

Key Points to Consider When Pre-planning for Post-wildfire Rehabilitation

FORREX SERIES 19



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National Library of Canada Cataloguing in Publication Data

Pike, R. G

Key points to consider when pre-planning for post-wildfire rehabilitation / R.G. Pike and J.G. Ussery.

(FORREX series ; 19)

Includes bibliographical references.

ISBN 1-894822-42-0

1. Wildfires. 2. Fire management. 3. Fire ecology. I. Ussery, J. G. (Joel Glynn), 1957-
II. FORREX III. Title. IV. Series: FORREX series (Online) ; 19

SD421.P53 2006

634.9'618

C2006-900823

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This report is published by:

FORREX Forest Research Extension Partnership
Suite 702, 235–1st Avenue
Kamloops, BC V2C 3J4

Preparation of this document was funded in part by the British Columbia Ministry of Forests and Range through the Forest Investment Account, Forest Science Program.

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ABSTRACT

Even though wildfire is a natural part of many forest ecosystems, it is perceived as a major threat. Where the consequences of wildfire are a concern, human intervention is often used to address damage and prevent (or minimize) additional negative effects that may arise after a wildfire. Planning and preparing for emergency stabilization and rehabilitation in advance of an event could save valuable time and potentially mean the difference between success and failure.

This document explores key points to consider when pre-planning for post-wildfire rehabilitation, including the following:

- Keep planning simple, focus on priorities.
- Understand watershed characteristics and the potential for undesirable effects after a wildfire.
- Identify key watershed values and analyze risks to these values.
- Consider proactive approaches to reducing risk.
- Clarify jurisdictional issues, and identify training and communication needs.
- Facilitate post-fire assessments by assembling required information and maps in advance.
- Develop risk-based strategies and match techniques with needs.
- Learn from existing experience and think long term.

This document also includes a comprehensive bibliography of references and information resources relating to fire suppression effects, post-wildfire salvage harvesting, post-wildfire rehabilitation techniques, and planning and risk assessment. It is hoped that this document will provide a basis for further discussion among the professionals practising post-wildfire emergency stabilization and rehabilitation in British Columbia.

KEYWORDS: post-wildfire rehabilitation, planning, emergency stabilization, preparedness, pre-planning, risk assessment

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Citation—

Pike, R.G. and J.G. Ussery. 2006. Key points to consider when pre-planning for post-wildfire rehabilitation. FORREX Forest Research Extension Partnership, Kamloops, B.C. FORREX Series 19. URL: <http://www.forrex.org/publications/FORREXSeries/FS19.pdf>

ACKNOWLEDGEMENTS

We would like to thank those who participated in the June 9, 2005, Working Session in Kelowna, B.C. (Appendix 1). Their ideas and expertise form the basis of this document. We would also like to extend our gratitude to the following reviewers whose comments greatly improved the utility of this document: Patrick Daigle, Don Dobson, Carolyn Napper, Rob Scherer, Dave Scott, Tim Smith, and Kevin Turner. Preparation of this document was funded in part by the British Columbia Ministry of Forests and Range through the Forest Investment Account, Forest Science Program.

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1 INTRODUCTION AND CONTEXT

Forested watersheds are frequently valued for the natural services they provide as well as for the resources they contain. In British Columbia, watersheds are often at the centre of land and resource management decisions. Watersheds provide a convenient unit within which multiple, and sometimes conflicting, values are managed and protected.

Within much of British Columbia, wildfire poses a major threat to watershed values even though wildfire is a natural part of many forest ecosystems. The potential risk of negatively affecting watershed values has led to a provincial policy of aggressive wildfire suppression. However, the effectiveness of many years of fire suppression in some watersheds has increased the 'buildup' of fuel loads consequently increasing the likelihood of more damaging fires, and subsequently, risks to watershed values.

Increased forest fire burn severity can potentially result in greater exposure of soils to erosion (i.e., loss of vegetation cover), and in some cases the formation of water-repellent soil conditions. Watershed values in burned watersheds are at risk if precipitation events following wildfire result in flooding, severe erosion, and mass movements. In some cases, these effects can pose a hazard to public safety, cause substantial damage to property and infrastructure (such as roads and drainage structures), and (or) degrade drinking water quality and valued ecosystem characteristics, such as fish habitat in fisheries sensitive watersheds. As demonstrated in 2003 by the Okanagan Mountain Park Fire near Kelowna, B.C., watershed impairments can occur well downstream of the burned area and in suburban areas.

