

Committee for Environmental Protection

CLEAN-UP MANUAL

1. Introduction

a) Background

In 1975 the Antarctic Treaty Parties adopted Recommendation VIII-11, which contained the first agreed guidance for the appropriate management and disposal of waste generated by expeditions and stations, with a view to minimising impacts on the Antarctic environment. As awareness of the potential environmental impacts of the disposal of waste in the Antarctic region increased, in parallel with improvements in logistics and technology, the Parties identified a need for improved on-site treatment of wastes and for the removal of some wastes from the Antarctic Treaty area.

Through Recommendation XV-3 (1989) the Parties adopted more stringent waste disposal and management practices, based on recommendations from a SCAR Panel of Experts on Waste Disposal in the Antarctic, with the aim of minimising impact on the Antarctic environment and minimising interference with scientific research or other legitimate uses of the Antarctic. These practices not only addressed requirements for the management of wastes associated with present and future activities, but also called for programs to clean up existing waste disposal sites and abandoned work sites, and for an inventory of locations of past activities.

Many elements of Recommendation XV-3 are closely reflected in the current provisions for waste disposal and management, contained in [Annex III to the Environmental Protocol](#), on Waste Disposal and Waste Management. The Environmental Protocol as a whole sets the context in which the provisions of Annex III should be implemented.

Among other requirements Annex III provides, in Article 1.5, that:

‘Past and present waste disposal sites on land and abandoned work sites of Antarctic activities shall be cleaned up by the generator of such wastes and the user of such sites. This obligation shall not be interpreted as requiring:

- a) the removal of any structure designated as a historic site or monument; or
- b) the removal of any structure or waste material in circumstances where the removal by any practical option would result in greater adverse environmental impact than leaving the structure or waste material in its existing location.’

Prior to these instruments, waste management at Antarctic facilities often involved the open burning and disposal of waste in tips. Similarly, it was commonplace to abandon disused facilities and leave them to deteriorate. Many past waste disposal sites and abandoned work sites require ongoing management today. Such sites are frequently characterised by a mix of physical debris (e.g. building materials, machinery, vehicles, general rubbish) plus chemical contaminants, some of which may be in containers (which are subject to deterioration) and some of which may have been released into the environment. In some instances waste disposal sites extend into the near shore marine environment. Seepage and runoff from abandoned sites, and from more recent spill sites, can result in contamination spreading to other parts of the environment. In general such contaminants degrade very slowly in Antarctic conditions.

Based on extrapolation from a few well documented sites, it has been estimated that the volume of abandoned, unconfined tip materials in Antarctica may be greater than 1 million m³ and that the volume of petroleum-contaminated sediment may be similar (Snape and others, 2001). Although this is a relatively small volume compared to the situation in other parts of the world, the significance of the associated environmental impacts is magnified due to the fact that many Antarctic contaminated sites are located in the relatively rare coastal ice-free areas that provide habitat for most of the terrestrial flora and fauna.

b) Overall Clean-Up objective

The overall objective for Parties' actions to address environmental risks posed by past waste disposal sites on land, abandoned works sites of Antarctic activities, and sites contaminated by spills of fuel or other hazardous substances is:

To minimise adverse impact on the Antarctic environment, and to minimise interference with the natural values of Antarctica, with scientific research and with other uses of Antarctica which are consistent with the Antarctic Treaty, by cleaning up past waste disposal sites on land, abandoned work sites of Antarctic activities, and sites contaminated by spills of fuel or other hazardous substances. Such clean-up actions shall not require the removal of any: structure designated as a historic site or monument: pre-1958 historic artefacts / sites subject to the provisions of [Resolution 5 \(2001\)](#); or structure or waste material in circumstances where the removal by any practical option would result in greater adverse environmental impact than leaving the structure or waste material in its existing location.

