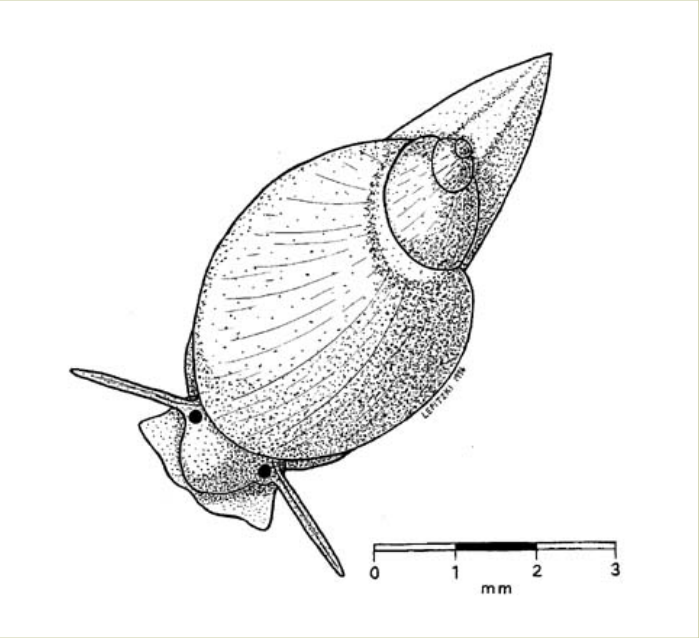
Species at Risk Act
Recovery Strategy Series

AMENDMENT

Recovery Strategy and Action Plan for the Banff Springs Snail (*Physella johnsoni*) in Canada

Banff Springs Snail



November 2010

Parks Canada Parcs Canada

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About the *Species at Risk Act* Recovery Strategy Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is *"to provide for the recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity."*

What is recovery?

In the context of species at risk conservation, **recovery** is the process by which the decline of an endangered, threatened or extirpated species is arrested or reversed, and threats are removed or reduced to improve the likelihood of the species' persistence in the wild. A species will be considered **recovered** when its long-term persistence in the wild has been secured.

What is a recovery strategy?

A recovery strategy is a planning document that identifies what needs to be done to arrest or reverse the decline of a species. It sets goals and objectives and identifies the main areas of activities to be undertaken. Detailed planning is done at the action plan stage.

Recovery strategy development is a commitment of all provinces and territories and of three federal agencies — Environment Canada, Parks Canada Agency and Fisheries and Oceans Canada — under the Accord for the Protection of Species at Risk. Sections 37–46 of SARA (http://www.sararegistry.gc.ca/the_act/default_e.cfm) outline both the required content and the process for developing recovery strategies published in this series.

Depending on the status of the species and when it was assessed, a recovery strategy has to be developed within one to two years after the species is added to the List of Wildlife Species at Risk. Three to four years is allowed for those species that were automatically listed when SARA came into force.

What's next?

In most cases, one or more action plans will be developed to define and guide implementation of the recovery strategy. Nevertheless, directions set in the recovery strategy are sufficient to begin involving communities, land users, and conservationists in recovery implementation. Cost-effective measures to prevent the reduction or loss of the species should not be postponed for lack of full scientific certainty.

The series

This series presents the recovery strategies prepared or adopted by the federal government under SARA. New documents will be added regularly as species are listed and as strategies are updated.

To learn more

To learn more about the *Species at Risk Act* and recovery initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/) and the Web site of the Recovery Secretariat (http://www.speciesatrisk.gc.ca/recovery/default_e.cfm).

Recovery Strategy and Action Plan for the BANFF SPRINGS SNAIL (*Physella johnsoni*) in Canada (Amendment)

November 2010

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DECLARATION

Under the *Accord for the Protection of Species at Risk* (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada. The *Species at Risk Act* (S.C. 2002, c.29) (SARA) requires that federal competent ministers prepare recovery strategies for listed Extirpated, Endangered and Threatened species.

The Minister of the Environment presents this document as the recovery strategy and action plan for the Banff Springs Snail as required under SARA. It has been prepared in cooperation with the jurisdictions responsible for the species, as described in the Preface. The Minister invites other jurisdictions and organizations that may be involved in recovering the species to use this recovery strategy and action plan as advice to guide their actions.

The goals, objectives and recovery approaches identified in the recovery strategy and action plan are based on the best existing knowledge and are subject to modifications resulting from new findings and revised objectives.

Success in the recovery of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the actions identified in this recovery strategy and action plan. In the spirit of the *Accord for the Protection of Species at Risk*, all Canadians are invited to join in supporting and implementing this recovery strategy and action plan for the benefit of the species and of Canadian society as a whole. The Minister of the Environment will report on progress within five years.

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STRATEGIC ENVIRONMENTAL ASSESSMENT STATEMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan, and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that recovery strategies and action plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are summarized below.

While this *Banff Springs Snail Recovery and Action Plan* will clearly benefit the environment by promoting the recovery of the Banff Springs Snail, several potentially adverse effects were also considered.

The potential for recovery actions to inadvertently lead to adverse effects on other species was considered. Recent surveys have shown that the Sulphur Mountain thermal springs in BNP harbour high numbers of rare species among several taxa. In addition to the Banff Springs Snail, survey work found two rare damselflies, 28 rare mosses (including one new provincial record), six rare liverworts, eight rare plants, and three rare amphibians.

It was determined that actions requiring the physical alteration of hot springs have the potential to adversely affect the mosses, liverworts and plants through direct physical damage to them or the substrates they require to grow. Water flow changes as a result of such physical alterations could leave mosses and liverworts submerged or result in them drying out. Water flow changes resulting in a reduction of cooler free-flowing water could lead to a reduction in damselfly larval habitat. In addition, the development of policies to address population lows, including such potential activities as supplemental feeding and modification of lighting, have the potential to cause adverse effects on the microbial community (algae and bacteria). Altered light regimes could lead to greater or lesser microbial growth, or changes in microbial community composition which could in turn effect the Banff Springs Snail as the microbial community makes up a large part of its diet. These proposed activities would be subject to specific environmental assessments prior to approval. For each environmental assessment the potential effects on other species, including the rare mosses, liverworts, vascular plants, damselflies and amphibians, must be included. Increasing ecosystem knowledge through designing a multi-species or ecosystem recovery strategy would have a large positive effect on all species,

including the rare mosses, liverworts, vascular plants, and amphibians, that inhabit the Sulphur Mountain thermal springs.

The SEA also looked at the potential effects of proposed actions on visitor experience and commemorative integrity. It was determined that the additional pickets added to guide rails along sections of boardwalk and the possibility of constructing a touching pool have the potential to affect both visitor experience and the commemorative integrity of the site by altering the natural physical attributes and sensory experience.

Preventing limb-dipping completely (through some sort of physical barrier) may affect both visitor experience and commemorative integrity, while allowing it could potentially cause harm to the Banff Springs Snail. The recovery strategy and action plan suggests evaluating the feasibility of constructing a specific thermal water touching pool. It is recommended that the proposal to build a specific touching pool be addressed in the Cave & Basin National Historic Site of Canada management planning and environmental assessment processes to ensure that it is addressed in the context of visitor experience and commemorative integrity for the entire site. It is also recommended that research be initiated into the effects of limb-dipping on the Banff Springs Snail.

If the re-establishment of snails at the Upper Hot Spring is biologically feasible effects on visitor experience and cultural resources will need to be evaluated.

Further information is presented in the *Strategic Environmental Assessment for the Recovery Strategy and Action Plan for the Banff Springs Snail (Physella johnsoni) in Canada* (Parks Canada 2006). Taking these mitigation measures into account, it was concluded that the strategy will not cause any significant adverse effects. Implementation of the recovery strategy and action plan will mitigate the effects of threats, protect and enhance critical habitat and improve upon knowledge gaps, thereby resulting in positive impacts to the species and its thermal spring habitat.

PREFACE

This Recovery Strategy and Action Plan addresses the recovery of the Banff Spring Snail. In Canada, this species range is limited to Banff National Park of Canada (BNP). This Recovery Strategy and Action Plan replaces an earlier version that was posted on the SARA Public Registry on February 14, 2007. This updated version contains a map (Figure 4h) that has been corrected since the posting of the original Recovery Strategy and Action Plan.

Under the Accord for the Protection of Species at Risk (1996), the federal, provincial, and territorial governments agreed to work together on legislation, programs, and policies to protect wildlife species at risk throughout Canada. The *Species at Risk Act (S.C. 2002, c.29*) (SARA) requires the competent minister to prepare recovery strategies for listed Extirpated, Endangered and Threatened species.

The Parks Canada Agency (PCA) led the preparation of this Recovery Strategy and Action Plan with the members of the Banff Spring Snail Recovery Team. The Recovery Team has developed and will make all efforts to implement this Recovery Strategy and Action Plan through the authority and local direction of the BNP Superintendent. This document is based on the PCA-approved Resource Management Plan for the Recovery of the Banff Springs Snail in Banff National Park (2002), which previously provided direction for research and recovery.

While recovery is administered by one jurisdiction, the juxtaposition of the snail's thermal spring habitat within BNP and the Cave and Basin National Historic Site (C&BNHS) requires that recovery can only be achieved if both commemorative and ecological integrity[1] values are fully integrated. The *Species At Risk Act*, the *Canada National Parks Act* (*S.C. 200, c. 32*), the BNP Management Plan, the C&BNHS Commemorative Integrity Statement, and the C&BNHS Management Plan provide the overall direction for this plan.

This document is intended to fulfill all SARA requirements for species recovery. It is a single species Recovery Strategy and Action Plan that covers the entire range of the Banff Springs Snail; the Action Plan for the species has been directly incorporated. A definition for and delineation of Critical Habitat are also included.

[1] Parks Canada is committed to protecting "ecological integrity" in National Parks and ensuring "commemorative integrity (to protect, present and manage cultural resources)" at National Historic Sites. Protecting these takes precedence in acquiring, managing, and administering heritage places and programs. The integrity of natural and cultural heritage is maintained by striving to ensure that management decisions affecting these special places are made on both ecosystem-based management and sound cultural resource management practices.

In the spirit of the Accord for the Protection of Species at Risk in Canada, all Canadians are invited to join in supporting and implementing this strategy for the benefit of the species and Canadian society as a whole. The Minister will report on progress within five years.

EXECUTIVE SUMMARY

This document contains a Recovery Strategy and an Action Plan for the Banff Springs Snail (*P. johnsoni*).

The Banff Springs Snail is a globally rare snail with a highly specialized habitat and restricted distribution. It has been recorded from eleven thermal springs in BNP, was extirpated from six springs, and has now been re-established into two springs. Snail populations fluctuate seasonally by up to two orders of magnitude, making population trends difficult to ascertain. While the species does not appear to be in danger of extinction, some populations appear to be at greater risk of extirpation than others.

The Banff Springs Snail has a restricted distribution within each spring and outflow stream that is correlated with higher water temperatures, lower pH and dissolved oxygen, and higher hydrogen sulphide levels. Water flow and the presence of particular microbial species may be required by the snail, which grazes on microbial mats within the springs. It is most likely the dominant grazer in the thermal springs, contributes excrement nutrients, and likely provides a minor food source for some birds and snakes.

There are several threats to the Banff Springs Snail. Many thermal springs in BNP are highly modified and regulated, and are subject to impacts by visitors. The stoppage, redirection, and reduction of thermal water flows can have a significant impact on snail populations. Soaking and swimming, trampling, and limb-dipping (the dipping of feet or hands) have been recorded at all sites. Natural threats include a susceptibility to stochastic events (unpredictable large disturbances), large population fluctuations, and genetic inbreeding. A Research and Recovery Program has been in place within BNP since 1996, resulting in many improvements and reductions in threats.

