Sanitation in Wilderness: Balancing Minimum Tool Policies and Wilderness Values

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Abstract—Officials with the four wilderness managing agencies are faced with balancing wilderness preservation values and the minimum tool policies of their respective agencies. One example is the management of sanitation, particularly human waste and the often intrusive infrastructure that accompanies its treatment and disposal. Because the treatment and disposal of human waste is a potentially serious public health hazard if mismanaged, it sometimes requires an elaborate infrastructure, including buildings and use of helicopters or pack stock. A paradox exists between public health concerns and the use of a minimum tool allowed by the agency to deal with human waste treatment and disposal. What is needed is a framework for balancing these interests to make explicit various options available to scientists and managers. This paper provides a matrix and related flow chart for considering various sanitation techniques while incorporating minimum tool options and concerns about related impacts.

The issue of sanitation in wilderness presents a troublesome paradox. On one hand, managers and scientists with the four wilderness-managing agencies must provide for the preservation of wilderness character while protecting the resource from impacts, including surface and ground water pollution caused by improper human waste disposal. The implementation of permanent structures to treat or store waste and the consistent use of helicopters or pack stock to transport waste or materials presents an interesting, albeit unusual perspective from which to examine the legal and ethical framework of wilderness.

The Wilderness Act of 1964 (Public Law 88-577) includes the characterizing phrases "untrammeled by man," "retaining its primeval character" and "man's work substantially unnoticeable," yet it also explicitly states that the areas are to be managed with "no use of motor vehicles, motorized equipment…no other form of mechanical transport, and no structure or installation…except as necessary to meet minimum requirements for the administration of the area." The notion of "minimum requirements" in wilderness areas mandated to be managed for "the preservation of their wilderness character" presents some ambiguity. The choice of a minimum tool is largely at the discretion of the land manager. Hendee (1990) refers to the "minimum tool rule" as "the minimum regimentation necessary to achieve established wilderness management objectives" and depends "on a manager's judgment about the degree of regulation necessary to achieve objectives and the likely effectiveness of various regulatory and nonregulatory actions in certain situations." Thus, management decisions can be based on subjective judgements, personal values or even administrative convenience.

Managers may neglect sanitation issues at specific sites or may implement a sanitation strategy with an emphasis on mechanized transport or an elaborate infrastructure that is incompatible with social values or biophysical constraints. Several studies of wilderness managers have indicated that steps to improve resource conditions are taken only after "substantial damage…had occurred" (Shindler 1992). Cole (1996) asserts that managers have been reluctant to attack problems directly, stating, "Two oft-cited wilderness management principles, that indirect management techniques are best and that use limits should be a last resort, have become so entrenched in the wilderness community that they have paralyzed many management programs." However, a new wave of purist sentiment has occupied recent discussion regarding management objectives in wilderness. Nash (1996) describes the wilderness experience as "delicate" and one that is "vulnerable to seemingly insignificant disturbance." Even the amount of noise heard that comes from outside of wilderness can elicit high levels of concern among wilderness recreationists (Shafer and Hammitt 1995). Noss (1991) posits that our desire to manage wilderness is "exceedingly arrogant" and thus what is needed is recognition of a humility value that represents "self-imposed restraint in a society that generally seeks to dominate and control all of nature." Recognizing restraint will prove increasingly difficult as use and intensity of wilderness continue to grow.

Problem Statement

Since 1965, recreation use in wilderness has grown by nearly 400 percent (Hampton and Cole 1995), increasing substantially during the 1990s in most wilderness areas and likely to intensify (Cole 1996). The protection of water resources is a vital component of wilderness integrity, and thus researchers commonly look to water to quickly determine the state of health of an entire watershed or ecosystem (Herrmann and Williams 1987). Several surveys reveal that the public believe preserving water quality is the most important wilderness value and reason for wilderness