Where the consequences of wildfire are a concern, human intervention is often used to address damage and prevent (or minimize) additional post-wildfire effects. Post-wildfire response activities fall into three main categories:

1. emergency stabilization of areas where post-wildfire conditions pose an immediate hazard to public safety, drinking water, property, infrastructure and (or) other watershed values;
2. rehabilitation of areas directly affected by wildfire suppression activities; and
3. rehabilitation of burned areas for longer-term goals, such as establishment of preferred vegetation (composition and structure) and (or) minimizing erosion potential.

In the field of emergency stabilization and rehabilitation, considerable research has been undertaken in the United States through the activities of the Burned Area Emergency Response (BAER) program (see Neary et al. 2000, United States Department of Agriculture Forest Service 2002). In British Columbia, the B.C. Wildfire Regulation, sections 16 and 17, requires that only damage associated with wildfire suppression activities on Crown land be rehabilitated to minimize the potential for negative watershed effects (see British Columbia Ministry of Forests and Range 2005, sections 16 and 17).

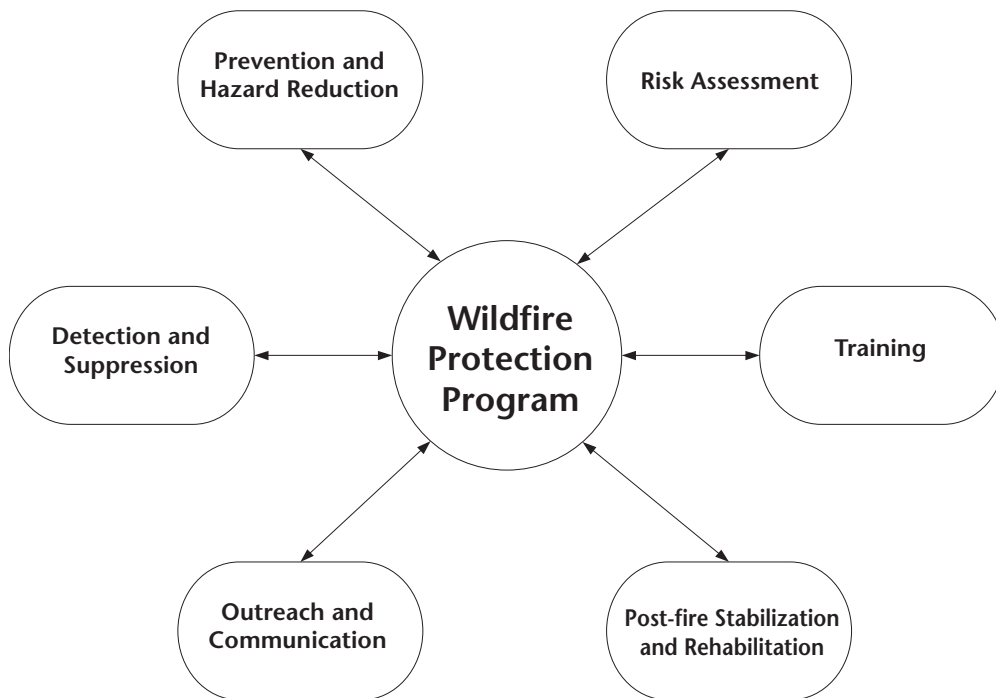
There is increasing recognition among professionals that a rapid response similar to the U.S. BAER approach is required to protect key watershed values and public safety prior to the occurrence of a storm event that might trigger undesirable post-wildfire conditions. In such cases, planning and preparing for emergency stabilization and rehabilitation in advance could save valuable time and potentially mean the difference between success and failure.