The recovery of the Banff Springs Snail is considered technically and biologically feasible. The goal of the recovery strategy is to restore and maintain self-sustaining populations of the Banff Springs Snail within the species' historic range. The recovery objectives are to:

- Protect populations and habitats by mitigating human and natural threats

- Restore self-sustaining snail populations and habitat within historic range, where and when possible, and
- Increase knowledge and understanding of snail ecology, thermal spring ecosystems and threats to them.

Specific actions, timelines, responsibilities, and performance measures are established in an Action Plan included in the document. Critical habitat has been identified for the Banff Springs Snail. A Strategic Environmental Assessment was completed and a summary is included.

The entire habitat of the Banff Springs Snail is found within BNP which is managed by the PCA under the CNPA. Four of the seven snail populations inhabit the highly regulated environment of the culturally significant C&BNHS. While recovery is administered by one jurisdiction, the juxtaposition of the snail's thermal spring habitat within BNP and the C&BNHS requires that recovery can only be achieved if both Ecological and Commemorative Integrity are fully integrated

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1 BACKGROUND

The recovery program for the Banff Springs Snail is administered by BNP. The Cave and Basin National Historic Site of Canada (C&BNHS) is located within BNP and as such, it is subject to the *Canada National Parks Act* and its Regulations, but as a national historic site, it is also managed to preserve commemorative integrity[2] in accordance with the Management Plan of the site and it's Commemorative Integrity Statement.

1.1 Species Assessment Information from COSEWIC

Common Name: Banff Springs Snail

Scientific Name: *Physella johnsoni* (Clench 1926)

Status: Endangered

Last Examination and Change: May 2000

Canadian Occurrence: Alberta

Reason for designation: Highly specialized species with extremely limited distribution subject to human disturbance and extreme fluctuations in population size.

Status history: Designated Threatened in April 1997. Status re-examined and designated Endangered in May 2000. Last assessment based on an existing status report.

1.2 Description

The Banff Springs Snail is a small, globe-shaped snail with a short spire about the size of a kernel of unpopped corn. The maximum published shell length is 8.8 mm (Clarke 1973) although living animals with shells up to 11 mm in length have been observed. It is a member of the Family Physidae and therefore has a shell coiling to the left. Technical descriptions and illustrations are given by Clench (1926) and Clarke (1973). Recent systematic studies have confirmed that the Banff Springs Snail is a unique species based on morphological, allozyme, and mitochondrial DNA analyses (Hebert 1997; Lepitzki 1998; Remigio and Hebert 1998; Remigio *et al.* 2001).

[2] Parks Canada is committed to protecting "ecological integrity" in National Parks and ensuring "commemorative integrity" at National Historic Sites. Protecting these takes precedence in acquiring, managing, and administering heritage places and programs. The integrity of natural and cultural heritage is maintained by striving to ensure that management decisions affecting these special places are made on both sound cultural resource management and ecosystem-based management practices. Commemorative integrity means protect, present and manage cultural resources.

1.3 Populations and Distribution

The Banff Springs Snail is endemic to Canada, and has been documented from only 11 thermal springs in BNP (Figures 1 and 2, Table 1). It is ranked G1 globally and S1 in Alberta, the only province where it occurs (NatureServe 2006). The snail continues to exist naturally in five springs (Lower Middle, Cave, Basin, Upper Cave and Basin (C&B) and Lower C&B). It has been recently re-established into two springs (Upper Middle and Kidney), and both of these populations continue to persist. Three populations (Upper Hot Spring, Gord's Spring, and Banff Springs Hotel Site) are extirpated. It is questionable if the species ever existed at the Vermilion Cool Springs (Lepitzki et al. 2002a). Four populations inhabit springs and outflow streams at the C&BNHS that are highly regulated by pipes, drains, and artificially maintained pools (Table 1). All populations can be considered individually because there is little opportunity for natural genetic mixing among the thermal springs (Lepitzki 2002a).

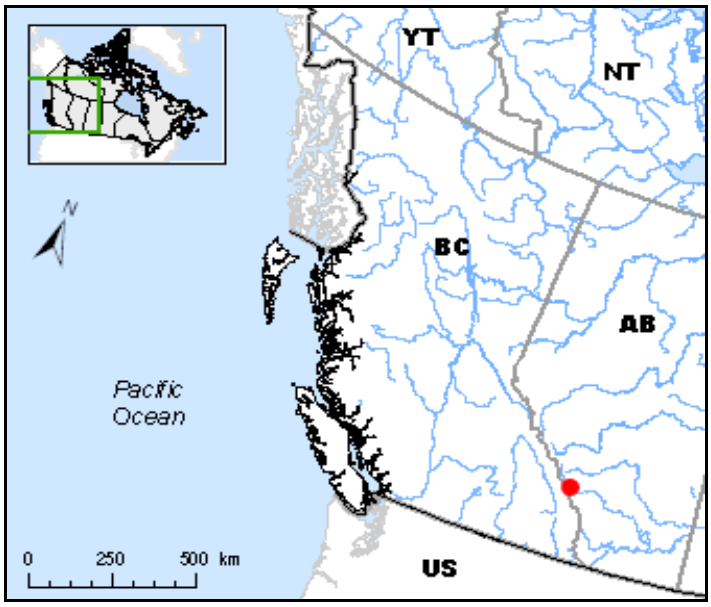

Figure 1 Distribution of the Banff Springs Snail.

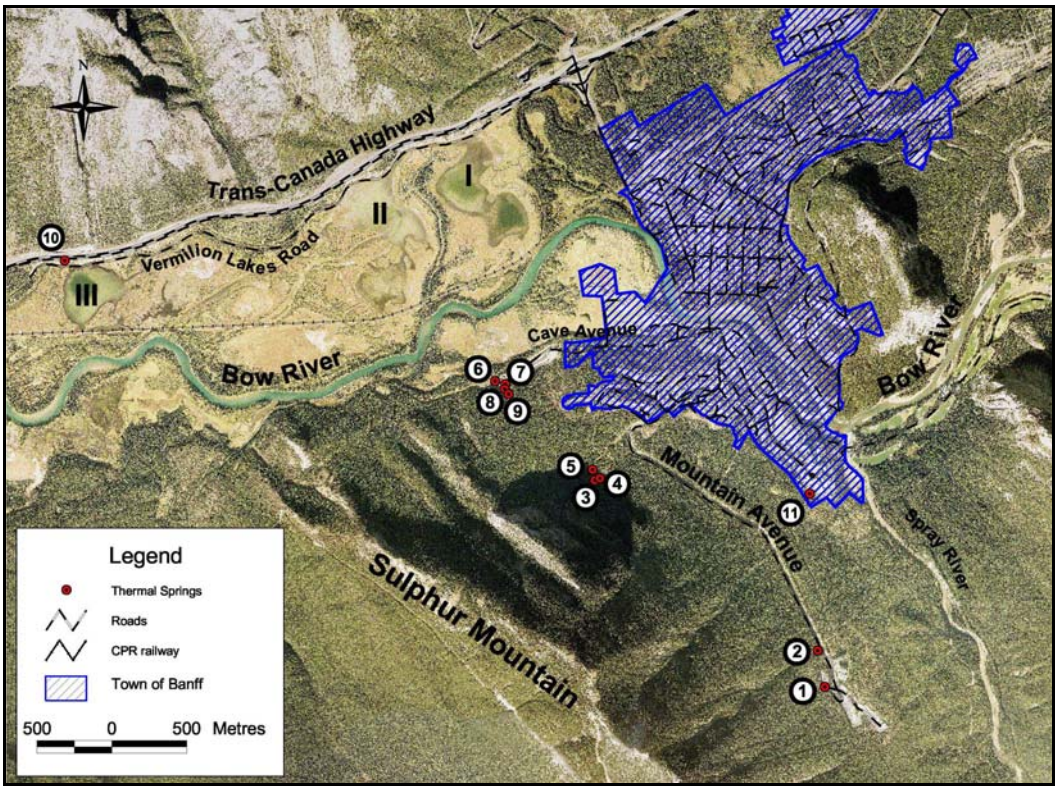

Figure 2 Location of Banff Springs Snail sites within Banff National Park.

1 is the Upper Hot Spring. 2 is the Kidney Spring. 3 is Gord's Spring. 4 is the Upper Middle Spring. 5 is the Lower Middle Spring. 6, 7, 8, and 9 are the Basin, Cave, Lower, and Upper Spring of the Cave and Basin National Historic Site. 10 is the Vermilion Cool Springs. 11 is the Banff Springs Hotel Site. I, II, and III are the three Vermilion Lakes.

As of the end of December 2005, the total global population was estimated to be nearly 34,000 snails (Figure 3). The snail's population fluctuates annually by over two orders of magnitude. Populations generally fluctuate seasonally, increasing during the fall and decreasing during the late winter and early spring. The cause of this seasonal pattern is unclear.

There are no historic population levels recorded for the Banff Springs Snail at any spring, so long-term trends cannot be determined. The overall population trend for the past ten years (1996 through 2005) is significantly increasing if yearly minima, maxima, and mean population estimates are examined, but only if the two re-established populations are added to the original five springs (Lepitzki unpubl. data). Within each individual spring, the only discernible 10-year trend is found at the Basin Spring, whose yearly minima and mean population estimates have also significantly increased (Table 1, Lepitzki unpubl. data).

Population modeling using data from 1996 through 2002 has calculated the probability of extinction for five populations over 40 years (Tischendorf 2003). Results suggest that, when all five original populations are combined, there is no extinction risk within 40 years. However, some populations are more vulnerable than others. After 40 years, extirpation probabilities were less than 5% for the Basin and Upper C&B populations; 20% for the Cave population, nearly 30% for the Lower C&B population, and between 25 and 30% for the Lower Middle Spring population (Tischendorf 2003). Uncertainty about several aspects of snail life history means that these figures should be cautiously interpreted (Tischendorf 2003).

Table 1 Summary of all populations, 1996-2005.

		Population (10 year)					
Spring	**Site Status ***	**Status**	**Mean**	**Max.**	**Min.**	**Trend (10 year)**	**Comments**
Upper Hot	R, O	Extirpated	-	-	-		Currently no suitable habitat
Kidney	N, C	Re-established	1,542	8,852	8	Annual fluctuations	Re-established in Nov. 2003
Upper Middle	N, C	Re-established	5,068	16,247	16	Annual fluctuations	Re-established in Nov. 2002
Lower Middle	N, C	Extant	748	4,221	30	Annual fluctuations (indiscernible)	
Gord's	N, C	Extirpated	-	-	-		Snail shells only, spring dried fall of 2005
Cave	R, O	Extant	1,877	5,657	474	Annual fluctuations (indiscernible)	C&BNHS. Origin pool and outflow streams regulated
Basin	R, O	Extant	2,893	10,242	162	Annual fluctuations (significant increase)	C&BNHS. Origin pool and outflow streams regulated
Upper C&B	R, O	Extant	1,280	2,858	147	Annual fluctuations (indiscernible)	C&BNHS. Outflow stream regulated
Lower C&B	R, O	Extant	1,728	4,619	43	Annual fluctuations (indiscernible)	C&BNHS. Outflow stream regulated
Vermilion Cool	R, O	Occupied by *Physella gyrina*	-	-	-		Possibly erroneous historical record, spring may not have been occupied by Banff Springs Snail
Banff Springs Hotel	-	Extirpated	-	-	-		Site no longer exists, most likely resulted from water piped from Kidney and Upper Hot Springs

**Site status refers to whether the site is Regulated (R) by a complex pipe and drain system, or Natural (N), i.e. largely undisturbed and not controlled through artificial means and whether the site is Open (O) to the public or Closed (C), i.e. access is restricted to authorized personnel only.*

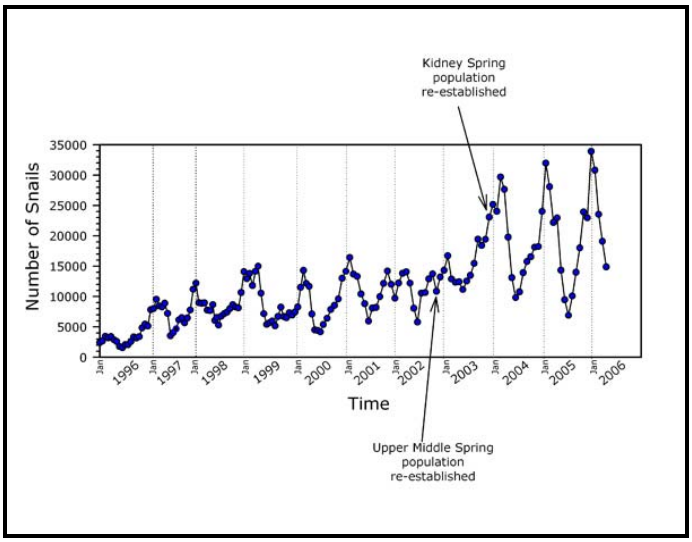

Figure 3 Total number of Banff Springs Snails counted in population surveys from January 1996 to April 2006.

