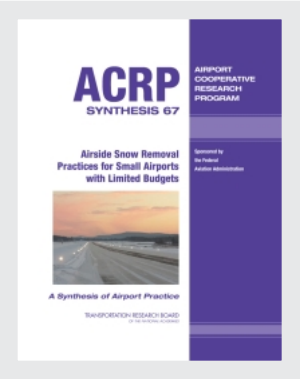


# Airside Snow Removal Practices for Small Airports with Limited Budgets



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AIRPORT COOPERATIVE RESEARCH PROGRAM

# ACRP SYNTHESIS 67

# Airside Snow Removal Practices for Small Airports with Limited Budgets

## *A Synthesis of Airport Practice*

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**Cover figure:** Plowed airport runway. Credit: M. Moriarty, Keene, NH.

**ACKNOWLEDGMENTS**

Appreciation is expressed to Kathleen O'Lenic for her research and editing assistance and to the panel members for their insight and content assistance.

## FOREWORD

Airport administrators, engineers, and researchers often face problems for which information already exists, either in documented form or as undocumented experience and practice. This information may be fragmented, scattered, and unevaluated. As a consequence, full knowledge of what has been learned about a problem may not be brought to bear on its solution. Costly research findings may go unused, valuable experience may be overlooked, and due consideration may not be given to recommended practices for solving or alleviating the problem.

There is information on nearly every subject of concern to the airport industry. Much of it derives from research or from the work of practitioners faced with problems in their day-to-day work. To provide a systematic means for assembling and evaluating such useful information and to make it available to the entire airport community, the Airport Cooperative Research Program authorized the Transportation Research Board to undertake a continuing project. This project, ACRP Project 11-03, "Synthesis of Information Related to Airport Practices," searches out and synthesizes useful knowledge from all available sources and prepares concise, documented reports on specific topics. Reports from this endeavor constitute an ACRP report series, *Synthesis of Airport Practice.*

This synthesis series reports on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems.

## PREFACE

*By Gail R. Staba*
*Senior Program Officer*
*Transportation Research Board*

The timely removal of snow from an airport surface can be an important safety and business matter for an airport. The purpose of this synthesis was to gather information on the challenges and successful strategies that airport operators use at small airports with significant budget and other constraints while coordinating and conducting snow removal operations.

Information used in this study was acquired through a review of the literature and survey of nonprimary commercial service and general aviation airport operators and industry experts.

Stephen M. Quilty, SMQ Airport Services, Lutz, Florida, collected and synthesized the information and wrote the report. The members of the topic panel are acknowledged on the preceding page. This synthesis is an immediately useful document that records the practices that were acceptable within the limitations of the knowledge available at the time of its preparation. As progress in research and practice continues, new knowledge will be added to that now at hand.

# CONTENTS

Note: Photographs, figures, and tables in this report may have been converted from color to grayscale for printing. The electronic version of the report (posted on the web at www.trb.org) retains the color versions.

# AIRSIDE SNOW REMOVAL PRACTICES FOR SMALL AIRPORTS WITH LIMITED BUDGETS


## SUMMARY

The objective of this synthesis was to gather information on the challenges faced by small airport operators, particularly those with budgetary and other constraints, in coordinating and conducting snow removal operations; and successful strategies they employ. Information in this report can be used by local and state policy makers, small airport managers, and users of small airports to better understand the needs of their local airports, to enhance snow removal efficiencies, and to help reduce liability exposure.

The targeted airports for the study were small nonprimary and general aviation airports in the United States. Survey methodology, detailed in chapter one, produced a list of 175 potential interviewees. All 175 airports were sent a letter requesting their participation in the study. Fifty (50) airports self-selected to participate; 46 completed the survey, for a response rate of 92%. The airports are diversified across the northern tier of the United States and are classified into five groups identified for comparison purposes: basic, local, regional, reliever, and nonprimary commercial service, as defined by the FAA's General Aviation Asset Report. The majority of airports involved in the survey were categorized as local; chapter seven discusses the unique challenges faced by rural airports in Alaska.

In documenting the efforts of small airports to meet federal guidelines and user expectations during winter snow events, the information sought included:

- the type and age of equipment airports commonly use;
- how equipment is acquired;
- the staffing levels and arrangements used;
- the pressures snow removal operators experience;
- operational strategies used;
- safety issues taken into account;
- employee training provided;
- equipment needs and desires; and
- lessons learned and helpful advice.

The timely removal of snow from an airport surface can be an important safety and business matter for an airport. For instance, three airports in the survey stressed the importance of being available for medical life-flights. Several airports cited the need to clear the runways to accommodate local corporate and business aircraft that might locate elsewhere if not able to use the airport. The inability of an aircraft to use an airport can result in a loss of fuel sales, maintenance business, or other income generating or economic opportunities. There are reports in the literature of aircraft suffering an accident as a result of incomplete snow removal.

The survey responses indicate that limited budgets severely hamper the ability of small airports to remove snow in a consistent and timely manner. However, the survey interviews and responses indicate that all of them strive to do the most efficient job possible with the limited resources available. Most of the airport operators responding to the survey had sole responsibility for their own snow removal, while a few had a municipality's public works department, fixed-base operator, or private contractor perform snow removal.

The prime challenges within the different categories of airports are related to the organizational structure of small airports, the budget constraints, the lack of equipment and adequate personnel, the expense associated with snow removal operations, and the difficulty in forecasting the number or severity of future winter events. In many cases, the equipment used at the surveyed airports is old and limited in functionality. It is primarily at the reliever and nonprimary commercial service levels, where activity and funding levels are much higher and where the user impact may have greater consequence within the community, that snow removal activities at the airport receive the greatest organizational support. It is those same airports that tend to be more financially sound and have greater opportunity to obtain grant-funded equipment, thereby relieving the local governments of those expenses.

Airports use a variety of funding mechanisms to acquire snow removal equipment. Airport Improvement Program (AIP) funding is the primary method. However, limitations exist on the quantity of equipment that can be acquired via AIP, and other funding methods will be necessary, such as acquiring surplus property. Additional funding is available from federal, state, or local governmental fleet purchases and state-to-state reciprocity agreements.

The airport managers indicated in their responses that fuel and personnel were the two main variable expense items associated with snow removal activities. The managers' responses all reflected the importance of having their airport available for public use because they understood its importance to the community and the users of the airport. The challenges they face, though numerous, can be addressed with lessons learned and advice from seasoned operators.

CHAPTER ONE

# INTRODUCTION

This synthesis presents information on the challenges and successful practices or strategies for coordinating and conducting snow removal operations at small, primarily general aviation (GA) airports with budget limitations. The study focuses on the removal of snow from the airports' airsides, not the landsides.

## LITERATURE REVIEW

The subject matter has not attracted extensive study or research. A web search of academic and public databases produced only a few articles having a particular focus on small airports. Most were news articles that highlighted a small community experiencing budget difficulty as a result of recent winter events. The budget issues were municipal-wide and did not reflect separately on the airport. Typical reports referred to the city's making fund transfers from reserve accounts and reconsidering adjustments to the next year's budget.

There is existing guidance on snow removal at airports, generally for larger-sized airports than those included in this report. However, the practices and strategies in the literature have applicability to small airports. The FAA produces three relevant advisory circulars (AC) that provide guidance for airport operators: *Airport Winter Safety Operations* (AC150/5200-30C 2012); *Airport Snow and Ice Control Equipment* (AC150/5220-20A 2014); and *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Material* (AC150/5220-18A 2007). Minimum safety requirements for airports with Part 139 certification are identified in 14 CFR Part 139 (2014). Appendix A provides a list of ACs and FAA orders related to airport winter operations. All ACs are intended to provide useful guidance material to all airports, whether GA or Part 139.

Another key literature resource is the *Guidebook for Airport Winter Operations* (McGormley et al. 2015), intended to help airports prepare for, operate during, and recover from disruptive winter events, as well as to manage airport user expectations. A number of strategies, techniques, practices, and resources are provided within the guidebook. For instance, it identifies and evaluates effective practices in airport airside and landside winter operations, and provides guidance on how to manage overall passenger experiences within a framework of safety and efficiency. The guidebook also provides guidance to airport operators on determining the optimal level of investment necessary to implement an effective program, given the expected winter conditions and the level of aviation activity at a particular airport.

## SURVEY METHODOLOGY

The study methodology addressed the following objectives and selection criteria:

- Focus on nonprimary commercial service and GA airports;
- Obtain a sampling of airports from a cross-section of states;
- Select public-use airports listed in the National Plan of Integrated Airport Systems (NPIAS);
- Select airports that have 30 inches or more of annual snowfall.

The NPIAS identifies nearly 3,400 existing and proposed airports that are significant for national air transportation and thus eligible to receive federal grants under the Airport Improvement Program (AIP). It also includes estimates of the amount of AIP money needed to fund infrastructure

development projects that will bring these airports up to current design standards and add capacity to congested airports. The FAA is required to provide Congress with a five-year estimate of AIP eligible development every two years (NPIAS 2013). The NPIAS comprises all commercial service airports, all reliever airports, and selected GA airports.

A review of the NPIAS identified more than 400 public-use nonprimary commercial service (NP COMM SVC) and GA airports in the northern tier of the United States that routinely experience snow. Public-use airports that routinely received more than 30 inches of snow a year—the FAA recommended threshold for having snow removal equipment beyond just one snow plow (AC150/5220-20A 2014)—were selected, as they were more likely to experience challenges associated with the purpose of the study, and to have established strategies to address them. (Annual snowfall amounts were obtained from the National Oceanic Atmospheric Administration National Climatic Data Center.)

The screening criteria produced 175 potential interviewees. All 175 airports were sent a letter requesting their participation in the study; 50 offered to participate. Forty-six (46) airports completed the 38-question survey, a response rate of 92%. Participating airports are identified in Appendix B and the survey is reproduced in Appendix C.

The survey sought to capture data on the following:

- Equipment inventory and preferences
- Type of snow and frequency
- Achievement of FAA guidelines timely removal of snow removal
- Snow clearing techniques
- Safety, including vehicle incursions and incidents from surface contamination, and airfield communication
- Snow plans and other effective practices
- Training
- NOTAMS and other condition reporting techniques
- Anti-icing and de-icing practices
- Joint purchasing or sharing arrangements for equipment.

GA and rural airports in Alaska have a different organizational structure for snow removal than airports in the contiguous United States. Therefore, they were not included in the survey solicitations; instead, interviews were conducted with persons having oversight of snow removal operations at multiple airports in the state. The information and data from the interviews are presented in chapter seven. Because of the different oversight structures, regulations, and geographical and operational needs, not all practices described in other chapters of the report are applicable to airports in Alaska. When referring to survey respondents, the report is addressing the responses from those airport operators in the contiguous United States; attempts are made to identify where practices differ.

## AIRPORT CATEGORIES

The airports responding to the survey represent a cross-section of sizes and roles of general aviation airports, as well as different weather conditions. The list of airports in Appendix B provides additional information on the number of snow removal equipment (SRE) reported at each airport and the number of personnel normally used for snow removal operations. The location of surveyed airports are displayed in Figure 1.

Airports are categorized throughout the synthesis using a combination of roles identified in the NPIAS funding categories and the GA ASSET Report (FAA 2012; NPIAS 2014). The NPIAS divides airports between primary and nonprimary. The nonprimary category includes GA, reliever, and NPCS. The category of NPCS is separate from the other categories, even though those airports could have a GA ASSET designation, because commercial service airports have funding capabilities different from the other categories, and their equipment needs and capabilities can also be distinct from others. The NPIAS's nonprimary categories are further broken out by the GA ASSET Report categories into the following roles: basic, local, regional, reliever, national, and unclassified. The

FIGURE 1 General locations of airports participating in the study.

categories allow for comparison of an airport's ability to receive FAA grant funding for SRE and for better comparison of snow removal characteristics and practices among the airports.

According to the 2014 NPIAS report, NPCS airports are publicly owned airports with scheduled air carrier service and annual boardings between 2,500 and 9,999 passengers. Reliever airports are high activity airports that provide GA aircraft with alternatives to congested hub airports. Reliever airports are located in metropolitan areas and have 100 or more based aircraft or have at least 25,000 annual itinerant operations. GA airports are public-use airports that do not receive scheduled commercial service and have fewer than 2,500 revenue passenger enplanements on air taxi or charter aircraft. GA airports in the NPIAS usually have at least 10 locally based aircraft and are at least 20 miles from the next nearest NPIAS airport.

Figure 2 provides a description from the GA ASSET Report and the type of activity that can be expected at each of the different categories of airports. The number of airports in each category

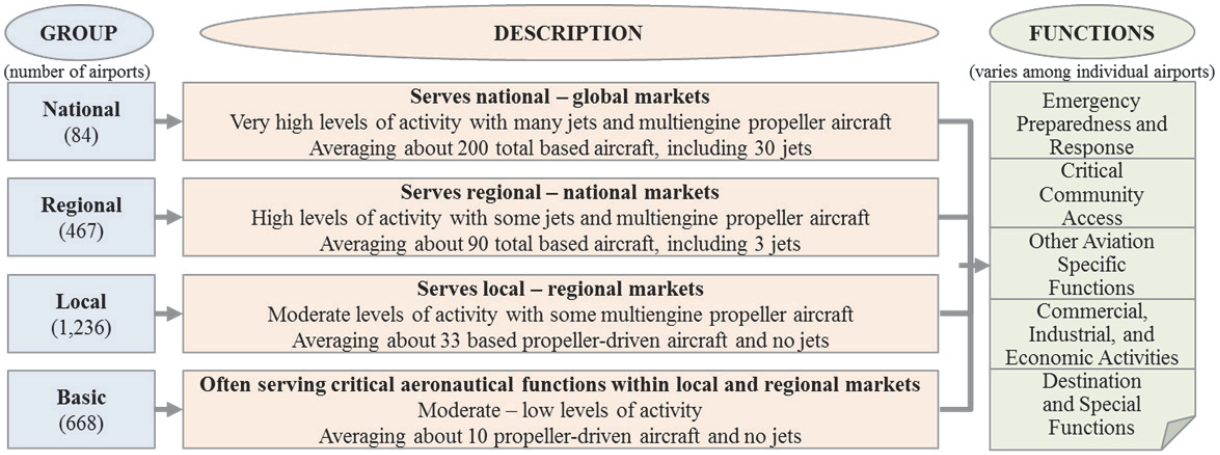



FIGURE 2 Description of typical aircraft activity at different categories of airports. *Source*: *General Aviation Airports: A National Asset* (2012).

TABLE 1
MOST DEMANDING TYPE OF AIRCRAFT SERVING SURVEYED AIRPORTS

| Type of Primary Aircraft Served | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Jet | — | 13 | 6 | 5 | 4 |
| Turboprop | 5 | 3 | 1 | 1 | 3 |
| Multi-piston | 1 | 2 | — | — | — |
| Single-piston | — | 3 | — | — | — |

— = no data.
*Source*: SMQ Airport Services.

represented in the synthesis are: basic (six); local (21); regional (seven); reliever (six) nonprimary commercial service (six). Only one national airport participated in the survey; its data were grouped with the reliever airports.

The different roles that airports play in the National Airspace System (NAS) are reflected in the type of aircraft that use them. The type of aircraft affects design and construction requirements for an airport's runway length and its airfield lighting and marking requirements. From a winter operations perspective, aircraft operations are affected by braking capabilities on runways that are wet, icy, or snow-covered; allowable snow bank heights; the type of pavement friction enhancement that can be used; and the need for timely clearing of the pavement surfaces. Table 1 summarizes the most demanding type of aircraft that routinely serve those airports surveyed, implying that any smaller-sized aircraft also use them.

## AIRPORT CERTIFICATION

Only 15 of the 46 airports participating in the survey have Part 139 certification. The applicability requirements for Alaskan airports are slightly different than those in the contiguous United States. Table 2 identifies the number of Part 139 airports and the category to which they belong. Part 139 airports located in regions that routinely experience snowfall are required to have a snow and ice control plan (SICP) as part of the regulation. As a result, they can receive higher priority under the FAA AIP to acquire SRE than non-certificated airports; AIP funding criteria is described later in this chapter. Noncertificated GA airports do not have the same requirement or eligibility priority to receive AIP grant assistance as certificated airports. The data in Table 2 illustrates the breakdown of certificated and noncertificated airports participating in the study.

## FUNDING OF SNOW REMOVAL EQUIPMENT

Small airports are more likely to have limited budgets because they do not generate the level of aircraft activity, fuels sales, or other revenue opportunities that larger commercial service airports can generate. As a result, the ability of a small airport or municipality to acquire SRE can be hindered by its lack of resources. Although SRE is an eligible item for acquisition and funding under Congressional authorization (FAA Modernization and Reform Act 2012), noncertificated airports receive a lower priority in the allocation of funds available.

TABLE 2
NUMBER OF PART 139 CERTIFICATED AND NONCERTIFICATED AIRPORTS IN THE SURVEY

| Certification | Basic (6) | Local (21) | Regional (7) | Reliever (8) | NP COMM SVC (6) | Total |
|---|---|---|---|---|---|---|
| Certificated 139 | — | 5 | 4 | — | 6 | 15 |
| Noncertificated | 6 | 16 | 3 | 6 | 0 | 31 |

— = no data.
*Source*: SMQ Airport Services.

TABLE 3
NUMBER AND PERCENT OF EQUIPMENT ACQUIRED FROM DIFFERENT FUNDING SOURCES

| How Vehicles Acquired | Basic | Local | Regional | Reliever | NP COMM SVC | Total Number of Vehicles |
|---|---|---|---|---|---|---|
| AIP Grant | 9 (52.9%) | 44 (46.3%) | 16 (40.0%) | 20 (55.9%) | 15 (83.3%) | 104 |
| State Grant | 1 (5.8%) | 8 (8.4%) | 8 (20.0%) | 2 (5.9%) | 1 (5.6%) | 20 |
| Fleet Purchase | 2 (11.8%) | 4 (4.2%) | — | 3 (8.8%) | — | 9 |
| Internal Funds | 1 (5.8%) | 13 (13.7%) | 11 (27.5%) | 6 (17.6%) | — | 31 |
| Surplus Property | 3 (17.6%) | 15 (15.8%) | 5 (12.5%) | 4 (11.8%) | 1 (5.6%) | 28 |
| Joint Purchase | — | — | — | — | 1 (5.6%) | 1 |
| Other | 1 (5.8%) | 1 (1.1%) | — | — | — | 2 |
| Contractor Provides | — | 10 (10.5%) | — | — | — | 10 |
| Total Number of Vehicles | 17 | 95 | 40 | 35 | 18 | 205 |

*Note*: Percent totals do not equal 100% due to rounding.
*Note*: Other is a personal vehicle and a shared vehicle.
— = no data.
*Source*: SMQ Airport Services.

Hence, small airports find it necessary to seek out different sources of capital funding. Table 3 provides a summary of purchase methods used to acquire SRE at surveyed airports. For all categories of airports in the survey, AIP funding was the most prevalent source. Fleet and surplus property purchases were most prevalent at basic category airports. Regional and reliever category airports had higher percentages of equipment purchases using internal funds.

### Airport Improvement Program Funding

SRE and snow removal equipment buildings (SREBs) are eligible for federal funding assistance under AIP, which is funded through a trust fund established by Congress. The funds are received from aviation taxes and fees and are distributed by the FAA to airports for needed improvements.

For nonprimary and GA airports, an AIP grant for SRE and SREB requires a 10% contribution share from the local sponsor, while the FAA contributes 90%. Some state aviation programs provide assistance to the local airport governing authority by contributing to the 10% local share.

### State Funding Assistance

State requirements can be a variable in the funding process. States can require an airport to submit its project through a state program or a regional planning agency before being reviewed by the FAA. This is more often true for noncommercial and GA airports, especially if an airport is located in one of the 10 states—Georgia, Illinois, Michigan, Missouri, New Hampshire, North Carolina, Pennsylvania, Tennessee, Texas, and Wisconsin—considered by the FAA to be a "block grant" state. As defined in 49 U.S.C. § 47128, a block grant state is one that has an established aviation department with the resources and capabilities to administer AIP funds on behalf of the FAA. The state allocates AIP funds to nonprimary NPIAS airports within the state.

## EQUIPMENT ACQUISITION

Before submitting an application for SRE or SREB purchase, the airport submits projects for consideration to the FAA's Airport Capital Improvement Program (ACIP). Some FAA Airport District Offices (ADO) require justification for the purchase of SRE. Within the ACIP, the FAA utilizes

a national priority rating scale to rank eligible projects among other submitting airports. Obtaining a high enough priority to qualify for grant assistance can be a challenge to small GA airports. The purchase of SRE is often given lower priority than other critical improvement projects on the airport, such as runway, taxiway, or safety area construction. Or, with limited total funds allocated for the AIP small airport fund, a state block program, or discretionary funds used for GA airports, there may not be enough money available for all eligible projects or items submitted to the state or the FAA.

**Assistance from State Aviation Agencies**

In a November 24, 2014, telephone interview, K. Wanner, State Aviation Director in North Dakota, commented that many small airport operators and municipalities do not think to ask the state aviation agency for assistance in acquiring equipment. A number of states have programs to assist airports in the purchase of SRE. They can share in the cost of an AIP SRE acquisition; have a separate state equipment list or fleet purchase program at federal or state contract prices; or provide coordination of purchases through a state surplus property program. There may also be state-to-state reciprocity agreements that allow airports to purchase equipment through contracts of an adjacent state agency.

SRE requirements are based on the annual aircraft operations at an airport and the amount of surface area to be cleared within certain times recommended by FAA. Airport operators seeking to use AIP funds to obtain SRE are to use the guidance provided in *Airport Snow and Ice Control Equipment* (AC150/5220-20A 2014), detailed in chapter two and excerpted in Appendix D.

In areas of the country where snowfall is particularly heavy, the AC indicates that a snowblower (rotary plow) is the primary piece of desirable equipment. For snow sweepers, guidance on specifications is to be obtained by contacting the local ADO. In Alaska, the acquisition process is slightly different for rural airports, as they are owned and operated by the state.

Upon acquiring a SRE using AIP funds, the airport is limited in its use of AIP for future SRE purchases for another 10 years, which is the expected life of the original SRE. ADOs have some flexibility with that time frame, provided airports are able to justify the need. For that reason, working with an airport's state aviation agency or ADO is important, as each ADO has responsibility for processing FAA grants.

Accepting an AIP-funded SRE grant places restrictions on the use of the equipment. It can only be used for aeronautical and related activities and are to remain in operation at the airport for the expected or useful life of the equipment, unless otherwise authorized by the FAA: AIP funds cannot be used for an airport's operating and maintenance costs. FAA Order 5100.38D states incidental use is permitted at nonprimary airports without an active Part 139 certificate only if:

- The activity does not significantly degrade the SRE useful life;
- The SRE is used only for airport purposes and will not be used off airport;
- The SRE is only used by airport employees;
- The SRE is generally used for activities on AIP eligible surfaces; and
- The incidental use cannot be included as part of the SRE justification.

In the review, it was found that several airports had received reminders in the past from either the state aviation agency or the FAA, reiterating the sponsor grant assurances. Authorization to sell used AIP-funded SRE requires FAA approval.

The FAA places the responsibility of purchasing SRE on the local airport sponsor and its purchase process. As with any federal funding assistance, certain provisions are required in all AIP contracts

TABLE 4
NUMBER OF AIRPORTS HAVING FLEXIBILITY IN THE TYPE OF EQUIPMENT NEEDED

| Flexibility of Equipment Acquisition | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Flexible | 2 | 5 | 4 | 2 | 2 |
| Limited | 2 | 9 | 2 | 3 | 1 |
| Depends | 1 | 7 | 1 | 1 | 3 |

*Source*: SMQ Airport Services.

and bid documents. Included are those related to preferentially buying goods produced in the United States, as required in 49 U.S.C.§50101, and to the bid process itself.

Provisions that are prohibited in bid documents are those that:

- provide for sole sourcing of equipment;
- restrict equipment to match existing airport equipment;
- require a local procurement preference; or
- add non-standard features to the specifications.

State grant funding can have similar requirements or restrictions, though it also may have more flexibility. Airport managers were asked about the degree of flexibility an airport has in acquiring equipment of its choice; Table 4 shows the responses. Local purchasing policies can affect the kind of equipment an airport can acquire. States may also have a pre-approved list of equipment available for municipalities to purchase at special prices. The drawback to pre-approved state lists can be the availability of generic vehicles and equipment not designed for airport purposes or needs.

Survey respondents with limited budgets and resources expressed the desire to acquire SRE that is multi-purpose rather than specialized, allowing them to address other safety concerns, such as maintaining the airfield during the summer months, limiting wildlife attraction, and addressing drainage issues. For GA airport communities, respondents suggest a multi-purpose vehicle is a better use of those limited resources.

Multi-purpose refers both to the ability to utilize several attachments with one prime vehicle and to be able to use the vehicle for activities other than snow removal, such as for mowing, brush removal, hauling, grading, and general on-airport duty. Multi-purpose is in contrast to multi-tasking equipment (MTE), which is found at larger air carrier airports and is eligible for AIP funding. MTE is a dedicated piece of SRE that includes a combination of carrier vehicle, snow plow, rotary broom, and high velocity air blast in one long unit. The integrated snow and ice removal system is capable of performing multiple and simultaneous functions requiring no more than one operator (SAE ARP 5548).

An issue with the acquisition of MTE and attachments is that current legislation does not allow AIP funds to be used for maintenance activities, such as mowing. A second issue is that multi-purpose equipment may do many things but not as well as a dedicated piece of SRE. Compromises exist in the design of vehicles. For instance, vehicle speed, weight distribution, maneuverability, and cabin visibility are factors to be considered. A third issue is at basic and local category GA airports where snow removal is often accomplished by a city or county public works department and not by a dedicated airport crew. The training of personnel and the storage and use of equipment outside the airport can be problematic if not properly addressed.

## REPORT ORGANIZATION

This chapter provides information on the objectives of the synthesis and lays the foundation for understanding how SRE can be funded. It also describes the survey participants and the classification of airports as used throughout the report.

Chapter two provides an overview of the governance of or arrangements made for snow removal, the practice of having a SICP, recommended snow removal clearance times, and discussion on budget allocations at the surveyed airports.

The procurement or acquisition of equipment, current equipment used and preferred, and the need for storage shelters and weather protection are discussed in chapter three.

Chapter four addresses the procurement or acquisition of equipment, current equipment used and preferred, the type and age of SRE being used at the surveyed airports, and the need for storage shelters and weather protection.

Operational safety, runway incursion prevention, winter accident and incidents, and Notices to Airmen (NOTAMs) and other condition reporting practices at surveyed airports are described in chapter five.

Chapter six discusses personnel staffing, training, and the importance of human factors during operation.

Alaska's rural airports have requirements and attributes different from those in the contiguous states. Chapter seven provides background and information on the unique characteristics of rural airports with limited budgets in Alaska.

Chapter eight provides conclusions from the study and the survey of small airport operators.

CHAPTER TWO

# SMALL AIRPORT WINTER OPERATIONS

This section provides background information and characteristics of the airports surveyed for the study. It addresses the different kinds of winter operations encountered or planned for (type of snow or ice, frequency and timing of operations, anti- and de-icing chemical use), and FAA advisory circular guidelines for snow removal and equipment.

Airports across the nation, both large and small, deal with diverse snow conditions, equipment types, governance, sharing arrangements, training, and condition reporting techniques. Although a fair amount of information exists on how larger airports manage snow removal, especially those certificated under Part 139, little guidance exists on GA airports. Difficulties in snow removal can arise at GA airports as a result of the organizational structures and responsibilities in place.

One survey question sought to identify who has primary snow removal responsibilities at different sized airports across the northern tier of the United States. Table 5 provides a breakdown of the responses received.

Thirty (30) of the airports surveyed are responsible for their own snow removal. As shown in later tables, the challenges of snow removal for small airports revolve around manpower and equipment problem. The basic and local category airports have the most problems, as they consistently rely on outside help more often than the other categories. Seven of the local airports have arrangements where they are responsible for the runways and taxiways and receive help from the fixed-base operator (FBO), a contractor, or volunteers who assist on the ramp, hangar and tie-down areas, and local street or roadway access. The basic, local and regional category airports associated with a city or county have the capability to call on their respective public works departments (PWD) to assist, once the roads in the city or county have been addressed.

## SNOW AND ICE CONTROL PLANS

Airports with operating certificates issued by the FAA are required to have snow and ice control plans. The goal of a SICP is to provide guidance to personnel responsible for snow removal on how to safely and efficiently perform those operations. It is also a plan for providing tenant and community access to air transportation during winter weather events. For these reasons, a SICP is important for successfully maintaining airport operations, even if only as part of a larger municipality's snow plan for city or county streets and roads.

The FAA has developed a number of useful winter operation guides for airports. AC 150/5200-30C is the primary source of guidance information. A sample template for developing a SICP for a Part 139 is provided in Appendix E. A related SICP checklist provided by the Eastern Regional Office of the FAA is provided in Appendix F. Both appendices can be modified for use at noncertificated Part 139 airports. Appendix G provides an example of a SICP for a GA airport.

At a minimum, a SICP would identify equipment, personnel, airfield inspection procedures, snow removal priorities, and a list of key contact personnel involved in coordinating airfield operations. Of added importance is information about when to begin plowing, who will make the decision to start snow removal operations, how the snow will be removed, what work schedules will be used, and how equipment or materials will be used. Any additional consideration is for emergency response in the event of an accident or incident. Lastly, planning would take into account what to do if the airport

TABLE 5
ENTITY RESPONSIBLE FOR CONDUCTING SNOW REMOVAL ACTIVITIES

| Responsible Party | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Airport | 2 | 11 | 6 | 6 | 5 |
| Airport with Others | — | 7 | 1 | — | — |
| City/County | 1 | — | — | — | — |
| FBO | 1 | 1 | — | — | — |
| Contractor | 1 | 1 | — | — | — |
| Volunteer | 1 | 1 | — | — | — |
| Other | — | — | — | — | 1* |

*One airport has no snow removal capability.
— = no data.
*Source*: SMQ Airport Services.

and the community are overwhelmed with a snow event. Thirty (30) of the 46 airports surveyed have a SICP in place. Table 6 provides detail on the responses.

AC 150/5200-30C is the main source of guidance for developing a SICP. A *Guidebook for Airport Winter Operations* provides examples of effective practices for SICP (McGormley et al. 2015). A review of the literature shows that a number of municipalities have published formal written policies or manuals on their home web pages. The policies outline their snow removal program, priorities, and procedures for snow removal. One sample is provided in Appendix G for Nampa, ID, a local category airport. Another example is the St. Louis Downtown Airport, a reliever airport with a part-time air traffic control tower (ATCT) (http://www.stlouisdowntownairport.com/cps-snow-plan.pdf.) Additionally, a number of states provide airport managers with guidelines for snow removal within their states. Appendix H provides an article from the Center for Transportation Studies at the University of Minnesota highlighting effective practices for keeping an airport safe, open and accessible (*AirTAP Briefings* 2011). Airports examined in the appendices have adopted SICPs even though they are non-certificated and the SICP does not require FAA approval.

More examples of SICPs can be found on the web. For example, St. Mary's County in Maryland is an example of an airport SICP embedded into an overall county plan. Included in the section on the airport is a picture of the priority areas to be addressed for snow removal (*Snow Removal and Ice Control Operational Plan* 2010) (Figure 3). Geauga County in Ohio is an example of an airport that contracts out all its snow removal activity. The request for proposal (RFP) they use to solicit contractors is shown in Appendix I. A map is included in the RFP to delineate the areas of contractor responsibility.

