continuing science and station operations are expected to be reduced compared with existing impact levels, while providing improved support for science.

Impacts from proposed modernization activities at McMurdo Station would include altering and modernizing the visual characteristics of the station and physically disturbing rock and soil in work site areas, including the generation of fines, releasing airborne pollutant emissions from construction vehicles and equipment, and generating construction waste, which requires handling and removal from Antarctica. These impacts would generally be confined to proposed project sites and would cease upon completion of modernization activities. Mitigation measures would further reduce potential impacts from the proposed activity.

Following the completion of demolition and construction activities, disturbed areas would either be regraded to the approximate original contour or prepared for new construction. The station modernization activities would improve visual sightlines when approaching the station from McMurdo Sound, thereby resulting in a beneficial impact to the aesthetic values of Ross Island.

During the multi-year construction phase, the proposed modernization activities would generate construction and demolition debris in excess of the non-hazardous solid waste currently generated

annually at McMurdo Station. All construction and demolition waste would be packaged and removed from Antarctica. Following completion of proposed modernization improvements, the amount of solid waste generated by ongoing science and operational activities would return to an amount similar to or below the amount currently generated. Thus, the proposed activity would have no long-term impacts from waste generated at McMurdo Station during modernization projects.

The use of mechanized equipment and associated fuel combustion would result in the unavoidable release of exhaust byproducts into the atmosphere during both modernization activities and ongoing science and operational activities. However, the multi-year timeframe for modernization activities would allow emissions to effectively disperse and only cause a localized impact that is consistent with normal emissions at McMurdo Station. Thus, emissions would not degrade local or regional air quality. Further, efficiencies gained through modernization activities, including an anticipated reduction of the vehicle fleet, would result in reduced fuel use and thus a reduction in associated air emissions from ongoing science and operational activities.

Proposed modernization activities would ultimately result in a reduction of impacts by

- consolidating and replacing aging structures;
- constructing new, better-insulated, and more-efficient facilities;
- upgrading power distribution to include smart grid systems;
- consolidating existing functions into a smaller developed footprint;
- reducing the amount of fuel used to generate heat and electricity;
- reducing the vehicle fleet and associated air emissions; and
- slowing snowmelt runoff drainage, thus reducing the scouring and erosion of drainage canals at McMurdo Station.

Cumulative and Unavoidable Impacts

Cumulative impacts are the effects of past, present, and reasonably foreseeable future activities that may occur over time and space and be interactive. McMurdo Master Plan (including AIMS) construction activities would be phased over time and would only occur on previously disturbed land within the McMurdo Station footprint to minimize impacts to the environment. Continued science and operations during and after modernization would result in impacts to the environment and contribute to cumulative impacts in the area. Continuing mitigation measures, monitoring, and cleanup of past-contaminated areas would reduce these impacts.

Unavoidable impacts directly resulting from implementing the proposed activity include physical disturbance of surfaces (fines and rock harvesting) in the McMurdo Station facility zone, air emissions (including fuel use and dust generation), releases to the environment (including spills and wastewater releases), waste generation, and noise. The proposed activity would not result in impacts that are substantively new or different from those already occurring. The USAP is committed to making the proposed improvements to better serve new and continuing research and to enhance stewardship of the Antarctic.

Mitigation Measures and Monitoring

As applicable, personnel implementing proposed modernization improvements would adhere to established general and/or facility-specific procedures, best management practices, and mitigation measures to minimize impacts from building demolition and construction, site preparation, explosives use, import of materials, and vehicle use. These measures would be consistent with procedures routinely implemented by the USAP and would be documented accordingly. As necessary during implementation, activities would be monitored to ensure that mitigation measures are implemented and that resulting impacts are consistent with those identified in this CEE.

Gaps in Knowledge and Uncertainties

Uncertainty and unknowns are inherent in the environmental analysis of the proposed activity. The greatest uncertainties and gaps in knowledge relate to the methodology used to estimate impact parameters, the precise timing of modernization activities, construction conditions, weather, and future science requirements. Impacts described in this CEE account for a range of conditions during facility modernization, including the service life of the facility. Therefore, variations or uncertainties that do not involve major changes to the proposed activities are not expected to significantly affect the impacts of those activities or alter the conclusions of this CEE. Additionally, if project-specific plans are refined or changed, the USAP EIA process would be implemented and updated or new EIA documentation may be prepared to meet the requirements of Annex I of the Protocol and in accordance with the ACA and its implementing regulations set forth in 45 C.F.R. § 641.

Conclusions

This CEE identifies impacts potentially resulting from the proposed activity, which would implement modernization projects at McMurdo Station over a period of approximately 15-20 years and continue ongoing science and operations at McMurdo Station and the area it supports.

The proposed activity (modernization and continuing operations) is not anticipated to expand the operational footprint of McMurdo Station or fixed facilities supported by McMurdo Station. Similarly, the proposed activity would not result in impacts that are substantively new or different from those that have already occurred. Impacts from the proposed activity are projected to be localized and either contained and removed from the continent (e.g., solid and hazardous waste) or at a level that the environment is able to absorb without change at the regional level (e.g., wastewater effluent and air emissions). However, some impacts would result in more than minor or transitory impacts, even with proposed mitigations. Therefore, the proposed activity is likely to result in some long-term, adverse impacts on the Antarctic environment, although any such impacts would be less than current operations.

The proposed activity would result in substantial improvements in environmental performance, and consistent use of mitigations and monitoring would further minimize impacts. Benefits would include continuing substantive scientific and logistic collaboration with other Antarctic programs and increased potential for enhanced international collaboration as new science and logistical opportunities arise.

The major benefits of modernization components of the proposed activity are

- improved capacity for the USAP's research in concert with continuing international collaborations in scientific and operational activities;
- enhanced safety performance in the USAP;
- increased operational efficiency (12% reduction in support staff; 40% reduction in maintenance staff);
- increased logistical efficiency (20% reduction in building square footage);
- reduced outdoor storage (at least 35%, and up to 90%, reduction);
- reduced energy consumption (35% reduction in station fuel consumption; 20% reduction in vehicle fuel use);
- reduced carbon emissions; and
- reduced long-term environmental impact.