1.4 Needs of the Banff Springs Snail

1.4.1 Biological and habitat needs

The Banff Springs Snail is highly specialized and has an extremely restricted micro-distribution within each spring. For example, more than 90% of the Cave Spring population is located in the origin pool, where the spring surfaces. Similarly, most snails in the Kidney, Lower Middle, Upper, and Lower C&B Springs are found within 10 to 20 metres of the origin pool. Causes of the specialized micro-distribution are unknown. High snail numbers are correlated with higher water temperature, lower pH and dissolved oxygen, and higher hydrogen sulphide levels (Lepitzki 2002b). Declining hydrogen sulphide along outflow streams may limit sulphide-oxidizing bacteria, such as *Thiothrix,* and cause other changes in the microbial community upon which the snail grazes. Green algae such as *Chara*, another species of snail (*Helisoma anceps anceps*), and introduced mosquito fish (*Gambusia affinis*) appear to become more abundant as Banff Springs Snail numbers drop along outflow streams (pers. obs., Lepitzki). The Banff Springs Snail appears to be dependent on constantly flowing springs to maintain these conditions, as the species has been extirpated at four springs where flow stoppage has been recorded.

The natural function of the springs depends on the flow of warm, gas- and mineral-laden waters that are modified by a subterranean bacterial community (Lepitzki unpubl. data, Parks Canada 2003). Upon surfacing, interactions with the environment, and microbial, riparian, aquatic, and terrestrial communities result in

abiotic and biotic gradients along the outflow streams. A summary of water physicochemistry parameters (water flow, temperature, pH, dissolved oxygen, conductivity, and sulphide) found at the ten existing springs where the snail has been recorded is located in Table 2.

Presumably, the Banff Springs Snail, like other physids, grazes on plant matter or *Aufwuchs* (a microscopic coating of plants and animals). Snails have been observed ingesting white-filamentous bacteria (pers. obs., Lepitzki). The diets of other physids (*P. gyrina*, *P. integra*) include dead and decaying vegetation and living algae, water molds, diatoms, filamentous algae, green and blue algae, rotifers, crustaceans, pieces of arthropods, small amounts of vascular plant tissue and sand grains (Dewitt 1955; Clampitt 1970). It is likely that the diet of the Banff Springs Snail is similar, although studies have not confirmed this. Microbial mats, consisting of bacteria, algae, sticks, and vascular plant leaves, are frequently the substrate to which snails are attached, and serve a structural habitat function as well.

Table 2 Range of water physicochemistry of thermal springs historically and currently inhabited by the Banff Springs Snail.

	Water physicochemistry (spring origin)					
Thermal spring	Flow rate (l/min)[a]	Temperature (^{o}C)	pH	Dissolved oxygen (mg/l)	Conductivity (µS/cm)	Sulphide (mg/l)
Upper Hot	545[1] 0-1000[5]	21.0-46.2	6.80-7.66	0.03-4.07	291-1396	0-3.470
Kidney	55[2] or 91[1] 0-105[5]	22.9-38.1	6.86-7.41	0.05-5.07	419-1313	0-3.722
Upper Middle	228[1] 250-1240[5]	34.1-37.3	6.93-7.29	0.08-1.80	1148-1402	0.134-5.599
Lower Middle	62-120[5]	34.1-37.3	6.92-7.42	0.15-2.51	1145-1411	0-5.599
Gord's	To Be Determined	4.8-35.2	6.94-7.78	0.10-6.75	1149-1517	0.013-4.060
Cave	501[3]	29.0-33.6	6.98-7.47	1.02-4.90	1037-1349	0-2.860
Basin	654[3]	31.6-34.9	6.88-7.33	0-2.47	1765-2010	0-6.370
Upper C&B	64[3]	29.7-34.4	6.69-7.38	0.03-11.55	1033-1347	0-5.011
Lower C&B	486[3]	30.2-35.3	6.84-7.74	0-4.67	1030-1330	0-2.865
Vermilion Cool	228[1] or 750[4]	17.1-21.4	7.00-7.70	0-2.20	543-718	0-1.771
Banff Springs Hotel	-	-	-	-	-	-

[a] Instantaneous flow rates: [1]Elworthy 1918; [2]Grasby and Lepitzki, unpubl. data; [3]Van Everdingen and Banner 1982; [4]Van Everdingen 1972 and seasonal range [5]Hayashi 2004, Schmidt 2005.

The snail is most likely hermaphroditic, or capable of self- or cross-fertilization, as are other physids (Clarke 1973; Dillon 2000). Reproduction likely occurs year-round, as reproduction in other physids is triggered by a minimum temperature (Dewitt 1955, 1967; Sankurathri and Holmes 1976). Egg capsules are normally found at or slightly above the water's surface, attached to a hard substrate such as the concrete pool wall, floating microbial mat, sticks, and live snail shells, suggesting that atmospheric oxygen may be required for development (Lepitzki, 1998, 1999, 2000a).

Recently, systematic and detailed basic resource inventories (Parks Canada 1992) were undertaken for some of the thermal spring ecosystems in BNP (Rice 2002; Wallis 2002; Hebben 2003; Krieger 2003; Lepitzki and Lepitzki 2003; Londry 2004; Yurkov 2004). Results indicate that the thermal springs contain high numbers of rare species in a number of taxonomic groups.

1.4.2 Ecological role

Just as large carnivores such as grizzly bears are used to indicate the ecological integrity of large ecosystems, the health of the thermal spring ecosystems on Sulphur Mountain may be indicated by the Banff Springs Snail. The extinction of the species would be a loss of biodiversity and the thermal spring ecosystems could shift due to the loss of this important grazer (Hebert 1997). Blooms of algae and bacteria could result and organisms potentially dependent on the infusion of snail excrement and shell material may suffer irrevocable harm (Lepitzki et al. 2002a).

The Banff Springs Snail may also provide a food source for some waterfowl, shorebirds and garter snakes (see below). Other roles it serves in the hot springs ecosystem are not well understood.

1.4.3 Limiting factors

The greatest natural limiting factors of the Banff Springs Snail are its limited habitat availability and large population fluctuations, leading to isolated and extremely low populations found in some springs at certain times of the year. The snail is a habitat specialist that is dependent on some of Banff's thermal springs, and it has been extirpated from four thermal springs where water flow stoppages have recently been recorded.

Predation may also occur at some springs. Predation is suspected by mallards (*Anas platyrhynchos*), blue-winged teal (*Anas discors*) (Dirschl 1969; Swanson *et al*. 1974; Taylor 1978), common snipe (*Gallinago gallinago*), robins (*Turdus migratorius*), varied thrushes (*Ixoreus naevius*), and garter snakes (*Thamnophis elegans*) (Russell and Bauer 1993). All of these species have been observed at the thermal springs (Lepitzki unpubl. data) but predation has not been confirmed.

Competition for food by soldier fly larvae (Stratiomyidae), which have a diet very similar to freshwater snails (Pennak 1978; Clifford 1981), may also occur in the thermal springs on Sulphur Mountain (Lepitzki 1997a,b).

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1.5 Threats

1.5.1 Threat Classification

Please refer to Table 3.

Table 3 Threat Classification Table.

Threat	Type	Status*	Upper Hot	Kidney	Upper Middle	Lower Middle	Gord's	Cave	Basin	Upper C&B	Lower C&B	Vermilion Cool
Thermal water flow - stoppages	N	C	H	H	H	H	H	H	H	H	H	-
Flow – reductions/fluctuations	N	C	H	H	M	L	M	L	L	L	L	-
	FO	C	H	-	-	-	-	H	H	L	M	-
Thermal water flow - redirections	N	C	L	L	L	L	L	L	L	L	L	-
	FO	C	H	-	-	-	-	H	H	L	M	-
Limited or low quality habitat	N/FO	P	M	M	M	M	M	M	M	M	M	-
Soaking and Swimming	Hu	C	M	M	M	L	L	M	M	M	L	-
Pop'n lows & genetic inbreeding	N	P	UNK	M	L	M	UNK	L	L	M	M	-
Trampling / local disturbance	Hu	C	M/L	L	L	L	L	M/L	M/L	M/L	L	M
Limb-dipping	Hu	P	M	L	L	L	L	M	M/L	L	L	M
Stochastic events	N	P	L	L	L	L	L	L	L	L	L	-
Others (collecting, predation, competition, twitch-ups)	Hu/N	P	L	L	L	L	L	L	L	L	L	-

Threats listed in order of certainty and severity (vertically) and among springs (horizontally). Type refers to whether it is naturally (N) occurring, caused by facility operations (FO), or humans (Hu). Status refers to whether the threat is Confirmed (C - there is evidence that the threat results in mortality or decreased reproductive success, etc.) or Potential (P - could be very likely but there is no evidence that it causes harm, often because confirmation studies have not yet occurred). The severity of the threat to the species or habitat is also indicated as high (H), medium (M), or low (L). Threats at the Upper Hot and Gord's Springs are anticipated if the species was re-established. A dash (-) indicates that the particular threat does not occur at that thermal spring, UNK indicates unknown.

1.5.2 Description of Threats

Threats are described below in order of certainty and severity.

Thermal water flow stoppages, reductions, and redirections

Thermal water flow stoppages are a threat with localized but severe consequences. Periodically, some of the thermal springs on Sulphur Mountain stop flowing. While it is normal for flow rates to decrease as underground reservoirs are depleted of water during late winter and early spring (Van Everdingen 1970, 1972; Grasby and Lepitzki 2002), there is evidence that flow stoppages are increasing. The only historically recorded instance of any Sulphur Mountain thermal spring drying is the Upper Hot Spring in 1923 (Elworthy 1926; Warren 1927). However, the Upper Hot Spring has ceased flowing every winter from 1998 through to 2005 (Lepitzki 1999, 2000a, 2002b, unpubl. data; Grasby and Lepitzki 2002). Flow stoppages have also been recently documented from Kidney Spring (Grasby and Lepitzki 2002; Lepitzki 2003), Upper Middle Spring (Lepitzki 1997b), and Gord's Spring (Lepitzki unpubl. data).

The effects of thermal spring flow cessations on the Banff Springs Snail are detrimental, as populations of the Banff Springs Snail have been extirpated from the four thermal springs where water flow stoppages have been recorded. These flow stoppages could threaten re-establishment success at Kidney and Upper Middle Springs, and potential re-establishment efforts at the Upper Hot and Gord's Springs. Coupled with already low population levels, thermal spring drying would result in the depletion or local extirpation of snail populations. Below normal precipitation may be the cause for the recent reduced flows (Grasby and Lepitzki 2002) and continued flow anomalies may be expected due to climate change (Scott and Suffling 2000).