## TIMELY SNOW REMOVAL

The timely removal of snow from an airport surface can be an important safety and business matter for an airport. Three airports in the survey stressed the importance of being available for medical life-flights, while six airports cited the need to clear the runways to accommodate local corporate and business aircraft. Aircraft accidents have occurred as a result of incomplete snow removal.

TABLE 6
NUMBER OF AIRPORTS THAT HAVE A SNOW AND ICE CONTROL PLAN

| Snow Plan | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Yes | — | 14 | 7 | 3 | 6 |
| No | 6 | 7 | — | 3 | — |

— = no data.
*Source*: SMQ Airport Services.

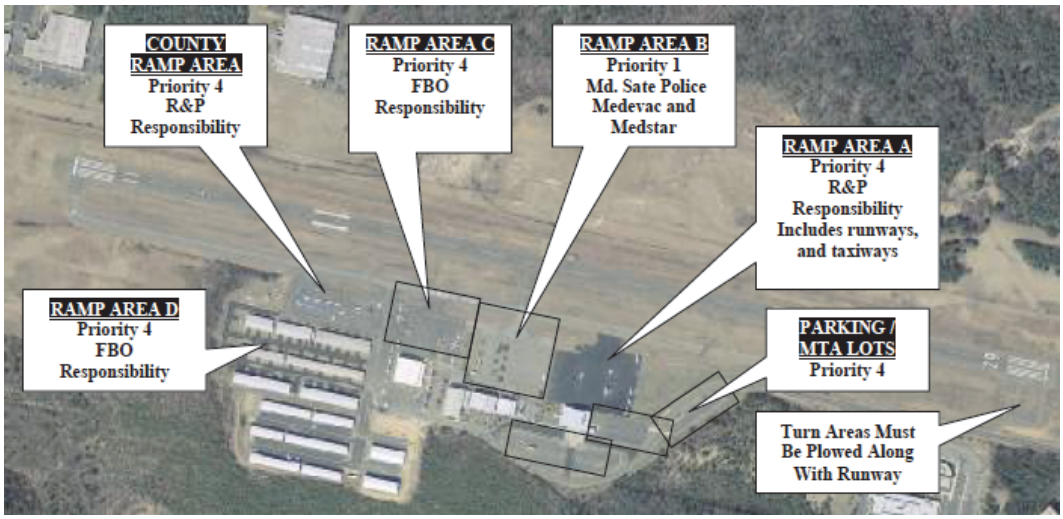



FIGURE 3 Example of priority areas for snow removal depicted on a diagram. *Source*: *Snow Removal and Ice Control Operational Plan* (2010).

**Case Study: Yellowstone Airport, Montana**

One airport in the survey is a nonprimary commercial service airport listed as "other." It is unique in that it is a Part 139 Class II airport, it is adjacent to a high elevation national park, and it does not have any snow removal equipment. Yellowstone Airport simply closes for the winter season.

The airport has an FAA-approved snow plan that calls for it to close the runway when snow or ice accumulate beyond acceptable limits. In 2014, the FAA cited the airport for not being in full compliance with Part 139 and that SRE was necessary to keep the airport open year-round. The State of Montana is the operator of the airport and is currently seeking funding to acquire SRE to comply with Part 139, based upon the deficiency notation during its 2014 inspection. The matching share of AIP funding would need to come from airport operating revenues.

The airport is an enterprise account within the state. It has budgetary issues associated with its proprietary account and is not financially self-sufficient. One budget challenge for airport management arises from its not having revenue-producing aeronautical activity during the winter season, and having added expenses if they do. Another budget challenge stems from its deed restrictions: While an active airport during the summer season, its major tenants are other governmental agencies that are exempt from being charged rentals and fees.

The airport relies on funding infusions from the state to balance its operating budget. The local community of West Yellowstone, while benefiting from the airport, does not participate in any funding assistance, as it is under no obligation to do so. The airport is eligible for the annual $150,000 allotment for nonprimary airports under AIP. Other capital budget assistance comes through the state aeronautics division, which has been able to have SRE identified in its capital improvement plan for funding in the upcoming fiscal year. Still of concern is obtaining the matching share, which the airport enterprise account is unable to provide on its own. Additional outside resource support will be essential.

Yellowstone Airport is an example of an airport having difficulty addressing winter operations because of operating and capital budget shortfalls. The written recommendation of an FAA inspector at a Part 139 airport can lend weight to the debate about acquiring SRE and about supporting winter operations snow and ice removal. For non-139 airports, the regulatory weight of Part 139 does not exist. Establishing the importance of snow removal activities at a GA airport often requires support from outside the airport organization, such as from a larger state or local governmental organization, the local community, or user and tenant groups associated with the airport.

The FAA advisory circular on airport winter safety and operations provides guidance on the desired time to clear snow from runways that have accumulations of one inch of wet snow. The times are normally two to six hours for the airports considered in this synthesis (Table 7) (AC150/5200-30C 2008). The clearance times identified in both Tables 7 and 8 are for what is known as "priority 1 surface areas." For small airports, priority 1 surface areas are generally identified as the primary runway, an access taxiway leading directly to the terminal or ramp area, and any airport rescue and fire fighting (ARFF)

TABLE 7
CLEARANCE TIMES FOR OTHER-THAN-COMMERCIAL SERVICE AIRPORTS

| ***Annual Airplane Operations*** (includes cargo operations) | ***Clearance Time[1] (hour)*** |
|---|---|
| *40,000 or more* | *2* |
| *10,000 – but less than 40,000* | *3* |
| *6,000 – but less than 10,000* | *4* |
| *Less than 6,000* | *6* |
| *General: Although not specifically defined, non-commercial service airports are airports that are not classified as commercial service airports [see Table 1-1, general note].*<br><br>*Footnote 1: These airports may wish to have sufficient equipment to clear 1 inch (2.54 cm) of falling snow weighing up to 25 lb/ft$^3$ (400 kg/m$^3$) from Priority 1 areas within the recommended clearance times.* | |

*Source*: FAA AC 150/5200-30C.

station and emergency access service roads, Navigational Aid System (NAVAIDs), and other areas deemed essential, such as fueling areas and airport surveillance roads. However, the AC states that the term "'reasonable' time" is based on the airport type and number of annual operations, and that the guidance provided is primarily to assist the airport operator in determining minimum equipment needs. It is recognized that FAA guidance on reasonable times for the removal of airfield snow may not be achievable at some airports, especially GA airports.

One airport in the survey stated it was not able to meet the recommended times because it uses snow removal equipment and personnel from the PWD, which has the airport as a last priority after the city roads are plowed.

Although the AC states the clearance times shown in Table 7 are not to be interpreted as a requirement to clear surfaces within any particular time, commercial service airports certificated under Part 139 have different standards (Table 8). As part of the requirements under Part 139, an airport organization is to address snow removal operations in its airport certification manual (ACM) by developing a SICP. The SICP often includes the clearance time as a target goal and is used to help the airport and the FAA determine compliance with the regulations. If the airport meets the snow removal clearance times, the airport is understood to have an adequate number of employees and equipment to meet the target.

Table 9 provides a synopsis of the clearance time targets for the airports participating in the survey. As the activity level increases at an airport, the target clearance times decrease.

Survey participants were asked whether or not they routinely met the targeted clearance time for their airport. Table 10 shows that half of the basic and commercial service airports, and a little fewer than half of the regional airports, do not meet the targeted clearance times. All of the regional and reliever airports stated they met the target clearance times. The reason cited for two of the commercial

TABLE 8
CLEARANCE TIMES FOR COMMERCIAL SERVICE AIRPORTS

| ***Annual Airplane Operations*** (includes cargo operations) | ***Clearance Time[1] (hour)*** |
|---|---|
| *40,000 or more* | *½* |
| *10,000 – but less than 40,000* | *1* |
| *6,000 – but less than 10,000* | *1½* |
| *Less than 6,000* | *2* |
| *General: commercial service airport means a public-use airport that the U.S. Secretary of Transportation determines has at least 2,500 passenger boardings each year and that receives scheduled passenger airplane service [reference Title 49 United States Code, Section 47102(7)].*<br><br>*Footnote 1: These airports should have sufficient equipment to clear 1 inch (2.54 cm) of falling snow weighing up to 25 lb/ft$^3$ (400 kg/m$^3$) from Priority 1 areas within the recommended clearance times.* | |

*Source*: FAA AC 150/5200-30C.

TABLE 9
TARGETED SNOW REMOVAL CLEARANCE TIMES AS REPORTED BY SURVEY RESPONDENTS

| Clearance Time Objectives | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| 1 hour | — | 1 | 4 | 1 | 2 |
| 1.5 hours | — | — | 1 | 1 | — |
| 2 hours | — | 6 | 1 | 3 | 3 |
| 2.5 hours | — | — | — | 1 | — |
| 3 hours | — | 7 | 1 | — | — |
| 4 hours | 1 | 3 | — | — | — |
| 6 hours | 5 | 4 | — | — | — |

*Note*: One commercial service airport is not included as it closes for the winter and does not conduct snow operations.
— = no data.
*Source*: SMQ Airport Services.

TABLE 10
NUMBER OF AIRPORTS IN THE SURVEY THAT REGULARLY MEET CLEARANCE TIME OBJECTIVES

| Routinely Meets Time Objectives | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Yes | 4 | 15 | 7 | 6 | 3 |
| No | 2 | 6 | 0 | 0 | 3 |

*Source*: SMQ Airport Services.

service airports' not meeting the targeted time was insufficient equipment or manpower. The third did not conduct snow removal operations.

The survey then asked what the average clearing time was for the whole airport versus the Priority 1 paved areas. Table 11 reflects the average times airport operators take to perform snow removal for a normal winter event at their airport, given the manpower and equipment normally available.

The length of time needed to remove snow at any one airport is dependent upon a number of factors, including the amount and type of snow, the time of the event, and the availability and capabilities of personnel and equipment. Table 12 describes the typical amount of snow normally received for any one event at the surveyed airports. Tracking the number of events, amount of annual snowfall, and single event totals is useful for providing justification for additional SRE to state aviation agencies and the FAA.

TABLE 11
AVERAGE TIME IT TAKES TO MANAGE A SNOW EVENT AT SURVEYED AIRPORTS

| Average Clearance Time | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Hours | 4.0 | 4.0 | 2.5 | 4.5 | 4.5 |

*Source*: SMQ Airport Services.

TABLE 12
NUMBER OF AIRPORTS AND THE TYPICAL AMOUNT OF SNOWFALL IN A SINGLE EVENT

| Typical Accumulation | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| 1–3 inches | 3 | 12 | 4 | 2 | 3 |
| > 3 inches | 3 | 9 | 3 | 4 | 3 |

*Source*: SMQ Airport Services.

FIGURE 4 Example of difficulty plowing after a snow event ends.
*Photo credit*: M. Daugherty, Mansfield, Ohio.

There is no one prevalent strategy among the surveyed airports for when snow removal is to commence, with the exception of basic airports, which predominately commenced snow removal after the winter snow event has occurred. It is a common practice from local to NPCS airports to commence snow removal at the beginning of a snow event. Doing so keeps the runway and taxiways available for use throughout the event and helps to maintain safe friction coefficients. The increased cost of a longer plowing period can be offset by the efficiency of operations and the potential for continued economic use of the airport. Waiting for the snow to stick to the pavement or for a certain snow amount to accumulate before commencing operations reflects a balance between a number of factors, such as expected costs, manpower availability, equipment capability, anticipated snowfall amounts, and pavement temperature. Waiting until after the storm to commence snow removal may be the simplest approach; however, it can result in higher operating costs resulting from increased strain on personnel and equipment, more difficulty in moving large accumulations of snow, lack of visual pavement area references, and longer time for cleanup activity. Figure 4 is an example of a snow removal effort after the snow event passed.

### TYPE OF WINTER EVENT

The type of winter event an airport experiences, which depends on the geographic location of the airport and the weather patterns that predominate, will dictate what equipment is needed and the timing of snow removal efforts. Dry snow is described as not having much moisture content and not being able to form a snowball, and can easily be managed with a broom or high velocity air blast. Wet snow is described as having enough moisture to make a snowball. Heavy snow has high water content that will drip moisture when slightly compacted; it is difficult to move because of its density, and requires a plow, loader, or snowblower to be managed well. A wet/dry mixture refers to the effect of different weather patterns at the airport resulting in one or the other, or both. Understanding weather forecasts is an important aspect of managing winter operations. An airport's proximity to large bodies of water or its location in geographic areas where cold northern air masses collide with warm southern air masses can result in high moisture content (wet/heavy) snow.

Three participants reported that they are seeing more icing events than in previous years. This has implications for their snow removal operations, as their existing equipment was purchased to handle primarily snow, not ice. Ice conditions are the most difficult winter event to manage, according to the respondents. Airports in the survey generally do not have equipment or resources to address the situation. As one respondent wrote:

> The icing line is moving further north. In years past we might have a single icing event at the beginning of winter. In the past 5 years we have endured wilder swings in temperature with 3–5 icing events per winter season. On December 3, 2013, we received a 3-inch slush fall followed by an inch of rain on cold (frozen) soaked ground. When it was done we had a solid inch of ice covering all our surfaces. Our equipment couldn't push the slush/snow because the ice buildup on the surfaces was too slippery. The extended cloudy cold snap that followed (till December 30) precluded any sublimation or melting. Our runways were essentially shut down for the duration. Sand was applied; but it was too cold for it to do any good, it just blew off the surface. It was too cold to apply our limited supply of runway de-icer. Our public works department assisted us by using

a grader with a special ice-scraping blade to remove the encrusted build-up. The blade gouged the blacktop in bare spots—but barely touched the ice build-up.

## BUDGETING FOR WINTER EVENTS

Municipalities and airports located in geographic areas where snow accumulations are low and do not justify dedicated SRE are faced with multiple decisions about airport snow removal activity. The decisions and challenges include evaluation of costs and benefits as a result of limited budgets for continued use or replacement of old and/or inadequate snow equipment; determination of snow removal priority over other activities; equipment operator training for airfield winter operations; and keeping up to date with current NOTAM protocols.

Budget allocations can be a reflection of the degree of importance a community places on the airport. It also represents the likelihood of a certain number of winter events occurring and the amount of time, effort, and supplies expended by the airport to address the events. The survey asked what percentage of the airport's operating budget is devoted to snow-related removal activities and supplies expenditures. The averages ranged from 13% to 24%, as shown in Table 13. Survey respondents indicated that fuel and personnel were the two main expense items associated with snow removal activities.

When asked the number of snow events the airport normally anticipates and budgets for, airport operators provided the responses shown in Table 14. The range of anticipated annual snow events reflects the airports' geographic locations.

Annual budget allocations for snow removal are often based on the number of past winter events experienced by airports, and the dollar amounts are often a continuation from the previous year's budget. When airports were asked what action is necessary if they exceed their budget, four main procedures emerged: For municipalities, the manager had to go "downtown" and request fund transfers after providing justification; managers transferred funds from reserve accounts, deferred summer maintenance, or cut back on the frequency of snow removal activities on noncritical areas of the airport. The managers' responses all reflected their perception of the importance of having the airport available for use and their willingness to seek fund coverage. Several of the airport managers cited the importance of keeping their city administrator or airport commission informed of the budget status so there would be no surprises.

One airport operated on a calendar year cycle (January–December) rather than a fiscal year (July–June) budget. The calendar year budget allowed for better use of resources from January

TABLE 13
PERCENT OF AVERAGE ANNUAL AIRPORT BUDGET ALLOCATED FOR EACH CATEGORY OF AIRPORT IN THE SURVEY

| Budget | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Average | 13% | 22% | 20% | 24% | 17% |

*Source*: SMQ Airport Services.

TABLE 14
RANGE AND AVERAGE NUMBER OF ANNUAL SNOW EVENTS BUDGETED FOR BY SURVEYED AIRPORTS

| Budgeted Number of Snow Events | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Range of number of snow events | 10–100 | 10–120 | 6–50 | 12–40 | 10–70 |
| Average number of snow events for a year | 49 | 36 | 23 | 20 | 35 |

*Source*: SMQ Airport Services.

through the end of winter, but could pose a problem for snow events in October through December if earlier resources were not managed well, or if unexpected winter events occur sooner than expected.

## PERFORMANCE MEASUREMENT

When asked how managers know, measure, or benchmark their snow removal efforts, the overwhelming majority cited tenant and user complaints, followed by the length of time it takes to complete snow removal operations, and then the number of safety incidents. Establishing performance measures assists airport managers to determine how well they do and whether justification exists for more efficient or effective measures. Two ACRP reports provide a list of performance measures that airports can use to benchmark their snow removal efforts (Infrastructure Management Group, Inc. et al. 2010; McGormley et al. 2015). Suggested measures include:

- Runway closure duration
- Annualized operating and capital costs
- Tenant or user delay or time to respond
- Amount of driver "windshield" time
- Run time of equipment
- Number of incidents
- Number of aircraft operations
- Gallons of fuel consumed
- Miles driven
- Amount of snow moved
- Gallons of de-icing/anti-icing agent or sand dispersed
- Hours of equipment downtime
- Hours spent on equipment maintenance
- Number of damaged lights or pavement
- Number of NOTAMs issued.

## SUMMARY

Complications in snow removal often arise at GA airports because of the different organizational structures and management that exist. Snow removal at the majority of surveyed airports is managed by the airport maintenance department. Other arrangements include snow removal accomplished by public works departments, FBOs, contractors, and even volunteers.

A SICP is one of the most effective ways to meet the challenges of a winter event at small airports with limited budgets. The plan provides guidance to personnel responsible for snow removal; it is also a plan for keeping the community and airport tenants informed of how access to air transportation will be available during winter weather events. Sixteen (16) of the 46 airports, primarily in the basic, local, and reliever categories, do not have a SICP.

Only 76% of the airports in the study are able to routinely meet FAA-recommended snow clearance times with the equipment and personnel available. Snow removal costs ranged from 13% to 24% of the surveyed airport's operating budgets.

CHAPTER THREE

# EQUIPMENT

This section addresses the procurement or acquisition of snow removal equipment, equipment currently used and preferred, the type and age of SRE being used at the surveyed airports, and the need for storage shelters and weather protection.

## TYPE OF EQUIPMENT

Guidance from the FAA is intended to have the airport operator maintain its runways and taxiways in a "no worse than wet" condition during inclement weather (AC150/5200-30C 2008) (Figure 5). The goal reflects the detrimental effect any contamination of the runway surfaces can have on safe aircraft operations. Planning to achieve the goal includes consideration of the types of SRE that can achieve the goal, given the expected weather conditions; aircraft activity levels; and other user demands at the airport.

The FAA suggests the minimum equipment for non-commercial service airports, based upon the number of operations and the amount of snowfall (Table 15). This information can be used to justify the acquisition of SRE under AIP.

AC 150/5200-30C provides guidance based on recommended performance requirements for clearing pavement on an airport. Factors include:

- amount of pavement surface area to plow
- length of time to remove snow per guidance material
- maneuverability
- multi-purpose capability
- funding restrictions
- purchase price
- operating costs
- storage size needed
- speed of vehicle
- safety design and functionality
- visibility
- compatibility with other equipment
- ease of maintenance.

Snow removal activity can be performed using different types of equipment. Basic to most airports is some type of displacement plow vehicle, whether the plow is mounted on the front of a truck chassis with a "bat wing" attachment, or a road grader with the blade underneath the chassis (Figure 6). A basic dump truck type of chassis with a plow has the ability to add a sanding, de-icing/anti-icing agent, or a high velocity air unit. Interchangeable blades can be used to address different snow conditions.

Higher activity airports may choose to have a broom (sweeper) in their SRE arsenal. Brooms are most effective at tackling light and dry snow accumulations, and for cleaning up residual snow from plowing or blowing operations. Removing snow before it can accumulate can reduce the amount of sand or de-icing material needed (Figure 7).

For airports routinely experiencing a heavy wet snow, a rotary snowblower is a necessary piece of SRE. As a plow pushes the snow to the side, the resulting snow banks create a hazard to aircraft.

FIGURE 5 Example of pavement being cleared to a "no worse than wet" condition with a sweeper assembly. *Photo credit*: C. Lawson, Romeoville, Illinois.

The heavy wet snow is also difficult for the plow to move. A snowblower is better able to remove the heavy snow or snowbanks (Figure 8).

A front-end loader with both bucket and blade attachments is useful for removing large or heavy accumulations of snow or, in the absence of a snowblower, removing hazardous snowbanks (Figure 9). A high velocity air blower can help to move snow residue off of paved surfaces and result in a clean dry surface. A material spreader (sand or de-icing/anti-icing material) can be loaded on the back of a chassis or be a separate vehicle. Some airports are creative, using a converted agricultural sprayer on a trailer or back of a pickup truck for spreading liquid de-icing/anti-icer, or a converted farm grain drill for chemical de-icer.

TABLE 15
FAA RECOMMENDATIONS FOR MINIMUM TYPE AND NUMBER OF SRE AT NON-COMMERCIAL SERVICE AIRPORTS

| Minimum high-speed rotary plow and snow plow for non-commercial Service Airports | | |
|---|---|---|
| **Annual Operations** | **Annual Snowfall (inches)** | **Minimum type and number of equipment** |
| **10,000 or fewer** | **30 inches** (76 cm) or less | 1 snow plow |
| | more than 30 inches (76 cm) | 1 high-speed rotary plow supported by 2 snow plows |
| **over 10,000** | **15 inches** (38 cm) or more | 1 high-speed rotary plow supported by 2 snow plows |
| | Less than 15 inches (38 cm) | 1 snow plow |

*Source*: AC150/5220-20A 2007.

FIGURE 6 Typical snowplow vehicle with front blade, bat wing plow, and sand spreader. *Photo credit*: G. Sussey, Watertown, New York.

FIGURE 7 Typical multi-purpose tractor vehicle with sweeper attachment. *Photo credit*: R. Horn, Eagle River, Wisconsin.

FIGURE 8 View of snowblower removing a plowed windrow. *Photo credit*: M. Moriarty, Keene, New Hampshire.

FIGURE 9 Example of a frontend loader with ramp plow moving a large volume of snow. *Photo credit*: M. Daugherty, Mansfield, Ohio.

Table 16 provides a list of the different vehicles and equipment in use at the surveyed airports. Interpretations were made of some of the descriptions used by the respondents to assist in grouping the responses. Large trucks with plows, pickups with plows, loaders, large blowers, blower attachments, and sweepers are the predominant SRE used. It is noteworthy that only one airport has a de-ice sprayer.

**Case Study: Steamboat Springs Airport, Colorado**

Steamboat Springs Airport has a particular problem with snow accumulation, as it routinely extends above the runway lights. Because of the limited airport property area, the additional accumulation of snow from the snowblower in the safety areas became a problem. The airport's solution was to lease a tracked Snowcat from the local ski resort to groom the safety areas. The Snowcat has reduced from days to hours the time needed to address safety area accumulations. An added benefit is the compacted snow acts as an arresting system for aircraft that may (as some have) overrun the runway.

Another challenge for Steamboat Springs is its use of personnel. As the airport operates the FBO, the employees engaged in snow removal are the same as those who provide FBO services. This results in a strain on scheduling and manpower. The airport manager reduces some of the pressure by supplementing his crew, hiring retired and experienced equipment operators from the local community.

## VEHICLE AND EQUIPMENT NEEDS AND AGE

Small airports with limited budgets and minimal ability to tap into FAA funding have a mix of new and old equipment. Table 17 provides an overview of the equipment used at the surveyed airports, which ranged in age from one to 66 years old. Commercial service airports had the newest equipment while local airports had the oldest fleets. Equipment funded through the AIP program is expected to last at least 10 years before a replacement can be funded through AIP. Table 17 includes all SRE on the airports. The effects of weather, use, and maintenance practices can lead to premature aging and depreciation of vehicles or equipment. The equipment in the following tables includes all pieces of major equipment and separate attachments.

A survey question asked how many SREs are in need of replacement. Table 18 indicates reliever category airports have the greatest need to replace vehicles or equipment (41%), closely followed by local airports (39%). The figures indicating a need for replacement do not include any additional pieces of equipment, only for replacement of existing SRE.

At some airports, vehicles or equipment are shared with others, such as with a public works department. If a vehicle or equipment is purchased with federal funds (and in some cases with state funds), the vehicle is required under the agreement to be dedicated for use only at the airport. Table 19 indicates regional, reliever, and NPCS airports in the survey are self-sufficient in their vehicle needs and use, while basic and local category airports rely on vehicles and equipment from other governmental departments.

TABLE 16
LIST OF THE DIFFERENT VEHICLES AND EQUIPMENT IN USE AT THE SURVEYED AIRPORTS

| Vehicle/Equipment | Basic | Local | Regional | Reliever | NP COMM SVC | TOTAL |
|---|---|---|---|---|---|---|
| Large truck w/plow | 2 | | 12 | 6 | 8 | 43 |
| Plow w/sander unit | — | 3 | — | — | — | 3 |
| Plow attachment | — | 2 | 1 | 8 | — | 11 |
| Pick-up w/plow | 3 | 14 | 8 | 4 | 2 | 31 |
| Ramp plow | — | 1 | — | — | — | 1 |
| Large blower | 1 | 13 | 1 | — | 2 | 17 |
| Blower attachment | 3 | 5 | 3 | 3 | 1 | 13 |
| Tractor | — | 3 | — | — | — | 3 |
| Tractor w/bucket | — | 2 | — | — | — | 2 |
| Tractor w/plow | 2 | 5 | 4 | 2 | 2 | 15 |
| Tractor w/blower | 1 | 1 | 1 | 2 | 2 | 7 |
| Tractor w/broom | — | 1 | — | — | — | 1 |
| Bulldozer | — | 2 | 1 | 2 | — | 5 |
| Grader | 1 | 1 | 1 | 1 | — | 4 |
| Loader | 2 | 16 | 6 | 7 | 1 | 32 |
| Bucket attachment | — | 2 | — | — | — | 2 |
| Loader w/plow | — | 1 | — | — | — | 3 |
| Push box attachment | — | 3 | — | — | — | 1 |
| Sweeper/broom | 2 | 4 | 6 | 4 | — | 16 |
| Large truck w/broom | — | 3 | — | — | — | 3 |
| Broom w/air | — | — | 2 | — | — | 2 |
| Snowcat w/tiller | — | 1 | — | — | — | 1 |
| Sand truck | — | 1 | — | — | 1 | 2 |
| Dump truck | — | 4 | — | — | — | 4 |
| Backhoe | — | — | 2 | — | — | 2 |
| De-icer sprayer | — | — | 1 | | — | 1 |
| Total | 17 | 103 | 49 | 39 | 19 | 227 |

— = no data.
*Source*: SMQ Airport Services.

TABLE 17
RANGE, AGE, NEED FOR REPLACEMENT, AND WHETHER EQUIPMENT IS A SHARED RESOURCE WITH OTHERS

| Vehicle/Equipment Age | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Age range | 1 to 41 years | 1 to 66 years | 1 to 36 years | 1 to 34 years | 1 to 22 years |
| Average age (years) | 13.4 | 18.8 | 15.7 | 14.4 | 11.3 |
| Median age (years) | 10 | 14 | 22 | 12 | 11 |
| Total Number of Vehicles/Equipment | 17 | 95 | 40 | 34 | 18 |

*Source*: SMQ Airport Services.

TABLE 18
NUMBER AND PERCENT OF VEHICLES THAT NEED REPLACEMENT AT SURVEYED AIRPORTS

| Replacement Need | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Vehicle/equipment should be replaced | 3 (17.6%) | 36 (37.9%) | 12 (30.0%) | 14 (41.2%) | 4 (22.2%) |
| Total Number of Vehicles/Equipment | 17 | 95 | 40 | 34 | 18 |

*Source*: SMQ Airport Services.

TABLE 19
NUMBER OF SRE SHARED WITH OTHER DEPARTMENTS

| Number of SRE Shared | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Shared Vehicle/ Equipment | 7 (41.2%) | 13 (13.7%) | 0 (0%) | 1 (3.0%) | 1 (5.6%) |
| Total Number of Vehicles/Equipment | 17 | 95 | 40 | 34 | 18 |

*Source*: SMQ Airport Services.

When asked what pieces of snow removal equipment, changes in policies or procedures, or other action would help improve snow removal operations, airports in the basic category focused on the need for equipment, in particular snowblowers (three of six airports). For the local category airports, new or additional equipment was also the focus, though more so for sweepers, plows and loaders. One manager pointed to the need for airport-owned equipment so he would not have to rely on the city to provide the equipment.

Multi-purpose vehicles were more commonly mentioned at the local level than at other levels. For the regional and NPCS airports, two airport operators in each category mentioned the addition of multi-purpose vehicles as being their preferred means to improve operation. At the reliever level, more specialized equipment was cited, such as a sweeper, front-end loader, de-icing unit or a snow-melter. Two airports commented that a typical large-scale plow would be too big for their operation; they preferred a mid-sized plow vehicle that had greater maneuverability to work on the ramp and taxiways and paved narrow areas of the airport.

One operator commented on the AIP restriction of only one vehicle purchase every 10 years, when the need exists at his airport for additional equipment. He is restricted to purchasing older or surplus equipment if he cannot justify the need to the local ADO. The older equipment breaks down more often and parts availability makes it difficult for the manager to properly perform snow removal and keep the equipment operating. Three operators mentioned a need to replace equipment on a regularly scheduled basis, but the availability of local funds had been delayed. Tables 20 through 24 provide a graphic comparison of the number and age of vehicles and equipment at the different categories of airports. Local category airports have the largest spread and age of SRE while commercial service airports have the lowest spread and newest SRE.

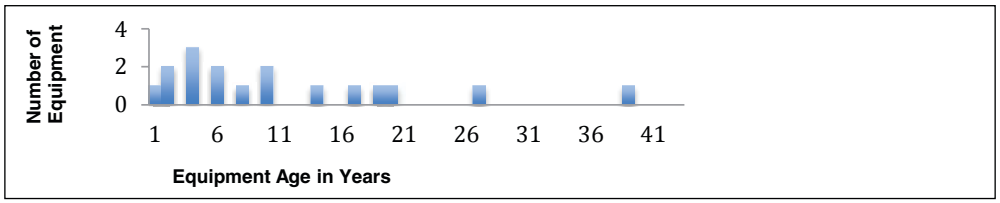
Gaps in SRE purchases between 1996 to 2000 (14 to 16 years of age) for the regional, reliever, and NPCS category airports may be partially explained by lapses in AIP authorization. A spike in purchases of SRE equipment from 2000 to 2003 (14 to 11 years of age) may be partially explained by passage of the Wendall H. Ford Aviation Investment and Reform Act for the 21st Century of 2000 (49 U.S.C. 40101). The Vision 100: Century of Aviation Reauthorization Act of 2003 continued investment and AIP authorization. Both acts authorized federal grant shares of 93.75%, meaning the required local contribution was 6.25% of costs rather than the previous AIP share. The local share cost reverted back to a 10% in 2012. For airports that provide essential air service and are located in economically depressed areas, which primarily applies to Alaska, the FAA policy is for eligible funding at the 95% level.

Although the design life of a SRE is expected to be at least 10 years, the tables show that more than 66% (140 of 213) of the total number of SRE for all airport categories is older than 10 years of age. Twenty-seven percent (27%, or 57 of 213) are older than 20 years. As SRE ages, replacement part availability and continued maintenance can become difficult.

