STRATEGY FOR RECOVERY

A core area represents the closest approximation of a biologically functioning unit for bull trout. The combination of both core habitat (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout, including for both spawning and rearing, as well as for foraging, migrating, and overwintering) and a core population (*i.e.*, bull trout inhabiting a core habitat) constitutes the basic core area upon which to gauge recovery within a recovery unit. Within a core area, many local populations may exist.

The Deschutes Recovery Unit Team identified one core area, and one core habitat which could become a core area if bull trout are reestablished there. The lower Deschutes Core Area and upper Deschutes core habitat are separated by Big Falls on the mainstem Deschutes River at about River kilometer 212 (River Mile 132). The lower Deschutes Core Area is generally described as the mainstem Deschutes and its tributaries from Big Falls to the Columbia River and contains five local populations. The mainstem Columbia River is not considered part of the lower Deschutes Core Area, but is identified as a primary research need due to the uncertainty of its current or potential use by bull trout as overwintering and migration habitat (see Chapter 1 for a discussion on the mainstem Columbia River).

The upper Deschutes core habitat is generally described as the upper Deschutes and its tributaries upstream from Big Falls at about River kilometer 212 (River Mile 132). The upper Deschutes core habitat does not currently support bull trout populations, but had bull trout historically. The recovery unit team determined that it likely has the necessary habitat elements to support reestablishment of bull trout. However, since some uncertainties remain regarding possible bull trout reestablishment in the upper Deschutes, and feasibility studies have been identified as a priority one research need.

Lower Deschutes Core Area. The lower Deschutes Core Area includes all current and historic bull trout habitat in the Deschutes River and tributaries from Big Falls downstream to the confluence of the Deschutes with the Columbia

River. It contains five local populations with spawning and rearing habitat in Shitike Creek, Warm Springs River, Whitewater River, Jefferson/Candle/Abbot river complex, and Canyon/Jack/Heising/mainstem Metolius river complex. Foraging, migrating, and overwintering habitats are also present in the core area.

Upper Deschutes Core Habitat. Bull trout are currently extirpated in this basin. Historic information indicates that bull trout were present in the upper Deschutes River, North Davis Creek, the Little Deschutes River, Crescent Lake, and Crescent Creek. Suitable but undocumented habitat was also identified in the Fall River, Browns Creek, Snow Creek, the Little Deschutes River, Whitefish Creek, Big Marsh Creek, Refrigerator Creek, Hemlock Creek, and Spruce Creek (Riehle and Nolte 1992). Recent preliminary investigations by U.S. Fish and Wildlife Service indicate that the Fall River, North Davis Creek, Browns Creek, Snow Creek, Quinn River, Cultus River, and the Little Deschutes River tributaries may contain suitable habitat for bull trout.

Recovery Goals and Objectives

The goal of the bull trout recovery plan is to **ensure the long-term persistence of self-sustaining complex interacting groups of bull trout distributed throughout the species' native range, so that the species can be delisted**. To achieve this goal the following objectives have been identified for bull trout in the Deschutes Recovery Unit:

- Maintain current distribution of bull trout within the lower Deschutes Core Area and restore distribution in previously occupied areas within the Deschutes Recovery Unit.

- Maintain stable or increasing trends in abundance of adult bull trout.

- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies.

- Conserve genetic diversity and provide opportunity for genetic exchange. Rieman and McIntyre (1993) and Rieman and Allendorf (2001) evaluated the bull trout population numbers and habitat thresholds necessary for long-term viability of the species. They identified four elements, and the characteristics of those elements, toconsider when evaluating the viability of bull trout populations. These four elements are 1) number of local populations; 2) adult abundance (defined as the number of spawning fish present in a core area in a given year); 3) productivity, or the reproductive rate of the population (as measured by population trend and variability); and 4) connectivity (as represented by the migratory life history form and functional habitat). For each element, the Deschutes Recovery Unit Team classified bull trout into relative risk categories based on the best available data and the professional judgment of the team.