This objective reflects requirements outlined in Annex III (Waste Disposal and Waste Management) to the Protocol on Environmental Protection to the Antarctic Treaty (the Environmental Protocol).

c) Purpose of the Clean-Up Manual

The purpose of this manual is to provide guidance to Antarctic Treaty Parties in order to meet the objective above. The manual includes key guiding principles and links to practical guidelines and resources that operators can apply and use, as appropriate, to assist with addressing the requirements of the Environmental Protocol, in particular Annex III. The practical guidelines are recommendatory and not all guidelines will be appropriate to all operations, or to all sites. The manual is intended to be updated and added to as new work, research and best practice emerges.

The guidance provided here is focussed on the repair and remediation of past waste disposal sites on land, abandoned work sites of Antarctic activities, and sites contaminated by spills of fuel or other hazardous substances. Practical guidance for preventing, monitoring and responding to the introduction of non-native species is presented in the Committee for Environmental Protection (CEP) [Non-Native Species Manual](#).

The Council of Managers of National Antarctic Programs (COMNAP) has developed a Fuel Manual, which outlines important measures for spill prevention and containment. This Clean-Up Manual complements the COMNAP Fuel Manual by providing guidance on appropriate clean-up and restoration actions, which the COMNAP Fuel Manual indicates should be addressed as part of the Operational Plans to be prepared for individual facilities or relevant geographic areas.

In practice, it will not be practicable to clean up all past waste disposal sites on land, abandoned work sites of Antarctic activities and contaminated sites immediately or concurrently, so the manual also aims to provide guidance on identifying priorities for clean-up activities, and on remediating or removing contaminated materials to a level where ongoing environmental risks are mitigated.

Reasons to undertake timely clean-up action, in accordance with the provisions of the Environmental Protocol, include:

- many abandoned waste disposal sites and abandoned work sites contain potential contaminants in containers (e.g. drums filled with fuel, oil, chemicals), and there is a limited time before they deteriorate, causing contamination and making clean-up much more difficult;
- as noted by the 2010 Antarctic Treaty Meeting of Experts on Climate Change and Implications for Antarctic Management and Governance, climate changes could accelerate localised release of contamination from past waste disposal sites and abandoned work sites through increased melting;
- the harmful effects of chemical contaminants on the environment and ecosystem can increase with increasing exposure time, and increase the chance of cumulative impacts from exposure to other environmental stressors;
- dispersion processes (e.g. entrainment with melt water) can cause the total area contaminated to increase with time, in some cases resulting in contamination of the marine environment;
- some sites may otherwise be lost to the ocean or covered by ice/snow where they may continue to have detrimental impacts but will be much more difficult and costly to manage; and
- possible risks to human health (e.g. hazardous chemicals or other substances, such as asbestos).

d) Glossary

The practice of environmental clean-up uses some technical terminology. Additionally, some words that are commonly used in everyday language have a specific meaning when used in the context of environmental clean-up. To help ensure a common understanding, this glossary will be expanded as part of the development of the manual. Definitions generally applicable to assessing, mitigating and monitoring the environmental impacts of activities are presented in the [Guidelines for Environmental Impact Assessment in Antarctica](#).

CLEAN-UP: the removal and/or on-site remediation of past waste disposal sites on land, abandoned work sites and sites contaminated by spills of fuel or other hazardous substances.

2. Key Guiding Principles

Information management

Record keeping is important throughout the clean-up process and should commence well before any clean-up activities occur on site.

- 1) Record keeping should be designed so that information on individual sites is easily accessible and so that information on actions and events at each site can be added over time.
- 2) The record of information should be kept up to date and should include the precise location and status of contaminated sites, the clean-up actions that have occurred, the reasons why key decisions were made and the lessons learned.
- 3) The type of information to be recorded should reflect its intended use, including:
 - site assessment and prioritisation;
 - supporting operational decisions;
 - ensuring compliance to environmental impact assessment / permit conditions;
 - monitoring and evaluating the effectiveness of a clean-up process; and
 - facilitating the exchange of information between Parties and with other stakeholders.
- 4) Record keeping should be designed so that it can also be used as the foundation for the Antarctic-wide inventory of locations of past activity, in accordance with Article 8.3 of Annex III.