## EQUIPMENT MAINTENANCE

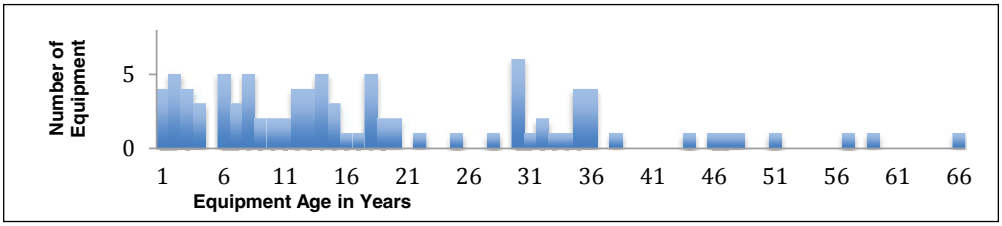
An important component of any winter maintenance operation is to have fully operational vehicles and equipment. However, limited budgets were found to cause issues for maintenance and repairs at the surveyed airports. An example of the effects of a limited budget is shown in Figure 10. The steel blade

TABLE 20
NUMBER AND AGE OF EQUIPMENT FOR *BASIC* AIRPORTS IN THE SURVEY



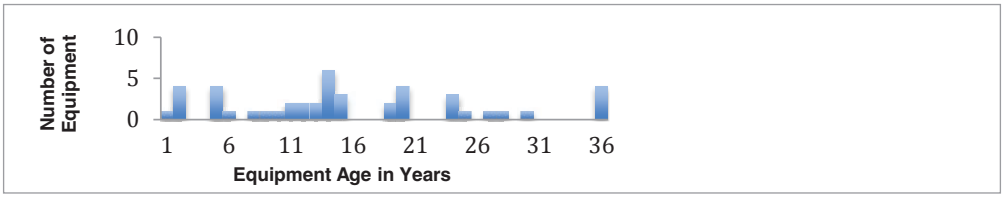

*Note*: SRE total is 17.
*Source*: SMQ Airport Services.

TABLE 21
NUMBER AND AGE OF EQUIPMENT FOR *LOCAL* AIRPORTS IN THE SURVEY



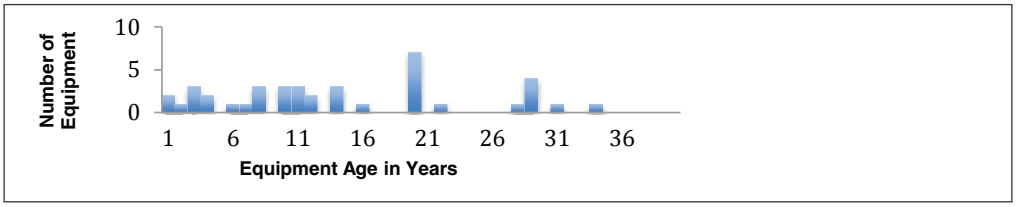

*Note*: SRE total is 93.
*Source*: SMQ Airport Services.

TABLE 22
NUMBER AND AGE OF EQUIPMENT FOR *REGIONAL* AIRPORTS IN THE SURVEY



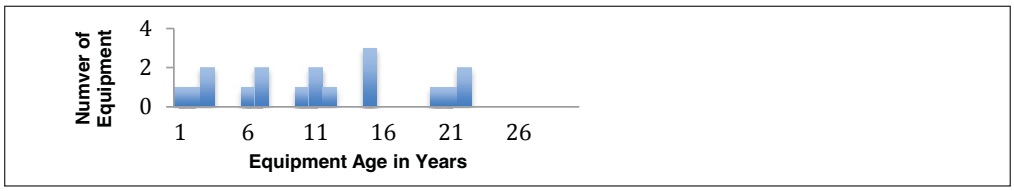

*Note*: SRE total is 45.
*Source*: SMQ Airport Services.

TABLE 23
NUMBER AND AGE OF EQUIPMENT FOR *RELIEVER* AIRPORTS IN THE SURVEY




*Note*: SRE total is 40.
*Source*: SMQ Airport Services.

TABLE 24
NUMBER AND AGE OF EQUIPMENT FOR *NONPRIMARY COMMERCIAL SERVICE* AIRPORTS IN THE SURVEY




*Note*: SRE total is18.
*Source*: SMQ Airport Services.

FIGURE 10 Example of plow damage not repaired due to budget issues. *Photo credit*: S. Quilty, SMQ Airport Services.

struck a stormwater grate on the apron and broke two feet of the steel blade and moldboard attachment. The airport budget was not able to accommodate repairs or a new moldboard, thus making snow removal more difficult. Table 25 provides an outline of who conducts maintenance on airport SRE.

The majority of airports that maintain their own vehicles report constraints. Respondents indicated they often have to contract out heavy (meaning a lift is necessary) or major maintenance and repairs beyond their in-house capabilities. Difficulties in having immediate maintenance work performed arose when airport vehicles or equipment were not included in a municipality's fleet maintenance program; scheduling of work had low priority compared with other PWD work; or qualified and readily available outside maintenance assistance was not available during a winter snow event.

## SNOWPLOW BLADES

Four types of cutting edge blades on snowplow moldboards are common: steel, carbon-tipped, urethane, and rubber. Poly or urethane blades are common because of their lower cost and reduced pavement wear characteristics. Carbon-tipped and steel blades are well suited for heavy snow or where a bond has started to form between the snow and pavement. In-pavement lights would preclude the use of steel or carbon blades. If highway department plows are to be used, the type of blade used is restricted to what the PWD uses.

A common maintenance expense is blade replacement. Airport maintenance personnel routinely extend the useful life of a blade by flipping it over as wear progresses. Blade life is also extended by preventing the blade from resting on the pavement surface. One airport suggests adding adjustable pads or caster wheels to raise the moldboard to a set level to relieve pressure on the blade, resulting in better vehicle maneuverability and extending the life of painted and thermoplastic pavement markings. However, it also results residual snow left on the surface that might freeze or obscure markings. A sweeper or high velocity air fan may be able to remove what remains on the surface, depending on the type of snow present. For ice conditions on the runway, the full pressure from a cutting blade is desirable to scarify and cut the ice.

TABLE 25
IDENTIFICATION OF WHO HAS RESPONSIBILITY FOR ROUTINE MAINTENANCE OF SRE

| Maintenance | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| In-house | 3 | 6 | 1 | 5 | 1 |
| City/County Fleet | 1 | 7 | 4 | 1 | 3 |
| Outside Contractor | 2 | 8 | 2 | — | 2 |

— = no data.
*Source*: SMQ Airport Services.

In Alaska, where gravel runways prevail at rural airports, the practice is to compact the snow using a drag plate, roller, or vehicle. The snow removal operator is then instructed to raise the blade 1 to 1.5 inches above the gravel surface. This practice reduces the possibility of eliminating the slope or crown of the runway and the removal of a protective gravel surface coating.

## SNOW REMOVAL EQUIPMENT BUILDINGS

Cold and inclement weather can accelerate the deterioration of SRE, affecting their operation and life span. Materials such as sand or de-icing/anti-icing chemicals require storage to maintain their effectiveness. *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials* (AC 150/5220-18A 2007) provides guidelines and recommendations for suitable facilities. In the AC, the FAA recommends all airport equipment and material be protected from the elements. For Part 139 airports, it is a requirement. The FAA will provide funding assistance, as will most states, for the construction of SREBs and facilities to house the equipment. In Alaska, the Department of Transportation & Public Facilities (DOT&PF) will not place SRE on an airport unless it is sheltered. Shelters for sand or chemical agents are also an AIP eligible item.

For AIP eligible facilities, there are restrictions on the size of the building covered by the grant. Costs beyond basic needs can be deemed ineligible for federal assistance and would be borne solely by the airport sponsor. Specifically, space for personnel quarters, training, or other non-equipment storage functions is not an eligible item (FAA Order 5800.38D 2014).

An airport will need to have a SICP to be eligible for SREB funding, as the SICP identifies the total Priority 1 paved area to be maintained. The Priority 1 paved area determines what eligible equipment the FAA deems appropriate for an airport and, therefore, is to be sheltered. Appendix J provides an excerpt from the FAA AIP Handbook that provides guidance to the ADOs and to airports on the eligibility and requirements for acquiring SREB under AIP.

Airports with limited budgets or low activity, especially the basic category airports, are less likely to have shelter available for their snow vehicles or equipment. Reliever and NPCS airports are able to shelter 100% of their equipment (Table 26). The survey did not ask if the available shelter was built using AIP or other grant money.

## SUMMARY

This chapter discusses the types of SRE airports need to achieve a pavement condition goal of "no worse than wet." Although the FAA recommends a snowblower as the primary acquisition, few smaller airports have them because they are not able to use AIP funding. A table is provided for an airport to calculate the number and type of equipment to be used given the number of operations, type of airport, and typical annual snowfall amounts.

Equipment funded through the AIP program is expected to last at least 10 years. However, the average age of SRE at surveyed airports ranges from 11 to 18 years, with some older than 40 years still in service. Several airports expressed a desire for multi-purpose vehicles and for mid-sized plow vehicles that could maneuver on smaller service areas. In addition, most airports have to rely on larger public works departments or outside facilities to help maintain SRE.

TABLE 26
NUMBER AND PERCENT OF VEHICLES OR EQUIPMENT SHELTERED AT AIRPORTS

| Equipment/Vehicle Sheltering | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Shelter Provided | 9 (52.9%) | 85 (91.4%) | 39 (97.5%) | 34 (100%) | 18 (100%) |
| Number of Vehicles | 17 | 93 | 39 | 34 | 18 |

*Source*: SMQ Airport Services.

CHAPTER FOUR

# SAFETY ISSUES

This section addresses NOTAMs and other condition reporting techniques, winter accident and incidents, and general operational safety.

## NOTICES TO AIRMEN

Airport managers have a duty and responsibility to inform airport users about field conditions and hazards that exist on the airport. By establishing standard design criteria for pavement surfaces, markings, lights, signs, and other areas of airports, the FAA seeks to minimize hazard exposure and provide for a common and familiar layout for pilots operating among airports. For this reason, airport operators are required to inspect their facilities on a regular basis. Any change in the condition of the inspected items requires notification to pilots and airport users.

The NOTAM system is the primary method for disseminating information to the pilot about the change in conditions at an airport. NOTAMs issued to reflect winter conditions at airports are often referred to as SNOWTAMs. For reporting special winter operational conditions such as braking actions, winter conditions, runway light obscuration, and snow bank obstructions, the airport manager can find guidance in the FAA advisory circular and the joint order on NOTAMS (AC150/5200-28D 2008; FAA Order JO 7930.2P 2014).

Pertinent to the need to remove snow and ice from pavement surfaces, AC 150/5200-28D reads:

> For commercial service airports, the FAA requires "prompt" removal of snow. For general aviation airports, the FAA does not impose any specific responsibility on the airport to remove snow or ice other than providing a safe and usable facility. If a winter storm renders parts of the airport unsafe, the airport is only obligated to promptly issue the necessary NOTAM, and close all affected parts of the airport until the unsafe conditions are remedied. The airport should then correct unsafe conditions within a "reasonable" amount of time.

The interpretation of "'reasonable' amount of time" is reflected in the recommended clearance times identified in Tables 7 and 8 in chapter two.

Different methods can be used for issuing NOTAMs. The primary means of dissemination is to contact the privately contracted Flight Service Station (FSS), either by telephone or by submitting a digital NOTAM (d-NOTAM). A newer system for authorized airports allows for direct electronic submission of information into the NOTAM database (e-NOTAM). The difference between a d-NOTAM and an e-NOTAM is primarily the level of authorization for issuing a NOTAM. With a d-NOTAM, information is conveyed to the FSS and is checked for conformance and clarification before entering the system. Under the e-NOTAM system, a trained airport operator has the authorization to enter the data directly into the system through a web-based standard menu-driven template approved for that airport (https://notams.aim.faa.gov/scert/).

Other means can be used to supplement NOTAMs and ensure that a change in airport condition is conveyed, as depicted in Table 27. Nearly half of the basic airports surveyed do not issue condition reports and instead rely either on a pilot to call the manager or to use Unicom frequency to request conditions. One interviewee mentioned that in his very northern state, it is common, and expected, that a pilot would call ahead to an airport to ask about conditions before conducting a flight because conditions change frequently and any report made to FSS can easily become outdated.

TABLE 27
SURVEY RESULTS OF WAYS NOTAM INFORMATION IS DISSEMINATED

| NOTAM-Condition Reporting | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Call to FSS | 2 | 15 | 5 | 5 | 5 |
| d-NOTAM | — | 5 | 1 | 1 | 2 |
| e-NOTAM | 1 | 10 | 3 | 1 | 2 |
| **Supplemental Reporting** | | | | | |
| ARTCC | — | 1 | — | — | — |
| ATCT | — | 1 | 4 | 2 | 1 |
| ATIS/AWOS | — | 5 | 2 | 2 | 1 |
| Unicom | 3 | 10 | 1 | 2 | 3 |
| Internet | — | 3 | 2 | — | — |
| Intranet | — | — | — | — | — |
| Social Media | — | 2 | 1 | — | — |
| Telephone Recording | — | 1 | — | — | — |
| Verbal or Oral Delivery | — | 5 | 3 | — | 1 |
| Post on Board | — | 1 | — | — | 2 |
| Pilots Call Manager | 3 | 10 | 4 | 3 | 1 |
| No Special Reports | 2 | — | — | — | — |

*Note*: Many airports use multiple methods to disseminate information.
— = no data.
*Source*: SMQ Airport Services.

Standard practice in the airport industry is to monitor changing airfield conditions carefully and disseminate information about those conditions in a timely manner to airport users. Runway condition reports are to be updated any time a change to the runway surface condition occurs. This presents a challenge to small airports with limited budgets, as the airport is not normally staffed 24 hours a day. For those airports that do not monitor weather conditions between certain hours owing to staffing limitations, the FAA suggests the airport issue a NOTAM and include the following text: "Airfield surface conditions are not monitored between the hours of 'x – y'." This additional text helps to avoid erroneous condition assessments by users of the information.

Airport managers are responsible for ensuring NOTAMs are issued for their airports. If a contractor is engaged to conduct snow removal operations, provisions are necessary to ensure notices are issued properly. Illustrative of one problem is an operator who commented that while the contractors he uses were diligent in their snow removal, they were not versed in field condition reporting. This made it necessary for the airport manager or other trained airport employee to be available whenever the contractor was conducting snow removal operations.

## RUNWAY FRICTION MEASUREMENT

The expected condition for a runway is that it is in "no worse than wet" condition, as aircraft performance tabulations are based upon such conditions. Because contaminants such as ice, snow, slush, and sand on the runway can greatly impede the performance characteristics of aircraft and cause hazardous conditions, the FAA limits aircraft operations as contamination develops on the pavement surfaces. In general, ice of any kind, accumulation of slush not exceeding one-half inch, wet snow not exceeding one inch, and dry snow not exceeding two inches are the trigger points for snow removal operations need to begin. The trigger points can be at lower thresholds for some aircraft types, which is why it is important to be familiar with the type of aircraft using an airport.

Reports of braking action using measuring devices can be reported as Mu (the symbol representing the coefficient of friction, or slipperiness of a paved surface), or by the descriptive terms of good, medium (fair), poor, or Nil. There is debate about the usefulness of braking action reports made to pilots, centering on the concern for variability and lack of correlation between the readings obtained and the actual braking experienced by aircraft.

The FAA is concerned that pilots may rely on information that can be misleading when making decisions about whether they can safely operate on the runway surface. The FAA has established that the correlation of a braking action report by vehicle or measuring device to the actual braking action that a pilot will experience is not consistent (AC150/5220-30C 2008):

> Airport operators must not attempt to correlate friction readings (Mu numbers) to Good/Medium (Fair)/Poor or Nil runway surface conditions, as no consistent, usable correlation between Mu values and these terms has been shown to exist to the FAA's satisfaction. It is important to note that while manufacturers of the approved friction measuring equipment may provide a table that correlates braking action to Mu values, these correlations are not supported by the FAA. To ensure that data collected are accurate, qualified personnel should use FAA-approved equipment and follow the manufacturer's instructions for use. Further guidance on runway friction measurement may be found in AC 150/5320-12C, *Measurement, Construction, and Maintenance of Skid-Resistant Airport Pavement Surfaces.*

Comments in the survey reflected the concerns stated in the AC about the accuracy of the determinations, with three airports reporting they use a vehicle to assess a runway condition only upon a pilot request. The use of friction measurement devices and the reporting of runway braking action varies among the airports.

For this reason, the FAA is transitioning to a new runway condition assessment matrix (RCAM) in 2016. The RCAM will provide for a standardized method of reporting runway surface conditions. Mu values or friction readings will no longer be used. FAA Order JO7930.29 NOTAMs has been revised to reflect the new standardized terminology (FAA Order JO7930.29 2014).

Although RCAM will not rely on friction measurements, the FAA views the use of friction measurement devices, which are eligible for AIP funding, as an aid to assist the airport operator in assessing the condition of the pavement surface over time, rather than as the actual state of pavement condition. AC 150/5220-30C specifically states:

> Therefore continued transmittal of Mu values is permissible with the understanding that the particular numerical value has no particular significance other than to provide changing runway condition trend information when associated with previous or subsequent runway friction measurement values. Airport operators are cautioned against using Mu values as their sole indicator of winter runway slipperiness. Additionally, note the U.S. movement to the use of the [International Civil Aviation Organization] term 'medium' instead of the term 'fair.' Until the transformation to ICAO terminology is complete, this AC will express the term as 'medium (fair).'

It is recognized in the industry that pilots continue to seek information from airports with or without approved devices, as any report is considered an additional piece of information pilots may find useful to their decision-making process to operate safely. AC 150/5220-30C instructs airport operators to conduct runway friction assessments or inspections whenever necessary to determine if conditions are deteriorating. Deteriorating conditions can include:

- frozen or freezing precipitation
- falling air or pavement temperatures that may cause a wet runway to freeze
- rising air or pavement temperatures that may cause frozen contaminants to melt
- removal of abrasives previously applied to the runway as a result of wind or airplane affects
- frozen contaminants blown onto the runway by wind.

The FAA expects the airport operator to take reasonable steps to improve any deteriorating pavement condition, if he/she have the capability; or to otherwise issue a NOTAM. The FAA reports in AC 150/5200-30C that studies it has conducted indicate a pilot's braking action report or a braking action assessment by the airport operator that results in a "nil" condition is a serious concern no matter what type of device or means made to measure the condition. The AC states:

> A NIL pilot braking action report (PIREP), or NIL braking action assessment by the airport operator, requires that the runway be closed before the next flight operation. The runway must remain closed until the airport operator is satisfied that the NIL condition no longer exists. . . . Under the conditions noted above, the airport operator must take all reasonable steps using all available equipment and materials that are appropriate for the condition to improve the braking action.

TABLE 28
NUMBER OF SURVEYED AIRPORTS THAT MAKE RUNWAY FRICTION OR BRAKING ACTION REPORTS AND THE TYPE OF EQUIPMENT OR METHOD USED

| Braking Action Reporting | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| None | 6 | 11 | 1 | 2 | 1 |
| Vehicle Braking | — | 6 | — | 2 | — |
| Decelerometer | — | 4 | 6 | 2 | 5 |

— = no data.
*Source*: SMQ Airport Services.

Of the airports in the survey using friction measurement devices, all identified them as being decelerometers (Table 28). It was not identified if the decelerometers were of the electronic or mechanical type. The FAA suggests in the AC that airports with mechanical decelerometers upgrade to the electronic type for better reporting capabilities.

Whether or not an airport has a friction measuring device, the FAA expects the operator to continuously monitor the airfield conditions and file NOTAMs as necessary. "Continuous monitoring" procedures can vary from airport to airport and can include the following:

- observing which exit taxiways are being used
- maintaining a regular program of friction testing to identify trends in runway traction
- monitoring runway physical conditions including air and surface temperatures, contaminant types, and depths
- monitoring pilot communications
- monitoring weather patterns.

## APPLICATION OF DE-ICING, ANTI-ICING, OR OTHER AGENTS

In the event of deteriorating pavement conditions, improvement may be achieved by application of treatment or by removal of contaminant. The means to prevent, improve, or correct a Nil or other braking action condition that impedes runway safety include the application of sand or chemicals to the runway surface. Because of cost, the majority of airport managers in the survey do not use any treatment method. Only 12 of the 45 airports in the survey reported using solid de-icing chemicals or sand to mitigate poor braking action. None of the surveyed airports reported the use of liquid de-icing chemicals. Sand applied to runways and taxiways are to meet specific FAA specifications, except in the state of Alaska. Ordinary sand is not acceptable. Several airport operators lacked adequate space or equipment for sand or chemical storage. Storage facilities are eligible for funding under AIP.

Table 29 identifies those airports that have available, and are able to apply, friction enhancements. Five managers in the survey noted they were often hesitant to use sand because of objections by pilots using the airport (concern for sand ingestion into the engines); and because of the added cost of having to clean any sand application from the pavement surface afterwards. As one airport operator noted, sand is simply not needed if they do a good job of snow removal (i.e., brooming slush or snow off before it becomes ice).

TABLE 29
NUMBER OF AIRPORTS THAT HAVE PAVEMENT FRICTION MATERIAL AVAILABLE

| Apply Runway Material | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| None Applied | 6 | 13 | 4 | 3 | 4 |
| Sand Applied | — | 7 | 2 | — | 3 |
| Chemical Applied | — | 7 | 2 | 3 | — |

— = no data.
*Source*: SMQ Airport Services

FIGURE 11 Example of hazardous snowbanks at a runway approach. *Photo credit*: S. Quilty, SMQ Airport Services.

More than half of the surveyed airports did not have friction enhancement capabilities. Beyond the cost, environmental issues also may apply, though the majority of respondents indicated stormwater pollution prevention was not a concern at their airports.

One effective means for managing icing conditions is to place an anti-icing agent on the pavement surfaces before the event to prevent the ice from forming. However, survey respondents stated anti-icing compounds are little used at their airports because of their cost, the dedicated equipment needed for spreading or dispersing the compounds, and the lack of facilities to store the material and protect it from the elements before disbursement. The use of mechanical ice removal is preferred.

## SNOWBANKS

Safe airport operation requires that any accumulation of snow is not to interfere with aircraft propellers, landing gear, or obscure runway or taxiway lights, signs, or NAVAIDs (AC150/5200-30C 2008). This can become a challenge as snow is pushed by plows from the center or far edge of a runway to one side. The snowbanks formed can obstruct a pilot's view of the lights and signs, or be of a hazardous height that might interfere with aircraft operation, propellers, or wings. Consistent winter storms with no melting in between add to the accumulation, possible obscuration, and difficulty of removal. Figure 11 is an example of hazardous snowbanks at the approach to a runway as a result of poor plowing technique.

The standard tool described by survey respondents for removing snow banks and leaving clean edges is the snowblower (Figure 12). Two related methods are to plow snow either to the pavement edge or plow to the center of the pavement and then use the rotary snowblower to cast the accumulation over the lights and signs (Figure 13).

FIGURE 12 Example of snowblower eliminating hazardous snowbanks at a runway approach. *Photo credit*: G. Sussey, Watertown, New York.

FIGURE 13 Example of snow having been windrowed to allow for a snowblower to remove it. *Photo credit*: C. Lawson, Romeoville, Illinois.

Another method is to run a plow along the pavement edge lights, pushing the snow toward and onto the adjacent pavement. This is most effectively accomplished when the ground is frozen to prevent a tire rut from forming or the vehicle becoming mired in soft ground. The berm is then cast over the lights with a blower or picked up by a loader.

Survey respondents used both techniques, with the wind direction and frozen ground determining where they placed the windrow. In the absence of a blower unit, several survey respondents call in a third party (city, county, contractor) to assist them with snow bank pushback or clearing with a loader.

Yet another method is to use a snowblower to clear either side of the lights or signs, provided the ground is frozen. An example is shown in Figure 14. Another method is to use a front-end loader with a bucket or blade attachment to push the snow past the lights. The last method, while not indicated as available at any of the airports surveyed, is a blade attachment that is split open to allow the light fixture to pass through.

One airport developed a site plan that does not allow snow mounds in certain areas of the airport. If the accumulation gets too high in any area where mounds are not allowed, it is moved with a loader and dump truck (Figure 15). Several airports call for the PWD or a contractor to move the banks. One airport operator in the basic category stated he had no option but to issue a NOTAM for hazardous snowbanks, as his equipment did not have the capability to prevent or remove them.

## RUNWAY INCURSION PREVENTION

A runway incursion is any occurrence at an aerodrome involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and take-off of aircraft (FAA Order 7050.1A 2010). In essence, an incursion can occur when SRE or an individual is within

FIGURE 14 Example of using a snowblower to eliminate snow accumulations around lights and signs. *Photo credit*: G. Sussey, Watertown, New York.

FIGURE 15 Example of a front-end loader removing snow mounds. *Photo credit*: R. Lanham, Auburn, Maine.

the runway environment and aircraft is moving to, from, or on the runway. An incursion poses a serious hazard to people and equipment. For an airport with an ATCT, vehicle movements on the runways and taxiways must be authorized by an air traffic controller whenever the tower is in operation. Preventing runway incursions at an uncontrolled airport becomes more problematic. The majority of airports for this synthesis are considered uncontrolled airports, as they do not have an ATCT (Table 30).

The six airports in the survey that have an ATCT have part-time hours of operation, 7 a.m. to 11 p.m. The other 40 follow the procedures to prevent incursions outlined in the FAA's *Aeronautical Information Manual* (AIM) for operations at uncontrolled airports (AIM 2014). With many snow events occurring in the late night or early morning hours, snow removal can occur when the ATCT is closed and uncontrolled procedures are to be used. Extra vigilance by equipment operators for radio communication and possible aircraft operation is necessary.

Radios and NOTAMs are means of communicating with pilots about hazardous winter conditions or for ongoing SRE operations. Table 31 identifies the number of airports in the survey that had radios installed in their SRE. A combination of radios refers to several SRE having a mixture of radios that receive and transmit, or receive only.

Installing runway entry signs and pavement hold line markings to prevent runway incursions are standard safety practices at many airports in the survey, as noted in Table 32.

TABLE 30
NUMBER OF AIRPORTS HAVING ATCT OPERATION

| Air Traffic Control Tower Operation | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Has Part Time ATCT | — | — | — | 3 | 3 |
| Has No ATCT | 6 | 21 | 4 | 3 | 6 |

— = no data.
*Source*: SMQ Airport Services.

TABLE 31
NUMBER OF AIRPORTS AND THE AVAILABILITY OF RADIOS INSTALLED IN THE SRE VEHICLES

| Type of Radio | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Receiver/Transmit | 1 | 1 | 7 | 6 | 6 |
| Receive Only | 5 | 20 | — | — | — |
| | | | | | |
| Combination | 1 | 3 | — | 2 | — |

— = no data.
*Source*: SMQ Airport Services.

TABLE 32
NUMBER OF AIRPORTS THAT DO OR DO NOT HAVE RUNWAY HOLD LINES OR SIGNS

| Incursion Prevention | Basic (6) | Local (21) | Regional (7) | Reliever (6) | NP COMM SVC (6) |
|---|---|---|---|---|---|
| Hold Lines Available | 2 do not have | All have | All have | All have | All have |
| Signs Available | 3 do not have | 10 do not have | All have | 1 does not have | All have |

*Source*: SMQ Airport Services.

Interviewees indicate the lack of signage is due primarily to the cost of installation for a low activity airport and that a hold line was considered adequate for their operation. However, pavement markings can be easily obscured by winter operations (Figure 16). Because of higher activity levels at the regional, reliever, and NPCS airports, those airports have appropriate signage installed, with the exception of one airport. For airports without signage, special snow removal effort is necessary to keep hold lines visible.

## ACCIDENTS AND INCIDENTS

Despite the installation of signs and markings, airport surface incidents continue to occur. A surface incident is defined as an occurrence of an unauthorized or unapproved movement within the designated movement area (excluding runway incursions), or an occurrence in that same area associated with the operation of an aircraft that affects or could affect the safety of flight (FAA Order 7050.1A 2010). In essence, a surface incident occurs when a vehicle or person interferes with the movement of an aircraft other than on the runway.

To help understand the hazards that can be present at small airports during winter operations, a survey question asked airport managers to identify various accidents or incidents over the previous three years (Table 33). Not all the accidents or incidents were reported to the FAA. Damage to lighting was the highest reported incident in the survey. Lights are generally damaged as a result of the force of plowed snow or by being struck by a SRE. Although all of the circumstances referred to in Table 33 are safety issues, the prevalence of NOTAM issuance or cancellation issues and SRE breakage or maintenance are concerns for airport operators. They are also budgetary concerns because of the disruption, expense, and impact it can have on airport business activity. The study did not delve into the nature of the breakages.

FIGURE 16 Example of obscured runway hold and taxiway centerline markings. *Photo credit*: S. Quilty, SMQ Airport Services.

TABLE 33
LIST OF ACCIDENTS OR INCIDENTS AT SURVEYED AIRPORTS OVER THE LAST THREE YEARS

| Incident/Accident Occurrence | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Vehicle or pedestrian incursion | — | 2 | — | 1 | — |
| Aircraft excursion due to poor friction | — | 2 | — | 1 | — |
| Aircraft collision with a snow bank | 1 | 2 | — | — | — |
| Vehicle–aircraft collision (accident) | — | — | — | — | — |
| Near vehicle collision (incident) | — | 1 | — | 1 | — |
| Damaged lights from SRE operation | 5 | 16 | 6 | 6 | 3 |
| Damaged navaids from SRE operation | 1 | — | 1 | — | 1 |
| Vehicle breakage while on the airfield | 2 | 8 | 5 | 3 | 2 |
| Inability to use equipment due to a maintenance issue | 1 | 9 | 4 | 3 | 2 |
| Miscommunication between SRE operator and ATCT or aircraft | — | 3 | — | — | 1 |
| NOTAM not issued, revised, or cancelled properly | — | 6 | 2 | 4 | 3 |

— = no data.
*Source*: SMQ Airport Services.

## SUMMARY

The accumulation of snow and ice can greatly impede the performance characteristics of aircraft. Ice is reported to be the greatest challenge, but about one-third of the surveyed airports do not have the ability to use sand or de-icing/anti-icing chemicals owing to cost, equipment, and storage limitations. Friction measuring devices are not used at approximately half of the airports in the survey; however, the FAA has announced a new format for communicating runway conditions and the reporting of friction values will no longer be disseminated.

The most frequent mishaps on airports in the survey during snow removal are damage to runway or taxiway lights. A surprising number of airports have experienced equipment breakage on the airfield or cannot use equipment because of maintenance issues.

CHAPTER FIVE

# OPERATIONAL PRACTICES

Small airports are consistently challenged to implement effective practices because of limited budgets, equipment, and available manpower. Although effective practices culled from larger airports may be impractical to implement or adapt at any one airport owing to the wide variability of operating conditions, airport managers are encouraged to review the practices for ideas and areas for consideration.

## SNOW FENCES

While not asked on the survey, one airport operator brought up the use of snow fences. Another described having used natural vegetation to help hold/trap snow by creating living snow hedges. The manager cut native vegetation very short about 50 feet parallel to and on the upwind side of the runway. A parallel swath about five feet wide was left uncleared, followed by 30 feet of cleared vegetation, and lastly another five-foot swath of natural vegetation. The undulating pattern assists in catching drifting snow through the varying air movement. It is effective until there is enough snow to bury the tall grasses and make for a smooth landscape.

Additional study revealed the use of snow fences is not uncommon and they appear to be beneficial. A research study on interstate highways in 2005 calculated that mechanical snow removal costs about $3 for every 2.2 tons of snow. A 20-foot section of four-foot snow fence can hold back 85 tons of snow, resulting in a snow removal saving of about $116.00 for every foot of snow fence (Snow Barrier Effectiveness 2012). The same article is a good reference source on snow fences in general. AC 150/5200-30C describes the use of snow fences at airports. Figure 17 shows a snow fence installed at the Lewistown Airport in Montana, where the wind blows a lot, according to the manager.