Ideally, pre-planning for post-wildfire stabilization and rehabilitation is part of a larger framework of wildfire risk assessment, and preparedness planning and programs (see Figure 1). The main purposes of this overall preparedness planning are to improve:

- awareness of how climate, physical watershed characteristics, and ecological processes relate to fire hazard, wildfire behaviour, and post-wildfire effects;

- the understanding of potential threats to watershed values and consequences as a result of wildfire, fire suppression activities, and post-wildfire conditions;
- the understanding of how management goals and objectives should influence wildfire suppression activities, and post-wildfire emergency stabilization and rehabilitation;
- communication and clarification among those with an interest in land and resources potentially at risk, and those who will be involved in fire suppression and post-wildfire emergency stabilization and rehabilitation;
- awareness of treatment options and priorities for post-wildfire emergency stabilization and rehabilitation;
- the collection and identification of required information and resources (e.g., maps, soils information, air photos, etc.); and
- the implementation and effectiveness of emergency stabilization and rehabilitation activities.

FIGURE 1. Conceptual overview of elements of a Wildfire Protection Program.



This document focuses on planning and preparing for post-wildfire rehabilitation *in advance* of an event. It sets out key points to consider when pre-planning for post-wildfire rehabilitation. The key points presented in this report are purposefully generic in order to be useful to a wide spectrum of readers. Many of these points are based upon participant input obtained from a working session held June 9th, 2005, in Kelowna, B.C. This one-day working session brought together professionals with a range of experiences in post-wildfire erosion control, forest hydrology, and geosciences (see Appendix 1). The goal of the working session was to stimulate discussion on the topic, and to obtain professional input on sample elements for a preparedness plan for post-wildfire rehabilitation in a forested drinking-water supply catchment area. Key points from the workshop were subsequently developed and refined by the authors.

It is hoped this document provides a useful resource and generates further discussion among the professionals practising post-wildfire emergency stabilization and rehabilitation in British Columbia.

2 KEY POINTS FROM THE WORKING SESSION

Key points have been selected and expanded upon by the authors. We have used these points to develop recommendations (presented in italics) to be considered in pre-wildfire planning for post-fire emergency stabilization and rehabilitation. These points have been used by a water utility on southeast Vancouver Island to develop an outline plan for post-wildfire rehabilitation. The outline of the draft Capital Regional District Water Services Plan for Post-wildfire Rehabilitation is provided in Appendix 2 as an example of one application of the points discussed below.

2.1 Keep Planning Simple, Clearly Define Terms, and Match Planned Activities to Goals

Keep pre-wildfire planning simple

The primary goal of pre-planning is to prepare for a strategic, effective, and rapid post-wildfire response. Although some post-burn scenarios should be developed (e.g., risk mitigation strategies for elements that are at a high to very high risk), the focus of a pre-wildfire plan should be on assembling information rather than attempting to predict and prepare for every possible event. Information assembly could include: the identification of key watershed characteristics, watershed values and factors relating to risk; clarifying roles, responsibilities and contact information; developing scenarios; setting goals and objectives; and identifying resources and training requirements. The information should also include maps, data, and photographs relating to biophysical characteristics and (or) infrastructure and maps that illustrate key watershed values and sensitive site factors. This information can help expedite the post-wildfire assessment and provide context for determining priorities and prescriptions for post-wildfire emergency stabilization and rehabilitation.

- *Pre-wildfire planning should be kept simple and set the stage for post-wildfire response by assembling key background information required for post-wildfire assessments and developing prescriptions and priorities for emergency stabilization and rehabilitation.*

Clearly define terms in plans

There is sometimes confusion and misuse of terms (e.g., fire intensity vs. burn severity) that can negatively affect communication. Plans should include a glossary where terms are clearly defined. Where standard definitions have been established, these should be used.

- *To ensure clear communication, technical terms should be explicitly and clearly defined.*

Match planned activities to goals

There are three categories of emergency stabilization and rehabilitation: i) short-term emergency stabilization; ii) rehabilitation of fire suppression related effects; and iii) long-term watershed rehabilitation. These activities have very different requirements regarding jurisdictional issues, time scales, and, subsequently, effectiveness. It is therefore important to recognize and select the most appropriate emergency stabilization and (or) rehabilitation activities to match planned goals.