Site assessment / characterisation

An assessment of the features of the site that will influence how contaminants behave, and the environmental values that may be impacted, should be undertaken before considering how best to clean-up a site.

- 5) The site assessment should consider:
 - the nature and extent of physical debris and/or chemical contamination, and the landscape (e.g. geology, geomorphology, glaciology) of the site and surrounding area, with particular emphasis on slope, aspect and water flows;
 - potential challenges for clean-up actions presented by the location, landscape, and surrounding area (e.g. accessibility and susceptibility to damage from machinery or recovery equipment);
 - the environmental values of the site and surrounding area, including the range of values protected under the Environmental Protocol; and
 - likely changes at the site including deterioration of containers (such as rusting fuel drums), changes in chemical compositions (e.g. through natural weathering processes) and transport of the contaminants (e.g. from wind or water flow).
- 6) All available information should be used to assess the current impact and potential future threat to the environment from the contamination.

Environmental risk assessment

Environmental risk assessment is the process of determining the inherent risks posed by the site to the environmental values.

- 7) The environmental risk assessment should use the information gained during site assessment, including uncertainties, and should inform the decisions taken throughout the clean-up process.

- 8) The environmental risk assessment should assist to prioritise which site(s) should be cleaned up first, to decide among the various clean-up options (see below) and to set realistic targets for clean-up (see below).
- 9) The environmental risk assessment should be regularly reviewed and confirmed or modified during the clean-up process.

Environmental quality targets for clean-up

In some cases, the complete removal of all traces of contamination would be impractical, or would result in greater adverse environmental impact. Environmental quality targets for clean-up are the concentration of contaminant that may remain within the environment without creating unacceptable impacts on the environmental values of the site.

- 10) Environmental quality targets for clean-up should be determined on a site specific basis taking into account the characteristics of the site and the environmental values present.
- 11) From the viewpoint of biodiversity conservation, environmental quality targets should be based on the sensitivity of relevant species to the specific contaminants (such as from ecotoxicology studies).
- 12) Environmental quality targets are just one factor when considering the options for clean-up (see below).

Consideration of clean-up options

At the highest level the range of possible clean-up options for sites contaminated by fuel and other hazardous substances may include: do nothing (which may result in natural attenuation); containment on site to reduce dispersion; *in situ* remediation to enhance attenuation processes; removal from the site with treatment in Antarctica (clean-up *ex situ*); and removal from the Antarctic Treaty area. Within each of these options there are further choices of possible clean-up actions (see below).

- 13) A risk assessment should be undertaken for all clean-up options being considered, with a focus on ensuring that greater adverse environmental impact does not occur as a result of the clean-up process.
- 14) Options analysis should consider the environmental quality targets and risk of additional adverse impacts arising from the clean-up activity. Given the practical realities of operating in Antarctica, other relevant considerations are likely to include feasibility, available technology, practicality, safety of personnel, and cost-effectiveness.

Clean-up actions

Clean-up actions are the operational activities that happen at the site and / or elsewhere on material that has been removed from the site.

- 15) Wherever appropriate, plans and environmental impact assessments for new activities in Antarctica should consider the nature and scale of any clean-up activity which will be subsequently required. Actions to clean-up sites of past activities should also be subject to environmental impact assessment in accordance with the provisions of the Protocol.
- 16) Clean-up techniques developed for contaminated sites in other regions of the world may have some value in Antarctica but are likely to require modification to make them suitable for local conditions.
- 17) All clean-up options, including the 'do nothing' option, may require some commitment of resources, such as monitoring (see below) to confirm the environmental risk assessment.
- 18) In some cases containment on site to reduce dispersion will be identified as the best means of protecting environmental values. Techniques for containment should be designed for:
 - the types of contaminants present (the principal distinction being organic (e.g. fuel) or inorganic (e.g. metals from waste dumps); and
 - the characteristics of the environment (principally the freeze/thaw process and the highly seasonal presence of free water).
- 19) *In situ* remediation to enhance attenuation processes (e.g. enhanced biodegradation by the adding of nutrients, increasing temperature and aerating soil) can be cost-effective and is likely to be less disturbing to the environment than options requiring extraction, but techniques must be appropriate for the types of contaminants and the characteristics of the environment (as above).
- 20) Removal from the site with treatment in Antarctica may create more disturbance at the site than *in situ* remediation but has the potential advantage of relocation to a site that is more easily managed such as