Natural, seasonal reductions in water flow rates could also threaten snail populations, however, as the magnitude of seasonal flow fluctuations is not equal among all springs (Table 2), the severity of the threat also varies (Table 3). The threat of flow re-direction is small because natural re-directions typically occur downstream of areas containing high snail numbers. Re-directions may occur due to tufa mound build-up, debris deposition, or erosion.

Thermal water flow stoppages, reductions and redirections can also result from facility operations at regulated springs (Tables 1 and 3). The prioritized diverting of water to the bathing facility and re-directing chlorinated, used pool water into the outflow stream significantly reduces potential snail habitat for re-establishment at the Upper Hot Spring. Without the periodic cleaning and flushing of drains, valves, and pipes at the C&BNHS, they become clogged with microbial mat and other debris that cause flooding and damage cultural resources. Changes in water levels in the Basin and Cave pools require the manipulation of valves. It is suspected that adult snails can cope with gradual decreases or increases in water levels (pers. obs., Lepitzki) but drastic drops

(up to 50 cm in less than 15 minutes) have stranded many snails. This necessitates washing snails into the water before they desiccate or freeze. Snail eggs have only been found at the water's surface, possibly as a consequence of very low levels of dissolved O_2 (Lepitzki 1999, 2000a, 2002b) and the presumed requirement of oxygen for development. Water level changes in the Basin and Cave pools could result in the termination of snail embryo development by asphyxiation or desiccation for those eggs attached to the pool walls (Lepitzki 2000a).

Valves and pipes also control the amounts of water in the various outlet streams at the C&BNHS. These valves and pipes periodically become clogged with microbial and other debris, redirecting water flow. This has resulted in the loss and lowering of outflow stream snail populations.

Limited or low quality habitat

Due to its extremely limited distribution and habitat requirements, some populations of the Banff Springs Snail may be very susceptible to extirpation. In general, additional populations would reduce the probability for species' extinction. Similarly, increasing snail numbers within individual populations would reduce the probability for population extirpation. Some built structures (outlet streams) and operations at the Upper Hot and C&BNHS may limit the quality of habitat thereby limiting the number of snails occupying or potentially occupying the habitat. For example, the rapid discharge of water through piping into steep terrain at some of the outflow streams at the C&BNHS diminishes the habitat's capacity to support snails.

Soaking and swimming

Soaking and swimming are documented threats with localized but occasionally severe consequences. Entering and exiting pools can crush snails and disrupt the floating microbial mat causing both the mat and snails to become stranded above the water line. Dislodged microbial mats clog pipes, affecting water drainage in regulated pools. Swimming can alter water clarity and water levels. Chemicals such as suntan oil, deodorants and insect repellents could impact snails and their habitat. Significant alterations in water physicochemistry have been detected following swimming events, as have significant changes in snail microdistribution (Lepitzki 1998, 1999). Others (Kroeger 1988; Lee and Ackerman 1999) have speculated that the addition of toxic substances (e.g. soap, shampoo, oil) by bathers may threaten hot springs flora and fauna. Confirming chemical toxicity to the Banff Springs Snail and its habitat could be challenging.

Swimming and soaking are not permitted at any of the springs where the Banff Springs Snail is found, and are prevented by surveillance, fencing and signage. Despite these efforts, some illegal swimming and soaking continue. Effects can be severe. Snails died

during two 2005 incidents when pipes draining the Basin Pool became clogged with debris and the pool flooded, stranding thousands of snails in freezing temperatures.

Population lows & genetic inbreeding

Although snail populations fluctuate naturally, extremely low population numbers in some years may increase the risk that some populations are extirpated. Monitoring has revealed that all populations fluctuate seasonally, although the causes are unknown. Demographic models indicate that the entire population shows no risk of extinction due to demographic factors alone (Tischendorf 2003). However, this modeling is based upon a limited understanding of certain demographic parameters. Low seasonal populations should still be considered a potential threat, especially in those springs where extremely low numbers have been documented (Tables 1 and 3).

A consequence of seasonally low populations is genetic inbreeding. The extent to which genetic inbreeding constitutes a threat to the Banff Springs Snail is not known. Hebert (1997) found very limited polymorphism, although this was not unexpected given that the snails are probably hermaphrodites and that other in-breeders have also shown impoverished levels of allozyme variation. Perhaps the only opportunity for genetic mixing occurs among the four populations at the Cave and Basin thermal spring complex during years of abnormally high spring run-off. Unless snails are transported by humans or birds, (Roscoe 1955; Rees 1965; Malone 1965a,b, 1966; Dundee *et al.* 1967; Boag 1986) there appears to be little opportunity for genetic mixing among the Kidney and Middle Spring populations and those at the Cave and Basin complex. Because this is likely a natural situation, genetic inbreeding is considered a potential but unconfirmed threat.

Trampling and other local disturbance

Trampling and other disturbance (e.g. littering, substrate movement or removal, dam construction) likely have a variable impact on Banff Springs Snail populations that is related to site visitation rates. Some effects have been observed at all springs. Trampling of fragile riparian habitat occurs when people or dogs walk along outflow streams or at the edges of thermal spring origin pools. While the boardwalks and barrier fencing at the C&BNHS prevent much damage, footprints are found along the outlet streams, or adjacent to origin pools. Removal or movements of substrates including the microbial mat, rocks, and sticks, the preferred micro-habitat of the snail, have been observed at all sites. Crushed, frozen and desiccated adult snails have been documented adhering to moved substrates. The tossing of garbage, coins, snow balls, ice chunks, rocks, and logs have been detected (Lepitzki et al. 2002a). The addition of coins containing copper may be particularly damaging as copper sulphate was used as a molluscicide (Swales 1935). Even the removal of garbage from the thermal springs by well-meaning visitors could result in the death of snails and eggs if the garbage is not first examined carefully for the small snails and cryptic eggs.

Limb-dipping

The dipping of feet or hands is a potential threat to the Banff Springs Snail, although its effects on the thermal spring environment are unknown. Like swimming, it may lead to the crushing of snails and the addition of toxic substances, but this is difficult to document. Limb-dipping is widespread and occurs with regularity, especially at the C&BNHS (Lepitzki 2000b; Thomlinson 2005). A study involving the observation of visitor behaviour in 1999 and 2000 determined that on average, 73% of visitors to the Cave Spring dipped their hands in the water (Lepitzki 2000b). Substantially fewer individuals did so at the other thermal springs (12%, 6%, and 8%, Basin, Upper, and Lower Springs, respectively), possibly because kneeling is required to reach the water. Since nearly 165,000 people visited the Cave and Basin Springs during 1998/99, over 120,450 people could have dipped their limbs into the Cave Spring water. Thomlinson's (2005) social science study re-affirmed limb dipping within the Cave and Basin springs and suggested that many of the individuals who limb dipped were unaware that this activity was not allowed. With limb-dipping occurring at all sites, it should be considered a potential widespread threat, and its effects on snail populations confirmed.

Stochastic impacts

Threats due to environmental stochasticity (e.g. disease, storms, flood) have not been studied and are virtually impossible to quantify but could have severe, local effects. In general, evidence indicates that stochastic impacts may increase as population size decreases (Lande 1993). The Banff Springs Snail may be very susceptible to catastrophic population loss, even through a single unpredictable chance event. Although only a potential threat, the fact that no other populations exist globally to recolonize sites magnifies its severity. Tischendorf (2003) commented that the main reason for increased probability of extinction over time in the Banff Springs Snail population modeling was due to propagation of stochastic events.

Other threats

Predation and competition are natural threats with which the species has evolved. However, they could result in extirpation of a population when combined with other threats, especially when snail populations are at their lowest. Similarly, trees adjacent to outflow streams form another natural mortality factor. During heavy, wet snowfalls branches become laden with snow and bend into the stream. Bacteria and snails colonize the immersed branches. When the snow anchor melts, the branch and its accompanying bacteria and snails rise out of the water, and freeze. Over 40 and 60 of these "quick-frozen" snails have been found in two separate incidents along the Lower Middle and Basin Spring outflow streams (Lepitzki 1998). It is possible that public awareness may result in illegal shell collection and may require enhanced enforcement.

1.6 Actions Already Completed or Underway

BNP has undertaken many recovery and management actions to date, many of which are outlined in the Resource Management Plan (Lepitzki et al. 2002a).

Direct habitat protection measures have reduced impacts and will continue. The Sulphur Mountain Wildlife Corridor (containing two inhabited thermal springs – Upper and Lower Middle) has been established, permanently closed to unauthorized persons and enforced through regular patrols and electronic surveillance. Closure and fencing of the re-establishment site at Kidney Spring has occurred. Swimming has ceased at the C&BNHS pools. Starting in 1997, illegal swimming at the Basin Spring pool has been reduced through signage, fencing, installation of a security system, and the apprehension and conviction of several individuals. Frequency of intrusions has further declined with additional signage and audio alarms. Restrictive signage was first placed at the C&BNHS springs in 1997, and has been augmented in subsequent years.

Because the C&BNHS is also a national historic site and an integral part of the history of Canada's National Park system, eliminating public access for the purposes of snail protection is not an option. However, The Commemorative Integrity Statement (Parks Canada 1998) for the Historic Site recognizes that protection of snail habitat enhances and supports heritage values at the site.

Changes in management practices have also occurred. Janitorial and technical trades staff have modified some activities that previously impacted the snail and its habitat. For example, the use of chemical de-icers along the Basin Spring pool boardwalk has stopped since at least 1999. A preliminary resource reconnaissance following the Natural Resources Management Planning Process (Parks Canada 1992) has occurred for some sections of some thermal springs.

A Research and Recovery Program was initiated in 1996. Population monitoring and measurement of physicochemical parameters have been completed regularly since the program began. A captive breeding program in aquaria was initiated in 1997 and decommissioned in 2006 (Lepitzki et al. 2002a; Lepitzki 2004). The captive breeding program has led to information on the successful rearing of snails, examination of various reproductive parameters, and the ability to maintain snails in tap water (as may occur if a thermal spring naturally dried).

Based on direction given in several assessments and discussion papers (Lepitzki et al. 2002a; Lepitzki and Pacas 2001, 2002, 2003), snail populations have been re-established at the Upper Middle and Kidney Springs. Fifty snails were translocated from Lower Middle Spring to re-establish the Upper Middle Spring population in November

2002. Fifty snails (25 from Lower Middle and 25 from Upper Middle) were subsequently translocated to Kidney Spring in November 2003. Following initial population drops, both populations increased and have undergone annual fluctuations similar to those observed at the other thermal springs. Both re-establishments appear to be successful.

Since 1997, communications strategies have directed actions aimed at key target groups to reduce disturbance to the snail and its habitat. Interpretive programs have undertaken public education about the Banff Springs Snail. Interpretive displays now introduce the public to the snail and efforts toward recovery. Information on the snail has been added to brochures and other Park publications. Other initiatives including posters, public and scientific presentations, press releases, fact sheets, magazine articles, and articles in local, regional, national, and international media, continue to raise public awareness of this species.

1.7 Knowledge Gaps

The Recovery Team identified the following areas where more information is required.