- *Address and distinguish between short-term emergency stabilization, rehabilitation of fire suppression related effects and long-term watershed rehabilitation activities in pre-wildfire planning.*
- *Select the most appropriate emergency stabilization and (or) rehabilitation activities that match planned goals.*

2.2 Identify Key Watershed Values

Identify key watershed values and risks

It is vital to have a good understanding of the location of key watershed values at risk, such as residences and businesses, drinking water sources, infrastructure, managed forest land, and valued ecosystem components (e.g., fish habitat in fisheries sensitive watersheds). It is also important to consider the potential consequences of wildfire and post-wildfire conditions on these identified values when risk planning. Recognizing potential hazards arising from wildfire and post-wildfire conditions is necessary for risk analysis and management, and can provide the rationale for additional resources focused on mitigating and (or) preventing fire and post-wildfire effects.

- ▶ *Identify and map risks to key watershed values from wildfire or post-wildfire hazards.*

2.3 Consider Watershed Characteristics

Review local watershed characteristics and how these relate to wildfire and post-wildfire conditions

All watersheds possess unique characteristics with respect to climate, storm patterns, storm frequency, geomorphology, hydrology, and vegetation. Regionally, there are also distinct differences in processes (i.e., landslide regimes, storms, drainage densities, etc.). It is important to consider how these watershed characteristics may influence weather and wildfire behaviour and, hence, the potential for post-wildfire effects. If there are information gaps, the pre-wildfire plan should set out strategies for obtaining required data.

- ▶ *Identify relevant watershed characteristics and consider how these might relate to post-wildfire effects.*
- ▶ *Incorporate watershed information into planning for post-wildfire emergency stabilization and rehabilitation.*
- ▶ *Identify strategies for gathering information or conducting research to better understand regional and local watershed characteristics.*

Consider historical wildfire regimes and changes in fire frequency and intensity

The frequency and intensity of natural fire regimes varies considerably across British Columbia. Most recently, climate change may have altered the historical frequency, intensity, and length of fire season in many areas. Fire suppression has also altered regional and local fire regimes leading to changes in vegetation patterns, and a general increase in forest fuel loadings and the potential for burn severity. These factors need to be considered when assessing risk and planning for response.

- ▶ *Determine the natural wildfire regime, and how climate change, fire suppression, and wildfire history have affected vegetation structure, density, and composition in the watershed.*
- ▶ *Consider how alterations to wildfire regimes and vegetation may affect predicted fire behaviour and the potential for more severe post-wildfire effects (i.e., burn severity).*
- ▶ *Conduct a risk assessment that examines and maps past wildfire history and considers the potential for rapid spread and high fire intensity.*

2.4 Understand the Triggers for Post-wildfire Hazards

Recognize that in severely burned areas, slopes do not necessarily have to be steep to generate substantial post-wildfire erosion potential

Knowledge from the British Columbia Southern Interior has demonstrated that erosion, flooding, and debris flows/floods can occur on relatively low-slope gradients.

- *Understand the hydro-geomorphic characteristics of the watershed and consider the potential for debris flows, debris floods, or flood events on low-slope gradients.*

Use permanent or portable climate stations and (or) Doppler radar to help understand and characterize local precipitation regimes that might trigger slope hazards in a watershed

It is recognized that a variety of rainfall events (e.g., rain-on-snow, high intensity/short duration, moderate-low intensity/long duration rainfall events, etc.) can be important triggers causing slope hazards in burned watersheds in British Columbia. Understanding local precipitation regimes (seasonality, frequency, duration, and intensity) is, therefore, an important part of pre-wildfire planning. Useful tools, such as climate stations and Doppler radar data, may help to understand storm return interval and characterize local precipitation regimes in watersheds.

- *Use available information, such as historic climate records and Doppler radar data, to identify areas within a watershed that are prone to rain events and other meteorological triggers. Investigate local precipitation trends (seasonal durations, frequencies, and intensities) and (or) map areas that are prone to storms or intense rain cells.*
- *Identify all nearby climate stations (and respective agency contacts to include on key contact list) to help characterize pre-wildfire storm return intervals and precipitation regimes.*
- *Consider supplementing available climate station data by installing portable climate stations to gain a better understanding of local variations in climate and specific weather events.*

2.5 Predict Areas Most Susceptible to Post-wildfire Erosion

Use physical watershed parameters to assist in identifying the potential for post-wildfire erosion and mass wasting deposition

Advance planning for post-wildfire stabilization and rehabilitation would benefit considerably from identifying areas most susceptible to post-wildfire mass wasting erosion and deposition. Factors, such as existing (pre-wildfire) slope stability, surface erosion potential, channel morphology, and sediment transport potential, may be useful to consider in pre-wildfire hazard assessment. It may also be useful to examine sediment containment/storage potential in streams and connectivity along the stream channel. It is important to remember, however, that any attempt to predict susceptible areas does not reduce the need to perform a post-wildfire assessment of conditions by a qualified professional. Such an assessment is required to validate potential hazards created by the wildfire prior to developing site-specific prescriptions for emergency stabilization and rehabilitation.