## TENANT AREAS

Survey responses indicate that in some cases the airport lease requires hangar tenants to remove snow in front and around of their hangars; in other cases, the airport has responsibility. Factors that appear to affect the arrangement are the size of the lease area, the availability of equipment and manpower, type of hangar door opening, and the concern for minimizing damage to the hangars by operating equipment close to the hangar.

City ordinances, airport rules and regulations, or airport minimum standards can be established to reinforce lease terms. In Anchorage, the local municipal code prohibits tenants' dumping or relocating snow onto or across taxi lanes, taxiways, runways, or airport roads (Snow Storage Procedures 2012). A diagram of the requirement accompanies the airport's communication to tiedown tenants (Figure 18).

## STRATEGIES AND PRACTICES

Small airports with limited budgets are faced with many challenges that were presented in earlier sections. This section compiles lessons learned, advice, and practices derived from the operators of the surveyed airports, the AC on winter operations, and other literature reviewed for this synthesis. The FAA Eastern Region ADO has produced a Certalert on winter practices for Part 139 that has pertinence to small airports (Appendix K).

FIGURE 17 Example of a snow fence installed at an airport.
*Photo credit*: J. Moline, Lewistown, Montana.

**Management**

- Develop a snow and ice control plan.
- Be dedicated to achieving your goal.
- Get buy-in from all stakeholders, including financial backing from outside benefiting groups if possible.
- Work closely with the [PWD] department and get mayoral support to prioritize the airport.
- Work with the governing body that budgets for work and continuously request additional funding.
- Address underlying issues of budget and equipment in a business plan and with the finance director.
- Track operational data on cost, performance, and winter events for comparison and budget development.
- Maintain a daily log of airport snow removal activities for comparison and justification of personnel, expenditures, and need for equipment.
- Charge the tenants a fee for snow removal from their leased areas.
- Prioritize what to plow.
- Plan out vehicle patterns in advance to minimize unproductive time and expense going back over previously plowed areas.
- Negotiate and establish priority repair of SRE with public works or private maintenance facility during a winter event.

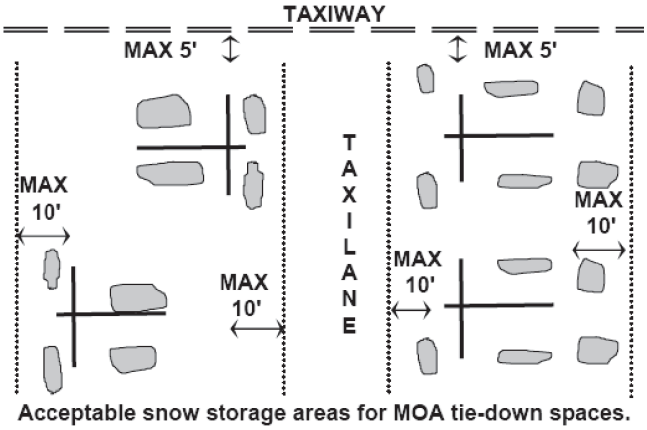



FIGURE 18 Guidance to aircraft owners on the placement of snow around tiedowns at Merrill Field, Alaska. *Source*: *Snow Storage Procedures* (2012).

- Develop a backup plan to address disabled vehicles or vehicles that may become stuck in an airfield location.
- Develop a state-wide peer network to exchange ideas and information on winter events.
- Identify performance measures that your airport can use to benchmark your snow removal efforts.

#### Personnel

- Train personnel on multiple pieces of equipment to reduce down-time.
- Have an experienced heavy equipment mechanic/operator/welder as part of the crew.
- Offer a higher pay rate for call-in personnel for storms only.
- Consider salaried or managerial positions for employees to reduce overtime or stand-by pay.
- Hire temporary seasonal employees.
- Use part-time or contract employees to supplement the one or two employees at the airport.
- Only allow employees to work 32 hours.
- Do not have part-timers plowing the high priority areas, such as runways and taxiways.
- Reduce personnel turnover.
- Keep the crew as happy and as rested as possible.
- Negotiate a single wage rate for operation of different SRE rather than base operation and cost on seniority.

#### Tenant Coordination and Communication

- Establish relations with airfield tenants and hold a tenant meeting or disseminate pertinent information before the season starts (see Appendix L).
- Have a snow committee involving tenants and agree on what is acceptable so that no single entity is served at the expense of the others.
- Establish communication protocols with FBOs, flight schools, and corporate flight departments to facilitate aircraft ground movements during winter operations.
- Have tenants keep the airport manager or office apprised of flight schedules.
- Post SICP, event operations, and contact numbers on bulletin boards and/or web.
- Coordinate activities and inform through text, e-mail, and phone.
- Focus on meeting the specific needs of the primary users for the airport, and develop a strong relationship/chain of communication with these users to identify routine operations schedules.
- Keep in touch with airline personnel as to the status of their flight versus the status of field conditions and coordinate specific airline use areas first [to] get them in the air. All other areas are second tier priority, as per lease agreements.
- Put in leases that tenants are responsible for three feet of snow removal in front of hangar doors to keep truck plows from damaging hangar doors.
- Develop a maintenance responsibility matrix that identifies where the tenant is responsible for snow removal.
- Purchase an electric demolition hammer with 2-foot-long, 4-inch floor tile spade for tenants to use to chip ice away from hangars, with training first.

#### Safety

- Develop a standard set of procedures for snow removal practices and use them always, making adjustments as necessary.
- Ensure NOTAMs are posted before commencing operation, especially by contractors (Figure 19).
- Get confirmation of NOTAM before approaching the runway.
- Use NOTAMS to close an area for snow removal rather than transiting back and forth between aircraft operation.
- NOTAM runway or taxiway closed, not entire airport, to allow for pilots to file flight plans.
- Make sure the NOTAMS reflect the field conditions at all times.
- Issue a NOTAM requiring a 10-minute prior permission approval during plowing operations.
- Issue NOTAMS by means of phone calls to eliminate having to stop and enter them electronically.


FIGURE 19 Example of a posted snow information board.
*Photo credit*: S. Quilty, SMQ Airport Services.

- If ATCT is not in operation or at an uncontrolled airport with instrument approaches, monitor or involve air traffic control center operations. Obtain phone number of air traffic operations desks.
- Use a telephone answering device for pilots to call in and check latest conditions.
- Broadcast conditions on automated information aids or social media.

### Equipment

- Constantly improve equipment in incremental steps.
- Use state surplus equipment programs to buy SRE at a discount to new, with state funding assistance.
- Acquire surplus equipment through GSAxess (General Services Administration listing of federal excess and surplus personal property); local ADO can obtain access to the website for screening.
- Avoid purchasing or accepting someone else's used equipment. Consider buying used equipment only if you have top quality mechanics that can ensure the reliability of the older equipment.

### Maintenance

- Make sure mower decks are removed and plowing equipment is clean and in good working order before winter weather starts.
- Have appropriate sized plow trucks.
- Keep equipment well maintained.
- Realize equipment breakage affects morale.
- Use adhesive plastic filament sheets on windshields to reduce pitting, chipping, and abrasion.
- Inspect equipment after each use.

### Techniques

- Plow crosswind runway and some ramp areas only during the regular workday after all other priority pavements have been taken care of.
- Wait to remove snow if there is a temperature inversion and rain might fall on frozen surfaces.

- Start at first snowfall and continue to the end of the event to minimize any large accumulations. This allows for the plowing to go as fast as possible.
- Establish a trigger point for commencing snow operations (e.g., accumulation one-half inch, one inch, etc.).
- Sweep after plowing to prevent packed snow/ice buildup and to keep windrows to a minimum.
- Position plowed snow in areas that allow for additional snow accumulation later in the winter.
- Limit snowpiles as they will cause drifts. Place snowpiles in strategic locations to minimize flooding in the spring.
- Plow several times a day if needed, rather than waiting until after the snow event has concluded.
- Hold off plowing if it appears that ice will develop after the snow falls. Ice on top of snow is easier to remove than ice on pavement.
- Monitor forecasts to mitigate snow removal expenditures. For instance, an expected strong sun exposure will often melt thin snow on non-priority surfaces.
- Place reflective tape on lights and signs to help drivers see them and prevent damage.
- Place castor wheels on the plow blade for better maneuverability.

Additional snow removal techniques can be found in Appendix M, *Alaskan Rural Airport Maintenance Manual.*

## SUMMARY

Managing snow on the airport, especially snow banks, wind drifts, and tenant areas, can be a problem for airports with limited budgets. Advice, lessons learned, or unique or standard practices from other airports can be of value to managers and may help them to cope within their budgets.

CHAPTER SIX

# TRAINING AND HUMAN FACTORS

This section discusses personnel staffing, training, and the role of human factors during snow removal operations. The inability to meet clearance time goals was previously stated to be due primarily to the lack of qualified individuals, equipment, or equipment capability. Table 34 illustrates the nature of the problem. At the basic category airports, the responsibility falls primarily upon one individual, the airport manager or operation supervisor. At local and NPCS airports, the number of employees is not much greater. Regional and reliever airports average more employees than basic, local, or non-primary commercial service airports, which can be a reflection of their higher aircraft activity levels and revenue generation to offset the added employee costs.

## TRAINING

There is a fair amount of literature on the importance and need for training of employees in winter operations. The FAA emphasizes the need for training in its advisory circulars, safety notices (*aka* Certalerts), and other communications to airports. At certificated airports, the airport manager is required to have trained all personnel who have access to and operate in the aircraft movement and safety areas of the airport (14 CFR Part 139 2014). At a minimum, the training includes instruction in airport familiarization; airport marking, lighting, and signs systems; radio communications; and the reporting of unsafe airport conditions.

The SICP requirement under Part 139 requires instructions and procedures in the prompt removal or control of snow, ice, and slush on each movement area; the positioning of snow off the movement area surfaces so aircraft propellers, engine pods, rotors, and wing tips will clear any snowdrift or snowbank; the selection and application of authorized materials for snow and ice control; the timely commencement of snow and ice control operations; and the prompt notification of less than satisfactorily conditions.

Even though the requirements of Part 139 do not apply to non-Part 139 airports, most effective practices suggest that similar training is beneficial. Table 35 identifies the number of airports that conduct winter operations training at their airport. Formalized training at airports in the survey is not well developed except at regional and NPCS airports. A majority of those airports have Part 139 requirements for training.

The method by which training on winter operations is provided by surveyed airports is shown in Table 36. *ACRP Synthesis 49: Helping New Maintenance Hires Adapt to the Airport Operating Environment* identifies that the challenges of training at small GA airports stem from the limited budgets available, the time available for training, and the capabilities of the person conducting the training (Quilty 2013). This current synthesis report supports the data presented in *ACRP Synthesis 49. ACRP Report 123: A Guidebook for Airport Winter Operations* provides a chapter on effective practices that can be of value to smaller airports (McGormley et al. 2015).

Because the state of Alaska contracts out the snow removal operations for most of the rural airports, the Department of Statewide Aviation has produced a training video and booklet (Contractor's Orientation 2014). The booklet is provided in its entirety in Appendix M. The FAA has produced a video segment on winter operations that is also available on the web (http://www.faa.gov/airports/safety-video-series/).

TABLE 34
AVERAGE NUMBER OF EMPLOYEES ENGAGED IN SNOW REMOVAL ACTIVITIES

| Average Number of Employees | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Full | 1 | 2.3 | 3 | 3.8 | 2.4 |
| Part | 2 | 1.5 | 2.2 | 2.3 | 1.3 |
| Contract | 1 | 4 | 1 | 2.5 | — |

— = no data.
*Source*: SMQ Airport Services.

TABLE 35
NUMBER AND TYPE OF WINTER OPERATIONAL TRAINING PERFORMED AT SURVEYED AIRPORTS

| Type of Training | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| Pre-winter Review | 2 | 11 | 4 | 1 | 3 |
| Equipment | 2 | 14 | 5 | 2 | 5 |
| Radio Communication | 3 | 18 | 6 | 4 | 6 |
| Airfield Driver | 3 | 17 | 6 | 4 | 6 |
| Incursion Prevention | 2 | 16 | 7 | 3 | 5 |
| Field Condition Assessment | 4 | 15 | 7 | 2 | 5 |
| NOTAM Issuance | 3 | 19 | 7 | 2 | 6 |
| Post-winter Review | 2 | 15 | 6 | 5 | 3 |

*Note*: Airports can perform multiple types of training.
*Source*: SMQ Airport Services.

TABLE 36
NUMBER AND TYPE OF WINTER OPERATIONAL TRAINING PROVIDED BY SURVEYED AIRPORTS

| Training Delivery | Basic | Local | Regional | Reliever | NP COMM SVC |
|---|---|---|---|---|---|
| None provided | 4 | 8 | 2 | — | 1* |
| Computer or web-based | — | 5 | 2 | 1 | 2 |
| Video | — | 3 | 3 | — | 3 |
| Classroom instruction | — | 5 | 6 | 2 | 4 |
| On-the-job | 4 | 15 | 7 | 4 | 6 |
| Workshop, seminar, or conference | — | 4 | 2 | — | 1 |
| Self-study | — | 2 | 4 | 1 | 1 |
| Contractor provided | — | 1 | — | — | — |
| No formal training, just experience | — | 1 | — | 1 | — |
| Written tests provided | — | 2 | 1 | 1 | 3 |
| Oral/practical tests provided | 1 | 5 | — | — | 2 |

*Seasonal airport closed for winter.
*Note*: Airports can conduct more than one type of training.
— = no data.
*Source*: SMQ Airport Services.

## HUMAN FACTORS

Human factors are a leading cause of accidents in aviation, affecting how aeronautical professionals interact with the people around them, the environment they work in, the use of equipment and tools, and the various operating rules and regulations that impact human behavior. A major emphasis of studying human factors is in understanding the perceptual, interpretive, or logical errors that people make. Those errors manifest themselves in mistakes, violations, incidents, and accidents, all of which have unplanned budgetary costs associated with them.

As it relates to winter operations, *ACRP Synthesis 12: Preventing Vehicle–Aircraft Incidents During Winter Operations and Periods of Low Visibility* provides an overview of the various performance factors that affect maintenance and operations personnel during snow removal operations at airports (Quilty 2008). Examples of human factors affecting winter operations in the report are time pressures, tenant and supervisory pressures, fatigue, low visibility, night operation, physical impairments, and equipment design and operation (Figure 20). *ACRP Synthesis 29: Ramp Safety Practices* also provides background information on human factors for maintenance personnel (Landry and Ingolia 2011).

During any winter event, pressures exist on personnel to have the airport available for operations in a timely manner, and to serve the emergency and normal needs of aircraft operators and airport users. The pressures appear to weigh more heavily if cargo, corporate, scheduled commercial, flight training, or emergency Medevac operations are routinely conducted at the airport. The operations identified all generate income for the airport. The most commonly cited pressure for all categories of surveyed airports was associated with time, followed by tenant and user demands or expectations, and then expenses associated with snow removal operation.

Based on literature and interviews, fatigue is an all too common issue during winter operations. The effects of cold temperatures, snow removal conducted in the early morning hours or for extended hours into the evening, and constant vibration and noise exposure can lead to mistakes being made, inefficiency of operation, irritability, and ill health. As noted earlier, many of the airports in the survey have only one to four employees to manage a snow event, no matter how long the event lasts.

Miscommunication is a concern of snow equipment operators, whether that miscommunication stems from use of the radio to the transmission of NOTAMs. It is incumbent upon a SRE operator to monitor the local air frequencies for aircraft traffic and to be cautious of aircraft operations. The loud and noisy conditions within a SRE often make it difficult to hear.

FIGURE 20 Nighttime operations create additional human factor issues. *Photo credit*: G. Sussey, Watertown, New York.

## SUMMARY

The effects of limited budgets at small airports are seen in the few number of employees engaged in snow removal. The average number of employees engaged in snow removal is 2.5 full-time personnel. To meet the challenges of snow removal, surveyed airports hired part-time personnel, engaged volunteers, or hired contractors to support operations. The formal training of individuals in snow removal operations was not evident at 14 of the 45 airports (31%). Most knowledge about snow removal operations came from on-the-job experience.

CHAPTER SEVEN

# RURAL ALASKAN AIRPORTS

A large majority of small airports with limited budgets can be found in Alaska. This section addresses the unique characteristics of snow removal operations at Alaskan rural airports that have gravel runways.

The Alaska DOT&PF owns 254 rural airports in the state of Alaska. The DOT&PF is divided into three regions: Southeast, Central, and Northern; most of the rural airports are located in the Central and Northern regions. Eighty-two percent (82%) of communities in Alaska have no road access and rely on water or aviation transportation. In the winter season, it is almost exclusively air transportation that serves the outlying communities. It is difficult to pave runways in the rural areas, so gravel runways prevail.

*ACRP Synthesis 49: Helping New Maintenance Hires Adapt to the Airport Operating Environment* describes the training of personnel responsible for maintenance at the rural airports in Alaska. It was noted in the case example that local communities do not have the resources, either the budgets or the equipment, to maintain the airports, so the DOT&PF takes on the responsibilities.

## WINTER CHALLENGES

With airports being the primary connection to the rest of the world for communities in Alaska, keeping them open during the winter (and summer) is quite challenging.

### Funding

Funding is difficult for the Department of Statewide Aviation. Alaska is not a block grant state but it is one of the 13 public land states identified in chapter two that receive special consideration in AIP legislation. AIP formulas benefit Alaska and the other public land grant states by making FAA grant contribution at the 93.75% level, rather than at the normal 90% level.

Through additional policy determinations, the DOT&PF is allowed to pool its entitlement funds from commercial service airports and to disperse funds in ways that benefit statewide aviation development. For this reason, many of the rural airports are included in the state airport system plan and the NPIAS, thereby becoming eligible to receive funds for SRE and SREB. Even though funds are pooled, the need for projects and resources far exceed the amount of funds available at any given time. The state has a prioritization process and takes a long-term approach to airport development.

A contract awarded for snow removal is spread out over 12 equal monthly payments. In exchange, the contractor is to check on the airport each day and conduct snow removal operations when accumulations exceed two inches. State contracts for snow removal are awarded to the lowest bidder.

### Personnel

Many Alaskan remote communities are very small, some with populations of fewer than 50 people. The pool of available contractors is limited by the scarcity of residents in the community; as a result, finding individuals who can operate heavy snow removal equipment can be difficult at times. On occasion, the availability of only one or two contractors and the low bid procurement process can

combine to result in higher than expected costs and less than optimal performance. Managerial oversight is often difficult because the managers are located several hundred miles away. On-site oversight requires the expense of chartering an aircraft to the community.

### Training

To assist in training the contractor, the state has developed a training DVD on snow removal operations at airports. The DVD provides orientation training to a contractor (Contractor's Orientation 2014), and a Rural Airport Maintenance Manual accompanies the DVD (Appendix M). If possible, the regional manager will attempt to visit the airport to further instruct a new contractor in operations. In recent years, the DOT&PF has partnered with unions and training centers to provide specialized heavy equipment training to contractors. This has proven to be valuable in terms of improving effectiveness and reducing damage to airfield surfaces, building, and equipment.

### Equipment

A typical rural airport will have one road grader and one loader, though no standard equipment requirement exists (Figures 21 and 22). A storage facility is built to house the equipment and protect it from the harsh winter conditions. Using AIP funding, the state purchases the equipment and builds the storage unit. General state funds are used to hire a local contractor to maintain the gravel runway. The grader is capable of placing a plow on its front, along with the underbody blade.

Data were collected and synthesized on the number and age of equipment for the rural airports managed by the Alaska DOT&PF. Not all Alaska rural airports are included. The 383 airports

FIGURE 21 Typical grader with underbody and front plow used at Alaskan rural airports. *Photo credit*: J. Worrall, Alaska DOT&PF.

FIGURE 22 Typical articulated frontend loader with attachments used at Alaskan rural airports. *Photo credit*: J. Worrall, Alaska DOT&PF.

identified are those that could be categorized into the GA ASSET categories of basic, local, regional, and NPCS airports. None of the airports in the database were identified as reliever airports. Basic category airports constitute the majority of rural airports in Alaska, twice as many as NPCS airports.

Table 37 presents data on the number and age of equipment for each of the airport categories. Alaska DOT&PF's acquisition process is to use AIP funds for the purchase of SRE for its equipment needs. The averages for each of the categories are slightly above two vehicles per airport. DOT&PF assigns an inventory number to each piece of equipment. An airport could have one prime mover vehicle but several attachments, such as a plow, blower, or bucket. SRE beyond their useful life are not normally retained and are sold as surplus property. In the year 2003, over 45 SRE were acquired. One factor for the large purchase was reduced AIP local share requirement of 6.25% under the Vision 100: Century of Aviation Reauthorization Act of 2003 AIP authorization. Significant savings were realized from the previous 10% requirement. The reduced local share authorization under Vision 100 expired in 2012. The SRE purchased in 2003 are now 12 years old and are eligible for replacement.

### Maintenance

Maintaining the equipment is an issue for Alaskan rural airports and DOT&PF. Since the state owns the equipment, it has responsibility for maintaining it as well. If a piece of equipment breaks, the regional manager has to fly in a mechanic with tools and parts to fix it. A ski-equipped aircraft is normally chartered to transport a mechanic to make necessary repairs. A routine call out for a mechanic can cost upwards of $3,000.00 for basic maintenance. If the equipment breaks while on the runway, or if the winter event persists over a long time, maintenance can be even more problematic. Sub-zero

TABLE 37
NUMBER AND AGE OF EQUIPMENT FOR RURAL AIRPORTS MANAGED BY THE ALASKA DOT&PF

| Equipment Age (years) | Basic (98 airports) | Local (6 airports) | Regional (3 airports) | NP COMM SVC (39 airports) |
|---|---|---|---|---|
| 25 | 9 | — | — | — |
| 24 | — | — | — | — |
| 23 | 4 | — | — | 4 |
| 22 | 17 | — | 2 | 1 |
| 21 | 15 | — | 1 | 4 |
| 20 | 34 | 7 | — | 13 |
| 19 | 5 | 5 | — | 4 |
| 18 | 2 | — | — | 1 |
| 17 | 3 | 2 | — | 3 |
| 16 | 12 | — | — | 8 |
| 15 | 3 | — | — | 3 |
| 14 | 7 | 3 | — | 5 |
| 13 | 2 | — | — | 4 |
| 12 | 32 | — | — | 15 |
| 11 | 11 | 1 | 1 | 13 |
| 10 | 5 | — | — | 3 |
| 9 | 11 | 1 | — | 5 |
| 8 | 11 | — | — | 6 |
| 7 | 3 | — | — | 5 |
| 6 | 7 | — | 1 | 3 |
| 5 | 11 | — | — | 3 |
| 4 | 7 | 2 | — | 10 |
| 3 | 10 | — | — | 6 |
| 2 | 3 | — | — | 1 |
| 1 | 10 | — | — | 3 |
| Total SRE | 234 | 21 | 5 | 123 |
| Average SRE per Airport | 2.4 | 3.5 | 1.7 | 3.2 |

— = no data.
*Source*: SMQ Airport Services.

FIGURE 23 Typical snow removal equipment building used at Alaskan rural airports. *Photo credit*: J. Worrall, Alaska DOT&PF.

temperatures and a lack of common heavy equipment repair tools such as cranes, machine shops, and specialty tools are additional complicating factors.

### Storage Buildings

Another challenge is associated with the equipment and the storage facility. Oftentimes, the SREB is the only large-type shop building of its kind in the village. The building can be an attraction for purposes other than the storage of state equipment (Figure 23). However, the building and equipment are purchased with AIP funds and therefore are restricted in their use to airport functions only. A number of communities have had to be issued stern warnings about the use of the heated and insulated building and the equipment for other than airport use.

### Snow Removal Techniques

Although the underbody blade on a grader is valuable in addressing snow and icing conditions, its use is not the same on a gravel runway as it is on a hard surface runway. As with the design of all runways, the surface has a graded crown to facilitate water drainage and runoff away from the runway. A snow removal challenge is to avoid removing the centerline crown.

Because most rural Alaskan airports do not have snowblowers available, any snow accumulation needs to be pushed past the runway lights. Operating the plows in between the lights poses greater risk for damage and for the buildup of snow in and around the lights. If not hand shoveled, the snow berms and ridges created by the plow will freeze and make it more difficult to clear the accumulation and gain access to a light if it needs maintenance. Figure 24 shows the accumulation of aggregate and snow around the lights and off to the side of the runway.

FIGURE 24 Example of frozen gravel berms surrounding light fixtures at Alaskan rural airports. *Photo credit*: J. Worrall, Alaska DOT&PF.

Another maintenance issue is that some gravel airports in Alaska have a costly surface treatment applied to the top layer to minimize dust and aggregate migration. Known as a dust palliative, it's a suppressant that binds the material together, similar to a sealcoat. If a road grader or plow scrapes the top of the gravel, it will remove the palliative, which requires costly reapplication when the weather improves. Palliatives are designed to last four to five years.

To minimize the disturbance to the palliative and to maintain the crown, a common snow removal technique is to establish a layer of compacted snow early in the season through the use of drag plates, rollers, or by simply driving up and down repeatedly over the surface. The resultant hard pack helps protect the underlying surface course gravel aggregate, provided proper techniques are used. The main technique is to keep the plow or underbody blade slightly raised or in "float" mode on compacted snow to minimize scraping down to the aggregate.

Rural airports in Alaska can receive upwards of 100 inches of snow a year or more. However, freezing rain poses the greatest difficulty, as the available equipment and the gravel runways are not set up to manage icy situations. During an interview for this report, one manager commented that Alaska is seeing more and more freezing rain events than the pure snow events of the past. An additional problem reported is that as Alaska sees warmer temperatures during the winter and summer months, the permafrost is becoming less thick. This is resulting in more maintenance issues with both gravel and paved runways as the soil beneath the surfaces react to the freeze-thaw cycles.

#### Runway Friction Enhancement

De-icing/anti-icing materials do not work well in the very cold arctic climate and are too expensive to use on the gravel runways, though it is used on paved surfaces of the larger airports. Sand is not normally available for many of the airports, and for the gravel runways sand is not needed. If sand is used, it tends to be a coarser mix than the fine-to-medium sand the FAA normally specifies because it is not as effective on the snow-compacted and high-wind driven runways in Alaska. NOTAMs are issued alerting pilots to sand application and the air carriers are involved in the decision-making as to what type and grade of sand is used.

#### Runway Condition Reporting

Runway condition reporting is a significant challenge at many small airports in Alaska, in part because the contractor is not stationed at the airport with regular work hours. The requirement is for the contractor to inspect the airfield and perform any snow removal necessary before the first scheduled flight arrival. The training video for the contractors describes the need for them to call the airport's manager or the FSS employee and inform him or her of the airfield condition. The manager or FSS employee then will enter the information into the NOTAM system. For the rural airports, access to the NOTAM system through the Internet is not generally available. The telephone is the normal mode of communication.

### NORTH SLOPE BOROUGH

Although the majority of airports in the state of Alaska are operated by the state, there are a small number of airports operated by municipalities, villages, and boroughs. One example is the North Slope Borough (NSB), which is similar in governance to a county unit in the lower contiguous states. The NSB covers the northern one-third of Alaska (an area about the size of the state of Minnesota) and operates six different gravel runway airports.

The typical operation in and out of the airports is small piston-engine aircraft. Several turbine-engine aircraft used for commercial service, such as the Beechcraft 1900 and Cessna Caravans, also frequent the airports. Occasionally, an airport will see a four-engine cargo DC-6, military C-130, or an emergency Medevac Beechcraft King Air 350 or Lear.

Like other Alaskan rural airports, the NSB uses AIP funds to acquire snow removal equipment for the airports. Common equipment includes graders, loaders, and snow plows. The NSB is acquiring

two snowblowers this year. Additional equipment, such as rollers and compactors, are provided by the PWD, which has responsibility for maintenance and snow removal at all six airports.

One airport manager oversees the six airports, but the maintenance employees are those of the PWD, as employed at each village. Budgets for snow removal at the airports are the responsibility of each village PWD. The airport manager works through the NSB budget process to coordinate capital equipment and AIP funding for the various airports. Because aviation is their main transportation access, the NSB and village PWD budgets support airport maintenance and operations.

The NSB experiences a very dry snow with little water content. Although annual snowfall accumulation is not very high, the winds create significant drifting. A unique aspect of the dry snow is that when it settles on the surface, the wind, coldness, and low humidity will cause the texture, size, and shape of individual snow grains to change and become almost tacky to the touch. For this reason, concern for a poor friction coefficient or braking action is minimal.

Snow removal practices are similar to that of other rural airports in that the grader plows are raised slightly above the gravel or are floated on hard-packed snow. The gravel runways have the dust palliative applied to them so care is taken to not grade the top layer. The major human factors concern for equipment operators is not so much the 24-hour darkness as it is the effect of sub-zero temperatures on personnel and the equipment.

Although equipment and manpower is available, suitable shelter is not available at all airports. In those situations, equipment may be left outside and are connected to electrical headbolt, water, and oil heaters. If temperatures fall below minus 32 degrees Fahrenheit, a procedure is in place to rotate equipment every two hours into a heated shelter. A standard practice before operating any equipment that has been left outside is to check the air filter and other components for accumulation of blown snow.

Like rural airports in the rest of Alaska, the NSB is challenged with reporting surface conditions. One advantage the NSB has is that PWD village supervisors are stationed to cover each airport and they have Internet access. Each morning the village supervisor will inspect the airport. Shortly thereafter, the NSB airport manager will conduct a daily online meeting with all supervisors to review conditions. A follow-up daily report is also filed. A select number of trained supervisors are authorized to issue NOTAMs, the airport managers among them. NOTAMs are issued by telephone to the FSS.

### ENHANCING SNOW REMOVAL OPERATIONS

In interviews with the managers of rural airports in Alaska, a number of enhancements were cited that could possibly improve the overall capability of managers to provide oversight and improvement in snow removal operations for Alaska's remote airports.

The use of available technologies can aid in better resource management. An example is remote tracking and monitoring capabilities for fuel storage tanks, building heating systems, and equipment usage. The installation of remote telematics on SRE would assist in better management and oversight of assets and runway safety. However, any such technology improvement requires Internet access, which does not currently exist at many of the remote airports.

Another example is the use of webcams for depicting weather conditions in common flight corridors and around airports, which Alaska has pioneered. However, the currently installed webcams are not designed to discern runway conditions. Dedicated camera or other instrumentation would likely help in that regard. Installation of automated weather reporting instrumentation at the airports would be a valuable added capability, but Internet access and remote monitoring remains a basic requirement for the technology.

Where both state road and airport snow removal responsibilities exists, the DOT&PF has sought to increase efficiency and avoid duplication of equipment purchase by proposing to acquire equipment under AIP using a shared or prorated purchase schedule. Current AIP limitations preclude such use.

To address the need for compaction of snow or the removal of ice, the acquisition of compaction rollers and ripper blades would be beneficial. However, neither is currently an AIP-eligible item, as they are considered to be maintenance devices for earthwork rather than for eligible snow operation use.

## SUMMARY

Rural airports in Alaska are often the lifeline of the community to the rest of the continent. For this reason, the state of Alaska manages many of the small rural airports. Among challenges these airports face are capital funding and limited operating budgets, obtaining qualified personnel to conduct snow removal operations, training, and maintenance.

Most of the rural airports in Alaska have gravel runways, which pose unique maintenance problems. Using AIP funding, the state provides local communities with snow removal equipment and a storage building, and uses general fund allocations to contract for the maintenance and snow removal activities.