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protection (Cordell and others 1998; Kloepfer 1992). Both standing and free-flowing water in wilderness is often the focal point of backcountry recreation; it tends to be limited and subject to ever-increasing consumptive, polluting and competing uses (Aukerman 1986). Research shows that certain backcountry locations with pristine-looking water can be contaminated with pathogenic organisms (Tippets 1999; Aukerman and Monzingo 1989; Suk 1986; Varness 1978). New and potentially dangerous organisms such as *Giardia lamblia* and *Cryptosporidium* are particularly worrisome because of their disabling effects and prevalence in some backcountry locations (Perry and Swackhammer 1990). While it has been difficult in the past to discern whether recreation is the cause of fecal contamination of water, new techniques have become more sophisticated. Human fecal contamination in recreation settings has been documented using a method that extracts the DNA from coliform bacteria to determine the source (human, beaver, horse, etc.) of the pollution (Tippets 1999).

The primary concerns of human waste disposal are, 1) the transmission of disease-causing organisms and, 2) the aesthetic concerns of improper human waste disposal or the accompanying sanitation infrastructure. The public is shown to be increasingly intolerant of sanitation problems. In their study of social and ecological normative standards, Whittaker and Shelby (1988) found that the standard for human waste represented a no-tolerance norm, in which 80 percent of the respondents reported that it was never acceptable to see signs of human waste. Increased use has led to increased social and biophysical impacts, particularly in sites not conducive to the decomposition of human waste. A recent study reports that 25 percent of National Park Service managers find human waste to be a common problem in many or most areas, and 43 percent consider it a serious problem in a few areas (Marion and others 1993). Increasing wilderness use, the severity of public health issues and lack of tolerance by the public combined with biophysical constraints, changing social values toward wilderness and limited human waste treatment and disposal techniques creates a complex situation for managers and scientists who must determine the application of a minimum tool.

Discussion

The matrix (table 1) and related flow chart (figure 1) were created to help managers and scientists design and maintain sanitation programs and infrastructures while incorporating minimum tool options and concerns about related impacts such as aesthetics, noise, trail erosion and the social acceptability of the option. Information contained in the matrix and flow chart were gathered from the limited quantity of research on water quality and human waste management in backcountry settings and makes explicit the technology or technique to treat and dispose of human waste, minimum tool options and related impacts. The flow chart presents various scenarios and actions relating to sanitation management options. The matrix establishes descriptions and related impacts of various sanitation techniques. Determinations of opportunity classes are based on Stankey and others (1990) and designed to define resource, social and managerial conditions considered desirable and appropriate in wilderness. Opportunity classes associated with techniques are approximated to gauge the severity of obtrusiveness. Within the matrix, Class I implies little or no evidence of site management, while Class IV implies extensive use of onsite management and site modification.

Numerous organizations including the USDA Forest Service, Leave No Trace and the National Outdoor Leadership School detail the positive and negative attributes of various sanitation techniques in the backcountry. Clearly, no means of human waste disposal in the backcountry is without ramifications, and no one method can be unconditionally recommended for every situation. Even urine, which is ordinarily sterile, can attract wildlife that defoliate plants and disturb soils. (Hampton and Cole 1995; Cole 1989). Good judgement is the key to proper human waste disposal. Hampton and Cole (1995) maintain that disposal techniques are best when they: 1) diminish human, animal and insect contact, 2) encourage decomposition, and 3) avoid polluting water sources. The fate of pathogenic organisms in human waste deposited on or in soils is highly variable and depends on numerous factors including soil type, moisture and temperature.

The "cat hole" method allows for aerobic decomposition by microbial activity within individual shallow holes in the ground. Hampton and Cole (1995) report that this is the preferred method in nearly every outdoor environment. However, research has documented the ineffective break down of coliform bacteria using this technique (Temple and others 1982). Use of the cat hole procedure should not be attempted in areas with less than optimal conditions for decomposition, including moderate temperatures, presence of organic matter in the soil and low chance of being found by potential users. The group trench latrine is a technique in which the waste is buried in a shallow trench used by a small group. This technique can also apply to parties camping in snow conditions. However, waste deposited in permanent snow conditions will most likely take hundreds if not thousands of years to decompose (Ells 1997). The smear method, also known as surface disposal, is a technique in which the waste is spread thinly on the surface to allow aerobic decomposition by microbial activity and breakdown by ultraviolet radiation. The method works well in low-use locations where others are not likely to find the waste (Cole 1989). The individual pack-out method is gaining popularity in high-use areas. The waste is double-bagged, or single-bagged and placed in a tube. However, because of social acceptability issues, compliance is often low (Drake 1997). Numerous commercial options are available for the pack-out of group waste (Meyer 1994). The waste is sealed in an ammunition can or other secure receptacle and then carried out. This method is most common on river trips where the receptacle can be placed in a boat.