- Analyze ten years of population and distribution data
- An evaluation of the population data in order to determine the level of monitoring surveys required to detect population trends
- Continue to study the diet and ecological role of the Banff Springs Snail
- Refine knowledge of demographic parameters (e.g. fecundity, longevity, etc.) in order to enhance population viability analyses with increased confidence.
- Improve knowledge of thresholds of tolerance to physicochemical parameters
- Confirm the extent to which limb-dipping, thermal flow stoppages, and genetic inbreeding threaten the Banff Springs Snail
- Confirm that operational, protection and communications actions result in a reduction in human impacts to the snail and its habitat
- Confirm public awareness of the snail, habitat and threats to its survival

Detailed actions that will help to fill knowledge gaps are identified in Table 4.

2 RECOVERY

2.1 Rationale for Recovery Feasibility

The recovery of the Banff Springs Snail is considered feasible. Although the species is geographically restricted and highly specialized, there are potentially thousands of individuals capable of reproduction annually. The snail is most likely hermaphroditic (Clarke 1973; Dillon 2000). Following natural seasonal periods of decline, it has

demonstrated the ability to rebound quickly to substantial populations. Sufficient habitat is available, at least for the maintenance of seven of the ten previously recorded natural populations. Results of re-establishments into Upper Middle and Kidney Springs are encouraging and will be monitored to ensure longer-term success. Feasibility for re-establishment at the Upper Hot and Gord's Springs will continue to be assessed. Recent population viability studies estimated that the probability of extinction of the species within the next 40 years is zero (Tischendorf 2003). Although individual spring extirpation probabilities are as high as 30%, the population trend over the past 10 years (1996 through 2005) is significantly increasing if results from the two re-established populations are added to the original five extant populations (Lepitzki unpubl. data).

Significant threats to the snail are mainly related to the management of and public visitation to the thermal springs within BNP. Recovery techniques already successfully employed include: limiting public access, construction of boardwalks, increasing signage, enhancing education and increasing surveillance and enforcement (Lepitzki and Pacas 2001, 2002). Techniques for habitat enhancement have been successful and additional enhancements are included in the Action Plan. For these reasons, recovery is considered feasible.

2.2 Recovery Goal

The recovery goal is to *restore* and maintain *self-sustaining* populations of the Banff Springs Snail within the species' historic range.

Restoring refers to re-establishing snail populations and habitat within historic range, where and when possible. Restoration does not only imply habitat enhancement at currently occupied thermal springs. Currently unoccupied thermal springs that may be restored include the Upper Hot and Gord's Springs, and former habitat areas at the C&BNHS.

A self-sustaining population is one that, while undergoing its natural and annual population fluctuation, continues to persist in the absence of human intervention.

Assigning this species to a lower risk category by COSEWIC[3] may not be possible due to the limited availability of thermal spring habitat and the endemic nature of the snail. Nevertheless, attaining the goal would improve the species' status and increase the probability of its long-term survival.

[3] Committee on the Status of Endangered Wildlife in Canada (COSEWIC) provides advice to the Minister of the Environment on the status of species in Canada. For the Banff Springs Snail, this means changing the species status from Endangered to Threatened, Species of Special Concern or Not at Risk.

2.3 Recovery Objectives

The primary objectives are to:

1. Protect populations and habitats by mitigating human and natural threats
2. Restore self-sustaining snail populations and habitat within historic range, where and when possible, and
3. Increase knowledge and understanding of snail ecology, thermal spring ecosystems and threats to them.

The objectives of this recovery strategy support the goal of restoring the snail to its historic range, to the extent possible. Objectives aim firstly to reduce the risks associated with the snail's highly restricted range, but also acknowledge its historical global rarity. No actions are directed to introduce the snail to thermal spring habitat outside its historic range as determined at the time the species was originally described in 1926. Secondly, there are still many actions that can be taken to mitigate human and natural threats at existing and restored sites. Finally, past monitoring and research has been considerable, but further monitoring and ecological research are essential to measuring success and improving recovery implementation (e.g. threat mitigation, habitat restoration).

2.4 Approaches Recommended to Meet Recovery Objectives

Broad strategies to meet recovery goals include:

- Habitat Protection
- Habitat Management, Restoration, Enhancement, and Snail Re-establishment
- Scientific Research and Monitoring
- Communication and Education

2.4.1 Recovery and Action Planning

Table 4 Recovery actions required to address strategy objectives and threats. Actions are listed in order of priority among and within each objective. Primary responsibility for all the actions lies with Parks Canada Agency.

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
Objective 1: Protect populations and habitats by mitigating human and natural threats.				
1	Soaking, swimming, trampling, other local disturbances, limb-dipping, and other threats (e.g., collecting)	Design and implement a revised protocol to monitor levels and amounts of human-caused habitat disturbance	Continue to collect data on human impacts that affect snails and their habitats during regular snail surveys Determine the level of monitoring required during visitation periods Ongoing revisions as required	Human impact trends assessed monthly Revised monitoring protocol by June 2006
1	As above	Reduce human-caused habitat disturbance	Updated and improved signage, through standardized messages and signage at the C&BNHS, Middle, and Kidney Springs Ensure that appropriate protection and presentation messages are incorporated into the C&BNHS Management Planning Process Publicize surveillance system charges and penalties	Signage updated and improved in 2006 C&BNHS Management Plan finalized by 2006 Information updated annually following Nov. Recovery Team (RT) meetings
1	As above	Continue to raise awareness and educate those potentially threatening the snail and its habitat	Targeted communications to service workers, visitors to the C&BNHS and improved pre-trip information for C&BNHS tour groups Improve visitor linkages between	Pre-trip communications improved prior to summer 2007 visitor season In 2006 improve linkages and messages between C&BNHS and Upper Hot Springs

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
			the Upper Hot Springs where visitors can soak and swim and the C&BNHS where visitors can see the snails Repeat Thomlinson (2005) to see if actions have resulted in visitor behavioural changes Communicate successes of actions to date	Thomlinson study repeated in 2008 Results of repeated study measuring effectiveness of social science research actions presented (Nov. 2008 RT meeting)
1	As above	Update the Protection Implementation Plan	Review and revise the Protection Implementation Plan annually Evaluate options to prevent human-caused habitat disturbance (e.g., Olson and Olson 2003)	Human incursions into snail habitat summarized Annual Protection and Operations report presented at Nov. RT meeting Annual work plan produced from Nov. RT meetings
1	As above	Design and implement a standardized protocol to test electronic surveillance devices currently employed to protect habitat	Test electronic devices Update, as required, testing protocols Establish and maintain a log of results from electronic surveillance device testing	Standardized testing protocol designed and implemented by Sept. 2006 Testing results presented at Nov. RT meeting, and thereafter included as part of the annual review of the Protection Implementation Plan
1	As above	Enforcement of regulations that protect the snail and its habitat Increase the number of wardens certified to enforce SARA	Continue to produce occurrence reports for habitat disturbance incidents and intrusions into closed areas Continue to document outcomes of	Results shared annually at Nov. RT meeting Fewer human intrusions and enforcement actions and increased knowledge in the

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
			incidents i.e. number of warden responses, warnings, tickets issued, court rulings Inform and educate the judicial system about the snail and its importance SARA Law Enforcement training scheduled for Fall 2006	judicial system (crown prosecutor, judges) Certify five wardens to enforce SARA by Fall 2006
1	As above	Complete annual staff orientation and training to: 1) increase awareness of how operations can affect snail habitat, and 2) inform staff about existing legislation and regulations that protect the snail and its habitat	Annual training (BNP, C&BNHS and Upper Hot Springs) for PC staff, researchers and partners involved in interpretation, protection and facility operations. Other processes may be required for technical trade contractors at the Upper Hot Springs facility Researchers are required to obtain PCA research and collection permits with SARA Authorizations Communicate to staff successes of measures taken to date	Staff aware of how operations can affect snail habitat and activities permitted under SARA Integrate snail awareness training and existing legislation into annual staff orientation and training packages by June 2007 SARA compliant research and operational activities
1	Thermal water flow stoppages, reductions Population lows	Develop response plans for stochastic events, i.e., thermal water flow stoppage/reduction and population declines Develop a response plan for the salvage of snail populations whose thermal spring habitats are in imminent danger of drying Increase public understanding	Monitor habitat during regular snail surveys in order to identify potential spring drying events Develop response plans e.g., drying of thermal springs and population declines Prepare public information packages detailing response plans surrounding flow stoppages and population declines	Monthly population trend information Thermal water flow trends and physiochemical properties monitored Response plan(s) and public information package finalized by Fall 2007

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
		of threats		
2	Habitat disturbances at the C&BNHS	Increase emphasis on providing for visitor needs and curiosity Increase awareness of visitors and their potential impacts Provide opportunities for visitors to touch thermal spring water without harming snails or habitat	Integrate visitor needs, and awareness of impacts and opportunities to touch thermal spring water around snail recovery in the C&BNHS Management Plan Review	Integration of ecological and commemorative integrity in the C&BNHS Management Plan
2	As above	Extend handrail pickets to all sections of the boardwalk adjacent to thermal spring habitat	Draft an addendum to the approved EA (Environmental Assessment) for the installation of hand-rail pickets onto some sections of the C&BNHS boardwalk	Install handrail pickets by May 2007
2	Thermal water flow reduction, fluctuations, redirections Local disturbances	Review maintenance procedures and operational protocols that may impact snails or habitat	Update Staff and Operational Protocols at the C&BNHS Eliminate snow throw and delineate a no snow dumping area adjacent to the Vermilion Cool Springs	Updated protocols by June 2006 Ongoing annual review of maintenance and operating procedures and protocols at C&BNHS Reduction of disturbance from facility operations at the C&BNHS Establish no-snow throw, no snow-dumping area by Oct. 2006
3	Population lows and genetic inbreeding Stochastic events	Develop an understanding of population thresholds below which extirpation is highly probable and actions that could reduce predation and	Develop policies and actions in the event of local extirpation or species extinction by factors other than imminent thermal spring drying	Policies and protocols finalized by 2010 Public information package finalized by 2010

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
	Competition and predation	competition pressures when snail populations are at their lowest Increase public understanding of natural threats	Prepare an information package detailing protocols	
3	Limited or low quality habitat Population lows and genetic inbreeding	Explore policies to address population lows and genetic inbreeding Improve understanding of annual population cycles and the occurrence of genetic inbreeding Increase public understanding of natural threats	Develop policies to address intervention of natural processes (e.g., population lows and genetic inbreeding) Research questions to be addressed include supplemental feeding, modification of light regimes and genetic inbreeding and population cycles Prepare a communications package to explain the policies and protocols surrounding species extinction	Policies finalized by 2010 Research questions integrated into the Research Implementation Plan by 2006
Objective 2: Restore snail populations and habitat within historic range, where and when possible.				
2	Limited or low quality habitat	Enhance snail habitat within outflow streams at C&BNHS	Integrate snail habitat enhancements within the C&BNHS Management Planning Process Examine the feasibility of reconfiguring the Cave East and West outflow streams and Upper and Lower C&B outflow streams into a series of pools and slow water-flow areas Complete an EA to evaluate	Integration of snail habitat enhancements within the C&BNHS Management Plan Completed stream reconfiguration project feasibility evaluation and EA by 2008 Outflow stream enhancements completed by 2008/09

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
			alternatives, mitigations and monitoring requirements for stream reconfiguration. The EA will also include an engineering and archaeological review, cost and socio-economic impact analyses, and impacts to other 'rare' thermal spring inhabitants Prepare information and communication packages to target PCA staff and managers, local residents, stakeholders and visitors detailing restoration efforts and SARA Undertake outflow stream enhancements Monitor snail populations in reconfigured streams to determine success of habitat enhancements	Monthly snail population and habitat surveys completed and summarized following Basin outflow stream enhancement
2	As above	Examine the feasibility of introducing or moving natural structures or objects (e.g., logs, rocks) to increase habitat	Continue monitoring habitat and identify potential habitat enhancements Complete EA's to evaluate alternatives, mitigations and monitoring requirements	Complete discussion papers produced for annual Nov. RT meetings
3	As above	Evaluate the feasibility of restoring natural flows from the Lower C&B Spring into the Basin Pool Spring, and from the Basin Pool Spring into the Basin Spring Outflow Stream	Integrate restoration opportunities within the C&BNHS Management Planning Process Complete an EA if the project is deemed feasible that addresses	C&BNHS Management Plan finalized by 2006. Evaluation completed by 2009 EA completed by 2010