- *Examine the utility of a range of physical parameters to assist in identifying areas that may be susceptible to post-wildfire mass wasting erosion and sediment deposition.*
- *Recognize that the usefulness of selected parameters may be affected by regional differences in watershed characteristics, as well as watershed values at risk.*

2.6 Determine Priority Areas for Action

Use a detailed hazard and risk analysis to identify priority areas for fire suppression and post-wildfire emergency stabilization and rehabilitation activities

In undeveloped areas of a watershed, it may be appropriate to let a wildfire burn unsuppressed and allow the site to naturally recover. However, in many areas fire suppression and post-wildfire emergency stabilization and rehabilitation activities will be critical in protecting key watershed values. Pre-planning should identify priority areas in watersheds for fire suppression and post-wildfire stabilization and rehabilitation based on the results of a hazard and risk analysis.

- *Use an assessment of potential hazards and risks to develop criteria for triggering wildfire suppression, and the level of suppression efforts.*
- *Use an assessment of potential hazards and risks to develop management and mitigation strategies with measurable goals and objectives for post-wildfire emergency stabilization and rehabilitation.*

2.7 Clarify Jurisdictional Issues

Identify organizations and individuals with an interest or role in the pre-wildfire plan, establish lines of communication, and clarify roles and responsibilities

It is important to understand which organizations and individuals have a role or mandate in the protection and management of watershed values, and which are responsible for fire suppression and post-wildfire activities. Identify these organizations within and adjacent to the planning area. Identification of key contacts in these agencies should occur prior to any watershed emergency (such as a large wildfire). Clarifying agency interests, roles, and responsibilities, and agreeing upon an **incident command structure** in advance, should minimize the potential for conflict, confusion, and inefficiencies.

- *Identify organizations and individuals with an interest in the protection and management of watershed values, and who are responsible for fire suppression and post-wildfire activities.*
- *Meet with agency representatives to assess how they might be involved in fire suppression and post-fire stabilization and rehabilitation.*
- *Develop a list of agency contacts, establish clear lines of communication, clarify emergency response and incident command structure, and define roles and responsibilities.*
- *Ensure agencies responsible for fire suppression and post-wildfire activities are aware of the location and risk to key watershed values.*

Consider the potential for downstream effects

Post-wildfire conditions can amplify and accelerate effects, such as flooding, erosion, and mass wasting that could affect downstream areas. Yet, these areas may be outside the jurisdiction of the agency responsible for the lands where a wildfire occurs. Such scenarios should be considered in pre-wildfire planning to identify and clarify downstream values and appropriately co-ordinate inter-jurisdictional responsibilities and activities in response to an emergency.

- *Consider the potential for negative effects on areas downstream of the wildfire and address accompanying inter-jurisdictional issues.*

2.8 Develop Strategies for Mitigation and (or) Management of Risk

Develop post-wildfire strategies that are linked to key watershed values and public safety

Given the need for quick action, and the substantial resources that are often required for post-wildfire emergency stabilization and rehabilitation, it is important to match the intensity of these activities with the level of risk (and consequence) to key watershed values and public safety, and resources available. It is also important to consider the potential risks to watershed values associated with access, machinery, and materials in post-wildfire interventions.

- *Develop post-wildfire strategies with goals that manage and mitigate risk to key watershed values and public safety.*
- *Assess the risks to watershed values with respect to access, use of machinery, and types of materials required for stabilization and rehabilitation activities.*
- *Develop risk mitigation strategies for the values and areas that are at a high to very high risk.*

2.9 Match Risk Reduction and Management Techniques with Needs

Match stabilization and rehabilitation techniques to the protection of watershed values and public safety, site objectives, and seasonal considerations

A number of techniques, such as seeding non-native grass mixes to control erosion, are almost universally applied in post-wildfire stabilization and rehabilitation. However, grass seeding has been evaluated as ineffective in providing first-year erosion control. Thus, it is important to consider if such techniques are appropriate given the site-specific risk to watershed values and public safety, the objectives for the site, physical site characteristics, the potential for native vegetation to re-establish on the site, and seasonal and timing concerns. For example, seeding non-native grasses may not be appropriate in native grasslands with high conservation values, or where native vegetation is fire adapted and will recover, or where there is not sufficient time for grass to establish prior to the onset of fall and winter precipitation. In such cases, an alternate approach to erosion control may be a better option.