Treatment and disposal techniques that generally require a structure (outhouse) include pit toilets. Pit toilets offer a simple and relatively low maintenance method of waste treatment. However, these toilets are often anaerobic, characterized by slow decomposition and producing ammonia which is odorous. In addition, their use can affect water quality, depending on water table and flow path characteristics (Leonard and Plumley 1979). Composting

Table 1—Matrix of sanitation and minimum tool options in wilderness.

Technology/ technique	Description	Appropriate use	Minimum tool requirement	Potential social impact	Potential biophysical impact	Opportunity class
Cat hole	Waste is buried in individual shallow holes to allow decomposition by microbial activity	Low-use locations (esp. Desert, Temperate)	Educational displays; Periodic monitoring	Aesthetic concerns	Surface or ground water pollution; Issues related to urination	Class I
Smear (Surface disposal)	Waste is spread thinly on surface to allow decomposition by microbial activity and UV radiation	Low-use locations	Educational displays; Periodic monitoring	Aesthetic concerns	Surface or ground water pollution; Issues related to urination	Class I
Group Trench Latrine	Waste is buried in shallow trench by group to allow decomposition by microbial activity	Low-use locations (esp. Temperate)	Educational displays; Periodic monitoring	Aesthetic concerns	Surface or ground water pollution; Issues related to urination	Class I
Individual Pack-out	Waste is carried-out in tube or bag	High-use locations (esp. Alpine)	Educational displays; Periodic monitoring; Provision of bags or tubes	Social acceptability of method	Surface or ground water pollution; Issues related to urination	Class I
Group Pack-out	Waste is carried-out in ammo can or bag	High-use locations (esp. Riparian)	Educational displays; Periodic monitoring; Provision of ammo can or bags	Social acceptability of method	Noncompliance can lead to surface or ground water pollution; Issues related to urination	Class I
Pit	Waste is deposited in unlined hole in ground by multiple parties and decomposes anaerobically	High-use locations	Latrine structure; Field Staff required for on-site maintenance	Odor; Aesthetic concerns of latrine structure	Surface or ground water pollution	Class II to IV
Composting	Waste decomposes through mesophilic or thermophilic methods using wood chips	High-use locations (esp. Temperate)	Latrine structure; Field Staff required for on-site maintenance; Pack stock or helicopter required transport of wood chips to site and removal of solids	Aesthetic concerns of latrine structure; Noise or trail erosion issues	Impacts related to use of pack stock (seed dispersal, trail erosion) and helicopter (wildlife issues)	Class II to IV
Incineration	Waste is cooked in propane-fired chamber	High-use locations	Latrine structure; Pack stock or helicopter required for transport of propane and ash	Odor; Aesthetic concerns of latrine structure; Noise or trail erosion issues related to transport	Impacts related to use of pack stock (seed dispersal, trail erosion) and helicopter (wildlife issues)	Class II to IV

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Table 1 (Con.)