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
			SARA preconditions, engineering, cost and socio-economic analyses	
3	As above	Examine the feasibility of restoring a snail population at Gord's Spring	Monitor habitat during snail surveys to identify if snails can be restored Revise re-establishment protocols as required and draft an addendum to the approved EA for snail re-establishment	Thermal water flow trends and physicochemical properties monitored and reported annually Evaluation completed by 2010 or earlier
3	As above	Examine the feasibility of restoring a snail population at the Upper Hot Spring	Continue to systematically and accurately measure and monitor thermal water flows Complete an EA if the project is feasible that addresses SARA pre-conditions as well as engineering, cost and socio-economic analyses	Flow trend evaluation completed by 2009. Evaluation determining re-establishment feasibility completed by 2010
Objective 3: Increase knowledge and understanding of snail ecology, thermal spring ecosystems and threats to them.				
1	All	Analyse and summarize10-years of snail population, distribution and water physicochemistry data to assess trends and update monitoring protocols Monitor snail populations, microdistributions, water physicochemistry and habitat disturbances	Continue dataset input, analyses and summaries Continue snail population, water physicochemistry and habitat disturbance monitoring Continue to engage partners to systematically and accurately measure water flow	10-year population trend completed and updated by March 2007 Assessment of future monitoring efforts completed by March 2007 Monthly data summaries from population and habitat monitoring incorporated into PC

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
				snail database Annual progress reports on water flows Analysis of relationships between water physicochemistry and population microdistribution trends completed by April 2007
1	All	Continue to study the diet and ecological role of the snail	Refine knowledge of diet and snail demographic parameters in order to enhance population viability analyses	Publications of diet and snail demographics completed by 2008.
1	All	Develop a Research Implementation Plan	Continue to identify and fill gaps in knowledge of thermal spring ecosystem components Engage thermal spring ecosystem and species experts Continue to combine components into models that depict and explain natural system dynamics	By Nov. 2006, draft a 5-year research implementation plan that also has a 10 to 20 year projection identifying long-term research needs Annually review the research implementation plan at the Nov. RT meeting; update and revise as required
1	All	Increased public understanding of snail ecology and thermal spring ecosystems	Incorporate updated knowledge of snail ecology and thermal spring ecosystems into a range of communications media	Interpret snail ecology and thermal spring ecosystems in the C&BNHS media plan by 2008
1	All	Develop a Communications Implementation Plan	Integrate research, communications and protection and enforcement actions required to meet objectives outlined in the Action Plan Increased stakeholder and public	A work plan will be produced and presented at the Nov. RT meetings By 2007 update the PCA website and information

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
			understanding of thermal spring ecosystems and compliance with snail protection initiatives Key items to be updated, as required, include the PCA website and information packages designed for media and other partners	packages designed for media and other partners Thomlinson study repeated in 2008
1	All	Hold RT meetings	Undertake an annual review of Research, Communications and Protection Enforcement Implementation Plans Update implementation plans where necessary	Evaluate success of efforts in research, communications and enforcement at RT meetings held biannually (spring and Nov.) Annual work plans to be updated at Nov. RT meeting
1	All	Validate science through peer review and publication	Continue to present at national and international scientific conferences, communicate in scientific newsletters, and publish results in accredited peer-reviewed scientific journals	Three publications written by the end of 2006; at least 2 publications per year thereafter
1 3	All	Identify thermal spring dependent species under COSEWIC	Determine list of thermal spring species that could benefit from a status assessment and provide information to COSEWIC Species Specialist Subcommittees	List of potential candidate species finalized by April 2007
2	All	Develop a protocol for entrance into the Lower C&B cave	Identify and address gaps in knowledge of thermal spring ecology by regaining entry to the Lower Cave and Basin Cave	Protocol for entrance to Lower C&B cave completed by December 2006
2	All	Incorporate thermal spring ecosystem component databases into one unified	Continue to expand snail master database to include results from habitat monitoring, captive-	Begin combining databases in 2006

Priority (1,2,3)	Threats Addressed	General Steps	Actions	Outcomes and Scheduling
		database	breeding, and preliminary resource reconnaissance Share species' occurrence data with the Nature Serve Network	Data properly documented (meta-data) and archived by 2008 Complete unified database by 2008 Annually update unified database
2	All	Forward all data to Parks Canada's RT Chair for archiving and disbursement	Continue to determine the best format for databases Species occurrence data are entered into the Nature Serve network through the Alberta Natural History Information Centre Information management flow documented and archived	Data forwarded annually; archived and distributed as necessary
3	All	Investigate the possibility of designing a multi-species or ecosystem recovery strategy for thermal springs	Based on COSEWIC listing of additional thermal spring dependent species and the short and long-term research direction, begin dialogue with RENEW on feasibility of multi-species or ecosystem recovery strategy and action plan	Begin dialogue with RENEW by March 2008

2.4.2 Narrative to support recovery and action planning table

Protection and communication strategies were developed as part of the Resource Management Plan for the recovery of the Banff Springs Snail (Lepitzki et al. 2002b and Dalman *et al.* 2002 in Lepitzki *et al.* 2002a). Detailed plans that address communications, protection and research will be developed to implement this Recovery Strategy and Action Plan.

Habitat Protection

Protection Implementation Plan: The Protection Strategy (Appendix 1 in Lepitzki *et al.* 2002a) presents information for each spring historically inhabited by the snail, identifies specific protection problems and offers potential solutions and will be revised and updated to form the Protection Implementation Plan. One specific addition will be the design and implementation of a standardized protocol to test electronic surveillance devices.

Habitat Restoration, Enhancement, and Snail Re-establishment

Assess feasibility to re-establish populations at the Upper Hot and Gord's Springs: Additional snail populations at historic locations would increase the security of the species, its probability of long-term survival, and likelihood of down listing. At this time, it is uncertain if restoring snail populations to the Upper Hot and Gord's Springs will be feasible due to recent water flow stoppages.

Habitat restoration and enhancement at C&BNHS: Springs within the C&BNHS are regulated and modified. Habitat restorations and enhancements, especially to outflow streams, could increase suitable habitat, and potentially snail populations, at these existing sites. These projects will be undertaken within the context of the C&BNHS Management Plan review.

Habitat Management

Finalize operational protocols and procedures: Management activities, particularly at the C&BNHS where water flow is regulated, can have an impact on snails and habitat. Many changes to maintenance protocols have been undertaken; however, finalizing operational protocols at this historic site is necessary to ensure that populations are protected.

Develop a response plan: A number of thermal springs have dried for varying lengths of time since the snail research and recovery program began in 1996. The frequency of drying events may be accelerating with global climate change. Without thermal spring water, snail populations will be extirpated. Drops in flow rate, temperature and conductivity usually foreshadow the drying of a thermal spring. It is recommended that a plan be developed to enable the preparation and maintenance of emergency habitat to be used specifically if any critical habitat areas are destroyed or are under severe threat, and to define the

conditions and methods used to re-establish populations. The intent is to maintain a core group of thermal springs in the event of a catastrophic habitat loss that may affect one or more springs simultaneously. The response plan will include discussion surrounding predation/competition, supplemental feeding and light regimes.

Scientific Research and Monitoring

Monitoring: Monitoring of all extant populations and water chemistry (see Table 2) has been undertaken regularly since 1996 and is critical to understanding population trends and habitat status. A revision of the monitoring protocol is required. The frequency of continued population and habitat monitoring may be reduced as long as recovery goals can be attained. The measurement of selected parameters from thermal springs allows comparison with those documented by others in 1968/69 at Kidney and Cave Springs and those collected since 1996.

Develop a research implementation plan. A research implementation plan that identifies and fills gaps in knowledge of thermal spring ecosystem components would allow for both short term i.e., 5 year and longer-term i.e., 10 to 20 year planning. Ecosystems components already identified include: water flow, water physicochemistry, hydrogeology, age of tufa mounds, and thermal spring dependent flora and fauna e.g. microbes, invertebrates, vertebrates, vascular and non-vascular plants. While data on each of these components have been collected since 1996, there has only been a preliminary attempt to integrate the various knowledge bases. The re-establishment of snails into two thermal springs may have changed the thermal springs' biodiversity. Similarly, future restoration and/or enhancement activities could affect other thermal spring ecosystem components both positively and negatively. An annual review of the research implementation plan will ensure incorporation of new data as they are acquired.

Develop a protocol for entrance into the Lower C&B cave: Access has been regained into the cave at the Lower C&B Spring. The cave serves as a restoration benchmark for an environment free from human impacts since the cave was closed to the public in 1985. The site was accessed in 2005 to evaluate flow dynamics. Potential impacts and mitigation resulting from entry will be assessed and implemented. Knowledge gaps of thermal spring ecology within the cave will also be assessed.

Communication and Education

Communication is considered essential to the recovery of the Banff Springs Snail. All objectives of this plan will have a communications component.

Communications Implementation Plan: A Communications Strategy (Appendix II of Dalman *et al*. 2002 in Lepitzki *et al.* 2002a) has been developed to raise public awareness about the Banff Springs Snail and thermal spring ecosystems and has been the primary tool to implement recovery actions and will be revised and

updated to form the Communications Implementation Plan. It targets specific audiences with the goal of reducing human disturbance to the snail. Many actions have already been implemented.

2.5 Critical Habitat

2.5.1 Identification of the species' critical habitat

Critical habitat is defined in SARA as "the habitat that is necessary for the survival or recovery of a listed wildlife species…"

Specific and required habitat attributes of the Banff Springs Snail include a warm (> 29º C), steady supply of thermal spring water containing a high concentration of dissolved minerals, noticeably high levels of hydrogen sulphide (Table 2), and a complex microbial community providing food and habitat structure. Most snails at most times of the year are found in the upper reaches of the thermal springs, however smaller numbers of snails are also found living further down in outflow streams (Lepitzki et al. 2002a*).*

Occupied habitat includes all areas where snails have been found during population surveys from January 1996 through December 2005 at all historically occupied thermal springs. Some of the outflow streams at the C&BNHS, while currently occupied by snails, have the potential for restoration to more natural conditions that would most likely result in increased snail numbers. Currently unoccupied habitat includes those areas where the species was historically found but not currently present: the Upper Hot, Gord's and Vermilion Cool Springs. There is also the possibility of other, as of yet unknown habitats, that could be considered suitable, unoccupied habitat. They would result from the redirection of existing or surfacing of new thermal water flows within the historic range of the species. Actions have been presented which address these potential habitat restorations and snail re-establishments.

Critical Habitat (CH) for the Banff Springs Snail is defined as all occupied habitat, including the thermal spring origin pool and outflow stream (Figures 4a through 4j). The contribution of the individuals or small number of snails (i.e. the outliers) at the extremes of occupied habitat to the self-sustainability of a population is most likely small but uncertain. However, given stochastic events and the possibilities of redirection of existing or surfacing of new thermal water flows, the outliers could become important in species' recovery following such events.

Critical habitat is currently restricted to the aquatic components. The riparian and upland components of the broader thermal spring ecosystem may become part of the critical habitat definition as knowledge of thermal spring communities and

linkages with the Banff Springs Snail improves. A multi-species ecosystem approach to recovery may be warranted in the future.