- *Match emergency stabilization and rehabilitation techniques to the protection of watershed values and public safety, site requirements, and seasonal considerations.*
- *Recognize that some treatments require maintenance throughout the year to be effective and (or) that alternate treatments may be required if the initial treatment fails.*

2.10 Consider Proactive Approaches to Reducing Risk

Consider reducing the level of burn severity where key watershed values may be at risk

There is a wide range of options for reducing potential burn severity (e.g., forest fuel reduction, creations of fuel breaks, etc.) to protect watershed values. Other options, such as wetting areas in the path of a wildfire, may also be useful in reducing burn severity in areas of concern.

- *Consider proactive strategies for reducing the potential for adverse wildfire effects in high-risk areas to minimize the need for post-wildfire emergency stabilization and long-term rehabilitation.*

2.11 Recognize Barriers and Constraints to Success

Recognize it may not be possible to prevent the worst case scenario

Comprehensive applications of emergency stabilization techniques may not be 100% successful in preventing all undesirable effects in every situation. Therefore, it is important to recognize that in some watersheds there may be serious constraints to effective stabilization and rehabilitation, and trade-offs may be required. In such cases, a structured approach, such as a cost and benefit analysis, should be incorporated into pre-planning for post-wildfire stabilization and rehabilitation.

- ▶ *Identify constraints that may limit the effectiveness of post-wildfire stabilization and rehabilitation, and establish a framework for a structured analysis of options and trade-offs.*

2.12 Think Long Term

Identify long-term targets for post-wildfire vegetation

Stabilization, and some rehabilitation, focuses on short-term goals and objectives, such as quickly re-establishing vegetation cover in an attempt to prevent or minimize erosion. However, some actions focused on the short-term (such as seeding non-native grasses) may interfere with establishing more desirable species (such as conifers) over the long term. Incorporating long-term goals and objectives into pre-planning can help ensure these targets are considered when addressing immediate needs. It is also important to identify how long-term targets for vegetation composition and structure in the watershed may differ from the existing (current) vegetation on the site. Prescriptions for stabilization and rehabilitation should focus on desired targets for vegetation composition and structure, not just on re-establishing the pre-wildfire conditions.

- ▶ *Identify the desired structure and composition of vegetation required in the long term to sustain or enhance identified watershed values.*
- ▶ *Incorporate the desired structure and composition of vegetation into planning for short-term stabilization and long-term rehabilitation.*

2.13 Identify Training and Communication Needs

Design strategies to ensure that everyone involved in fire suppression and post-wildfire stabilization and rehabilitation activities has the necessary level of awareness and training required to minimize undesirable effects on watershed values

Fire suppression and post-wildfire activities involve personnel with a wide range of expertise, skills, and backgrounds. Because many fire and post-wildfire activities involve contract work, it is difficult in some emergency situations to verify training of all employed personnel (e.g., machine operators). Yet, it is critical that pre-wildfire planning include strategies to ensure that all personnel involved are aware of the location and characteristics of key watershed values and the best approaches and techniques (such as machine-free areas) to protect key values. Timely information sharing and (or) daily debriefing can be effective mechanisms to ensure continued professional development, and maintain clear lines of communication as an event unfolds. Annual end-of-season debriefing sessions (e.g., sharing case studies) can also help disperse useful information. Post-treatment field trips to identify treatment successes and failures and (or) additional threats to watershed values not identified during the original post-wildfire assessment, might also be considered useful learning techniques.

- *Consider strategies to ensure continued professional development of key staff prior to an event.*
- *Establish clear lines of communication to implement during and after an event to prevent undesirable effects on watershed values.*

Develop a list of qualified professionals cross-referenced by services, such as post-wildfire assessments, risk analyses, and emergency stabilization and rehabilitation

It is important to have a list of professionals readily at hand to facilitate a rapid response to emergency situations. This list should be updated annually prior to the fire season. The administrative and financial policies and procedures for retaining contract services in emergency situations should also be in place and well understood.