Runway condition assessment and reporting of those conditions is another challenge for rural airports. The challenges lie with the training of part-time personnel to be able to assess and make reports, and the lack of technology to communicate reports in an efficient or expedited manner.

CHAPTER EIGHT

# CONCLUSIONS

The main conclusion from the study is that despite struggling with limited budgets, older equipment, and few employees, airport operators in the survey displayed a resiliency and independence in doing all they can to keep their airports operational during the winter season.

The prime challenges within the different categories of airports studied are related to the organizational structure of small airports, the lack of equipment and adequate personnel, the expense associated with snow removal operations, and the difficulty in forecasting the number or severity of future winter events. Some of the challenges the airports in the survey face lead to the following conclusions:

- Limited budgets for personnel or overtime is a major issue cited by many survey respondents, as is the lack of available or skilled personnel. The surveyed airports generally had only one to four people to manage any winter event. The potential cost to airports is longer work hours and overtime, employee fatigue and possible mistakes/errors, and lost productivity in other areas of the airport.
- Higher activity airports, such as the reliever and regional category airports, have better financial capabilities, but also higher snow removal equipment (SRE) needs. To address and support the higher capabilities, budget alignment is important.
- Keeping older equipment operational is a problem for some airports because equipment or vehicle parts are hard to come by or maintenance personnel are not readily available. The airports struggled with maintaining equipment that averaged 15 years in age and ranged from one to 66 years old. Equipment breakdown from age-related issues can impact the budget in many ways: lost business, expense of removing/repairing the equipment, inability to remove future snow, lost employee productivity, and lower employee morale, to name a few.
- A surprising number of airports have experienced equipment breakage on the airfield or cannot use equipment because of maintenance issues or parts availability.
- Keeping the airport open for medical evacuation activity is a pressing problem for those airports with based activity.
- Disruptions to the flow of snow removal activities, such as equipment breakage, pilot arrivals and departures, and tenant requests for non-critical plowing, are stress points for snow removal operators. Snow removal efficiency comes from having a plan and working the plan without disruptions.
- Airports with limited budgets or low activity are less likely to have shelter available for their snow vehicles or equipment. This is more problematical for the basic category airports, where only 53% of those surveyed had snow removal equipment buildings (SREs); whereas reliever and non-primary commercial service airports are able to shelter 100% of their equipment. Increased funding assistance from state or federal government for SREB can help prolong service life of SRE.
- The number of airport operators reporting damage to equipment and airfield fixtures points to a possible training or skill development issue at the surveyed airports. Most training was on the job rather than formal. Improving budgets or making funds available for training or educational opportunities can improve the return on both capital investment and human performance.
- The proper dissemination or cancellation of NOTAMs and the maintenance of SRE are other areas for valuable training.
- To help address the challenges of limited budgets, the FAA and state aviation agencies assist airports with SRE acquisition through grant funding or other means. Restrictions placed on the equipment's use was found to be a factor for why many airports have not pursued federal assistance.

- The use of Airport Improvement Program (AIP) funds is the most prevalent means for small airports to acquire SRE. However, fleet and surplus property purchases were more prevalent at basic category airports than for the other airport categories. Regional and reliever category airports had higher percentages of equipment purchases using internal funds. Surplus SRE acquisitions are prevalent because of restrictions on the number of AIP SRE an airport can have and the perceived lower cost of acquisition. Older equipment is more likely to lead to greater maintenance expenditures and more downtime than newer equipment. Small airports would benefit from being able to acquire additional AIP-funded SRE in less than the current 10-year limitation.
- The surveyed airports were often relegated to acquiring used or hand-me-down equipment because low operational activity or competing airport capital priority requirements made the AIP or state grant process unavailable.
- Several small airports expressed a desire for multi-purpose tractors or vehicle that can be used for purposes other than snow removal.
- More than 30% of existing SRE at the local, regional, and reliever airports were identified by management as needing replacement.
- About one-third of the airports do not have the ability to use sand or de-icing/anti-icing chemicals because of cost, lack of equipment, or storage limitations. Increased funding assistance from state or federal government for chemical storage can enhance safety through the use of de-icing/anti-icing methods.
- A snow and ice control plan (SICP) is one of the most efficient ways to meet the challenges of a winter event at small airports with limited budgets; however, 35% (16 of 46) of small airports surveyed do not have a SICP. An SICP is necessary for receiving FAA consideration for SRE under AIP. Improved planning results in more efficient operations when trying to do more with less. A well-defined SICP can help justify more SRE and staffing.
- Small GA airports are often the last priority for snow removal under a community-wide snow plan because of low activity or perceived lack of importance. Airport managers would benefit from better communicating airport needs and stress positive economic or emergency attributes of the airport to local governmental officials.
- Airport managers bring an important safety perspective to snow removal operations that other municipal workers or contractors engaged in snow removal may not have. A manager's dedication to safe operations and education needs support from policy makers, administrators and other managers.
- Airports need more financial and community support. Increases in capital funding for acquisition and maintenance of SRE and facilities can improve safety, reduce liability exposure, and increase economic activity.

# ACRONYMS

| | |
|---|---|
| AC | Advisory Circular |
| ACIP | Airport Capital Improvement Program |
| ACM | Airport Certification Manual |
| ADO | Airport District Office (FAA) |
| AIM | Aeronautical Information Manual |
| AIP | Airport Improvement Program |
| ATCT | Air Traffic Control Tower |
| CFR | Code of Federal Regulations |
| DOT&PF | Department of Transportation & Public Facilities |
| FBO | Fixed-base operator |
| FSS | Flight service station |
| GA | General aviation |
| MTE | Multi-tasking equipment |
| NAS | National Airspace System |
| NOTAM | Notice to Airmen |
| NP COMM SVC | Nonprimary Commercial Service |
| NPIAS | National Plan of Integrated Airport Systems |
| NSB | North Slope Borough |
| PIREP | Pilot Report |
| PWD | Public Works Department |
| RCAM | Runway Condition Assessment Matrix |
| RFP | Request for proposal |
| SICP | Snow and Ice Control Plan |
| SRE | Snow removal equipment |
| SREB | Snow removal equipment building |

# REFERENCES

14 CFR 139, Code of Federal Regulations, Title 14 Aeronautics and Space, Part 139—Certification of Airports, current as of Nov. 26, 2014 [Online]. Available: http://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title14/14cfr139_main_02.tpl [accessed Nov. 30, 2014].

Advisory Circular 150/5200-28D—Notices to Airmen (NOTAMS) for Airport Operators, Federal Aviation Administration, Washington, D.C., Jan. 28, 2008 [Online]. Available: http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentID/73588 [accessed Nov. 30, 2014].

Advisory Circular 150/5200-30C—Airport Winter Safety and Operations, Federal Aviation Administration, Washington, D.C., Dec. 9, 2008 [Online]. Available: http://www.faa.gov/regulations_policies/advisory_circulars/index.cfm/go/document.information/documentNumber/150_5200-30C [accessed Nov. 30, 2014].

Advisory Circular 150/5220-18A—Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials, Federal Aviation Administration, Washington, D.C., Sept. 14, 2007 [Online]. Available: http://www.faa.gov/documentLibrary/media/advisory_circular/150-5220-18A/150_5220_18a.pdf [accessed Nov. 30, 2014].

Advisory Circular 150/5220-20A—Airport Snow and Ice Control Equipment, Federal Aviation Administration, Washington, D.C., Sept. 24, 2014 [Online]. Available: http://www.faa.gov/documentLibrary/media/Advisory_Circular/150-5220-20A.pdf [accessed Nov. 30, 2014].

Aeronautical Information Manual (AIM), Federal Aviation Administration, Washington, D.C., Apr. 3, 2014 [Online]. Available: https://www.faa.gov/air_traffic/publications/ATpubs/AIM/ [accessed Nov. 30, 2014].

"Airport Data & Contact Information," Federal Aviation Administration, current as of Nov. 13, 2014 [Online]. Available: http://www.faa.gov/airports/airport_safety/airportdata_5010/ [accessed Dec. 21, 2014].

Anand, P., et al., "Cost Comparison of Alternative Airfield Snow Removal Methodologies," presented at the 2014 FAA Worldwide Airport Technology Transfer Conference, Galloway, N.J., Aug. 5–7, 2014 [Online]. Available: http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=1008&context=ccee_conf [accessed Nov. 30, 2014].

*Capital Weather Gang Blog*, "Snow Fences: Do They Still Serve a Purpose?" blog entry by Don Lipman, Jan. 10, 2013, the website for *The Washington Post*, [Online]. Available: http://www.washingtonpost.com/blogs/capital-weather-gang/post/snow-fences-do-they-still-serve-a-purpose/2013/01/09/9b37e1a4-5a95-11e2-beee-6e38f5215402_blog.html [accessed Nov. 30, 2014].

*Contractor's Orientation—Rural Airport Maintenance & Operation Training Video*, CD-ROM, State of Alaska, Transportation and Public Facilities, Juneau, May 2014.

"FAA Modernization and Reform Act of 2012 (Public Law 112-95)," FAA, Washington, D.C. [Online]. Available: https://www.faa.gov/regulations_policies/reauthorization/media/PLAW-112publ95%5B1%5D.pdf [accessed Oct. 29, 2014].

FAA Order 5100.38D, *Airport Improvement Program Handbook*, Federal Aviation Administration, Washington, D.C., Sept. 30, 2014 [Online]. Available: http://www.faa.gov/airports/aip/aip_handbook/media/AIP-Handbook-Order-5100-38D.pdf [accessed Feb. 2, 2015].

FAA Order 5100.38D—Airport Improvement Program (AIP) Handbook, Federal Aviation Administration, Washington, D.C., Sept. 30, 2014 [Online]. Available: http://www.faa.gov/airports/aip/aip_handbook/ [accessed Nov. 30, 2014].

FAA Order 7050.1A, Runway Safety Program, Federal Aviation Administration, Washington, D.C., Sept. 16, 2010 [Online]. Available: http://www.faa.gov/documentLibrary/media/Order/7050.1A.pdf [accessed Nov. 30, 2014].

FAA Order JO 7110.65V, Air Traffic Control, Federal Aviation Administration, Washington, D.C., Apr. 3, 2014 [Online]. Available: http://www.faa.gov/documentLibrary/media/Order/ATC.pdf [accessed Nov. 30, 2014].

FAA Order JO 7930.2P, Notices to Airmen (NOTAM), Federal Aviation Administration, Washington, D.C., Apr. 3, 2014 [Online]. Available: http://www.faa.gov/air_traffic/publications/atpubs/ntm/ [accessed Nov. 30, 2014].

General Aviation Airports: A National Asset, Federal Aviation Administration, Washington, D.C., May 2012, 34 pp. [Online]. Available: http://www.faa.gov/airports/planning_capacity/ga_study/media/2012AssetReport.pdf [accessed Nov. 30, 2014].

Guide for Justifying Snow Removal Equipment, Federal Aviation Administration, the Minneapolis Airports District Office, Minneapolis, Minn., updated Nov. 2012 [Online]. Available: http://www.faa.gov/airports/great_lakes/about_airports/dma-ado/Conferences/media/2013/Guide-for-Justifying-Snow-Removal-Equipment.pdf [accessed Nov. 30, 2014].

Infrastructure Management Group, Inc., The Performance Institute, and Counter Technology Incorporated, *ACRP Report 19: Developing an Airport Performance-Measurement System*, Transportation Research Board of the National Academies, Washington, D.C., 2010 [Online]. Available: http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_019.pdf [accessed Feb. 2, 2015].

Landry, J. and S. Ingolia, *ACRP Synthesis 29: Ramp Safety Practices*, Transportation Research Board of the National Academies, Washington, D.C., 2011 [Online]. Available: http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_029.pdf [accessed Feb. 2, 2015].

McGormley, R., T. Arendt, and D. Seal, *ACRP Report 123: A Guidebook for Airport Winter Operations*, Transportation Research Board of the National Academies, Washington, D.C., 2015 [Online]. Available: http://onlinepubs.trb.org/onlinepubs/acrp/acrp_rpt_123.pdf [accessed Jan. 28, 2015].

"National Climatic Data Center," National Oceanic Atmospheric Administration, Washington, D.C., 2014 [Online]. Available: http://www.ncdc.noaa.gov/ [accessed Nov. 30 2014].

National Plan of Integrated Airport Systems (NPIAS), Federal Aviation Administration, Washington, D.C. 2013 [Online]. Available: http://www.faa.gov/airports/planning_capacity/npias/ [accessed Nov. 30, 2014].

Quilty, S., *ACRP Synthesis 12: Preventing Vehicle–Aircraft Incidents During Winter Operations and Periods of Low Visibility*, Transportation Research Board of the National Academies, Washington, D.C., 2008 [Online]. Available: http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_012.pdf [accessed Feb. 2, 2015].

Quilty, S., *ACRP Synthesis 49: Helping New Maintenance Hires Adapt to the Airport Operating Environment*, Transportation Research Board of the National Academies, Washington, D.C., 2013 [Online]. Available: http://onlinepubs.trb.org/onlinepubs/acrp/acrp_syn_049.pdf [accessed Nov. 30, 2014].

"Runway Safety—Runway Incursions," Federal Aviation Administration, Washington, D.C., 2014 [Online]. Available: http://www.faa.gov/airports/runway_safety/news/runway_incursions/ [accessed Nov. 30 2014].

"Snow and Ice Control Plan Template," Federal Aviation Administration, Washington, D.C., n.d. [Online]. Available: http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB4QFjAA&url=http%3A%2F%2Fwww.faa.gov%2Fairports%2Fnorthwest_mountain%2Fairport_safety%2Fmedia%2Fsicp_for_airports.doc&ei=TmZ7VODKBsaogwTpqoGgDg&usg=AFQjCNH8Yh84u1DN8KiAk6KVifDVwxAO1w&bvm=bv.80642063,d.eXY [accessed Nov. 30, 2014].

*Snow Barrier Effectiveness*, New Mexico Institute of Mining and Technology, Final Report NM09SAF-01, Socorro, N.M., June 30, 2012 [Online]. Available: http://dot.state.nm.us/content/dam/nmdot/Research/NM09SAF_01_SnowBarrier_FinalReport.pdf [accessed Nov. 30 2014].

*Snow Removal and Ice Control Operational Plan*, St. Mary's County Department of Public Works & Transportation, California, Md., Nov. 2010, 30 pp. [Online]. Available: http://www.stmarysmd.com/docs/Snow%20Removal%20%28web%29%2010-10-2010.pdf [accessed Nov. 30, 2014].

"Snow Storage Procedures," *Merrill Field Bulletin*, Sept. 2012, p. 4 [Online]. Available: http://www.muni.org/Departments/merrill_field/Documents/September%202012.pdf [accessed Nov. 30, 2014].

Vision 100-Century of Aviation Reauthorization Act (Public Law 108-176), Dec. 12, 2003.

Wendell H. Ford Aviation Investment and Reform Act for the 21st Century, 49 U.S.C. 40101 (April 5, 2000).

# BIBLIOGRAPHY

Bolander, P. and A. Yamada, *Dust Palliative Selection and Application Guide*, Forest Service, U.S. Department of Agriculture, Washington, D.C., Nov. 1999 [Online]. Available: http://www.fs.fed.us/eng/pubs/html/99771207/99771207.html [accessed Mar. 10, 2015].

Kuemmel, D., *NCHRP Synthesis 207: Managing Roadway Snow and Ice Control Operations*, Transportation Research Board, National Research Council, Washington, D.C., 1994.

Singer, J.A., *Small Airport Management Handbook*, Carl Vinson Institute of Government, The University of Georgia, Athens, 1985.

Vercouteren, P., "Managing Slippery Runways, Taxiways & Ramps at GA Airports," *Midwest Flyer Magazine*, Oct. 4, 2013 [Online]. Available: http://www.midwestflyer.com/?p=6795 [Feb. 2, 2015].

# APPENDIX A

## Advisory Circulars and Orders Related to Winter Operations

- AC 91-6A, Water, Slush, and Snow on the Runway
- AC 120-57A, Surface Movement Guidance and Control System
- AC 150/5200-18C, Airport Safety Self-Inspection
- AC 150/5200-28D, Notices to Airmen (NOTAMS) for Airport Operators
- AC 150/5200-30C, Airport Winter Safety and Operations
- AC 150/5210-20, Ground Vehicle Operations on Airports
- AC 150/5210-25, Performance Specification for Airport Vehicle Runway Incursion Warning Systems (RIWS)
- AC 150/5220-16D, Automated Weather Observing Systems (AWOS) for Non-Federal Applications
- AC 150/5220-18A, Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials
- AC 150/5220-20, Airport Snow and Ice Control Equipment
- AC 150/5220-22B, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns
- AC 150/5220-26, Airport Ground Vehicle Automatic Dependent Surveillance—Broadcast (ADS-B) Out Squitter Equipment
- AC 150/5300-14C, Design of Aircraft Deicing Facilities
- AC 150/5320-12C, Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces
- AC 150/5320-15A, Management of Airport Industrial Waste
- AC 150/5340-26B, Maintenance of Airport Visual Aid Facilities
- AC 150/5370-17, Airside Use of Heated Pavement Systems
- Order 5100.38D, Airport Improvement Program (AIP) Handbook
- Order 7050.1A, Runway Safety Program
- Order JO 7110.65V, Air Traffic Control
- Order JO 7930.2P, Notices to Airmen (NOTAM)

# APPENDIX B

## Survey Participants

Note: F = Full time, P = Part time, C = Contractor.

| BASIC AIRPORTS | | | PIECES OF EQUIPMENT | NUMBER OF PERSONNEL | | |
|---|---|---|---|---|---|---|
| 1S6 | Priest River Municipal Airport | Priest River, ID | 1 | 1-F | 2-P | |
| FVE | Northern Aroostook Regional Airport | Frenchville, ME | 4 | 1-F | 2-P | |
| RED | Red Lodge Airport | Red Lodge, MT | 2 | 1-F | | |
| 06D | Rolla Municipal Airport | Rolla, ND | 4 | | 1-P | |
| 5C8 | Washburn Municipal Airport | Washburn, ND | 1 | | | 1-C |
| PTD | Potsdam Municipal Airport (Damon Field) | Potsdam, NY | 6 | 1-F | | |

| LOCAL AIRPORTS | | | PIECES OF EQUIPMENT | NUMBER OF PERSONNEL | | |
|---|---|---|---|---|---|---|
| SBS | Steamboat Springs Airport | Steamboat Springs, CO | 7 | 1-F | 2-P | |
| 65S | Boundary County Airport | Bonners Ferry, ID | 3 | 2-F | | |
| MYL | McCall Municipal Airport | McCall, ID | 4 | 1-F | 1-P | |
| C15 | Pekin Municipal Airport | Pekin, IL | 2 | 1-F | | 4-C |
| MGC | Michigan City Municipal Airport | Michigan City, IN | 2 | 2-F | | |
| 0B5 | Turners Falls Airport | Montague, MA | 1 | | 2-P | 3-C |
| IWI | Wiscasset Airport | Wiscasset, ME | 7 | 2-F | 2-P | |
| MNM | Menominee–Marinette Airport | Menominee, MI | 4 | 1-F | 1-P | |
| AXN | Chandler Field Airport | Alexandria, MN | 6 | | 2-P | |
| TVF | Thief River Falls Regional Airport | Thief River Falls, MN | 6 | 1-F | 1-P | |
| LWT | Lewistown Municipal Airport | Lewistown, MT | 7 | 2-F | 1-P | |
| 7G8 | Geauga County Airport | Middlefield, OH | 7 | | | 4-C |
| D60 | Tioga Municipal Airport | Tioga, ND | 4 | 2-F | | |
| CNH | Claremont Municipal Airport | Claremont, NH | 2 | | 2-P | |
| EEN | Dillant–Hopkins Airport | Keene, NH | 7 | 1-F | 5-P | |
| HIE | Mount Washington Regional Airport | Whitefield, NH | 3 | 1-F | | |
| ART | Watertown International Airport | Watertown, NY | 11 | 11-F | 1-P | |
| IDI | Indiana County Airport | Indiana, PA | 4 | 4-F | | |
| BKX | Brookings Regional Airport | Brookings, SD | 4 | 2-F | | |
| HON | Huron Regional Airport | Huron, SD | 7 | 3-F | 1-P | |
| DDH | William H. Morse State Airport | Bennington, VT | 1 | 1-F | | |
| EGV | Eagle River Union Airport | Eagle River, WI | 9 | 2-F | 1-P | |

| REGIONAL AIRPORTS | | | PIECES OF EQUIPMENT | NUMBER OF PERSONNEL | | |
|---|---|---|---|---|---|---|
| LOT | Lewis University Airport | Romeoville, IL | 6 | 4-F | 4-P | |
| LEW | Auburn/Lewiston Municipal Airport | Auburn/Lewiston, ME | 6 | 8-F | | |
| BVY | Beverly Municipal Airport | Beverly, MA | 4 | 2-F | 1-P | 1-C |
| ASH | Boire Field Airport | Nashua, NH | 11 | 3-F | 1-P | 4-C |
| BTP | Butler County Airport/K W Scholter Field | Butler, PA | 6 | 2-F | | |
| ETB | West Bend Municipal Airport | West Bend, WI | 4 | | 2-P | |
| GXY | Greeley–Weld County Airport | Greeley, CO | 7 | 5-F | | |
| HNB | Huntingburg Airport | Huntingburg, IN | 6 | 2-F | 1-P | |
| MFD | Mansfield Lahm Regional Airport | Mansfield, OH | 11 | 3-F | | |
| STC | St. Cloud Regional Airport | St. Cloud, MN | 9 | 3-F | 2-P | |
| PVU | Provo Municipal Airport | Provo, UT | 6 | 3-F | 1-P | 1-C |
| BKW | Raleigh County Memorial Airport | Beckley, WV | 6 | 4-F | | |

| COMMERCIAL SERVICE AIRPORTS | | | PIECES OF EQUIPMENT | NUMBER OF PERSONNEL | |
|---|---|---|---|---|---|
| CEZ | Cortez Municipal Airport | Cortez, CO | 4 | 2-F | |
| WYS | Yellowstone Airport | West Yellowstone, MT | 0 | 0 | |
| AOO | Altoona–Blair County Airport | Altoona, PA | 5 | 2-F | 1-P |
| BFD | Bradford Regional Airport | Bradford, PA | 7 | 3-F | 1-P |
| DUJ | Dubois Regional Airport | Dubois, PA | 6 | 4-F | 1-P |
| CDC | Cedar City Regional Airport | Cedar City, UT | 3 | 1-F | 2-P |

# APPENDIX C

# Survey Instrument

**Airport Cooperative Research Program**
**Synthesis S14-09-06**
**Airside Snow Removal Practices for Small Airports with Limited Budgets**

**ACRP SNOW REMOVAL SURVEY QUESTIONS**

Airport:
Airport Identifier
Name:
Title:
E-mail:

1. Who performs snow and ice removal on the airfield at the airport (check all that apply)?
   - ☐ Airport
   - ☐ Public Works, Township, County, or similar (specify)
   - ☐ FBO
   - ☐ Contractor other than FBO
   - ☐ Volunteers
   - ☐ The sun works for us
   - ☐ Other arrangement (explain)
2. What is the most demanding type of aircraft that uses your airport in the wintertime (check one)?

   ☐ Turbojet ☐ Turboprop ☐ Multi-engine piston ☐ Single piston
3. Is your airport certificated under 14 CFR Part 139?
   ☐ no ☐ yes If yes, what class is your operating certificate?
4. What type of winter conditions are you more likely to experience?
   ☐ mostly wet snow ☐ mostly dry snow ☐ 50/50 wet/dry
   ☐ icing ☐ other (describe)
5. What is the number of times you budgeted or expected to perform snow removal operations this past winter, or budgeting for next winter? Number of times
6. What is the typical accumulation for a snow event at your airport?
   ☐ less than 1 inch ☐ between 1 and 3 inches ☐ more than 3 inches
7. For a typical snow event, how much time does it normally take to remove snow from your main runway and its associated taxiways? Hours Minutes
8. Do you have a stipulation in any policy, contract, or agreement for how quickly snow removal must be accomplished?
   ☐ no ☐ yes If yes, how much time? Hours Minutes
9. To help prevent runway incursion,
   A. Does your airport have surface painted runway hold lines? ☐ no ☐ yes
   B. Does your airport have runway hold line signage? ☐ no ☐ yes
10. Does each vehicle or operator used for snow removal at your airport have an aviation radio installed or available for use when plowing the airfield? ☐ no ☐ yes ☐ some do/some do not
    If radios are made available, are they
    ☐ Scan only ☐ Receive single frequency ☐ Transmit & receive

11. In the last three years during winter operations has your airport experienced any of the following as a result of snow removal operations (check all that apply):

- ☐ runway vehicle or pedestrian incursion?
- ☐ aircraft excursion from pavement due to poor braking or contaminated surface?
- ☐ damaging aircraft collision with snow banks?
- ☐ damaging aircraft collision with snow removal equipment or vehicles?
- ☐ an incident or near collision between equipment or aircraft?
- ☐ damaged runway lights or signs from vehicle/equipment operation?
- ☐ damaged navigational aids from vehicle/equipment operation?
- ☐ vehicle/equipment breakage while on the airfield?
- ☐ inability to use snow removal vehicle or equipment due to maintenance/parts issues?
- ☐ radio miscommunication between equipment operators and air traffic control or aircraft?
- ☐ NOTAM not issued, revised, or cancelled properly by airport operator or flight service?

12. How do you report airfield surface or other conditions to pilots, tenants, or aircraft operators (check all that apply)?

- ☐ call to Air Route Traffic Control Center (ARTCC)
- ☐ call to Air Traffic Control Tower (ATCT)
- ☐ Automatic Terminal Information System (ATIS)
- ☐ UNICOM
- ☐ e-NOTAM system
- ☐ Digital NOTAM system
- ☐ call to Flight Service System (FSS)
- ☐ Internet web page
- ☐ Intra-net airport system
- ☐ Social media
- ☐ Telephone recording
- ☐ Hand or verbal delivery
- ☐ Posting on bulletin board or similar
- ☐ Pilots call airport or manager
- ☐ Other (describe)
- ☐ We don't normally make reports

13. If your airport provides runway friction or braking action reports to pilots, what type of equipment or method is used?

14. What do you use to obtain and monitor weather information about approaching winter storms?

15. In the chart below, please list (1) all the equipment used at the airport to remove snow; (2) its age; (3) if it needs replacement; (4) whether it is sheltered in a storage building or not; (5) whether it is dedicated or shared, and (6) how it was acquired;

- For Replace, write **Y**es or **N**o if it should be replaced.
- For Shelter, write **Y**es or **N**o.
- For Owns, who owns the equipment? **A**irport, **G**overnment, **F**BO, **C**ontractor, **O**ther
- For Dedicated or Shared, type "**D**" if the vehicle or equipment is solely dedicated for airport use; or type "**S**" if it is shared with other departments (or for other purposes) outside the airport.
- For How acquired, enter the corresponding number below:
  - **1** FAA Airport Improvement Program grant.
  - **2** State grant.
  - **3** Purchased under state or similar fleet purchase plan.
  - **4** Internal capital project funding or purchase.
  - **5** Rental, lease, or lease–to-own.
  - **6** Contractor provided.
  - **7** Surplus property or hand down from other department.
  - **8** Joint purchase with other department, community, or airport.
  - **9** Other (describe _____).

| | Type of vehicle/ equipment | Age (years) | Replace? (Y/N) | Shelter (Y/N) | Owns? (A,G,F,C,O) | Dedicated Shared | How Acquired? |
|---|---|---|---|---|---|---|---|
| A. | | | | | | | |
| B. | | | | | | | |
| C. | | | | | | | |
| D. | | | | | | | |
| E. | | | | | | | |
| F. | | | | | | | |
| G. | | | | | | | |

If more vehicles/equipment exist, please enter in Comments at the end of the survey.

16. Who performs the maintenance on your snow removal equipment?

17. Do you use runway treatment material such as sand, urea, or other chemical?
☐ no ☐ yes If yes, what do you use?

18. Given the cost of anti-ice or de-ice or sand, what factors affect your decision process for whether you will use it or not?

19. Do you have a written snow plan for the airport? ☐ yes ☐ no ☐ don't know

20. FAA guidance material provides the below targeted performance times for clearing one main runway and related taxiway. The clearance times are for clearing 1 inch of wet snow.

| Annual Aircraft Operations | Commercial Service Airport (more than 2,500 enplanement) | General Aviation Airport |
|---|---|---|
| 40,000 or more | *½ hour* | *2 hours* |
| 10,000–39,999 | *1 hour* | *3 hours* |
| 6,000–9,999 | *1½ hour* | *4 hours* |
| Less than 6,000 | *2 hours* | *6 hours* |

A. Based on the category of airport and the total number of operations at your airport, what is your airport's targeted clearance time? Hours

B. Are you able to routinely meet the target? ☐ no ☐ yes

C. If unable to meet the times on a regular basis, what factors limit your ability to do so?
Explain

21. In acquiring snow removal equipment at the airport, do you have flexibility in acquiring the equipment you need or are you constrained or limited in the purchasing process to only certain types of equipment?
☐ Flexible ☐ Limited ☐ Depends

22. What pieces of snow removal equipment, changes in policies or procedures, or other action would help you to improve your winter snow operations (airfield side only)? Please list or describe.

23. Which of the strategies below represent the typical snow removal actions taken at your airport (check all that apply)?
☐ A. Weather forecast is monitored and personnel are called in as the event begins.
☐ B. Runway conditions are monitored and when snow/ice starts to stick, employees are called in or contractor/FBO is notified.
☐ C. Wait until more than a certain amount has accumulated before commencing snow removal (how much?
☐ D. Snow removal is planned to coincide with scheduled or anticipated flight arrivals or departures.
☐ E. Snow removal commences after the snow event has passed.
☐ F. FBO has total responsibility for removal as part of an agreement.

- ☐ G. City or county (or other entity) sends out a crew to plow the airport as part of an agreement or as time allows.
- ☐ H. Ice is common and we try to apply sand
- ☐ I. Ice is common and we try to chemical de-ice or anti-ice material.
- ☐ J. No ice or snow removal is accomplished.
- ☐ K. Other (please describe)

24. What pressures do you experience to keep the runway surfaces clean or open during a winter event (ex., time, expenses, tenants, flight training, commercial service, corporate, etc.)?

25. Please write about the most pressing challenges or perplexing problems you currently face or have faced in the past regarding the timely removal of snow at you airport?
(For instance, problems can be related to budget constraints, availability of manpower, limitations of existing equipment, competing priorities within the municipality, timeliness of response, adequate supervision, operational needs, ice or snow accumulations, special weather circumstances, etc.)

26. How have you addressed or tried to solve the problems and challenges mentioned above in Question 25?

27. How do you limit the height or buildup on snow banks along the runway and taxiways?

28. Given your budget situation, do you have any unique methods or tactics that make for efficient and effective snow removal operations despite the challenging budget?
☐ no ☐ yes If yes, please describe

29. How many individuals are normally engaged in snow removal at your airport during any one normal snow event (enter number of each)?
Full-time Part-time Contract employees

30. How do you normally arrange for or schedule personnel during a snow event?

31. What type and method of training is provided to snow removal personnel (check all that apply)? For method, enter the letter(s) associated with the delivery method used

**A** - Computer or web-based based training
**B** - Video
**C** - Classroom instruction
**D** - On-the-job
**E** - Outside conference, workshop, or seminar training
**F** - Self-study
**G** - Written tests
**H** - Oral or Practical testing
**I** - Other (describe)
**J -** No formal training, just experience over the years

| Type | Delivery Method (Select A thru J above) |
|---|---|
| ☐ Equipment manufacturer training | |
| ☐ Radio communication training | |
| ☐ Airfield driver training | |
| ☐ Runway incursion prevention training | |
| ☐ Field condition assessment training | |
| ☐ NOTAM training | |
| ☐ Post season review | |
| ☐ Pre-season review | |
| ☐ Other (describe) | |

32. Do you have any unique employee, volunteer, or contractor arrangements that make for efficient and effective snow removal operations? ☐ no ☐ yes
If yes, please describe

33. Over the years, what valuable winter operational lessons have you learned about what works and doesn't work at your airport? (Suggestions: write about contractor or tenant relations, snow or ice removal techniques, winter

forecasts, coordination with stakeholders, equipment operation, personnel resource allocation, NOTAM issuance, accident/incident situations, etc.)