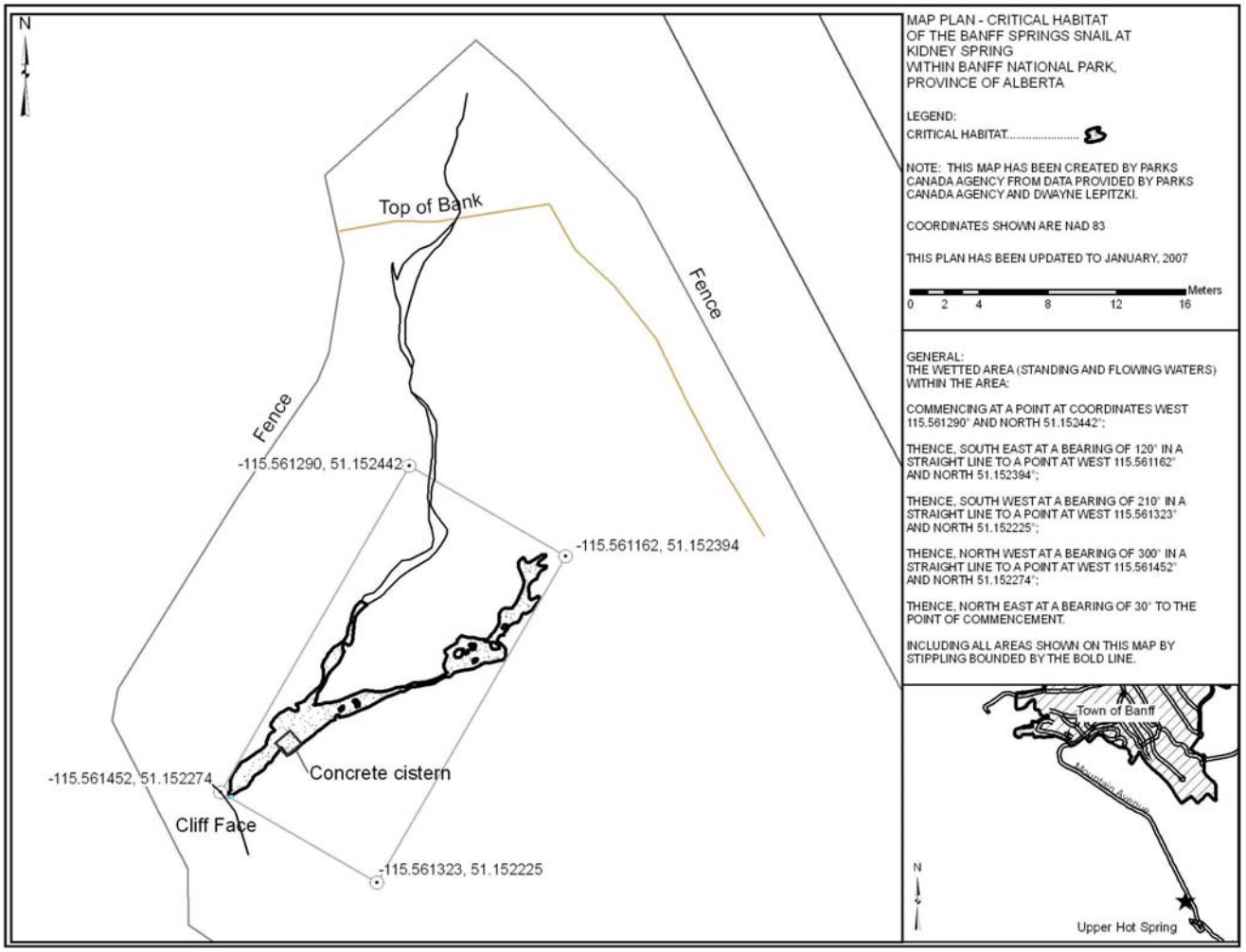

Figure 4a Critical Habitat for the Banff Springs Snail at Kidney Spring in Banff National Park (Site 2 on Figure 2).

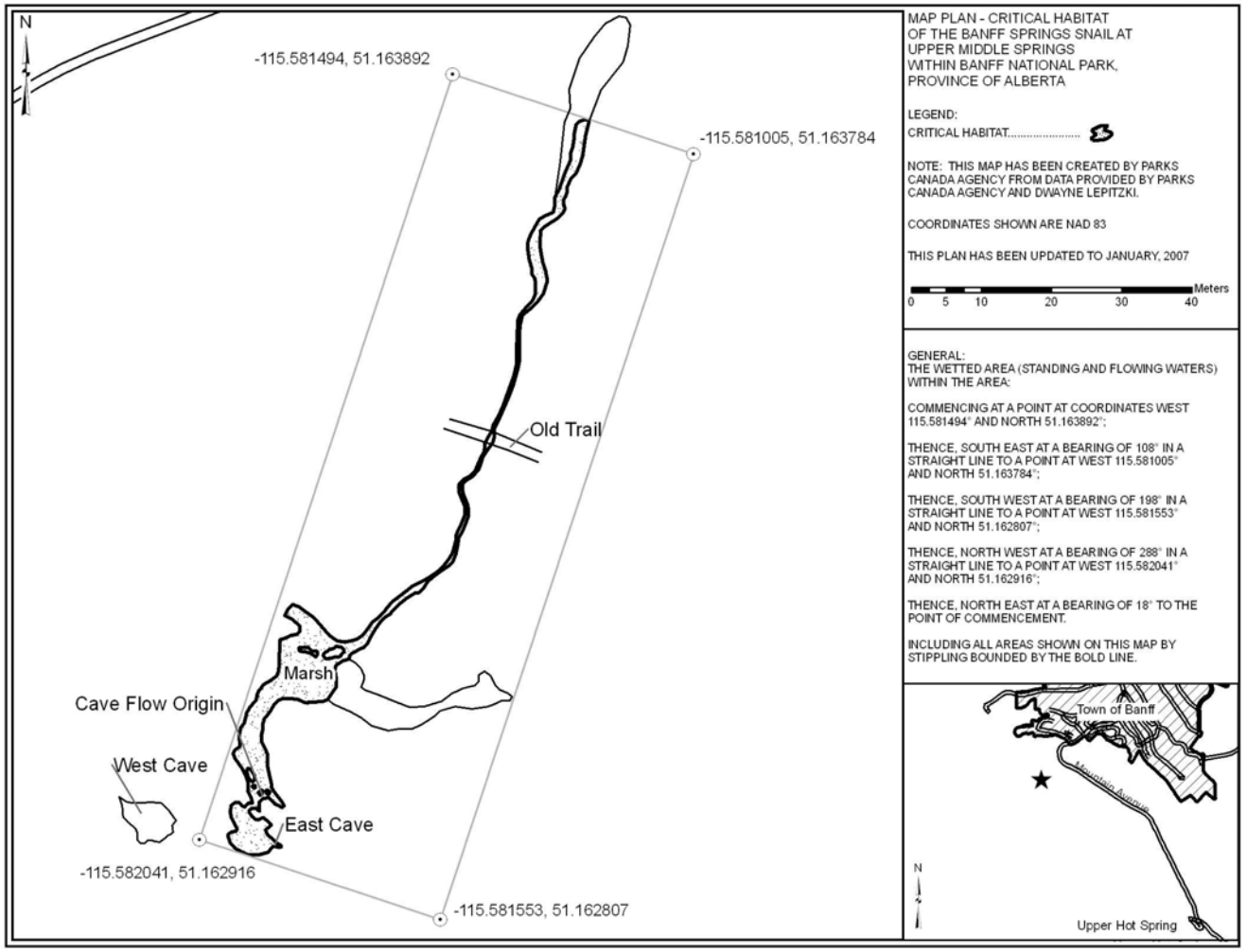

Figure 4b Critical Habitat for the Banff Springs Snail at Upper Middle Springs and Caves in Banff National Park (Site 4 on Figure 2).

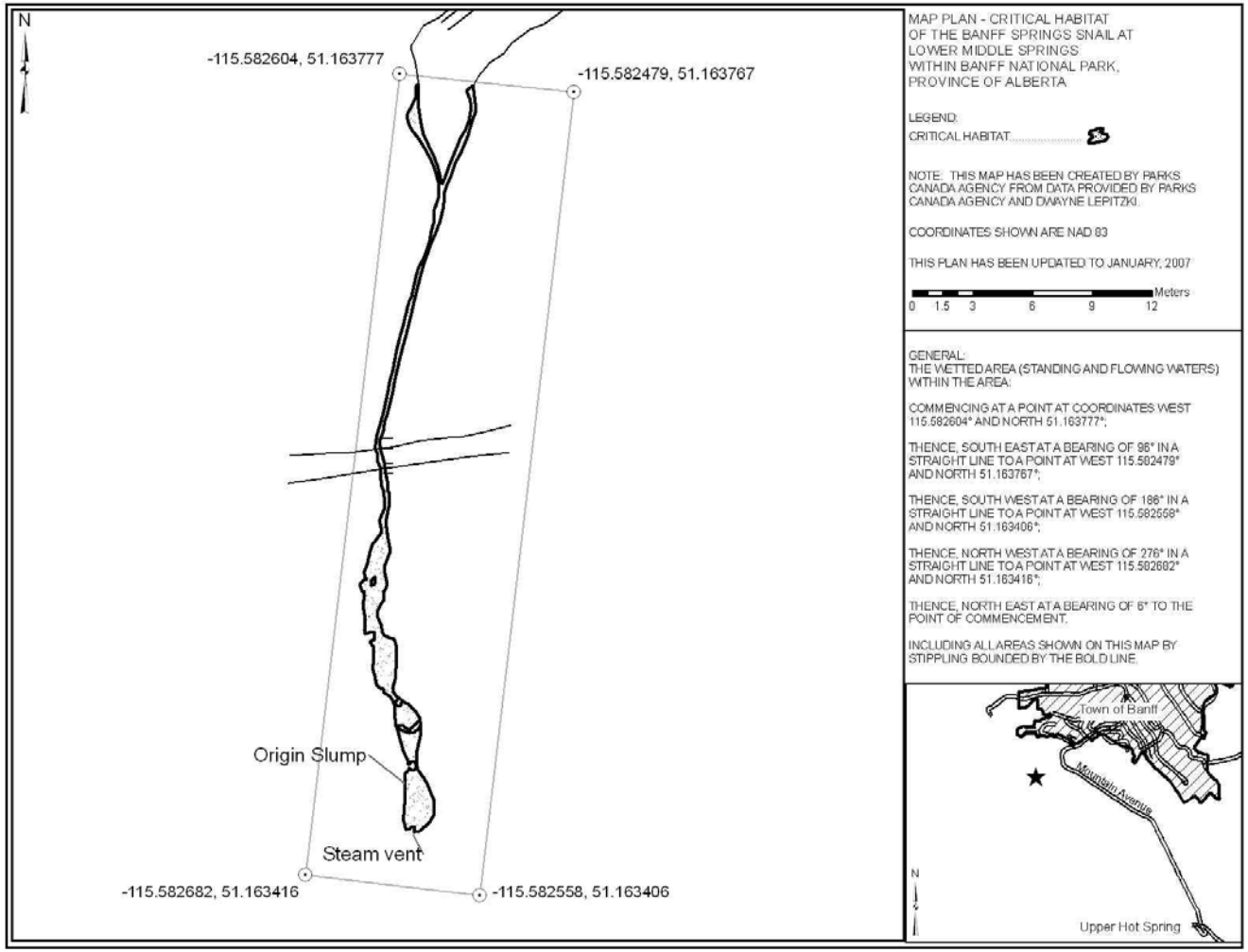

Figure 4c Critical Habitat for the Banff Springs Snail at the Lower Middle Spring in Banff National Park (Site 5 on Figure 2).