The Deschutes Recovery Unit Team also evaluated each element under a potential recovered condition to produce recovery criteria. Evaluation of these elements under a recovered condition assumed that actions identified within this chapter had been implemented. Recovery criteria for the Deschutes Recovery Unit reflect 1) the stated objectives for the recovery unit, 2) evaluation of each population element in both current and recovered conditions, and 3) consideration of current and recovered habitat characteristics within the recovery unit. Recovery criteria will probably be revised in the future as more detailed information on bull trout population dynamics becomes available. Given the limited information on bull trout, both the level of adult abundance and the number of local populations needed to lessen the risk of extinction should be viewed as a best estimate.

This approach to developing recovery criteria acknowledges that the status of populations in some core areas may remain short of ideals described by conservation biology theory. Some core areas may be limited by natural attributes or by patch size and may always remain at a relatively high risk of extinction. Because of limited data within the Deschutes Recovery Unit, the recovery unit team relied heavily on the professional judgment of its members.

Local Populations. Metapopulation theory is important to consider in bull trout recovery. A metapopulation is an interacting network of local populations with varying frequencies of migration and gene flow among them (Meffe and Carroll 1994). Multiple local populations distributed and interconnected throughout a watershed provide a mechanism for spreading risk from stochastic events. In part, distribution of local populations in such a manner is an indicator of a functioning core area. Based in part on guidance from Rieman and McIntyre (1993), bull trout core areas with fewer than 5 local populations are at increased risk, core areas with between 5 and 10 local populations are at intermediate risk, and core areas with more than 10 interconnected local populations are at diminished risk. For the lower Deschutes Core Area, there are currently 5 known local populations. Based on the above guidance, bull trout in the Deschutes Recovery Unit is at an intermediate threat category.

Adult Abundance. The recovered abundance levels in the Deschutes Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information, and the professional judgment of recovery team members. In general, effective population size is a theoretical concept that allows us to predict potential future losses of genetic variation within a population due to small population sizes and genetic drift (see Chapter 1). For the purpose of recovery planning, effective population size is the number of adult bull trout that successfully spawn annually. Based on standardized theoretical equations (Crow and Kimura 1970), guidelines have been established for maintaining minimum effective population sizes for conservation purposes. Effective population sizes of greater than 50 adults are necessary to prevent inbreeding depression and a potential decrease in viability or reproductive fitness of a population (Franklin 1980). To minimize the loss of genetic variation due to genetic drift and to maintain constant genetic variance within a population, an effective population size of at least 500 is recommended (Franklin 1980; Soule 1980; Lande 1988). Effective population sizes required to maintain long-term genetic variation that can serve as a reservoir for future adaptations in response to natural selection and changing environmental conditions are discussed in Chapter 1 of the recovery plan.

For bull trout, Rieman and Allendorf (2001) estimated that a minimum number of 50 to 100 spawners per year is needed to minimize potential inbreeding effects within local populations. In addition, a population size of between 500 and 1,000 adults in a core area is needed to minimize the deleterious effects of genetic variation from drift.

For the purposes of bull trout recovery planning, abundance levels were conservatively evaluated at the local population and core area levels. Local populations containing fewer than 100 spawning adults per year were classified as at risk from inbreeding depression. Bull trout core areas containing fewer than 1,000 spawning adults per year were classified as at risk from genetic drift.

Adult abundance in the lower Deschutes River Core Area was estimated at 1,500 and 2,000 adult spawners per year in the 5 known local populations. Based on the aforementioned abundance guidance, bull trout in the Deschutes Recovery Unit was considered to be at an intermediate risk of inbreeding depression.

Productivity. A stable or increasing population is a key criterion for recovery under the requirements of the Endangered Species Act. Measures of the trend of a population (the tendency to increase, decrease, or remain stable) include population growth rate or productivity. Estimates of population growth rate (*i.e.*, productivity over the entire life cycle) that indicate a population is consistently failing to replace itself also indicate an increased risk of extinction. Therefore, the reproductive rate should indicate that the population is replacing itself, or growing.

Since estimates of the total population size are rarely available, the productivity or population growth rate is usually estimated from temporal trends in indices of abundance at a particular life stage. For example, redd counts are often used as an index of a spawning adult population. The direction and magnitude of a trend in the index can be used as a surrogate for the growth rate of the entire population. For instance, a downward trend in an abundance indicator may signal the need for increased protection, regardless of the actual size of the population. A population that is below recovered abundance levels, but that is moving toward recovery, would be expected to exhibit an increasing trend in the indicator.