close to a station. The receiving site should be controlled to ensure the safety of personnel and to prevent further environmental impact (e.g. clearly identifiable and known to station personnel, contained to prevent dispersal of contaminants).

- 21) In some cases the removal of contaminated materials from the Antarctic Treaty area may be the most appropriate option for addressing the requirements of the Environmental Protocol. As above, this may create more disturbance than in situ remediation and, in the case of ice-free sites, also has the disadvantage of removing rare soil from Antarctica. This option is also likely to be the most costly, is dependent on the availability and capacity of shipping, and may raise biosecurity or contaminated material concerns for the receiving country.
- 22) Monitoring and evaluation (see below) should be designed as an integral part of the clean-up process.
- 23) Clean-up should be considered complete only once the environmental quality targets have been met.

Monitoring and evaluation

Monitoring and evaluation are both used to characterise and record the quality of the environment but have specific and distinct roles before, during and/or after clean-up.

- 24) Monitoring should be undertaken to identify and provide early warning of any adverse effects of the clean-up activity that may require modifications of procedures, and to assess and verify predictions identified in the environmental impact assessment.
- 25) Evaluation refers to determining whether the clean-up activity has achieved the desired environmental quality targets.
- 26) Both monitoring and evaluation should focus on the vulnerable environmental values of the site and take into account the final use of the data.

3. Guidelines and resources to support clean-up

As the manual is developed, this section will be expanded to contain voluntary guidelines and resources to assist Parties to address their clean-up obligations under Annex III to the Protocol. Examples of desirable materials include:

- a standard approach and/or form for record keeping and reporting on clean-up activities;
- checklists and/or matrices for site assessment and environmental risk assessment;
- scientific information to inform the setting of appropriate environmental quality targets;
- techniques for preventing mobilisation of contaminants such as melt water diversion and containment barriers;
- techniques for in-situ and ex-situ remediation of sites contaminated by fuel spills or other hazardous substances;
- techniques for the clean-up of buildings or other structures at abandoned work sites;
- guidance for planning and undertaking monitoring and evaluation.

Resources

Checklist for Preliminary Site Assessment: See Annex 1

References

This list of references will be expanded to list further papers as the manual is developed.

[ATCM XXXV/IP6](#) (Australia). 2012. Topic Summary: CEP Discussions on Clean-Up (contains links to electronic versions of papers on the subject of clean-up submitted to the Committee for Environmental Protection between 1998 and 2011)

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Filler, D., Snape, I., & Barnes, D., Eds. 2008. *Bioremediation of Petroleum Hydrocarbons in Cold Regions*. Cambridge. 288 pp.

Poland, J.S., Riddle, M.J., & Zeeb, B.A. 2003. Contaminants in the Arctic and the Antarctic: a comparison of sources, impacts, and remediation options. *Polar Record*, 39(211), 369-383.

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Snape, I., Riddle, M.J., Stark, S., Cole, C.M., King, C.K., Dubesque, S., & Gore, D.B. 2001. Management and Remediation of contaminated sites at Casey Station, Antarctica. *Polar Record*, 37(202), 199-214.