34. What suggestions might you provide to other airports your size about how to manage snow removal on a limited budget?

35. Approximately what percentage of your operating budget makes up snow-related removal activities and supplies? percent

36. Does your state provide funding or grant assistance in the purchase of snow removal equipment?
☐ no ☐ yes

37. Do you have any snow related documents that you are willing to share and to help other airports, such as contractor agreement, training outline, snow plan, NOTAM instructions, equipment purchase plan, snow policies or procedures, price share agreements with other local agencies, agreements to purchase de-ice fluid or sand from another airport's contract, etc.? ☐ no ☐ yes If yes, please list:

38. COMMENTS: Please enter any qualifying information or comments about your winter operations on any of the questions above.

**THANK YOU VERY MUCH** for assisting other airports to learn and benefit from your snow removal situation and experiences!!!

Best regards,
Stephen M. Quilty, A.A.E.

# APPENDIX D

# AIP Requirements for Snow Removal Equipment and Building Eligibility

Airport Improvement Program Handbook
**ORDER 5100.38D**
September 30, 2014
**http://www.faa.gov/airports/aip/aip_handbook/media/AIP-Handbook-Order-5100-38D.pdf**

**Table M-1 Other Equipment Project Requirements**

**d.** Acquire Snow Removal Equipment

**(1)** For 14 CFR part 139 certificated airports:

**(a)** Equipment required for clearing snow and ice from the runways, principal taxiways, aprons, and emergency access roads is eligible.

**(b)** The equipment must be justified based on the current version of Advisory Circular 150/5200-30, Airport Winter Safety and Operations and Advisory Circular 150/5220-20, Airport Snow and Ice Control Equipment.

**(c)** The number of eligible pieces must be determined using the above two advisory circulars and the airport's approved Snow and Ice Control Plan, and there must be existing FAA specifications for the equipment.

**(d)** Eligibility is limited to the minimum requirements recommended by the advisory circulars unless the ADO approves the airport's assertion that the volume of traffic requires additional equipment. Sponsors must have submitted detailed information supporting additional equipment and the ADO must have agreed with the justification.

**(2)** For airports that are not 14 CFR part 139 certificated airports:

**(a)** Per FAA policy, only one snow removal carrier vehicle is eligible unless the ADO concurs that the airport is large enough, busy enough, and/or has significant snowfall to warrant an additional vehicle.

**(b)** The equipment must be designed and justified based on the current version of Advisory Circular 150/5200-30, Airport Winter Safety and Operations and Advisory Circular 150/5220-20, Airport Snow and Ice Control Equipment.

**(c)** Per FAA policy, incidental use is permitted at nonprimary airports without an active 14 CFR part 139 certificate only if:

**(i)** The activity does not significantly degrade the SRE useful life.
**(ii)** The SRE is used only for airport purposes and will not be used off airport.
**(iii)** The SRE is only used by airport employees.
**(iv)** The SRE is generally used for activities on AIP eligible surfaces.
**(v)** The incidental use is not used as part of the SRE justification.

**(3)** The sponsor provides the ADO with a current Snow Removal Equipment Inventory.

**(4)** Fixed and portable snow melters are eligible in very limited circumstances and must have been coordinated and approved by APP-500. The airport must be able to document that there is no other safe and efficient way to remove snow without adversely impacting aircraft operations.

ADOs often issue guidance to the airports in their region. One example is the Minneapolis ADO (PGL 08-04, April 24, 2008) (Appendix D). Reflecting national direction, the Policy states that no more than a single piece of AIP-funded SRE for a nonprimary airport is eligible unless written justification is submitted by the airport sponsor to the FAA for approval. The Minneapolis ADO provides a spreadsheet to help an airport justify acquisition of SRE for their airport (Appendix E).

**Table O-3 Other Building Project Requirements (Other than Terminals)**

**c.** Snow Removal Equipment Building (Construct, Expand, Modify, Improve, or Rehabilitate)

**(1)** Snow removal equipment buildings are intended to protect the AIP-funded snow removal equipment and materials.

**(2)** Funding snow and ice control buildings is limited to space in the building necessary for eligible Snow Removal Equipment as well as storing abrasive or chemicals used in treatment of paved areas. All other areas and equipment recommended in the current version of Advisory Circular 150/5220-18, Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials, must be paid for by the sponsor.

**(3)** The eligibility of a maintenance bay for safety and security equipment is provided elsewhere in this table and may be included in the SRE building if the requirements for the safety and security equipment maintenance bay are met.

**(4)** At the time the building is programmed, the eligible equipment must be owned, on order, or budgeted by the airport within the next five years.

**(5)** The SRE building is not intended to function as personnel quarters, snow desk, training space, or other functions. It is only intended for storage of eligible equipment. If non-eligible equipment storage is included in the building, the requirements for including ineligible or non-AIP funded work in the contract in Paragraph 3-42 must be met.

**(6)** The difference between construct, expand, modify, improve, and rehabilitate is listed in Table O-2.

**d.** Construct Sand and Chemical Storage Building (Construct, Expand, Modify, Improve, or Rehabilitate)

**(1)** Small stand-alone buildings for storage of airport surface deicing chemicals and sand may be constructed if the size and design is appropriate for the facility.

**(2)** This function may also be incorporated as eligible area in a snow removal equipment building.

**(3)** Snow and ice control abrasive or chemicals are to be used for airport pavement (not aircraft) because 49 USC § 47102(3)(G) does not permit the purchase or storage of deicing materials for aircraft.

**(4)** The difference between construct, expand, modify, improve, and rehabilitate is listed in Table O-2.

*Source*: Excerpt from FAA Order 5100-38D AIP Handbook 2014.

# APPENDIX E

## Sample Table of Contents for a Snow and Ice Control Plan

**Phase #1 Pre and Post Winter Season Topics** **Page**



**Phase #2 Winter Storm Actions and Procedures**



*Source*: FAA Great Lakes Region.
(https://www.faa.gov/airports/great_lakes/airports_resources/certification_bulletin_archive/media/09-05%20Attachment.doc.)

# APPENDIX F

## Sample Checklist for a Part 139 Airport Snow and Ice Control Plan

**AIRPORT LOCID _____**

**AIRPORT OPERATOR (CERTIFICATE HOLDER)**

The following checklist is intended to be a guide for those certificated airports which are tasked with developing a Snow and Ice Control Plan (SICP) in accordance with 14 CFR Part 139 requirements. To assist in the development of the SICP, as well as the review and approval process by the FAA, the airport operator should include the page reference on the left hand column and submit it with the SICP.

**AIRPORT CERTIFICATION AND SAFETY INSPECTORS (ACSI)**

The following checklist is intended to be a guide for the ACSI during the review and approval of the SICP. He/she is required to ensure that all elements of checklist are properly addressed within the SICP and documented on the checklist. Any elements which are not properly addressed should be referred back to the airport operator.

| √ included with page #/ X not included or NA | FAA References | SICP Requirements |
|---|---|---|
| | 313(a) | I. Snow and Ice Conditions Exist |
| | | |
| | 313(b)(1) | II. Procedures for prompt removal or control of snow, ice, and slush on each movement area? |
| | | Airfield Priority |
| | AC 150/5200-30C, Fig. 1-1 and Para 1-4 & 1-5 | A. Airfield Clearing Priorities in place? |
| | 1-4a | 1) Priority 1- Including ARFF mutual aid access point(s) to include gate(s) operability. |
| | 1-4b | 2) Priority 2 |
| | AC 150/5200-30C Table 1-1 or 1-2 and Para 1-6 a. | B. Airfield Clearance Time Calculated? Determine the number of annual operations a year and refer to Table 1-1 or 1-2 depending on commercial or non-commercial traffic (used for guidance only). |
| | 313(b) (4), AC 150/5200-30C Para 1-6b. | C. Action-initiating condition determined? |
| | AC 150/5200-30C Para 1-6 b., 3-1 and 3-2 | 1) if using weather forecasts or runway surface condition sensors = 1 inch of snowfall (25 $lb/ft^3$) |
| | AC 150/5200-30C, Para 1-6 b. | 2) if region snow density is over 25 $lb/ft^3$ = ½ inch snowfall |
| | AC 150/5200-30C, Para 1-7 | D. Sizing and Staffing Snow and Ice Control Equipment Fleet |
| | AC 150/5220-20 | 1) Priority 1 (paved area) calculation? Multiply length and width of all priority one areas (Runway, Taxiway, Fillets, ARFF aprons and roadways, aprons, blast pads, NAVAID road, any other miscellaneous areas). Total all square footage. |
| | | 2) Refer to the number of annual operations for the airport. |
| | | 3) AC 150/5220-20 used to offer guidance to determine # and type of equipment required to meet 4.a.? |
| | AC 150/5220-20, Figure 2-4 or Figure 2-5 | a. Rotary Plow Calculations—Reference either Figure 2-4 for airports without Commercial Service or Figure 2-5 for airports with Commercial Service |
| | | i. At the bottom of the graph select the Square Footage of the Priority One Area; draw a line vertically until it meets the line for the number of Annual Operations. At the point of intersection between Square footage and Annual Operation, draw a horizontal line to the left and that will give you the Snow Tons per hour. Continue the same line to the left and you'll see the number of Rotary Plows needed to clear the Priority One Areas, depending on the Class of Rotary Plow. |

| | | |
|---|---|---|
| | | The Rotary Plow Class can be determined by Table 2-1 (page 4) which gives you the Rotary Plow Capacities and the snow casting distances required.<br><br>Include this analysis in the SICP. |
| | 303(b), AC 150/5200-30C, Para 1-7 | E. Staffing requirements ("to equip personnel w/sufficient resources") met? |
| | AC 150/5220-18 and AC 150/5200-30C, Para 1-8 | F. Storage of Snow & Ice Control Equipment |
| | | 1) Heated building? |
| | | 2) Repair facilities w/in building? |
| | | 3) Equipment inspected after each use? |
| | AC 150/5200-30C, Para 1-2 and 2-2 | G. Airport Snow and Ice Control Committee (SICC) in place? Applicable to airports subject to icing conditions or annual snowfall of 6 inches or more<br>1) Airport clearing operations meeting?<br>2) Air carrier ground deicing/anti-icing program meeting? |
| | AC 150/5200-30C, Para 1-3 | H. Snow Control Center (SCC) or snow desk in place? |
| | | |
| | 313(b)(2), AC 150/5200-30C, Chapter 4 | III. Procedures for positioning snow off the movement area for air carrier clearance? |
| | 150/5200-30C, Para 4-1 | A. Wet snow vs. dry snow conditions. |
| | 313(b)(5) | B. Prompt notification, in accordance with 139.339, of all air carriers using the airport when any portion of the movement area normally available to them is less satisfactorily cleared for safe operation by their aircraft |
| | 150/5200-30C, Para 4-2 a. | C. Snow Clearing Principles—NOTAM procedures included? |
| | 4-2a | 1) Ramp and Terminal—Clearing Objectives |
| | | a) Slick Ramp Surfaces |
| | | b) Increased Airplane Engine Thrust |
| | | c) Obscured Taxi Signage |
| | | d) Obscured Terminal Visual Aids |
| | | e) Snow stockpiles adjacent to airplane operating areas |
| | 150/5200-30C, Para 4-2 b | D. Runway and Taxiway Suggested Clearing Objectives |
| | 150/5200-30C, Para 4-2 b.(1) | 1) Keep the entire primary runway(s), as practicable, bare from snow accumulations or ice buildup |
| | 150/5200-30C, Para 4-2 b.(2) | 2) Depending on the equipment fleet, etc., some operations will start at the center of the runway and work outward to the shoulders. |
| | 150/5200-30C, Para 4-2 b.(3) | 3) Sweepers or brooms used initially to keep the primary runway or its center portion, as near as practicable, bare of accumulations. When snow has melted or ice begins to separate from the pavement due to the action of chemicals, sweepers, or brooms should be used to remove the residue. As soon as snow has accumulated to a depth that cannot efficiently be handled by the sweepers or brooms, displacement plows and rotary plows (snowblowers) should be used as follows: |
| | | a) use of displacement plows in tandem to windrow snow |
| | | b) clear paved areas with surface condition sensors |
| | | c) use of appropriate polyurethane cutting edges and casters on plow moldboards to prevent damage to lights (assemblies). |
| | 150/5200-30C, Para 4-2 b.(4) | 4) Procedures for obscured visual aids |
| | 150/5200-30C, Para 4-2 b.(5) | 5) Safe driver distance between equipment operating in echelon |
| | 150/5200-30C, Para 4-2 b.(6) | 6) Removal of snow/ice or drifts that may affect the signal of electronic NAVAIDs. |
| | 150/5200-30C, Para 4-2 b.(7) and Chapter 5 | 7) Procedures for runway friction measurements after completion of snow clearing operations to assess the effectiveness of the snow clearing operation. |

| | | |
|---|---|---|
| | 150/5200-30C, Appendix 3 & 4 | a. Confirm approved Decelerometers (DEC) devices—recommended for airports where a "long" runway down-time is acceptable<br>i. Electronic—provides print-out readings and<br>ii. Mechanical—confirm used as back-up only |
| | 150/5200-30C, Para 5-4, and 150/5320-12C, Chapter 3, section 2, para 3-7 and Appendix 3 & 4 | b. Continuous Friction Measuring Equipment (CFME) devices—preferred recommended equipment (especially for airports with turbo-jet traffic for runway maintenance & weather purposes) as they provide a continuous graphic record of the pavement surface friction characteristics with friction averages for each one-third zone of the runway length.<br>i. self-contained or<br>ii. towed |
| | 150/5200-30C, Para 5-3 a. & b. | c. Procedures includes conditions acceptable to use DEC or CFME |
| | 150/5320-12C, Appendix 5 and 150/5200-30C, Para 2-6, 5-4c.(6) and Appendix 4 | d. Training for DEC or CFME included in SICP or ACM personnel training section? If used, are contractors addressed? |
| | 150/5200-30C, Para 4-2 b.(8) | 8) Snow Bank Profile Limits Figure 4-1 included? |
| | 150/5220-22A | 9) Does your airport have an EMAS System? If so, is snow removed from the EMAS, describe the process. |
| | 150/5200-30C, Para 4-2 b.(9) | 10) Warm pavement temperature procedures/use of anti-icing chemicals and/or heated sand prior to start of precipitation. |
| | 150/5200-30C, Para 4-2 b.(10) | 11) Radio communication with ATCT. |
| | 150/5200-30C, Para 4-2 b.(11) | 12) High-speed runway turnoff clearing procedures. |
| | 150/5200-30C, Para 4-2 b.(12) | 13) Procedures for clearing arresting barriers at joint-use military airports. |
| | 150/5200-30C, Para 4-2 c | E. Surface Incident/Runway Incursion Mitigation Procedures |
| | | 1) How can pilots of small or large airplanes or vehicle drivers traversing the airfield cause a runway incursion because of our snow clearing operations? |
| | | 2) How do snow operation personnel at either non-towered airports or airports with less than 24-hour ATCTs monitor information released by the ATC enroute center? |
| | 150/5200-30C, Para 4-2 b. (1), | 3) Radio Communications—Lead operator designated? |
| | 150/5200-30C, Para 4-2 c. (2) | 4) Failed Radio Signal Procedures Included? |
| | 150/5200-30C, Para 4-2 c. (3) | 5) Airfield Signage and Lights |
| | | a. Priority should be noted for lights and signs associated with hold lines, direction and location signs, and ILS critical areas. |
| | 150/5200-30C, Para 4-2 c. (4) | 6) Low visibility and whiteouts procedures included? |
| | 150/5200-30C, Para 4-2 c. (5) | 7) Driver fatigue procedures included? |
| | 150/5200-30C, Para 4-3 | F. Snow Drift Controlling Procedures Included? |
| | 150/5200-30C, Para 4-3a. | 1) Snow fence procedures? |
| | 150/5200-30C, Para 4-3b. | 2) Snow trench procedures? |
| | 150/5200-30C, Para 4-4 | G. Snow disposal procedures |
| | 150/5200-30C, Para 4-4a. | 1) Use of melting pits or portable melters |
| | 150/5200-30C, Para 4-4b. | 2) Identifying disposal sites |
| | 150/5200-30C, Para 4-5, App. 2 | H. Methods for Ice Control and Removal |
| | 313(b)(3), 150/5200-30C, Para 4-6 | I. Approved Chemicals |
| | | 1) Airside Chemicals |
| | | a. Fluid Deicer/Anti-icer |
| | | b. Solid Deicer/Anti-icer (generic solids or airside urea) |
| | | 2) Landside Chemicals |
| | 150/5200-30C, Para 4-8 | 3) Approved Sand Requirements met? |
| | 139.201(b)(1) and 150/5200-30C, Para 2-2 | Procedures for conducting annual review of SICP including verification of snow equipment list and lessons learned. |
| | 150/5200-30C, Para 2-2 | **Best Practices:** Ensure SICP answers the following questions when outlining new plans or revising existing plans |
| | | **1.** Are we materially prepared and adequately budgeted for the new winter season? |

| | | |
|---|---|---|
| | | **2.** Did the SICP incorporate identified post-season improvements? |
| | | **3.** Are we staffed adequately with qualified personnel? |
| | | **4.** Is our training program adequately tracking test records and development of qualified personnel? |
| | | **5.** Do our environmental mitigation procedures for disposal of deicers and equipment maintenance materials and supplies keep us in compliance with storm water regulations? |
| | | **6.** Should our Snow and Ice Control Committee (SICC) conduct more pre- and post-season meetings? |
| | | **7.** Did our weather forecasting method monitor last year's storm events accurately and in a timely manner? |
| | | **8.** Do we need to change our prescribed storm conditions to start clearing operations or preventative measures? |
| | | **9.** Do we need to change our runway closure procedures as defined in paragraph for closing a runway and other paved areas used by airplanes |
| | | **a)** Para 5-6 states in part: A NIL pilot braking action report (PIREP), or NIL braking action assessment by the airport operator requires the runway to be closed before the next flight operation. The runway must remain closed until the airport operator is satisfied that the NIL condition no longer exists. When previous PIREPs have indicated GOOD or MEDIUM (FAIR) braking action, two consecutive POOR PIREPs should be taken as evidence that surface conditions may be deteriorating and require the airport operator to conduct a runway assessment. If the airport operator has not already instituted its continuous monitoring procedures, this assessment must occur before the next operation. If the airport operator is already continuously monitoring runway conditions, this assessment must occur as soon as traffic volume allows, in accordance with the airports snow and ice control plan |
| | | **10.** In reference to our runway closure procedure, do we need to revise the steps we prescribed in the SICP for continuously monitoring the runway(s)? *Note: Anytime a runway is closed a full runway inspection must be accomplished prior to returning the runway to the ATCT.* |
| | | **11.** Do the same personnel continue to initiate the runway closure procedure (as developed by the airport) and are there any new procedures for the closure of a runway? |
| | | **12.** Are there any changes to our chain-of-command and phone numbers? |
| | | **13.** Do we need to update or issue a Letter of Agreement (LOA) with the airport traffic control tower (ATCT) or other parties for implementing runway closure procedures? |
| | | **a)** Para 5-6 states in part: Airport operators with an ATCT should formalize a LOA between the airport operator and ATCT. At a minimum, the LOA should specify how all PIREPs of "POOR" and "NIL" are to be immediately transmitted to the airport operator for action. It should also include an agreement on actions by Air Traffic personnel for immediate cessation of operations upon receipt of a "NIL" PIREP. Should an airport have other parties responsible for receiving PIREPs (i.e., FBOs monitoring Unicom Frequency), the airport operator should also have a formalized LOA in place between those respective parties similar to the LOA between ATCT and the Airport. |
| | | **14.** Suggested ACM Template Language; The runway will be closed for operations when the following occurs |
| | | **a)** Accumulations exceed ½" of Slush or 2" of Dry Snow (or other accumulation amount as required by aircraft utilizing airport) |

| | | |
|---|---|---|
| | | **b)** Any PIREP that reports a NIL braking action in addition, any (2) consecutive PIREP s when braking actions are reported as POOR, the airport will reassess the runway and take the appropriate actions to improve the runway conditions |
| | | **c)** The airport will continuously monitor the airfield for changing conditions during Snow Events and take the appropriate actions as needed. |
| | | **d)** ATCT (if applicable) will immediately relay all PIREPs to the airports as per the Letter of Agreement. |
| | | **15.** Were there any changes to the airfield areas to be cleared and maintained, the timing of operations, and how clearing will be done? |
| | | **16.** Are we informing our users frequently and in a timely manner when we must close the airport or report less than satisfactory surface conditions? Did we get complaints |
| | | **17.** Are we meeting all applicable Part 139 requirements |
| | | **18.** How do we ensure markings, signs, and lighting systems are legible/visible after clearing operations? |
| | | **19.** Are touchdown markings addressed in our procedures? |
| | | **20.** What are our procedures in case of airfield accidents involving snow clearing crews, airplanes, or other airport vehicles? |
| | | **21.** Did we address all unique airport site conditions |
| | | **22.** Have all storm crews received training on the SICP and trained on new equipment? |
| | | **23**. Educate/Train for low visibility and white out conditions to include special provisions to cease snow removal operations when visibility impairs a driver's ability to safely navigate. |
| | | **24.** Set standards for how long a driver can operate on the airfield to minimize fatigue. |
| | | **25.** Minimize distractions such as non-essential telephones or radios during snow removal operations. Recommend, if personnel is available, to add a person to each vehicle to handle communications. |
| | | **26.** Ensure airfield guidance signs and mandatory hold signs are clearly visible and operational. If snow or ice cannot be promptly removed, ensure appropriate NOTAMs are in place to identify obscured and or missing signs. |
| | | **27.** Vehicles should use adequate/appropriate lighting to ensure they are visible. |
| | | **28.** Communications:<br>• Communicate intentions; read back clearances verbatim, whether on ATCT frequency or company frequency; call clear as required. Note: Understand the use of ATCT "Explicit Runway Crossing" Procedures.<br>• Use Proper Aviation Phraseology.<br>• **At Controlled Airfields**, periodically check in with ATC to reconfirm ATC clearances.<br>• **At Uncontrolled Airfields**, vehicle operators should continually self-announce positions and intentions. |
| | | **29.** Personnel, who only operate on the movement area during seasonal times of the year should receive recurrent training just prior to that seasonal period. |

*Source*: FAA Eastern Region.
(https://www.faa.gov/airports/eastern/airport_safety/cert_bulletins/2011/10%20SICP%20Template%20and%20Checklist/10%20SICP%20Template%20and%20Checklist.pdf.)

# APPENDIX G

## Example of a General Aviation Snow and Ice Control Plan

NAMPA MUNICIPAL AIRPORT
SNOW REMOVAL PROCEDURES

1. MANAGEMENT

   a. The Airport Administration is responsible for determining when snow removal operations shall begin. This is based on forecasted weather reports and an accumulation of at least one (1) inch of snow.
   b. The runway condition will be checked continually for snow depth, slush, and braking.
   c. A Notice to Airmen (NOTAM) will be issued when any conditions exist that could present a hazard to aircraft operations. If the conditions persist to the point of Aircraft safety, the Airport Director can choose to close the field until operations are back to safe conditions.
   d. All fixed base operators and, or leased premises will be responsible for snow removal on their designated ramp areas.

2. VEHICLES

   a. All snow removal vehicles operating on any aircraft movement area must be equipped with a two-way radio which must be monitored by the vehicle operator at all times.
   b. All outside contractors utilized by the Airport Administration or any Airport Tenant on the Airport shall be subject to the Airport Rules and Regulations. Any Tenants with there own Snow Removal Plan should inform the Airport Administration.
   c. No one shall operate beyond the existing ramp areas without first being cleared by the Airport Administration. All such vehicles must have the necessary lights and warning signals to operate beyond the existing ramp areas.

3. SNOW REMOVAL PRIORITIES

   a. PRIORITY 1: Runway 29/11 (Based on the size of our equipment, a continuous-circuit pattern will be used starting from the leading edges and working towards the center line.)
   b. PRIORITY 2: Parallel Taxiway and the large Connector Taxiways at each end. (Based on the size of our equipment, a continuous-circuit pattern will be used starting from the leading edges and working towards the center line.)
   c. PRIORITY 3: Mid-Field Connector Taxiway, Terminal Area Ramp and City Facilities. (All the snow on the ramp area is pushed to Southeast corner of the ramp where it is stock piled.)
   d. PRIORITY 4: Last remaining Connector Taxiways and the Major Hangar Taxiways. (Snow where feasible is removed first from in front of the Hangars as close as the Operator feels comfortable [MAX 5ft]. The snow is then placed at the ends and in-between the Hangars where feasible.)
   e. STOCKPILE AREAS

f. Airport access roads, public parking lots, and service areas will be plowed by a Private Contractor if Airport Staff cannot handle it.

g. Once all the PRIORITY AREAS have been cleared Airport Staff will direct their attention to anyone who may have requested the area in front of their hangar cleared. After that all other remaining Taxilane areas will be cleared.

IF YOU NEED A VISUAL REFERENCE OF THE PRIORITY AND SNOW PLOW AREAS, PLEASE CLICK ON THE MAP LINK PROVIDED.

4. SNOW REMOVAL EQUIPMENT

a. The Nampa Airport runs two different snow plows depending on the availability of manpower and equipment resources. The first vehicle that is always on Airport property is a 1-TON GMC pickup with a 9ft Western Plow. The second vehicle that is brought in if needed is a 2-TON Ford Dump truck with a 12ft Snow Plow.

b. This equipment is maintained and inspected on a regular basis by the Airport Administration, and the City's Vehicle Maintenance Department.

5. CONCLUSION

The Nampa Airport Administration will strive to implement all of the standards that proposed in this Procedures Plan. If you have any questions or comments that you would like to bring to our attention, please feel free to contact us.

PHONE: (208) 468-5823

E-MAIL: airport@cityofnampa.us

ADDRESS: Nampa Municipal Airport
116 Municipal Drive
Nampa, ID 83687

APPROVED, FEBRUARY 12, 2007

*Source*: Nampa, ID (http://www.cityofnampa.us/DocumentCenter/View/452).

# APPENDIX H

# Minnesota Best Practice Guide to Airport Snow Removal

**Keeping your airport safe, open, and accessible this winter**
Airport snow removal is a critical winter operation in Minnesota. To ensure effective and efficient snow removal, airports should create and implement a plan and train staff that will play a role in carrying it out—before the snow flies.

**Creating a snow plan**

Your pre-season planning should begin with developing or updating your snow removal plan—a step-by-step document outlining how winter operations will proceed. This plan should include timelines, plowing guidelines and techniques, equipment and materials to be used, contact information, procedures for closing runways, and staff assignments and responsibilities.

It should also identify a snow disposal site on the airport, state how team members will be notified when a snow event occurs, and name the member(s) of the removal team who can make decisions, reduce response time, and maximize the availability of runways and taxiways. FAA Advisory Circular 150/5200-30C, Airport Winter Safety and Operations, provides guidance to prepare for the winter snow removal season. (Advisory circulars can be found on the FAA website at www.faa.gov.)

Consider the following when developing a snow removal plan:

- Are we materially prepared and adequately budgeted for the new winter season?
- Where will we store the snow?
- Who will close the runway and issue the NOTAM? What are the closure procedures for the runway and other paved areas used by airplanes?
- Did we address all unique airport site conditions?
- Are we adequately staffed with qualified personnel?
- Do we have a continuous training program and do we document our training activities?
- Do we have good weather forecasting methods that give us accurate and timely information?
- What processes are needed to revise the steps we take for continuously monitoring the runway(s)?
- How do we ensure markings, signs, and lighting systems are legible and visible after clearing operations? Are touchdown markings addressed in our procedures?
- What are our procedures in case of airfield accidents involving snow clearing crews, airplanes, or other airport vehicles?
- What is our plan for identifying the need for post-season improvements?

A snow removal plan should also include a map of the airport that shows required access for both planes and automobiles; a prioritized list of areas to be cleared of snow, and in what order; and a map showing boundaries and hold lines for airplane operating areas.

Be sure to make copies of the plan for all snow removal staff.

**Preparing for snow**
Many airports have formal or informal agreements with the local city or county for snow removal. Bring maintenance staff to the airport to discuss snow removal and the airport's plan before the weather changes so they are well informed about airport and runway boundaries, safe operating procedures, and imaginary surfaces.

Once your plan is developed but before it snows:

- Train personnel in equipment operations; communication techniques and terminology; markings, lighting, and signs; and the airport layout.
- Make practice runs with the equipment in typical operational scenarios before allowing access to the movement areas.
- When training staff, remind them that the visibility from inside their truck may be very different than the visibility from the air or from a landing plane. In addition, the noise level inside a snowplow may be high, so instruct operators in using the radio effectively in non-optimal conditions.
- Plan for snow storage when developing airport improvement projects such as parking lots and aprons.
- Write into your leases the areas that the airport will clear and the areas that each hangar tenant is expected to clear around private and public hangars.
- Meet with local pilots, hangar tenants, airport users, and fixed-based operators (FBOs) as well as emergency aircraft operators that use the airport (e.g., medical helicopters) to discuss your strategy for winter operations.

**Snow removal strategies**
Once the snow arrives, consider the following strategies for safely and efficiently removing it:

- Make radios readily available to plow operators and educate them on required and proper radio communications with pilots. Instruct plow operators to give aircraft the right-of-way at all times.
- Remind operators to allow for additional stopping distance near planes and wings that extend far beyond the plane.

- Issue a NOTAM when more than one inch of snow will fall on the runway. Always check to make sure your NOTAMs are posted before plowing and are removed after the event.
- When removing snow around lights, tell pilots and airport users that operators are on the airfield. If you see an aircraft circling to land and the runway is usable, leave the runway while it lands and then return to your work.
- Remember that the sides and ends of the runway must be cleared of snow. Pilots need to see the runway lights from the air, and snow banks should be far enough back to provide plenty of wingtip clearance. Never pile snow off the ends of the runway; push it to the sides beyond the runway ends. Finally, remember to clear more than just the main runway or you leave pilots with no way to move off of it. Plow the main runway first, followed by the taxiways, aircraft loading areas, public roadways, secondary runways and taxiways, hangar taxi lanes, and vehicle parking areas.
- Plowing around lights and navigational aids is extremely important. Clear the sensors on the automated weather observing station and provide access to the beacon and other NAVAIDs for maintenance and visibility. Use caution, since lights are mounted to break away when hit and the force of snow being pushed by a plow can easily dislodge them. Check NAVAIDs and light couplings after plowing to ensure they were not damaged.
- Know the airport and its boundaries, particularly the location of taxiways and runways, since some signs may be covered with snow.
- Check NOTAMs to ensure the runway has been closed before moving onto it for plowing.
- Listen to the radio carefully and communicate your movements clearly.
- Read back any communications from pilots.
- Note required clearances indicated on snow removal maps.
- Maintain situational awareness.
- Admit it when you're lost.
- Understand signs, lighting, and markings.
- Never assume anything.
- Take extra care due to low-visibility conditions during winter operations.