Technology/ technique	Description	Appropriate use	Minimum tool requirement	Potential social impact	Potential biophysical impact	Opportunity class
Dehydration	Waste is dried in straining system; can use passive solar assitance	High-use locations	Latrine structure; Liquid treatment system; Pack stock or helicopter required for removal of solids	Odor; Aesthetic concerns of latrine structure; Noise or trail erosion issues related to transport	Impacts related to use of pack stock (seed dispersal, trail erosion) and helicopter (wildlife issues); Surface or ground water pollution	Class II to IV
Vault with no liquid separation	Liquid and solid waste is collected in sealed vault	High-use locations	Latrine structure (Wallowa-style); Pack stock or helicopter required for removal of vault	Odor; Aesthetic concerns of latrine structure; Noise or trail erosion issues related to transport	Impacts related to use of pack stock (seed dispersal, trail erosion) and helicopter (wildlife issues)	Class II to IV
Vault with liquid separation	Liquid and solid waste is separated using strainer and liquid treatment system	High-use locations (esp. Temperate)	Latrine structure; Liquid treatment system; Pack stock or helicopter required for removal of solids	Odor; Aesthetic concerns of latrine structure; Noise or trail erosion issues related to transport	Impacts related to use of pack stock (seed dispersal, trail erosion) and helicopter (wildlife issues); Surface or ground water pollution	Class II to IV