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Annex 1: Checklist for Preliminary Site Assessment

ASSESSMENT AND REPORTING INFORMATION				
Title of Report/Assessment				
Date of Report		Prepared by:	Contact details:	
Date of Site Visit (if applicable)		Assessor(s):	Contact details:	
GENERAL CHARACTERISTICS OF SITE				
Place Name				
Location (coordinates of point)				Status (Antarctic Specially Protected Area (ASP) / Antarctic Specially Managed Area (ASMA) etc):
Location (coordinates of bounding polygon)	North:	South:	East:	West:
Nearest Operational Antarctic Station		Distance from Station:	Accessibility:	
General Description of Site				
Site Type (seasonally ice-free land, lake, permanent snow/ice, marine)				
Geomorphology (slope, aspect, landscape features etc)				
Geology (rock type, rock fracturing etc)				
Regolith (depth and type of soil/sediment if present, depth to permafrost etc)				
Fauna / flora present				
HISTORY OF SITE USE AND CONTAMINATION EVENTS				
History of Site Use and Activities				
Information Sources (Station/Voyage Leader Reports, people interviewed, photographs etc)				
Contamination History				

(operational activities and events, such as spills and spill responses if applicable)	
Information Sources (Station/Voyage Leader reports, incident reports, people interviewed, photographs etc)	

CONTAMINANTS PRESENT

Contaminant Type	Contained Material estimated quantity (range: min/max)	Uncontained/mixed with soil/water etc estimated quantity (range: min/max)	Evidence (records, observations - sight, smell etc)	Coverage (patchy/localised, whole site etc)	Samples Taken (Yes/No, number, type)
1. General waste (including abandoned waste dumps)					
2. Metals					
3. Hydrocarbons (including fuel and oil)					
4. Other organic chemicals (e.g. polychlorinated biphenyls (PCBs), flame retardants etc)					
5. Radionuclides					
6. Sewage, Nutrients					
7. Biological (including Non-Native Species and microorganisms)					
8. Asbestos					
9. Other Contaminants					

CONTAMINANT MOBILISATION PROCESSES AND PATHWAYS

Mobilising Processes	Site Specific Information on Processes	Timing (daily /seasonal /multi-year /occasional etc)
Surface melt streams		

Sub-surface / groundwater		
Tidal inundation		
Wind		
Deterioration of containers		
Sensitivity to climate change processes		
Other processes (such as vehicle movements)		

VALUES/RECEPTORS POTENTIALLY OR ACTUALLY IMPACTED

Values/Receptor	Site-Specific Information on Values/Receptors and Exposure Pathways (include estimates of distance from contaminants)	Actual or Potential Impacts?
Fauna and flora		
Scientific		
Historic		
Aesthetic		
Wilderness		
Geological and geomorphological		
Other environments (atmospheric, terrestrial (including aquatic, glacial, marine))		
Human health		
Other values/receptors (such as station water supply)		

OTHER FACTORS TO CONSIDER

Issue	Comments
Potential for cumulative impacts from other activities or sites	
Interaction with activities of other Parties	
Critical timing (including logistics and operational factors, access, freeze/thaw, breeding cycles, other sensitive times etc)	
Factors that may influence ability to clean-up without creating greater adverse environmental impacts	
Location of contaminants in relation	

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to ground surface (e.g. surface only, completely / partially buried)	
Health and Safety (including human exposure pathways, personal protective equipment (PEP), access restrictions etc)	
Incident response plans (including those actually implemented at site and existence of relevant Contingency Plans)	
Interim control measures already in place	
Unusual specialist skills, experience or accreditation required for personnel involved in further investigation, sampling and management of site	

MANAGEMENT RECOMMENDATIONS (MAY BE REVISED IF NEW INFORMATION BECOMES AVAILABLE OR CONDITIONS CHANGE)

Proposed Action	Comments
No Action Proposed <input type="checkbox"/>	
Further Investigation <input type="checkbox"/>	
Contain <input type="checkbox"/>	
Clean-up <input type="checkbox"/>	
Other <input type="checkbox"/>	