**Tips for plow drivers**

- Know the airport and its boundaries, particularly the location of taxiways and runways, since some signs may be covered with snow.
- Check NOTAMs to ensure the runway has been closed before moving onto it for plowing.
- Listen to the radio carefully and communicate your movements clearly.
- Read back any communications from pilots.
- Note required clearances indicated on snow removal maps.
- Maintain situational awareness.
- Admit it when you're lost.
- Understand signs, lighting, and markings.
- Never assume anything.
- Take extra care due to low-visibility conditions during winter operations.

*Source*: AirTAP Briefings, Fall 2011, Center for Transportation Studies University of Minnesota. Used with permission.

# APPENDIX I

## Example of a General Aviation Airport Snow Removal Request for Proposal

Geauga County Airport Authority
P.O. Box 1308
Middlefield, Ohio 44062
440-632-1884 phone and fax
geaugacountyairport@windstream.net

### Snow Plowing Specifications

**Airport Management will notify contractor when to plow**. FAA regulations require a NOTAM to be posted by airport management if equipment will be within 200 feet of the runway. Airport manager must post NOTAM prior to beginning work.

Airport Management reserves the right to wait to plow until precipitation has stopped. This may mean three inches or more than three inches. Price per push remains the same.

Bids must include a 2-year contract proposal per push for the 2014-2016 seasons as follows

A - Full Plow includes all areas highlighted and within highlighted outline
B - Secondary runway cleanup includes runway and taxiways only
C - Driveway includes driveway and parking areas as highlighted

1st Alternate – 3-year contract proposal per push for the 2014-2017 season on A, B, and C as stated above.

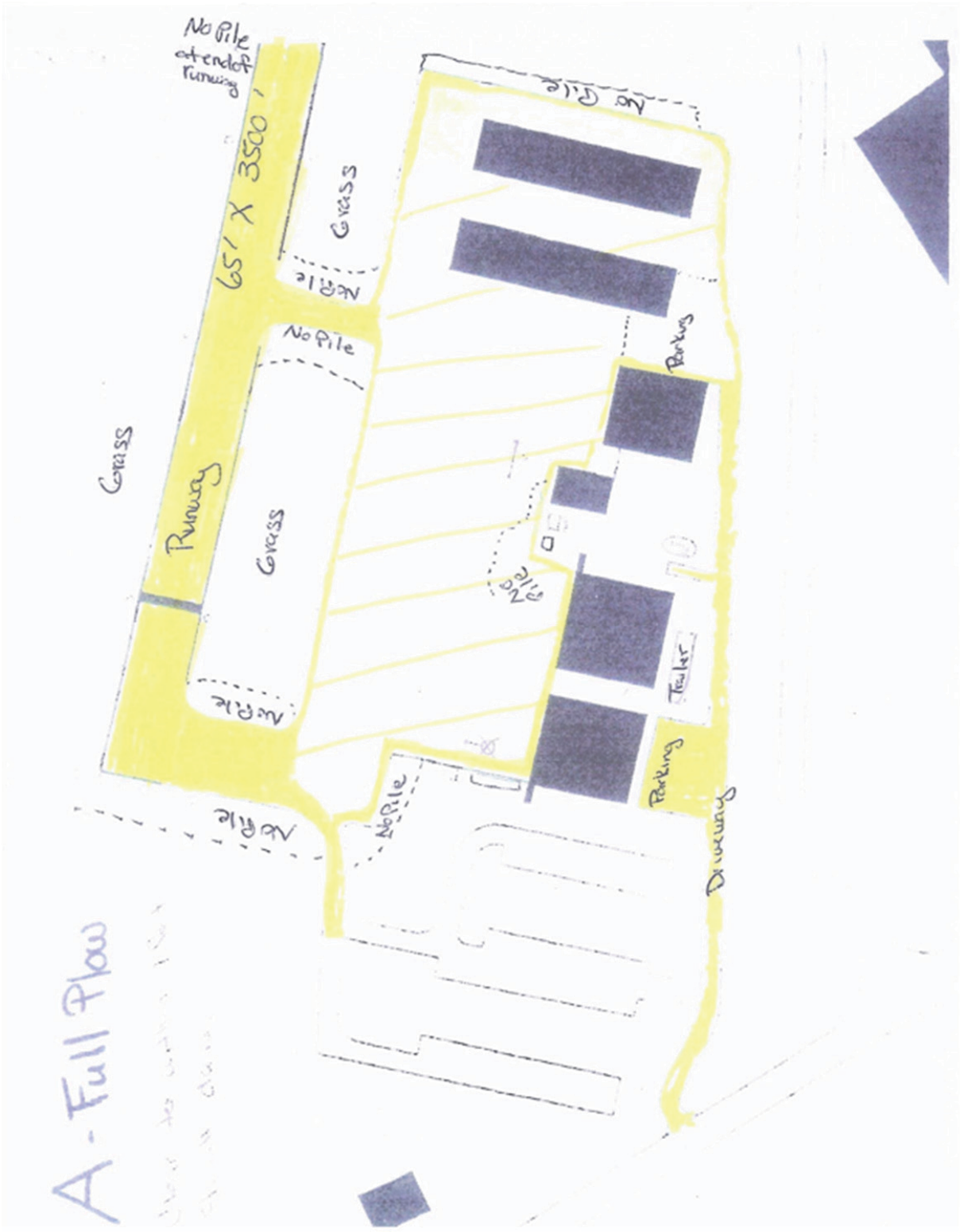
Contractor must provide proof of sufficient insurance and proof of worker's compensation coverage and a current equipment list.

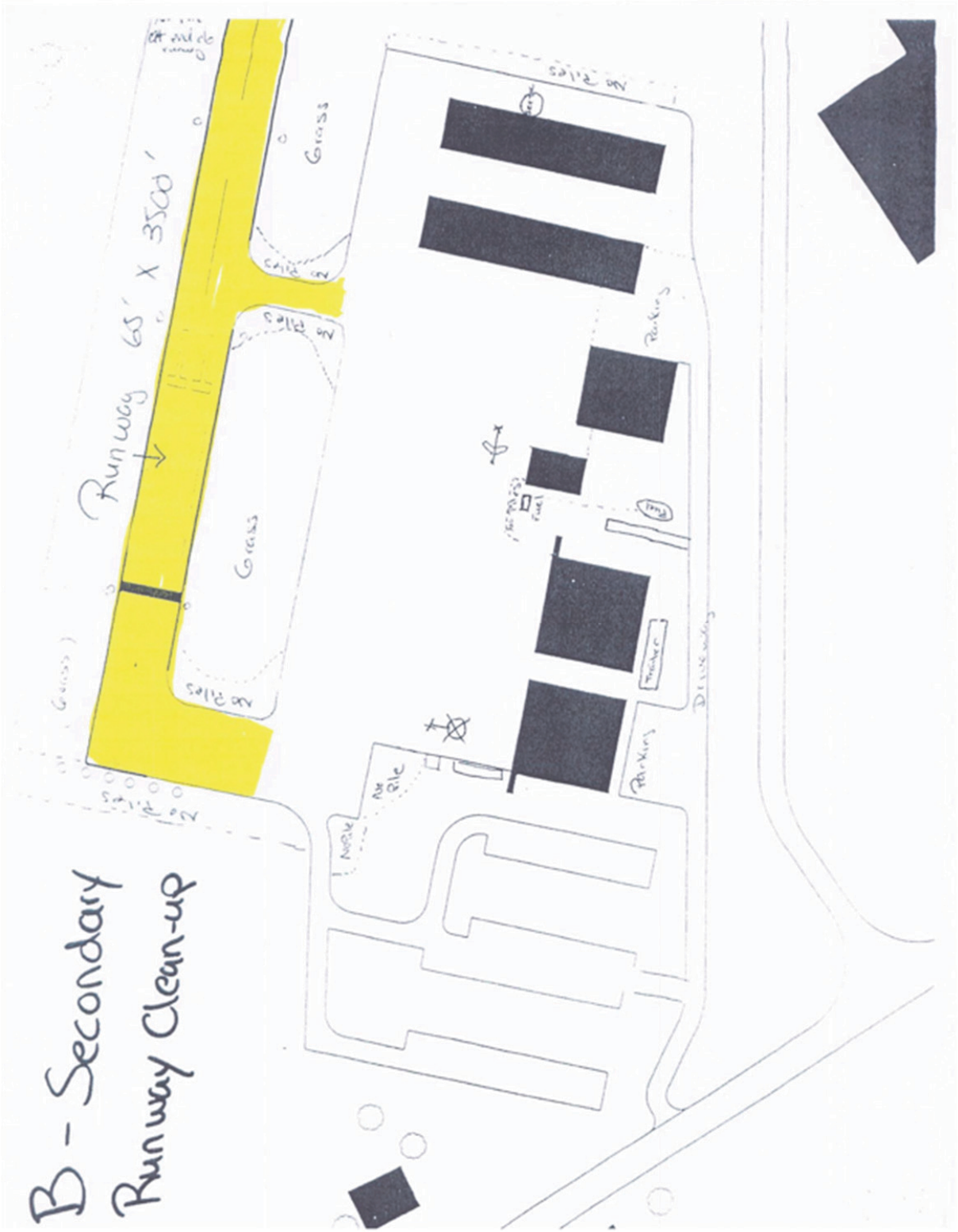
Snow must be piled as per the provided airport diagram. Areas listed as, "no pile" shall not hinder sight lines for aircraft. Snow will be plowed away from all hangar doors, entrances and access areas. Presume that doors open to the corners of all buildings therefore NO snow may be piled or left in front of a building. Snow will be pushed far enough off of the pavement areas that aircraft can be moved easily in and out of any hangar, taxiway, or ramp. Unlike automobiles, aircraft use a 45 ft. wide path to navigate.

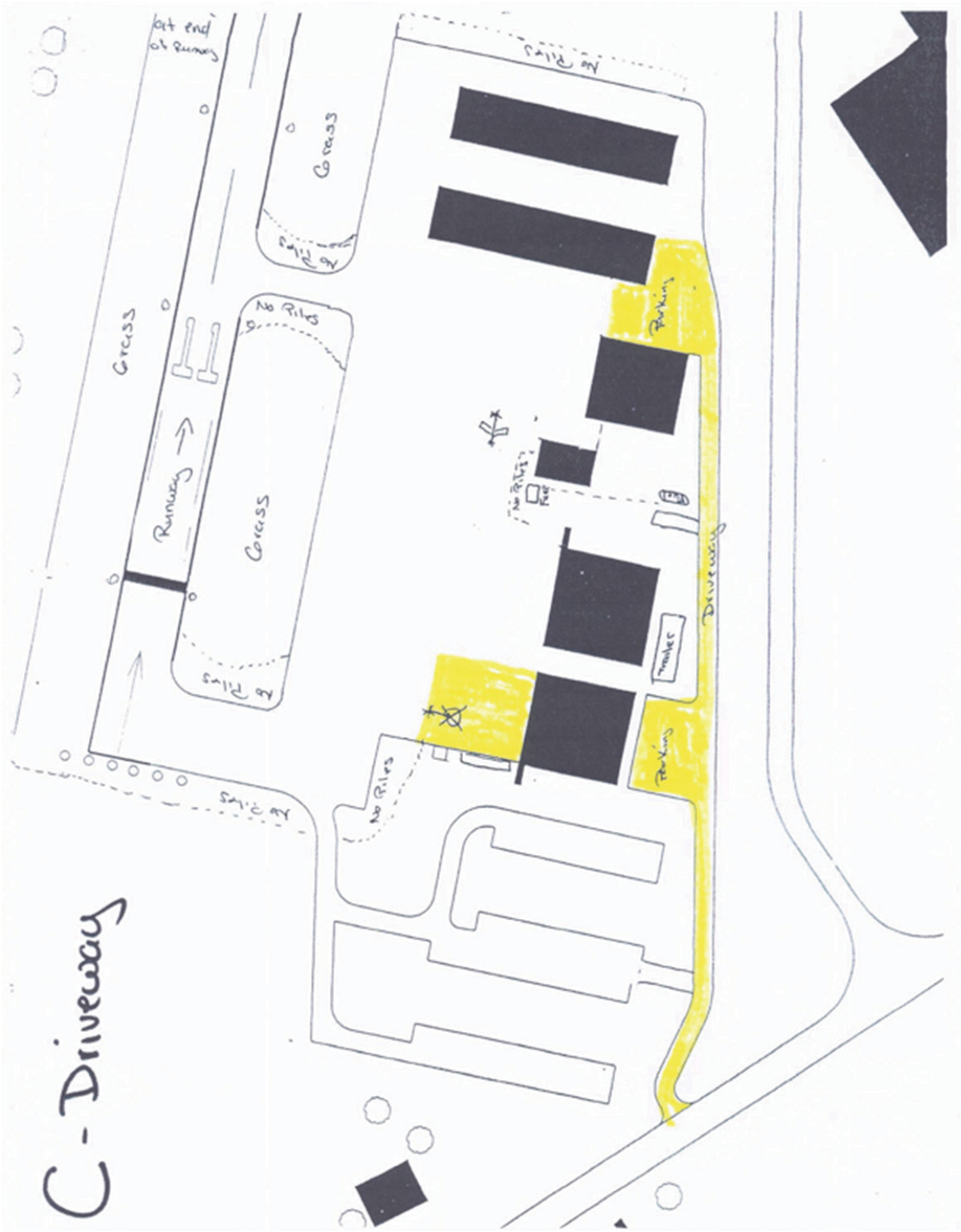
NO SALT OR CORROSIVE MATERIAL SHALL BE APPLIED AT ANY TIME.

Proposals may be dropped off at the airport office or mailed as long as they are received by the deadline. **Deadline for proposals is Monday, October 6 , 2014 at 11:00 a.m.**

DIAGRAMS ATTACHED








*Courtesy*: Geauga County Airport Authority, Ohio.

# APPENDIX J

# AIP Requirements for Snow Removal Equipment Building Eligibility

**Table O-3 Other Building Project Requirements (Other than Terminals)**

**c.** Snow Removal Equipment Building (Construct, Expand, Modify, Improve, or Rehabilitate)

**(1)** Snow removal equipment buildings are intended to protect the AIP-funded snow removal equipment and materials.

**(2)** Funding snow and ice control buildings is limited to space in the building necessary for eligible Snow Removal Equipment as well as storing abrasive or chemicals used in treatment of paved areas. All other areas and equipment recommended in the current version of Advisory Circular 150/5220-18, Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials, must be paid for by the sponsor.

**(3)** The eligibility of a maintenance bay for safety and security equipment is provided elsewhere in this table and may be included in the SRE building if the requirements for the safety and security equipment maintenance bay are met.

**(4)** At the time the building is programmed, the eligible equipment must be owned, on order, or budgeted by the airport within the next five years.

**(5)** The SRE building is not intended to function as personnel quarters, snow desk, training space, or other functions. It is only intended for storage of eligible equipment. If non-eligible equipment storage is included in the building, the requirements for including ineligible or non-AIP funded work in the contract in Paragraph 3-42 must be met.

**(6)** The difference between construct, expand, modify, improve, and rehabilitate is listed in Table O-2.

**d.** Construct Sand and Chemical Storage Building (Construct, Expand, Modify, Improve, or Rehabilitate)

**(1)** Small stand-alone buildings for storage of airport surface deicing chemicals and sand may be constructed if the size and design is appropriate for the facility.

**(2)** This function may also be incorporated as eligible area in a snow removal equipment building.

**(3)** Snow and ice control abrasive or chemicals are to be used for airport pavement (not aircraft) because 49 USC § 47102(3)(G) does not permit the purchase or storage of deicing materials for aircraft.

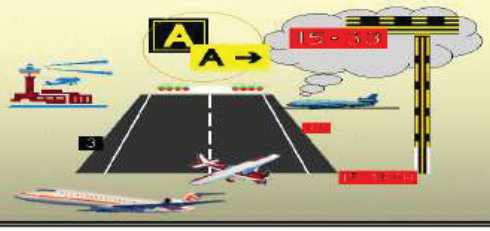
**(4)** The difference between construct, expand, modify, improve, and rehabilitate is listed in Table O-2.

*Source*: Excerpt from FAA Order 5100-38D AIP Handbook 2014.

# APPENDIX K

## FAA Certalert Best Practice for Winter Operations

AIRPORT CERTIFICATION INFORMATION BULLETIN



Eastern Region
Federal Aviation Administration
Airports Division, AEA-620
Safety & Standards Branch
1 Aviation Plaza,
Jamaica NY 11434

**AEA-03-11**
**12/20/2010**

Bulletin: 2011-03
Subject: Best Practices for Winter Operations
Issue Date: December 20, 2010
Revised Date:

**Prepared by**: Evelyn Martinez
**Phone**: 718-553-3348

**Contact:** Please contact your assigned Airport Certification Safety Inspector with further questions.

**Application:** This bulletin is being sent to Part 139 Airport Certificate holders to communicate the FAA's best practices for winter operations. Please note a Snow and Ice Control Plan Review Checklist will be forthcoming.

**Action Required:** Please distribute to all staff as necessary.

**Best Practices:**

Maintain Situational Awareness

- Educate/Train for low visibility and white out conditions to include special provisions to cease snow removal operations when visibility impairs a driver's ability to safely navigate.
- Set standards for how long a driver can operate on the airfield to minimize fatigue.
- Minimize distractions such as non-essential telephones or radios during snow removal operations. Recommend, if personnel is available, to add a person to each vehicle to handle communications.

1

- Ensure airfield guidance signs and mandatory hold signs are clearly visible and operational. If snow or ice can not be promptly removed, ensure appropriate NOTAMs are in place to identify obscured and or missing signs.

Vehicle Lighting & Visibility

- Vehicles should use adequate/appropriate lighting to ensure they are visible.

Communications

- Communicate intentions; read back clearances; call clear as required.
- Use Proper Aviation Phraseology.
- **At Controlled Airfields**, periodically check in with ATC to reconfirm ATC clearances.
- **At Uncontrolled Airfields**, vehicle operators should continually self-announce positions and intentions.

Operational Safety

- It is encouraged to close runways for snow removal operations via NOTAM when personnel and equipment will occupy the runway for an extended period of time.
- Provide timely and accurate Airfield Condition Reporting.
- Issue NOTAMs as appropriate.
- Communicate airfield conditions with ATCT and users.
- Update – any change of conditions with particular emphasis on rapidly changing conditions.
- Institute continuous monitoring procedures when required.
- 14 CFR Part 139 Airport Operators must initiate runway closures when the following circumstances occur:

  1. A NIL pilot braking action report (PIREP), or NIL braking action assessment by the airport operator requires the runway to be closed before the next flight operation. The runway must remain closed until the airport operator is satisfied that the NIL condition no longer exists.

  2. When previous PIREPs have indicated GOOD or MEDIUM (FAIR) braking action, two consecutive POOR PIREPs should be taken as evidence that

- **At Controlled Airfields**, periodically check in with ATC to reconfirm ATC clearances.
- **At Uncontrolled Airfields**, vehicle operators should continually self-announce positions and intentions.

Operational Safety

- It is encouraged to close runways for snow removal operations via NOTAM when personnel and equipment will occupy the runway for an extended period of time.
- Provide timely and accurate Airfield Condition Reporting.
- Issue NOTAMs as appropriate.
- Communicate airfield conditions with ATCT and users.
- Update – any change of conditions with particular emphasis on rapidly changing conditions.
- Institute continuous monitoring procedures when required.
- 14 CFR Part 139 Airport Operators must initiate runway closures when the

*Source*: FAA Eastern Region.
(http://www.faa.gov/airports/eastern/airport_safety/cert_bulletins/2011/03%20Best%20Practices%20for%20Winter%20Ops/03%20Best%20Practices%20for%20Winter%20Ops.pdf.)

# APPENDIX L

## Example of a Winter Operations Information Brochure

### Frequently Asked Questions

**Question:** How do I put in a request to clear the snow from the Taxilane in front of my hangar?

**Answer:** Contact the Airport Administration office at 468-5823. All requests will be handled first come, first serve. *Requests must be made to the administration office and will be handled according to the priority schedule.*

**Question:** I am a city hangar tenant, will Airport staff clear the snow all they way to my hangar door?

**Answer:** Airport staff will clear snow with in 5 feet of the hangar entrance.

**Question:** I am in a non– City owned hangar on the Airport, will staff clear the snow on my ramp space?

**Answer:** We will assist you in snow removal from your ramp if you request assistance by calling the Airport Administration office at 468-5823. *All requests will be handed first come, first serve and will be handled according to the priority schedule.*

**Question:** I live in Boise, is there a way I can check the Airfield conditions before I drive over?

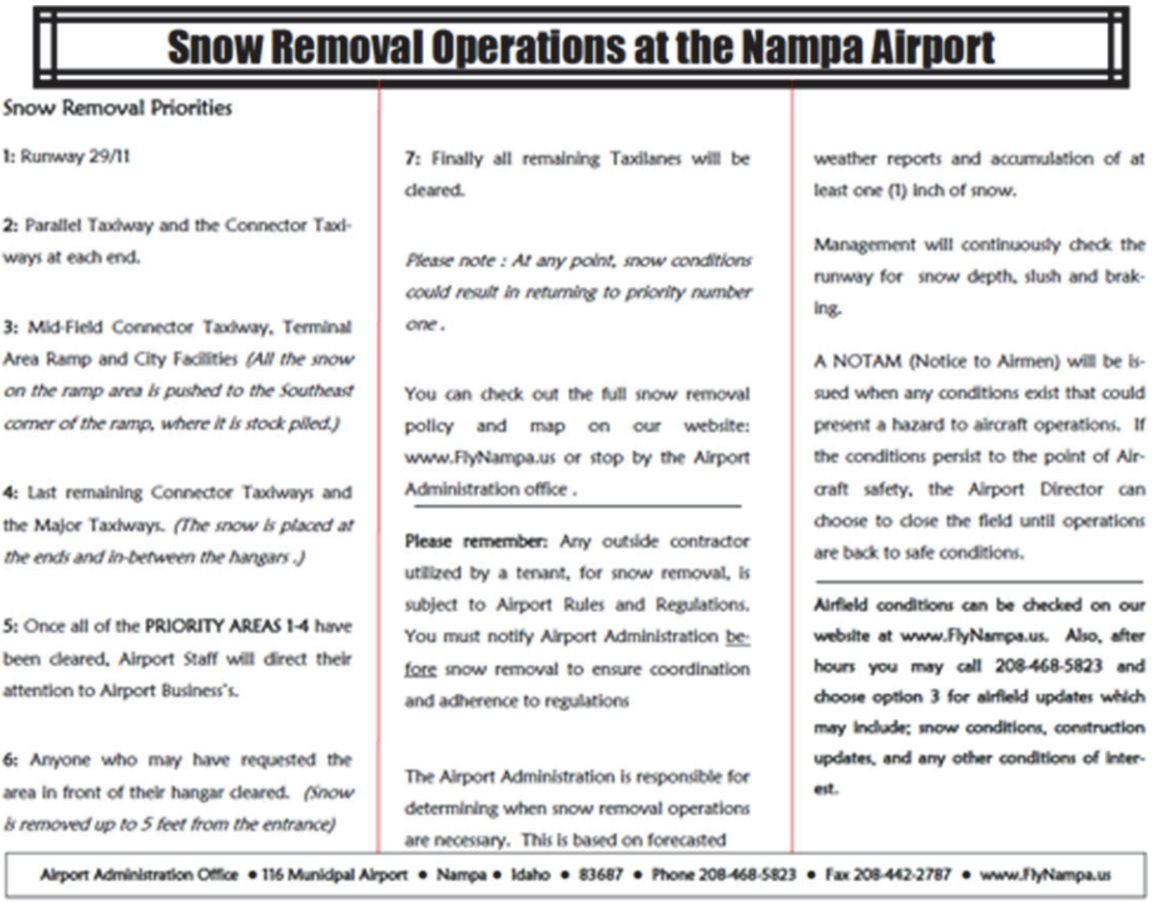
**Answer:** Yes, you can call 208-468-5823 anytime for Airfield updates, after hours press option 3 for updates. You may also check the homepage of our website at www.FlyNampa.us. You may also check for NOTAMS.

Airport Administration Office
116 Municipal Drive
Nampa, Idaho 83687

NAMPA
MUNICIPAL AIRPORT
IDAHO

DESTINATION

**Winter Operations at the Nampa Airport**



# Snow Removal Operations at the Nampa Airport

## Snow Removal Priorities

**1:** Runway 29/11

**2:** Parallel Taxiway and the Connector Taxiways at each end.

**3:** Mid-Field Connector Taxiway, Terminal Area Ramp and City Facilities *(All the snow on the ramp area is pushed to the Southeast corner of the ramp, where it is stock piled.)*

**4:** Last remaining Connector Taxiways and the Major Taxiways. *(The snow is placed at the ends and in-between the hangars .)*

**5:** Once all of the **PRIORITY AREAS 1-4** have been cleared, Airport Staff will direct their attention to Airport Business's.

**6:** Anyone who may have requested the area in front of their hangar cleared. *(Snow is removed up to 5 feet from the entrance)*

**7:** Finally all remaining Taxilanes will be cleared.

*Please note : At any point, snow conditions could result in returning to priority number one .*

You can check out the full snow removal policy and map on our website: www.FlyNampa.us or stop by the Airport Administration office .

**Please remember:** Any outside contractor utilized by a tenant, for snow removal, is subject to Airport Rules and Regulations. You must notify Airport Administration before snow removal to ensure coordination and adherence to regulations

The Airport Administration is responsible for determining when snow removal operations are necessary. This is based on forecasted weather reports and accumulation of at least one (1) inch of snow.

Management will continuously check the runway for snow depth, slush and braking.

A NOTAM (Notice to Airmen) will be issued when any conditions exist that could present a hazard to aircraft operations. If the conditions persist to the point of Aircraft safety, the Airport Director can choose to close the field until operations are back to safe conditions.

**Airfield conditions can be checked on our website at www.FlyNampa.us. Also, after hours you may call 208-468-5823 and choose option 3 for airfield updates which may include; snow conditions, construction updates, and any other conditions of interest.**

Airport Administration Office • 116 Municipal Airport • Nampa • Idaho • 83687 • Phone 208-468-5823 • Fax 208-442-2787 • www.FlyNampa.us

*Courtesy*: Nampa, ID (http://www.cityofnampa.us/DocumentCenter/View/453).

# APPENDIX M

## Alaskan Rural Airport Maintenance Manual

Department of Transportation & Public Facilities
**RURAL AIRPORT MAINTENANCE MANUAL**

**New Contractor Orientation**

Let's get Alaska moving through service and infrastructure

**TABLE OF CONTENTS**

## 1. INTRODUCTION

Rural Airports provide vital services to our Alaskan communities such as:

- Connecting the local people with the rest of Alaska and the world.
- Supporting Medevac flights and transporting people to medical treatment facilities.
- Transporting goods and services which helps to support local businesses.

As the State Airport Maintenance Contractor, your community will be depending on you to keep the airport open and safe for use so that these necessary services remain available. This manual is intended to help you achieve these goals.

**Roles and Responsibilities**

It takes many people to keep our airports safe and listed below are key players to ensure this happens.

- **Federal Government** – The Federal Aviation Administration (FAA) publishes laws known as Federal Aviation Regulations (FAR's). These must be followed to stay in compliance.
- **State of Alaska (SOA)** – Alaska Department of Transportation (AKDOT) plans, builds and supports the maintenance of village airports. The state also has guidelines that must be followed.
- **Rural Villages** – A resident of the village steps up to perform the day to day maintenance and operations at the airport under contract with AKDOT.
- **Air Carriers** – They provide safe and reliable service into your communities. They often provide feedback to AKDOT on the airport facilities and services.
- **AKDOT** – In the back of this manual there are some helpful names and numbers when you have questions, need help, or need something fixed.

## 2. CONTRACTOR RESPONSIBILITIES

As a contractor, you have the very important responsibility to make sure the airport is safe and secure. No two airports are identical, but there are a variety of duties common to all airports. You must perform these duties in a professional manner.

- Never work under the influence of drugs or alcohol and be aware that an illness may affect your work performance and safety.
- Communicate with pilots using "Air to Ground" or "VHF" radios.
- Perform basic maintenance activities.
- Operate equipment properly.
- Keep the inside of buildings clean and safe.
- Help initiate Notices to Airmen (NOTAMs) as required.
- Perform snow removal activities when necessary.
- Protect and care for the tools and equipment.
- Perform routine maintenance on equipment; i.e., oil, greasing, belt, and hose replacements.
- Basic runway light and windsock inspections.
- Responding to emergencies such as fuel spills and aircraft accidents.

**Consequences of Poor Maintenance**

Poor maintenance of the airport and its associated equipment can lead to the following problems:

- Airplanes can crash and people can die.
- Equipment and property can be damaged or rendered unusable.
- Food and other essential good that people rely on may not be able to arrive in your community.
- People cannot travel to receive medical services, attend meetings and sporting events, or go on vacations.
- Mail services may be interrupted.
- Airlines may be restricted to serve your community.

**NOTAMS**

"Notices to Airmen" (NOTAMs) are issued to let pilots know when the airport is not up to normal safety standards or something is out of the ordinary.

NOTAMS are issued for a number of reasons such as:

- A runway is closed.
- Airfield lighting, navigational aids, and/or radios are inoperable.
- Temporary obstacles are near the airfield (i.e., cranes, containers).
- Flocks of birds are in the vicinity of the airfield.
- Notifications of runway, taxiway, and apron status in respect to snow, ice, and standing water.
- Notifications of frost heaves, potholes, depressions, and soft spots.

When conditions such as these exist, it is your responsibility to issue a NOTAM and to keep it current. Also, contact your supervisor with this information so they are aware of the current conditions.

## 3. SAFETY AND SECURITY

As a contractor for the State of Alaska you are expected to include SAFETY into everything you do at the airport.
YOU MUST:

- Keep the airport safe
- Keep the people safe
- Keep yourself safe

To accomplish these very important goals, ALL of your work must be done in a safe manner.
Security is another important responsibility for you as the contractor. Keeping the States equipment safe and secure is vital for you to do your job safely and efficiently. You must always remember to:

- Keep the buildings, fuel tanks, and equipment locked when not in use.
- Prevent or report when cargo, fuel barrels, vehicles, or any other material are stored on the apron, taxiways, and especially the runways. These areas must remain clear for safe passage of the aircraft.
- Report vandalism and security infractions immediately to local law enforcement and AKDOT.

**People on the Runway**
The runway is not a safe place for people or vehicles, especially snow machines and ATVs. You are expected to ask unauthorized people to leave the restricted areas (runways and taxiways) and to remove their vehicles immediately. If they refuse to do so, again, call the local law enforcement and AKDOT.

**Aircraft Accidents**
If an aircraft has an incident or accident near your airport, you can use State equipment and buildings to help your community respond to the event. As the State contractor we ask you to do the following:

- Call your local law enforcement and ask for assistance if necessary.
- Call your supervisor and let them know what has happened.
- When possible, take as many pictures as you can. This can be done with phones, digital cameras, film cameras, and even from other people at the scene. Pictures are a critical part in the investigation.

**Personal Accidents**
If you are injured while working, you must:

- Call for help immediately if required
- Seek first aid or medical attention
- Notify your supervisor

**Vehicle/Equipment Accidents**
Vehicles and equipment do have accidents at airports and here are some examples of them:

- Hitting the doors of the building with a loader, grader, or dozer
- Backing too far into the building and hitting the wall
- Trucks hitting the outside of the building
- Snow machines or ATV's crashing on the runways, taxiways, or aprons.