- *Develop and incorporate a list of qualified professionals and the required procedures for retaining emergency services in the pre-wildfire plan for post-wildfire stabilization and rehabilitation.*

2.14 Learn from Experience

Review information from case studies on documented post-wildfire events, existing predictive models, and post-wildfire stabilization and rehabilitation trials

Much of what is known in British Columbia about undesirable post-wildfire conditions, such as flooding, erosion, and mass movements, comes from recent experiences in the B.C. Southern Interior and the western United States. While differences in climate and biophysical characteristics exist between these areas, it is worth investigating case studies. Existing predictive models, such as the *Erosion Risk Management Tool (ERMiT)* which predicts the probability associated with a given amount of soil erosion in each of five years following a wildfire (Robichaud et al. 2005), may be useful in understanding site factors that can lead to undesirable post-wildfire conditions. A review of the growing literature (see Appendices 3, 4, 5, 6, and 7) on post-wildfire effects, and the types and effectiveness of stabilization and rehabilitation techniques, provides a wide range of options to include in a pre-wildfire plan. Understanding which techniques are most effective will help planners and practitioners make the most efficient use of limited resources.

- *Review and assess available information and predictive models on how watersheds respond to wildfire and post-wildfire conditions.*
- *Review and assess available information on the efficacy and success of strategies and techniques for post-wildfire emergency stabilization and rehabilitation.*
- *Identify the potential limitations in applying information and models based on data from jurisdictions outside of British Columbia in the pre-wildfire plan.*

3 RESEARCH AND INFORMATION NEEDS

There is a considerable body of literature on post-wildfire emergency stabilization and rehabilitation from the U.S. (see Appendices 3 and 6). However, research on post-wildfire effects and the effectiveness of stabilization and rehabilitation techniques in British Columbia is in the very early stages. Although a comprehensive listing of research and information needs is beyond the scope of this report, the Kelowna working session did suggest some initial needs:

- Document and conduct follow-up research on the effects of wildfire and post-wildfire conditions in different areas of the province.

- Research water-repellent soils in British Columbia and triggers for post-wildfire hazards.
- Research the physical factors associated with terrain and stream channel characteristics in British Columbia that can be used to predict the potential for post-wildfire impacts.
- Expand research on the effectiveness of stabilization and rehabilitation techniques in British Columbia and ground-truthing of techniques that work well in other regions (e.g., in the U.S.).

4 SUMMARY OF KEY POINTS AND CONCLUSIONS

Advanced planning (pre-planning) for post-wildfire emergency stabilization and rehabilitation is a relatively new concept in British Columbia that requires further exploration. The purpose of pre-planning is to facilitate a rapid post-wildfire assessment and an appropriate response to ensure implementation is completed prior to the occurrence of a storm event that might trigger undesirable post-wildfire effects. Assembling information in advance allows for the rapid refinement of planned strategies for emergency stabilization and short- and long-term rehabilitation. Therefore, the level of pre-planning needs to be kept relatively simple with this purpose firmly in mind.

This report has presented a number of key points to consider when pre-planning for post-wildfire rehabilitation:

- Keep planning simple, clearly define terms, and match goals to planned activities.
- Identify key watershed values.
- Consider watershed characteristics.
- Understand the triggers for undesirable post-wildfire hazards.
- Predict areas most susceptible to post-wildfire erosion.
- Determine priority areas for action through preliminary analyses of hazards and risk.
- Assemble information resources (maps, data, photographs, contacts) and prepare maps that illustrate key watershed values and sensitive site factors.
- Develop risk-based strategies.
- Match techniques with needs.
- Clarify jurisdictional issues.
- Consider proactive approaches to reducing risk.
- Recognize barriers and constraints to success.
- Think long term.
- Identify training and communication needs.
- Learn from experience.

The plan should consider a risk-based approach to assessing the impacts of potential hazards on key watershed values and public safety from wildfire and post-wildfire conditions.

It is recognized that not all of these key points will be applicable to agencies attempting to better address the potential negative effects of wildfire on watershed values. However, we hope the points will stimulate thought and discussion, and serve as a useful framework for focused planning.