The population growth rate is an indicator of probability of extinction. This probability cannot be measured directly, but it can be estimated as the consequence of the population growth rate and the variability in that rate. For a population to be considered viable, its natural productivity should be sufficient for the population to replace itself fromgeneration to generation. Evaluations of population status will also have to take into account uncertainty in estimates of population growth rate or productivity. For a population to contribute to recovery, its growth rate must indicate that the population is stable or increasing for a period of time.

Based on the intermediate level of adult abundance and local populations, bull trout in the lower Deschutes Core Area is considered at intermediate risk due to an apparent population trend that is not declining and has low to moderate annual variability (based on 10 years of data).

Connectivity. The presence of the migratory life history form within the Deschutes Recovery Unit was used as an indicator of the functional connectivity of the recovery unit. If the migratory life form was absent, or if the migratory form is present but local populations lack connectivity, the core area was considered to be at increased risk. If the migratory life form persists in at least some local populations, with partial ability to connect with other local populations, the core area was judged to be at intermediate risk. Finally, if the migratory life form was present in all or nearly all local populations, and had the ability to connect with other local populations, the core area was considered to be at diminished risk.

Migratory bull trout may persist in some local populations in the lower Deschutes Core Area and therefore are considered at an intermediate risk.

Recovery Criteria

Recovery criteria for the Deschutes Recovery Unit are the following:

1) **Bull Trout are distributed among five or more local populations in the Deschutes Recovery Unit, with five or more local populations in the**

lower Deschutes Core Area. In a recovered condition the lower Deschutes Core Area would have spawning and rearing populations in the Whitewater River, Jefferson/Candle/Abbot river complex, Canyon/Jack/Heising/mainstem Metolius river complex, Warm Springs River, and Shitike Creek. Existing foraging, migrating, and overwintering habitats in these and other streams in the core area must also be maintained.

The upper Deschutes core habitat could also contain one or more local populations as yet to be identified. Feasibility analyses are needed to assess the potential for reintroducing bull trout into historic habitat in the upper Deschutes core habitat. This is a high priority research need, and should be accomplished by 2003. Additional population studies and a better understanding of bull trout fidelity to their natal streams is needed to better define local populations in the recovery unit.

Bull trout are currently extirpated in the upper Deschutes River. Historic information indicates that bull trout were present in the upper Deschutes River, North Davis Creek, the Little Deschutes River, Crescent Lake, and Crescent Creek. Suitable but undocumented habitat was also identified in the Fall River, Browns Creek, Snow Creek, the Little Deschutes River, Whitefish Creek, Big Marsh Creek, Refrigerator Creek, Hemlock Creek, and Spruce Creek (Riehle and Nolte 1992). Suitable but undocumented habitats are those in which there are no historical records of bull trout use, but which have water temperatures and substrate suitable for bull trout. Recent preliminary investigations by U.S. Fish and Wildlife Service indicate that the Fall River, North Davis Creek, Browns Creek, Snow Creek, Quinn River, Cultus Creek, and the Little Deschutes River tributaries may contain suitable habitat for bull trout. Recovery criteria will be established, if necessary, based on the outcome of further study in the next 2 years.

2) **Estimated abundance of adult bull trout is 1,500 to 3,000 or more in the recovery unit's lower Deschutes Core Area.** Increased population abundance is expected to occur within existing population complexes.

There is potential to expand population abundance in the Warm Springs and Shitike river basins. Spawning habitat in the upper Metolius River, Warm Springs River, and Shitike Creek should to be restored and protected. There are opportunities to protect and expand year round rearing and migration habitat in the lower Deschutes River below the Pelton Round-Butte Project on private, Tribal and public lands. Increased population abundance in the lower Deschutes Core Area is expected to occur by securing the distribution in the Warm Springs River, securing and expanding seasonal distribution in the Crooked and Deschutes rivers above Lake Billy Chinook, and expansion of populations to additional basins such as historic habitat in Mill Creek, Link Creek, Suttle Lake, and Blue Lake.