If any of these accidents or a similar accident happens at your airport, call your supervisor as soon as possible. If there are any injuries involved in these accidents, always call your local law enforcement first. This will insure that medical assistance will arrive as quickly as possible.

**Fuel Spills**
If you encounter a fuel spill, the first step is to try to stop the flow if possible. The next step is to try and contain the spill so it will not reach any drains or waterways.

- Less than 5 gallons may be contained and cleaned up locally and you may call your supervisor for help or materials.
- More than 5 gallons MUST be reported to you supervisor.
- Additional training may be required for these types of incidents.

## 4. GENERAL AIRPORT KNOWLEDGE

**Airport Terminology**
Most of the following terms are used throughout the world, so they should always have the same meaning for everyone.

**Runways**
The surface where aircraft land and take off from and are numbered according to the direction they face based on a compass heading.

**Apron**
These are the areas where the aircraft park and load or unload passengers and freight.

**Taxiways**
These are the areas that join the runways to the apron and are identified by letters. They are referred to with the phonetic alphabet (i.e., A = Alpha, B = Bravo, C = Charlie…).

**Threshold Areas**
Generally, this is the first one or two hundred feet of each end of the runway.

**Over-runs**
These are the developed areas just before each end of the runway. You must keep these areas in the same good condition as the runway itself in case of an aircraft landing short or overshooting a runway.

**Safety Areas**
These are areas along the edges of the runways. These areas go beyond the runway edge lights, should be clear of obstacles, and should be firm enough to support and aircraft.

**Common Traffic Advisory Frequency (CTAF)**
This is the radio frequency for your airport. Pilots use this frequency when taking off from, landing at, or in the flight pattern at your airport. You, as the contractor, can communicate with the pilots on this frequency to inform them of runway conditions or any other important information that they may need to know. This frequency may also control the runway lights at your airport.

**Windsock**
This is an orange fabric cone at the end of a pole that blows like a flag. It shows the pilots which way the wind is blowing and how strong it is blowing at ground level. They need to be changed out when the color fades, they get damaged, or they simply get blown away. It is also the contractor's responsibility to grease the pole two (2) times a year. Most airports have several windsocks in the area.

**Airport Beacon**
This is a green and white rotating light that signals pilots where the airport is located and what type of airport it is. If this light burns out, the contractor must replace the bulb.

## 5. AIRFIELD MARKING AND LIGHTING

Airports are standardized in reference to the color of lights and markings they use on the runways and taxiways. This helps the pilots know where they are on the airfield as well as where to taxi.

**Runways**
White lights and white paint are used to mark the runway edges. There are only paint markings if the surface is paved. Towards the ends of the runways, the lights may be split to show white in one direction and amber in the other direction. (Split lens light). The amber color is used to show a pilot that they are nearing the end of a runway. On the threshold of the runway, there will be a red and green split lens light to show the pilot where the beginning and the end of the runway is (see Figure 1).

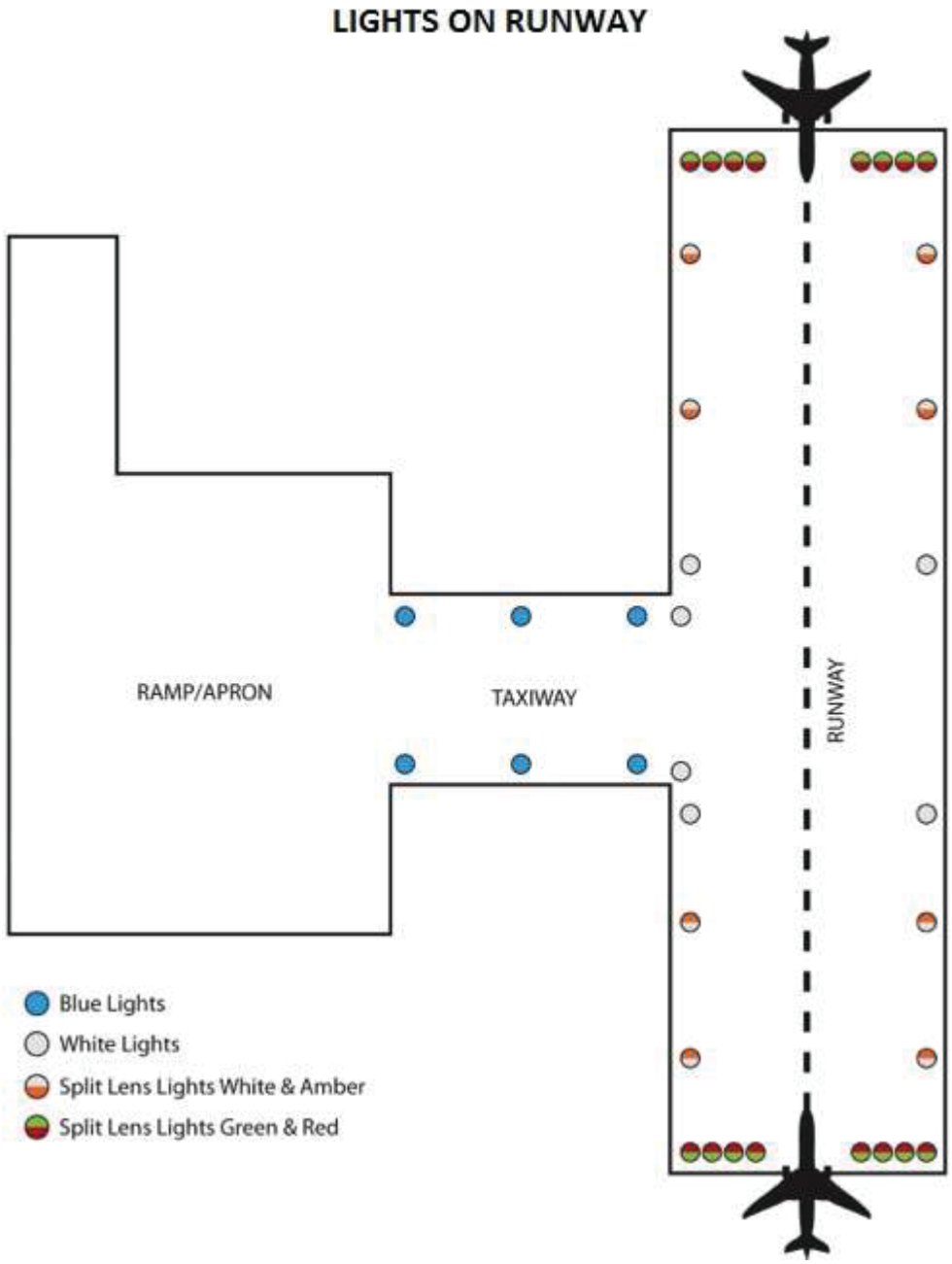



Figure 1

**Taxiways**
Taxiways are marked with blue lights and yellow paint markings. There are only paint markings if the surface is paved.

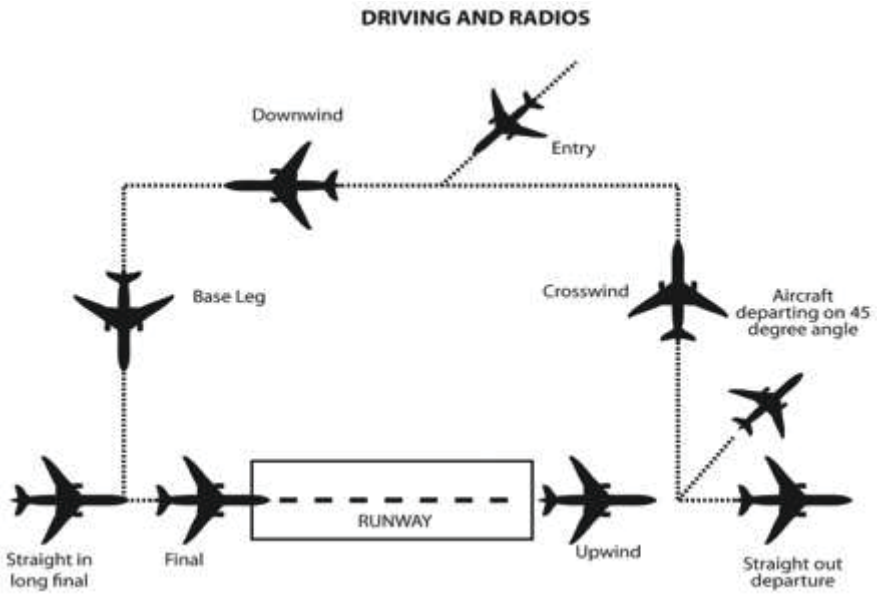
**Apron/Ramp**
Rural airports generally do not have Apron/Ramp lights.

**Airfield Lighting Repair**
When light bulbs burn out, you are expected to replace them. When you are awarded the maintenance contract, you should have some training on how to perform this task safely. You should avoid hitting or damaging airport lighting while performing maintenance. It will be your responsibility to repair minor damage done to airfield lighting such as broken couplers, lenses, and stems. Parts for fixing the lights can be ordered by calling your supervisor or the electrician.

If your airport is equipped with cones, they should be predominantly orange with reflective bands. Damaged or faded cones shall be replaced. Call your supervisor to order new ones.
Signs and threshold markers must remain visible and free of damage. Keep snow, brush, and any other items away from the signs and threshold markers. Call your supervisor if any of these things are damaged.

## 6. DRIVING ON THE AIRFIELD AND RADIO COMMUNICATION

Aircraft always have the right-of-way. You should never interfere with an aircrafts intended path unless that path is un-safe. If it is un-safe, you are expected to communicate with the pilot using a radio.
Your equipment will have a two-way radio (ground to air). This enables you to talk with the aircraft that are in the area. The Common Traffic Advisory Frequency (CTAF) is the frequency you will need to tune your radio to so you can talk to the pilots. Depending on what area you are in is what determines what frequency you tune to. The aircraft use CTAF to talk to other planes in the area and to talk to you on the ground. When talking on the radio, always say who you are calling 1st and who you are 2nd.
Example: "ERA 27M, this is Akiak Maintenance."
Pilots will announce on CTAF when they are coming to your airport. When they do call, they will report their position. These positions are shown below.




Knowing these positions can help you find the plane as it gets near your airport.

## 7. SNOW REMOVAL EQUIPMENT BUILDING (SREB)

These buildings are built by AKDOT to house and protect state equipment at your airport. When the equipment is not being used, it should be locked inside the buildings. Parts and tools for working on the equipment or maintaining the building can also be stored inside. You should keep the inside of the building neat, clean, and not cluttered with items that do not belong to the state. For example:

- No private snow machines or ATV's
- No outboard motors or skiffs

It is very important that you keep everything locked up when you are not at the airport. This includes:

- Lock the man doors.
- Lock the equipment doors.
- Lock the fuel tanks and/or the gates to the fuel tanks.
- Lock the lighting and radio building.

**Equipment Damage**
Use caution when driving equipment into and out of the buildings. It is very difficult to repair the buildings once they have been significantly damaged. These are some of the common accidents:

- Hitting the equipment doors.
- Hitting the building with the wing blade.
- Backing into the back wall of the building.

**Fuel Tanks**
As a contractor for the State of Alaska, you are expected to protect the fuel supply provided for your equipment and buildings.
THE USE OF STATE FUEL FOR ANYTHING OTHER THAN STATE EQUIPMENT OR STATE BUILDINGS IS A CRIMINAL ACT!
This means:

- Make sure the fuel is locked up.
- Make sure the fuel is protected from the weather.

Fuel tanks should not be left with pumps removed or openings that would allow water to get into the fuel.

**Vandalism**
Report any vandalism to AKDOT, local law enforcement, the Alaska State Troopers and your supervisor as soon as you notice the damage. Common things to look for are graffiti/spray paint, broken windows, and bullet holes.

## 8. EQUIPMENT MAINTENANCE

As an operator, you will be required to perform some basic maintenance tasks. This includes things like adding motor oil, changing a tire, greasing the equipment, or changing a cutting edge.

**Equipment Walk-Arounds**
As a daily routine, you must do a walk-around inspection on the piece of equipment you are about to operate. You will be looking for:

- Leaks or puddles of motor oil, hydraulic fluid, anti-freeze, and diesel fuel.
- Loose nuts and bolts.
- Unusual signs of wear.
- Low or flat tires.
- Low fluid levels (engine oil, hydraulic fluid, transmission fluid, coolant, and fuel).
- Cutting edges on mold boards, plows, and buckets.
- Cleanliness of the windows, lights, and the cab area.

Do not let the cutting edges on graders, buckets, or plows get too low. When they are down to 1” or less they should be changed to prevent permanent damage to the mold board, plow, or bucket.
If you notice anything wrong during the walk-around that you cannot fix yourself, contact your supervisor or mechanic.
You are required to report the equipment hours to your supervisor at the end of each month. This lets the mechanics know when the service is due on each piece of equipment.

**Pre-Winter Inspection**
During the summer months, you should check to make sure your equipment is ready for the next winter. Here is a list of things to look for:

- Block heaters are working properly.
- Batteries are in good condition (charged and terminals in good shape).
- Anti-freeze at correct strength.
- Winter oils, lubricants, and fluids are installed.
- Cab heaters operational.

- Windshield wiper blades are working and in good condition.
- Tires are in good condition.
- Cutting edges, impeller blades and chutes are in good repair
- Fuel tanks are checked and free of moisture. You are also required to keep track of your fuel consumption and report this to your supervisor at the end of every month. This helps them order fuel in advance so you will not run out.

*__IMPORTANT*__ Please call your supervisor or mechanic as soon as possible if there is a problem that you cannot fix.

## 9. WINTER AIRFIELD MAINTENANCE

The key winter maintenance activities are snow removal and ice control.

**Winter Airport Safety**

- NOTAMs—You must issue a NOTAM if more than 2" of snow is on the runway, if there are berms present, or if you are going to be on the runway plowing snow.
- Contact your supervisor if you are unable to plow the snow or if there are berms you cannot remove. They will assist you as soon as they are able.
- Use your radio to communicate with pilots and answer any questions they may have.
- Snowplowing—Try to keep your blade 1" above the gravel surface. Getting too low causes the gravel to be bladed off the runway creating more work and money to fix.
- Snow Berms and Windrows—Remove snow berms and windrows as quickly as possible. Do not leave them on the runway edges, ends of runways, or across the entrance to a taxi-way.

**Airport Inspections**

During the winter, it is very important to check your runway conditions during and after snowfall events or during times of high winds. The wind may leave snow drifts on the runway which can be just as dangerous as deep snow.

**Snow Removal Priorities**

You should inspect the runway to make sure the snow or drifts are no deeper than 2" (two inches). You also need to check that aircraft do not have to taxi through any snow berms. Snow berms on the sides of runways or taxiways cannot be any higher than 12" (twelve inches) high and they should be pushed outside of the lights as soon as possible. High snow berms can cause serious damage to an aircraft if they run into one.

There are three levels of snow removal priorities:

1. Runways
2. Taxiways
3. Ramps/Aprons

**Snow Plowing Tips**

- Leave 1" (one inch) of snow on the runway. Do not plow the gravel off the runway. Maintain the crown on the runway as best as possible (see Figure 2).
- Do not plow the snow onto the runway or taxiway lights.
- Leave the windrows or berms 5' (five feet) inside the lights. As soon as possible, these berms should be carefully pushed outside of the lights without damaging any lights. Push this berm as far off the shoulder as possible. This gives you more room for snow later in the season and it will help with break-up in spring. The longer you wait, the harder the berms become making them much harder to move.
- Do not leave snow berms across any taxiways or the ends of the runways because this may cause damage to aircraft.

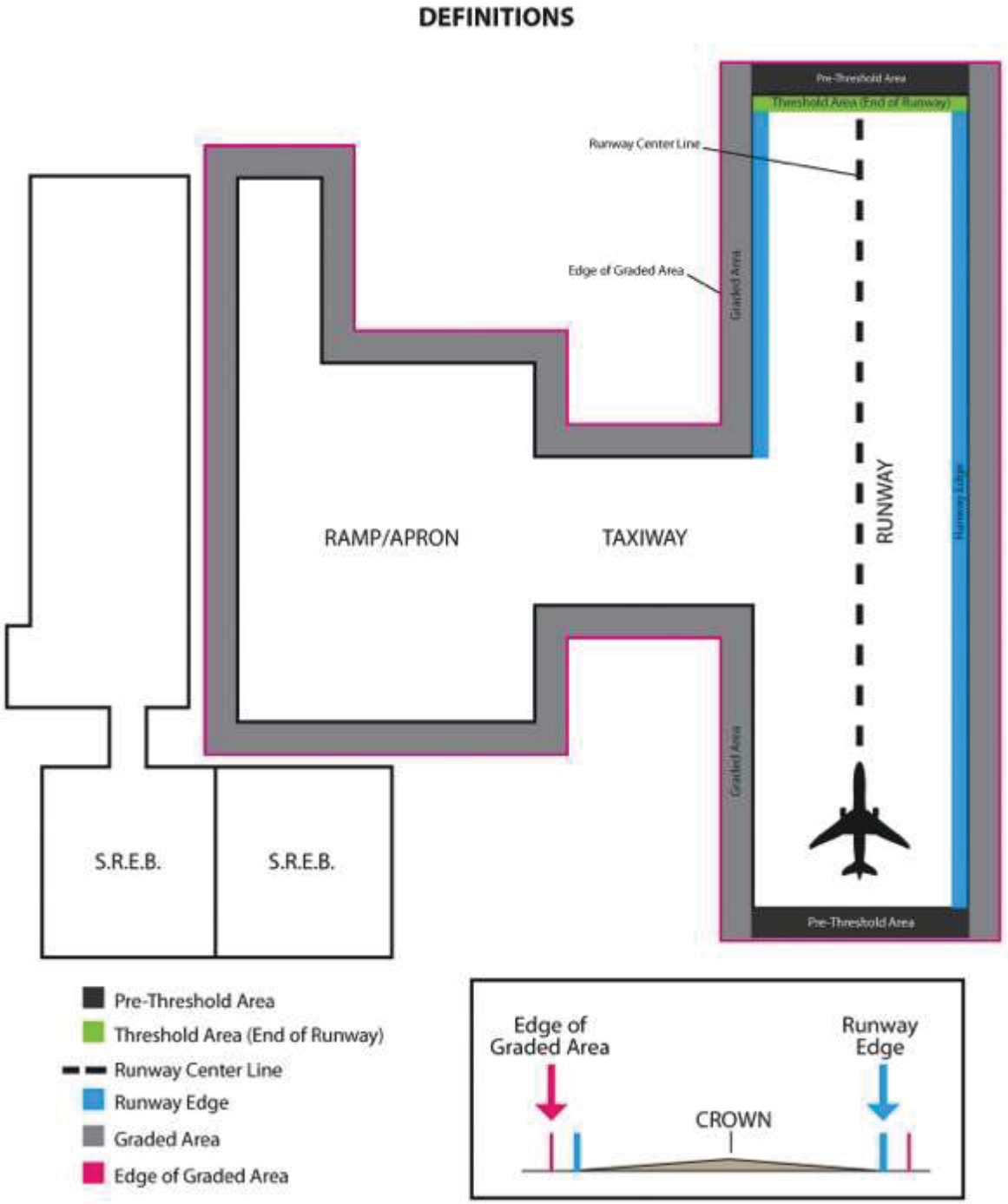



Figure 2

**Snow Removal**

Plowing the runway is the first priority and there are two acceptable methods for removing snow.

1. **Split the Runway** – This is the fastest, safest, and preferred method for removing the snow on the runway. Plowing lengthwise, you start in the middle of the runway and move the snow to the right towards the edge lights (see Figure 3). (Plowing to the right is helpful because many of the graders have a wing blade on the right side allowing you to make use of this attachment). Once you reach the end of the runway, lift your blade and turn

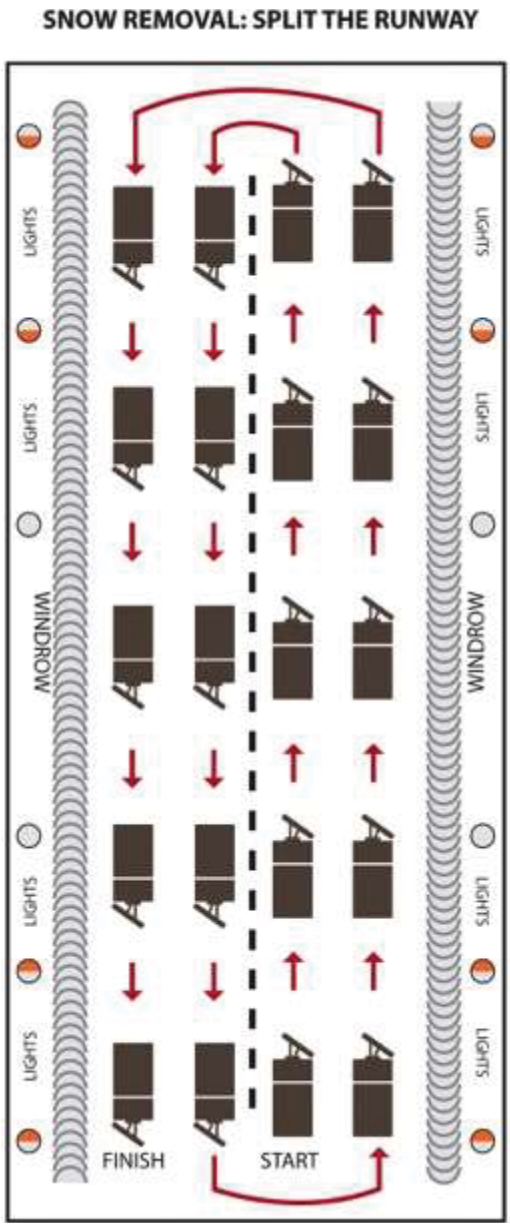



Figure 3

around. Still plowing to the right, proceed down the opposite side of the centerline moving the snow towards the edge lights. Continue doing circles moving the snow from the center of the runway to the edges of the runway. Use this method when there is little or no wind or if the wind is strong but blowing down the length of the runway. Leave your windrows/berms 5' (five feet) inside of the edge lights. You can now carefully push this berm outside the lights and off the edge of the runway as soon as possible. Remember to be careful not to damage any of the runway or taxiway lights.

2. **Plow across the runway** – This method can be used when there is a strong crosswind. Starting at one edge of the runway and plowing lengthwise, begin moving the snow across the entire width of the runway. Plow in the direction the wind is blowing so it helps you and not hurts you.
   Your first pass should be 5' (five feet) inside the lights to avoid damaging them. You must also be careful with the threshold lights or cones when you are turning around. Once you reach the end of the runway lift your blade,

turn around, and change the direction of your blade to the opposite side (see Figure 4). (If you were plowing to the right, rotate your blade so you are plowing to the left for the next pass down the runway).
This technique makes the runway unsafe and unusable until you are finished plowing the runway. This is because you are moving the berm across the entire width of the runway. This technique also creates a much larger berm so clearing it off the runway as soon as possible is crucial. If you have a berm on the edge of the runway and a pilot wants to land, you must let them know the location and the height of the berm.

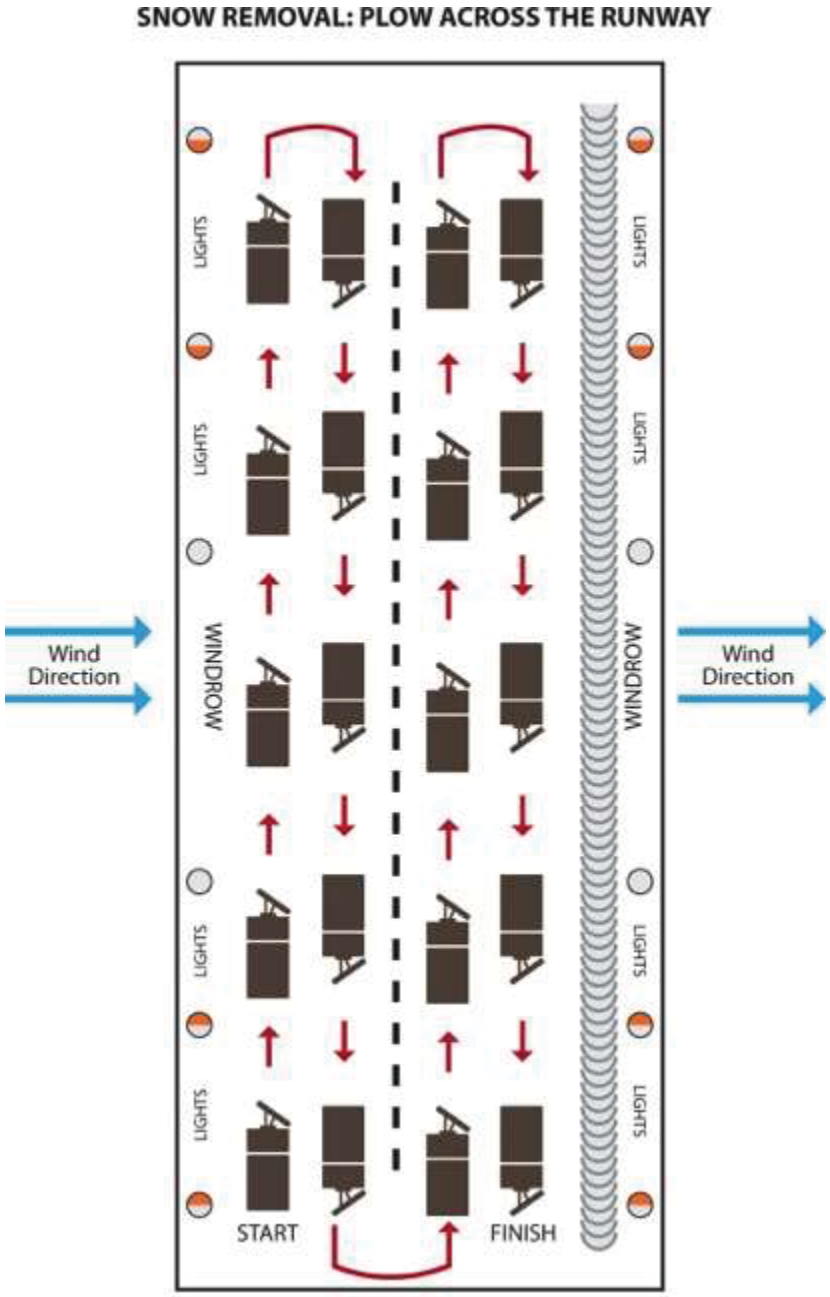



Figure 4

## 10. SUMMARY

As you can see, obtaining a state contract for airport maintenance comes with many rewards and responsibilities. Many people rely on you to do a safe and accurate job maintaining the airport in your community. If you feel that something is unsafe or if you are having problems with your equipment, never hesitate to call your supervisor. Using this manual as a training and a reference guide should make your job become easier, safer, and more efficient.

## EMPLOYEE ORIENTATION CHECKLIST

Employee: _____
Supervisor: _____

Does the employee understand:

1. The contractor responsibilities? Yes___No___
2. The importance of safety and security? Yes___No___
3. The general airport knowledge? Yes___No___
4. The airfield marking and lighting? Yes___No___
5. Driving and communicating on the airfield? Yes___No___
6. How to maintain the SREB? Yes___No___
7. How to do basic equipment maintenance? Yes___No___
8. How to do winter maintenance? Yes___No___

Employee Signature:_____
Date: _____
Supervisors Signature:_____
Date: _____

## EVALUATION FOR EQUIPMENT ORIENTATION

Equipment Type: _____
Name: _____
Date: _____

It is very important to know and understand the equipment you are running. Please mark the level of understanding you feel you have received from this orientation.

| Poor | Below Average | Average | Above Average | Excellent |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |

1. _____ **Walk around for entire machine**
2. _____ **Engine compartment** (engine oil, transmission fluid, hydraulic fluid, and coolant)
3. _____ **Cab** (warning lights, gauges, switches, controls, steering and seat adjustments)
4. _____ **Attachments** (attaching and removing buckets)
5. _____ **Operator maintenance** (what to lubricate, change cutting edges)
6. _____ **Equipment limitations**
7. _____ **Safety** (getting in and out of the equipment, seat belts, fire extinguisher)
8. _____ **Were all your questions answered?**
9. _____ **Was the training worthwhile?**

**Was there any information that was missed? _____**

## OPERATORS DAILY INSPECTION GUIDE

**VEHICLE NUMBER_____MONTH/YEAR ___/___**

**ITEMS TO BE CHECKED DAILY:**

1. **Clean Vehicle** (Interior, windows)
2. **Damage** (Exterior, interior, missing parts)
3. **Tires and Rims** (Damage, proper inflation, lugnuts are tight)

4. **Fluid Leaks** (Puddles under vehicle, fluids in engine compartment)
5. **Check Fluid Levels** (Oil, hydraulic, transmission, coolant, fuel)
6. **Belts and Hoses** (Check for fraying and cracks)
7. **Lights and Strobes** (Make sure they are clean and functioning properly)
8. **Safety Devices** (Seatbelts, signs on vehicle)
9. **Instruments, Horn, Wipers**
10. **Brakes and Steering** (responsiveness and effectiveness)

**Date** Initial the appropriate date once inspections are complete.

| | | | |
|---|---|---|---|
| **1.** _____ | **11.**_____ | **21.**_____ | **31.**_____ |
| **2.** _____ | **12.**_____ | **22.**_____ | |
| **3.** _____ | **13.**_____ | **23.**_____ | |
| **4.** _____ | **14.**_____ | **24.**_____ | |
| **5.** _____ | **15.**_____ | **25.**_____ | |
| **6.** _____ | **16.**_____ | **26.**_____ | |
| **7.** _____ | **17.**_____ | **27.**_____ | |
| **8.** _____ | **18.**_____ | **28.**_____ | |
| **9.** _____ | **19.**_____ | **29.**_____ | |
| **10.** _____ | **20.**_____ | **30.**_____ | |

*Courtesy*: Alaska Department of Transportation & Public Facilities.

Abbreviations used without definitions in TRB publications:

| | |
|---|---|
| A4A | Airlines for America |
| AAAE | American Association of Airport Executives |
| AASHO | American Association of State Highway Officials |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI–NA | Airports Council International–North America |
| ACRP | Airport Cooperative Research Program |
| ADA | Americans with Disabilities Act |
| APTA | American Public Transportation Association |
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| ATA | American Trucking Associations |
| CTAA | Community Transportation Association of America |
| CTBSSP | Commercial Truck and Bus Safety Synthesis Program |
| DHS | Department of Homeland Security |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FHWA | Federal Highway Administration |
| FMCSA | Federal Motor Carrier Safety Administration |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| HMCRP | Hazardous Materials Cooperative Research Program |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISTEA | Intermodal Surface Transportation Efficiency Act of 1991 |
| ITE | Institute of Transportation Engineers |
| MAP-21 | Moving Ahead for Progress in the 21st Century Act (2012) |
| NASA | National Aeronautics and Space Administration |
| NASAO | National Association of State Aviation Officials |
| NCFRP | National Cooperative Freight Research Program |
| NCHRP | National Cooperative Highway Research Program |
| NHTSA | National Highway Traffic Safety Administration |
| NTSB | National Transportation Safety Board |
| PHMSA | Pipeline and Hazardous Materials Safety Administration |
| RITA | Research and Innovative Technology Administration |
| SAE | Society of Automotive Engineers |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005) |
| TCRP | Transit Cooperative Research Program |
| TEA-21 | Transportation Equity Act for the 21st Century (1998) |
| TRB | Transportation Research Board |
| TSA | Transportation Security Administration |
| U.S.DOT | United States Department of Transportation |

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