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APPENDIX 1 Listing of June 9, 2005, “Pre-wildfire Planning to Reduce Post-wildfire Impacts” working session participants

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Carolyn Napper	U.S. Forest Service
Chris Oman	B.C. Forest Practices Board
Dan Hogan	B.C. Ministry of Forests and Range
Dave Scott	UBC Okanagan
Dave Wilford	B.C. Ministry of Forests and Range
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Garnet Mierau	Linbir Holdings Ltd
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Gordon Joyce	Capital Regional District Water Services
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Mike Curran	B.C. Ministry of Forests and Range
Patrick Daigle	B.C. Ministry of Environment
Peter Jordan	B.C. Ministry of Forests and Range
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Tim Giles	B.C. Ministry of Forests and Range
Tim Smith	Westrek Geotechnical Services

APPENDIX 2 Outline of the Capital Regional District water services plan¹ for post-wildfire rehabilitation

Introduction

- Mandate of Water Services
- Key Values of the Water Supply Area
- Overview of Issues Relating to Impacts from Wildfire
- Overview of the Water Services Wildfire Program
- The Importance of Post-wildfire Emergency Stabilization and Rehabilitation
- Importance of Advance Planning for Post-wildfire Emergency Stabilization and Rehabilitation
- Relationship to Other Water Services Plans

Purpose of Document

Overview of the Water Supply Area

- Climate
- Terrain and Soils
- Hydrology
- Ecosystems
- Natural Fire Regime
- Human Alterations to Landscape and Processes

Assessing Risk

Assumptions

Areas at Risk of Wildfire

- Locations of Past Wildfires
- Areas of High Forest Fuel Hazard
- Areas with Constraints for Fire Detection and Suppression

Important Water Supply Area Values

- Primary Values (water quality, reservoirs, intakes, facilities, infrastructure)
- Secondary Values (listed ecosystems and species, fish habitat)

Areas with Potential for Post-wildfire Effects

- Overview of Potential Biophysical Hazards
- Areas with a Combination of Biophysical Hazards

Potential Consequences for Each Value at Risk

- Types of Impacts
- Timing, Duration, and Magnitude
- Assess Potential Consequences for Each Facility

Framework for Evaluating Hazards and Consequences

¹ Note, the complete plan is in draft form and not currently available. This outline is provided for information only. Interested readers should contact Joel Ussery, CRD Water Services (jussery@crd.bc.ca) for more information.

Priority Areas for Post-wildfire Emergency Stabilization and Rehabilitation

- Areas with a moderate to high probability of impacts to key water supply area values from wildfire and post-fire conditions that require post-wildfire emergency stabilization or rehabilitation

Advance Planning for Post-wildfire Stabilization and Rehabilitation

Guiding Principles for Land Management

(relevant to minimizing impacts from wildfire suppression and carrying out post-wildfire emergency stabilization and rehabilitation)

- Goals and Objectives for the Management of the Water Supply Area
- Policies for the Management of the Water Supply Area

Agencies and Organizations with an Interest in the Water Supply Area

(relevant to wildfire suppression and post-wildfire stabilization and rehabilitation)

- Roles and Responsibilities
- Consultation and Communication Requirements

Goals and Objectives for Stabilization and Rehabilitation

Risk-based Strategies and Techniques for Post-wildfire Emergency Stabilization and Rehabilitation

Required Resources

- Expertise
- Equipment
- Supplies

Criteria for Post-wildfire Assessment

Framework for Assigning Priorities

Framework for Assessing Options and Trade-offs

Worker Training and Orientations

Monitoring Requirements

References

Glossary of Terms

Appendices

- List of Contacts (provincial agencies, fire departments, health authorities, consultants, suppliers)
- List of Data Sources to Assist with Post-fire Assessments
- Terms of Reference for Post-wildfire Assessment
- List of Available Equipment and Supplies
- List of Policies, Best Management Practices, Standards, and Specifications Relating to Post-fire Stabilization and Rehabilitation
- Overview of Staff Training Program
- Monitoring Framework
- Listing of Watershed Data Sources Relevant to Post-fire Emergency Stabilization and Rehabilitation

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APPENDIX 7 Select references: Planning, risk assessment, and modelling

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