Opportunities to protect spawning and rearing habitat on private lands through purchase, conservation easement, land exchange or other means should be pursued in the lower Deschutes Core Area. This will address previously identified threats associated with agricultural development, forest practices, grazing, and residential development. Restoration efforts to improve anadromous salmonid production in the lower Deschutes Core Area can be expected to benefit existing and potential migration corridors and overwintering habitat for bull trout as well as improve their prey base.

3) **Adult bull trout exhibit stable or increasing trends in abundance in the recovery unit**. Achievement of this recovery criteria will be based on a minimum of 10 years of monitoring data.

4) **Connectivity criteria will be met when migratory forms are present in all local populations, with intact migratory corridors among all local populations** in core areas providing opportunity for genetic exchange and diversity. In the lower Deschutes Core Area this means addressing upstream and downstream passage at Pelton Round-Butte's dams. Passage barriers at Opal Springs Dam, Link Creek, and upper Squaw Creek must also be addressed. Additional barriers may also be identified.

If reestablishment of bull trout is undertaken in the upper Deschutes core habitat upstream and downstream passage at Wickiup, Crane Prairie, and several privately owned hydropower and irrigation diversion dams must be addressed. Additional barriers may also be identified.Recovery criteria for the Deschutes Recovery Unit were established to assess whether recovery actions are resulting in the recovery of bull trout. The Deschutes Recovery Unit Team expects that the recovery process will be dynamic and will be refined as more information becomes available. While removal of bull trout as aspecies under the Endangered Species Act (*i.e.*, delisting) can only occur for the entity that was listed (Columbia River Distinct Population Segment), the criteria listed above will be used to determine when the Deschutes Recovery Unit is fully contributing to recovery of the population segment.

Research Needs

Based on the best scientific information available, the recovery unit team has identified recovery criteria, and actions necessary for recovery of bull trout within the Deschutes Recovery Unit. However, the recovery unit team recognizes that many uncertainties exist regarding bull trout population abundance, distribution, and needed recovery actions. As part of this adaptive management approach, the Deschutes Recovery Unit Team has identified essential research needs within the recovery unit.

Additional information is needed on bull trout life history and abundance to better estimate adult abundance, monitor genetic health, and assess population viability in the recovery unit. A tentative list includes: 1) annual abundance of breeders per local population and total for the recovery unit; 2) population structure and connectivity; 3) life history characteristics including age at first spawning, incidence, regularity and timing of repeat spawning, and total life span; 4) reproductive success in production of pre-adult offspring; 5) survival rates to breeding adult; and 6) reproductive success in replacement of breeders (K. Kostow, pers. comm., 2001).

Tributaries where there may be isolated bull trout populations, or where anecdotal reports of bull trout capture have occurred should be targeted to clarify bull trout distribution within the recovery unit. These areas include but are not limited to Tumalo Creek in the upper Deschutes core habitat.

Feasibility analysis is needed to assess the potential for reestablishment of bull trout into the upper Deschutes core habitat. Analysis should include: assessments of available habitat for spawning and rearing; subadult/adult foraging, overwintering, and migration corridors; passage barriers; exotic species, as well as the benefits and risks associated with reestablishment. The analysis is a priority one action, and should be completed by 2003.

ACTIONS NEEDED TO INITIATE RECOVERY

Recovery Measures Narrative

In this chapter and all other chapters of the bull trout recovery plan, the recovery measures narrative consists of a hierarchical listing of actions that follows a standard template. The first-tier entries are identical in all chapters and represent general recovery tasks under which specific (*e.g.*, third-tier) tasks appear when appropriate. Second-tier entries also represent general recovery tasks under which specific tasks appear. Second-tier tasks that do not include specific third-tier actions are usually programmatic activities that are applicable across the species' range; they appear in *italic type*. These tasks may or may not have third-tier tasks associated with them; see Chapter 1 for more explanation. Some second-tier tasks may not be sufficiently developed to apply to the recovery unit at this time; they appear in *a shaded italic type (as seen here)*. These tasks are included to preserve consistency in numbering tasks among recovery unit chapters and intended to assist in generating information during the comment period for the draft recovery plan, a period when additional tasks may be developed. Third-tier entries are tasks specific to the Deschutes Recovery Unit. They appear in the implementation schedule that follows this section and are identified by three numerals separated by periods.

