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Disclaimer

1. Current State of Technology

The science of controlling snow has long enough history. According to Brown (1983), the first known reference to snow fences was in an 1852 Norwegian publication describing snow fences as a means of providing water for livestock. Another early reference was an article that appeared in an Alaskan newspaper (Seward Weekly Gateway, 1909) describing miners using snow fences to augment water supplies for placer mining. Since then there has been considerable progress achieved with using snow fences to increase water yield or local water supplies (Jairell and Schmidt, 1990; Tabler, 1989; Slaughter et al., 1975).

The Cold Regions Research and Engineering Laboratory experimented with this technique in Barrow, Alaska, in 1973 (Slaughter et al, 1975). McFadden and Collins (1978) used snow fences to supplement the water supply at Point Hope, a coastal Alaska village noted for its constant high winds. Tabler and his associates used the technique to enhance snow depth and to increase water yield in a research watershed in Wyoming in 1983-1989 (*e.g.*, Tabler and Sturges, 1986; Tabler, 1994). *Table 1* summarizes the results in Alaska achieved by these groups using snow fences of different heights.

Table 1. Snow accumulated by snow fences used for watershed enhancement.

Fence Height (m)	Extra Snow Accumulated over normal for the area (Cm of Water Equivalent)	Water Equivalent (liter per meter of fence)	Location in Alaska	Source
1.5	22	15,650	Barrow	Slaughter et al, 1975
2.7	43	32,950	Barrow	Slaughter et al, 1975
1.5	Not reported	10,900	Point Hope	McFadden and Collins (1978)

The nature of soil and parent material was found to be a key factor in success or failure of snow management for water resources (Sturges, 1989). A snow fence 396 m long and 3.8 m tall built to increase water yield doubled snow deposition in the channel above a streamgauge, but melt water failed to reach the gage site (Tabler and Sturges, 1986; Tabler et al., 1990). The soil was extremely permeable and was underlain by deeply fractured granite. Conversely, the results in the area of continuous permafrost (Barrow, Alaska’s North Slope) were so successful that the resulting snow drift lasted onto July of the following summer and runoff from the large snow drift went directly to the village water supply reservoir (Slaughter et al, 1974; Slaughter et al, 1975; Hinkel and Hurd 2006).

2. Development Strategies

The oil and gas industry owns very little land on Alaska’s North Slope (ANS). Most of the oil and gas operations are located on state, federal or Native-owned lands. Many oil and gas exploration activities require a permit, authorization or notification before initiating work. Among others activities, permits are needed for construction of roads, pads, or islands, even during winter (e.g., tundra travel) and withdraw of water from any natural source (lake, river, wetland) for ice road construction. The general reasoning behind ice road construction is that, unlike gravel roads, they leave little or no trace behind and require no mitigation or reclamation activities once they are no longer used. The Bureau of Land Management estimates that 3.8 million to 5.7 million liters (1 to 1.5 million gallons) of water is needed per mile to build an ice road 15 cm (6 inches) thick and 9-11 meters (30-35 feet) wide (Cumulative environmental effects of oil and gas activities on Alaska's North Slope, 2003). The UAF North Slope Tundra Lake project (Hinzman et al., 2006) assessed the Potential impacts to tundra lake ecosystem resulting from the withdrawal of water for ice road construction. Current regulation allows withdrawing 15% of water from lakes with fish and all the water from the lakes without fish. Arising from the North Slope Tundra Lake study and presenting current questions for federal and state land agencies is whether the lakes completely recharge after use.

3. Future

There is usually a surface storage deficit over the summer at the watershed scale, because summer evapotranspiration generally exceeds summer precipitation (Mendez, 1997). Some of the surface storage deficit is made up during the early fall period when precipitation is generally at an annual maximum while evapotranspiration is rapidly shutting down (Bowling et al., 2003). Late summer precipitation may result in runoff from upland tundra areas to partially recharge coastal pond storage. None of these happened in summer and fall 2007, resulting in extreme surface storage deficit in spring 2008. This raises the questions, "Would the lakes/reservoirs be completely recharged over the next season? Is there enough water for the next year ice road construction?"

The majority of water runoff from large Arctic wetlands results from snowmelt in the late spring and early summer. The largest decrease in saturated surface extent takes place in the first one or two weeks following snowmelt (Bowling et al., 2003). Our research will attempt to create additional water supply in the form of snow drift next to the lake intensively used during the winter, so that the lake is completely recharged during the summer despite possible surface storage deficit or/and low precipitation winter. We believe that finding an optimum position for the snow drift would increase probability that this snow management project will be successful and effectively augment the recharge of the lake by the time water is needed for ice road construction.

Observational water balance data and estimated cost of additional water are considered to be project deliverables. Practical recommendations on using snow fences for ANS water resources management will be produced as a part of the project. In general, the results of this project will improve our understanding of snow water equivalent distribution in windy treeless environment, and it will allow us to utilize them in varied engineering and scientific applications. The periodic and final reports will describe progress of the project and be submitted in accordance with the "Federal Assistance Reporting Checklist." Other deliverables include peer reviewed publications in scientific journals and presentation of results on local (Alaska AWRA) and national conferences (AGU).

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