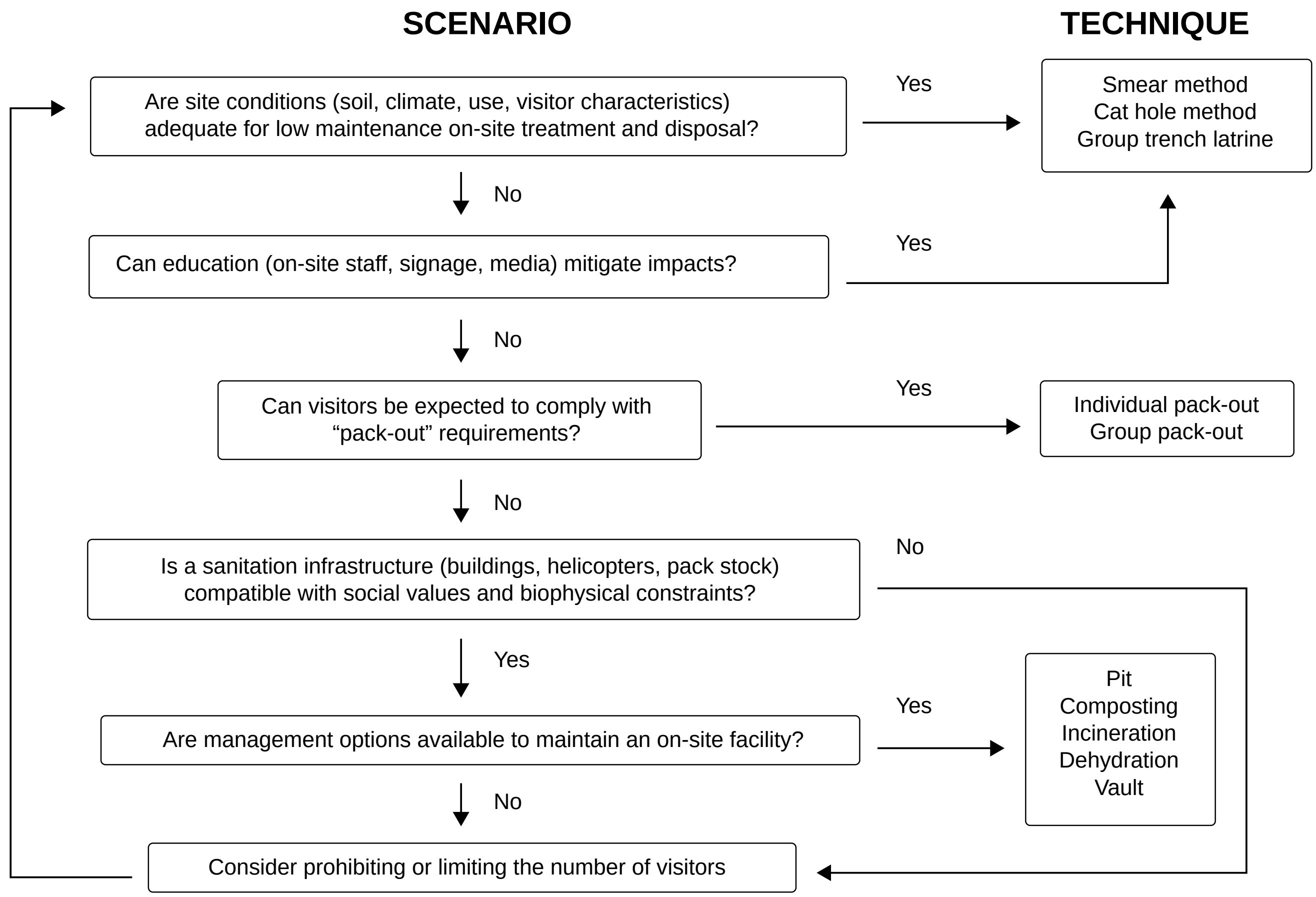

Figure 1—Flow chart of sanitation options for wilderness managers.

toilet options involve the aerobic breakdown of waste in a sealed bin or tank. These methods operate favorably in locations where the climate is temperate and there is regular maintenance. Numerous composting methods have been tested and used in various applications (Lachapelle 1997; Land 1995a; Davis and Neubauer 1995; Yosemite National Park 1994; Weisberg 1988; Jensen 1984; Cook 1981). Although not a popular option, incineration offers an alternative that has been applied in backcountry settings. Mechanical difficulties have often been cited as a limiting factor. The use of dehydrating toilets is especially popular in extreme conditions such as alpine or desert locations (Drake 1997; Mt. Rainier National Park 1993; McDonald and others 1987). Surface and ground water pollution can result from liquid discharge and the dehydrated solids must still be removed from the site. Vault toilets can either incorporate a liquid treatment system or be large enough to accommodate the liquid. (Land 1995b; Leonard and others 1981). Helicopters or pack stock such as mules are generally used in these situations because of the great weight and volume factors of transporting the waste. However, pack stock may contribute to fecal contamination of surface and ground water sources while the use of helicopters may intensify social impacts.

Conclusions and Recommendations

Several trends suggest that managers and scientists must design and maintain sanitation programs and infrastructures with an emphasis on incorporating minimum tool options and concerns about related impacts. First, use and impact have intensified and are expected to grow. Second, there is little research on sanitation and related public health concerns that result from wilderness use. Third, monitoring programs appear to be lacking. Marion and others (1993) found that only 52 percent of national parks had implemented some type of water quality monitoring program. Herrmann and Williams (1987) cite four reasons for a lack of water quality research in wilderness as the difficulty of access to sites, difficulty in discriminating the effects from background water quality levels, the magnitude of the action to the consequence and the limited opportunity for control in the wilderness environment.

Options for managers and scientists are often limited depending on social values and biophysical constraints. Cole and others (1987) describe five strategies for managers when dealing with human waste issues as 1) reducing use (prohibiting or limiting the number of visitors), 2) modifying the location of use (locate facilities on durable sites), 3) modify type of use and visitor behavior (education), 4) increase resistance of the resource (provide sanitation infrastructure), and 5) maintain or rehabilitate the resource (remove waste from toilets). The matrix and flow chart incorporate these strategies in order to make explicit various sanitation techniques, minimum tool options and related impacts. Since these options present the manager with numerous potential management actions, they must all be considered in relation to social values and biophysical constraints. While a reduction in use can conceivably lessen the sanitation impact, Cole and others (1997) report that reduction levels can sometimes result in more negative than positive consequences. This has been described as the "toothpaste effect," in which limits on one area may expand to other areas when "pressed" by management actions (Cole 1993). Priorities should be well-developed in order to identify, monitor and publicly report the internal and external threats to wilderness values (McCool and Lucus 1990).

Increasingly, issues associated with visitor use and intensity, the severity of public health impacts and lack of tolerance by the public regarding sanitation has created a complex situation of determining methods of balancing minimum tool requirements and wilderness values. The difficult issue of sanitation options in wilderness would benefit from increased discussion and research. The situation remains a challenge for managers and scientists who strive to ameliorate the issues associated with sanitation, increasing use and changing values toward wilderness.

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