The Deschutes Recovery Unit Chapter should be updated or revised as recovery tasks are accomplished, environmental conditions change, and monitoring results or additional information becomes available. The Deschutes Recovery Unit Team should meet annually to review annual monitoring reports and summaries, and make recommendations to the U.S. Fish and Wildlife Service.

1 Protect, restore, and maintain suitable habitat conditions for bull trout.

1.1 Maintain or improve water quality in bull trout core areas or potential core habitat.

1.1.1 Stabilize roads, crossings, and other sources of sediment delivery.

1.2 Identify barriers or sites of entrainment for bull trout and implement tasks to provide passage and eliminate entrainment.

1.2.1 Screen water diversions and irrigation ditches.

1.2.2 Restore connectivity and opportunities for migration by securing instream flows and/or water rights in Squaw Creek, Lake Creek, the middle Deschutes, and lower Crooked. (Using the Oregon Department of Fish and Wildlife's prioritization process.) Possible water rights applications through which instream rights could be secured include:

Application No. 70087 on the Deschutes
Application No. 70695 on the Deschutes
Application No. 71194 on the Deschutes
Application No. 73220 on the Metolius
Application No. 73221 on the Metolius
Application No. 73223 on Squaw Creek
Application No. 70693 on Canyon Creek
Application No. 70694 on Candle Creek
Application No. 70696 on Jack Creek
Application No. 70697 on Jefferson Creek
Application No. 70766 on Abbot Creek

1.2.3 Restore passage at Pelton Round-Butte and include a monitoring strategy. A Portland General Electric/Tribal proposal for experimental passage is currently being drafted as part of the long-term passage plan. If approved it would be implemented in 2006.

1.2.4 Restore passage at Opal Springs hydro project and include a monitoring strategy.

1.2.5 Restore passage to Blue Lake and include a monitoring strategy.

1.2.6 Restore passage to upper Squaw Creek and include a monitoring strategy.

1.3 Identify impaired stream channel and riparian areas and implement tasks to restore their appropriate functions.

1.3.1 Revegetate to restore shade and canopy, riparian cover, and native vegetation along mainstem lower Deschutes River, Crooked River and Squaw Creek.

1.3.2 Reduce grazing impacts with current, proven technology, e.g., fencing, changes in timing and use of riparian pastures, off-site watering, and salting along the mainstem lower Deschutes River, Crooked River, and Squaw Creek.

1.3.3 Increase or improve instream habitat by restoring recruitment of large woody debris or by using other methodologies; possibilities include lower Lake Creek and the upper mainstem Metolius.

1.4 Operate dams to minimize negative effects on bull trout in reservoirs and downstream.

1.4.1 Review reservoir operational concerns such as water level manipulation, entrainment, etc., such as at Pelton Round-Butte. Provide operating recommendations

through Federal Energy Regulatory Commission relicensing process and/or Federal consultation.

1.4.2 Maintain instream flows downstream from dams and Reservoirs, including Bowman Dam.

1.4.3 Meet Tribal, State, and Federal water quality standards downstream from hydropower dam, Federal dams, and irrigation diversions, e.g., temperature, nitrogen, etc.

1.5 Identify upland conditions negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

1.5.1 Complete watershed assessment for applicable streams, such as the Crooked River.

1.5.2 Assess feasibility of reintroducing bull trout in the upper Deschutes, including an assessment of the capacity of habitat in the upper Deschutes to support self-sustaining populations of bull trout.

1.6 Identify where conditions outside of riparian areas such as uplands which are negatively affecting bull trout habitats and implement tasks to restore appropriate functions.

1.6.1 Assess current risk of catastrophic fire to bull trout populations. Take corrective action to reduce risk of catastrophic fire to bull trout populations.

2 Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.

2.1 Develop, implement, and enforce public and private fish stocking policies to reduce stocking of nonnative fishes that affect bull trout.

2.2 Evaluate enforcement of policies for preventing illegal transport and introduction of nonnative fishes.

2.3 Provide information to the public about ecosystem concerns of illegal introductions of nonnative fishes.

2.4 Evaluate biological, economic, and social effects of control of nonnative fishes.

2.5 Implement control of nonnative fishes where found to be feasible and appropriate.

2.6 Develop tasks to reduce negative effects of nonnative taxa on bull trout.

3 Establish fisheries management goals and objectives compatible with bull trout recovery, and implement practices to achieve goals.

3.1 Develop and implement State and Tribal native fish management plans integrating adaptive research.

3.1.1 Incorporate bull trout recovery actions into Oregon Department of Fish and Wildlife Deschutes basin fish management plans, the Oregon Plan for Salmon and Watersheds, and the Pacific Northwest Power Planning Council Subbasin plans. Request assistance with implementation of recovery strategies for bull trout through all three plans.

3.1.2 Coordinate and include bull trout recovery with recovery efforts, management plans, etc. of other species, e.g., chinook salmon.

3.2 Evaluate and prevent overharvest and incidental angling mortality of bull trout.

3.3 Evaluate potential effects of introduced fishes and associated sport fisheries on bull trout recovery and implement tasks to minimize negative effects on bull trout.

3.4 Evaluate effects of existing and proposed sport fishing regulations on bull trout.

4 Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.

4.1 Incorporate conservation of genetic and phenotypic attributes of bull trout into recovery and management plans.

4.1.1 Collect samples for genetic analysis to contribute to establishing a program to understand the genetic baseline and monitor genetic changes throughout the range of bull trout.

4.1.2 Manage local populations (numbers and life forms) to maintain long-term viability.

4.2 Maintain existing opportunities for gene flow among bull trout populations.

4.3 Develop genetic management plans and guidelines for appropriate use of transplantation and artificial propagation.

5 Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.

5.1 Design and implement a standardized monitoring program to assess the effectiveness of recovery efforts affecting bull trout and their habitats.

5.1.1 Coordinate bull trout recovery monitoring in the Deschutes basin with the Oregon Plan for Salmon and Watersheds monitoring program.

5.2 Conduct research evaluating relationships among bull trout distribution and abundance, bull trout habitat, and recovery tasks.

5.3 Conduct evaluations of the adequacy and effectiveness of current and past best management practices in maintaining or achieving habitat conditions conducive to bull trout recovery.

5.4 Evaluate effects of diseases and parasites on bull trout, and develop and implement strategies to minimize negative effects.

5.4.1 Monitor for effects of fish pathogens on Oregon bull trout populations. Follow Oregon Department of Fish and Wildlife pathology department protocols (in development) for handling and disposition of bull trout mortalities, e.g., submission to Oregon Department of Fish and Wildlife fish pathology laboratories for disease assessment.

5.5 Develop and conduct research and monitoring studies to improve information concerning the distribution and status of bull trout.

5.5.1 Conduct periodic surveys in potential habitat currently accessible to bull trout, but where bull trout status is unknown or recolonization is anticipated. This could include Link Creek and Mill Creek.

5.5.2 Determine movement and seasonality of use of different habitat types of adult and sub-adult migratory bull trout in multiple drainages, with emphasis on lakes, reservoirs, and mainstem rivers.

5.6 Identify evaluations needed to improve understanding of relationships among genetic characteristics, phenotypic traits, and local populations of bull trout.

6 Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitats.

6.1 Use partnerships and collaborative processes to protect, maintain, and restore functioning core areas for bull trout.

6.1.1 Develop an outreach program to guide interaction with watershed councils and other entities in the basin. Disseminate information to a wide variety of interests groups and educational institutions via publications, world wide web, and presentations. Develop and implement processes to involve interested public by promoting public involvement in recovery projects, and providing for public review of conservation strategies.

6.2 Use existing Federal authorities to conserve and restore bull trout.

6.2.1 Identify opportunities to incorporate bull trout recovery actions into hydro- relicensing projects in the Deschutes basin.

6.3 Evaluate enforcement of existing Federal, State, and Tribal habitat protection standards and regulations and evaluate their effectiveness for bull trout conservation.

7. Assess the implementation of bull trout recovery by recovery units, and revise recovery unit plans based on evaluations.

7.1 Convene annual meetings of each Recovery Unit Team to review progress on recovery plan implementation.

7.1.1 Develop a Participation Plan to support implementation in the recovery unit.

7.2 Assess effectiveness of recovery efforts.

7.3 Revise scope of recovery as suggested by new information.