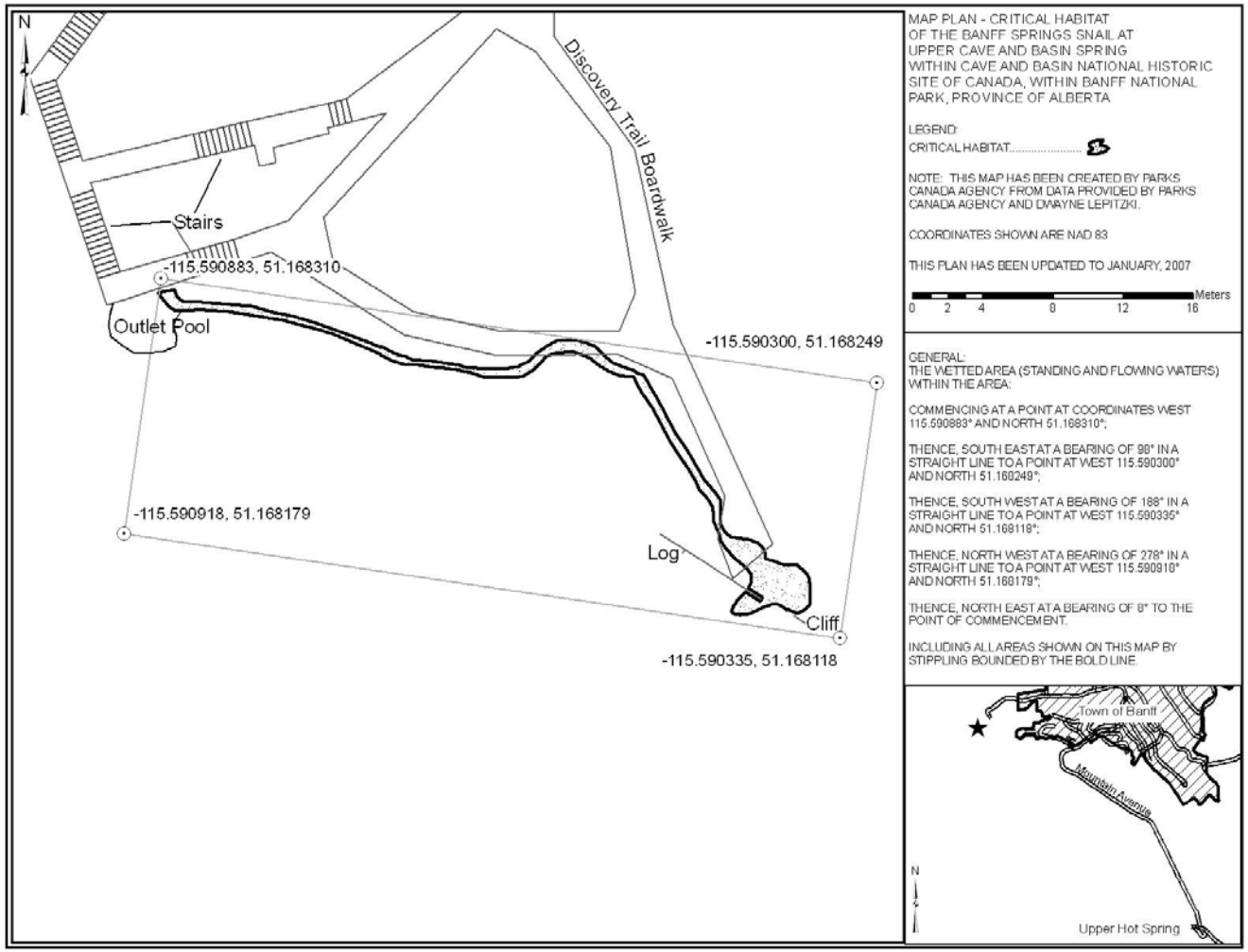

Figure 4d Critical Habitat for the Banff Springs Snail at the Upper Spring, Cave and Basin National Historic Site, Banff National Park (Site 9 on Figure 2).

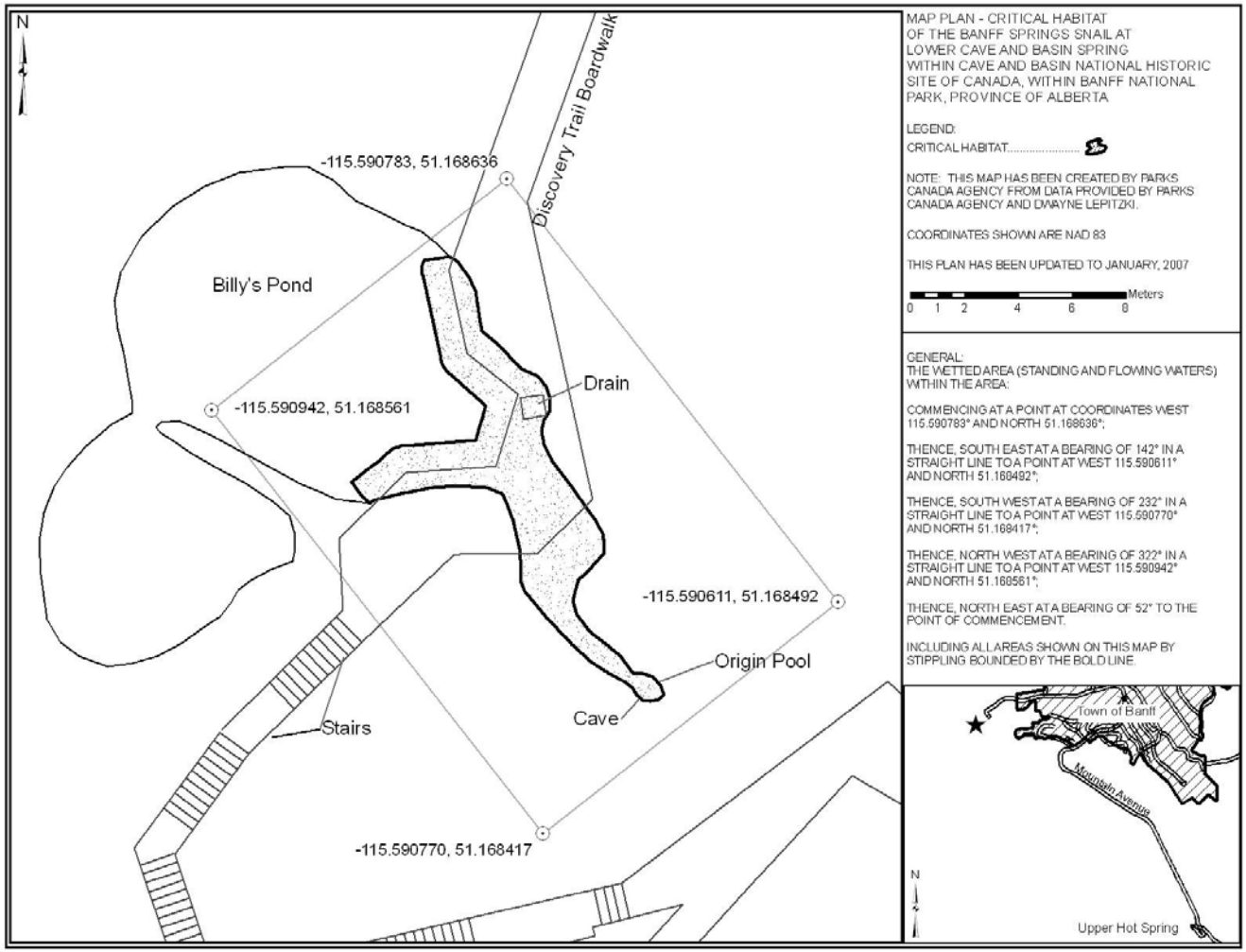

Figure 4e Critical Habitat for the Banff Springs Snail at the Lower Spring, Cave and Basin National Historic Site, Banff National Park (Site 8 on Figure 2).

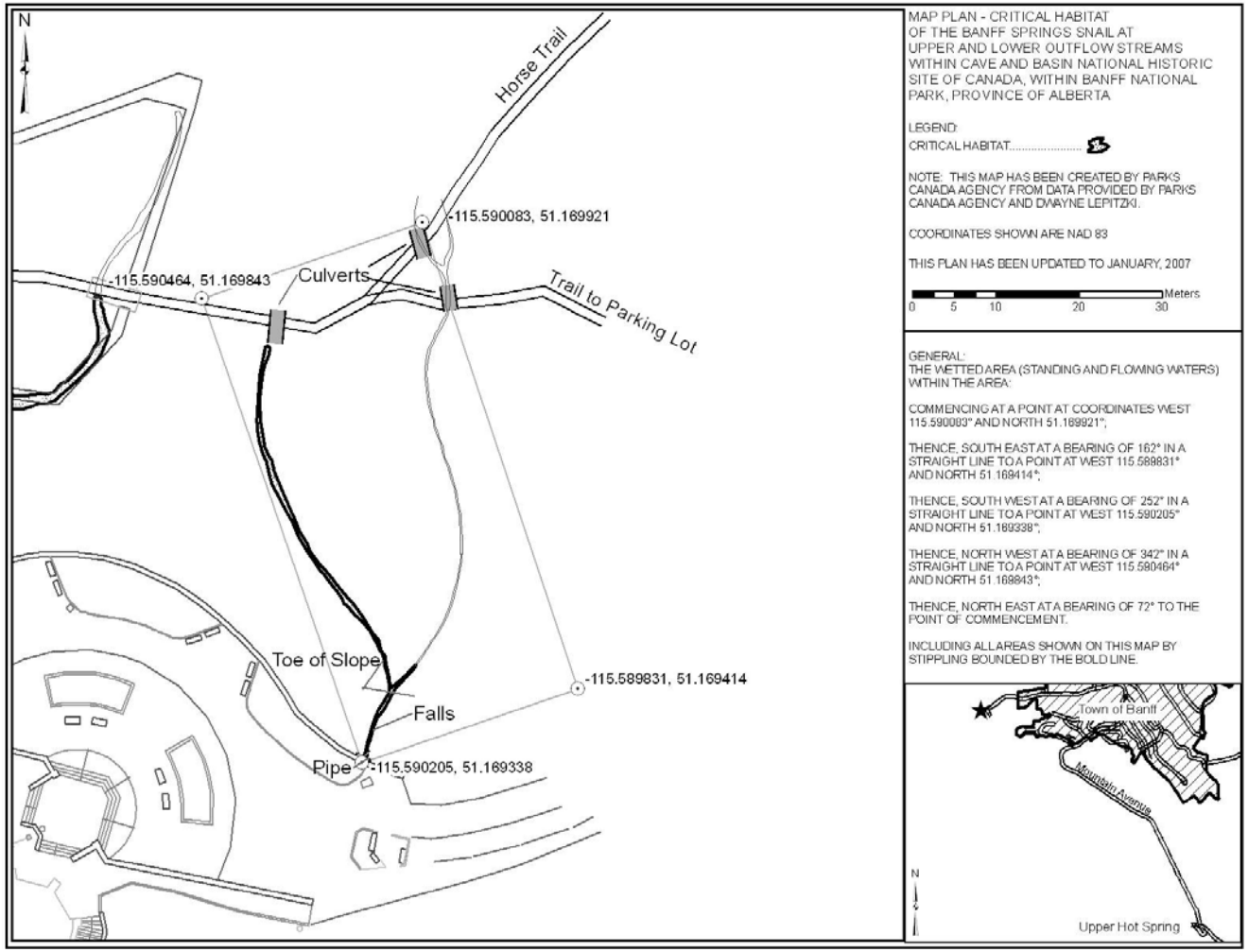

Figure 4f Critical Habitat for the Banff Springs Snail at the Upper and Lower Outflow Streams, Cave and Basin National Historic Site, Banff National Park.

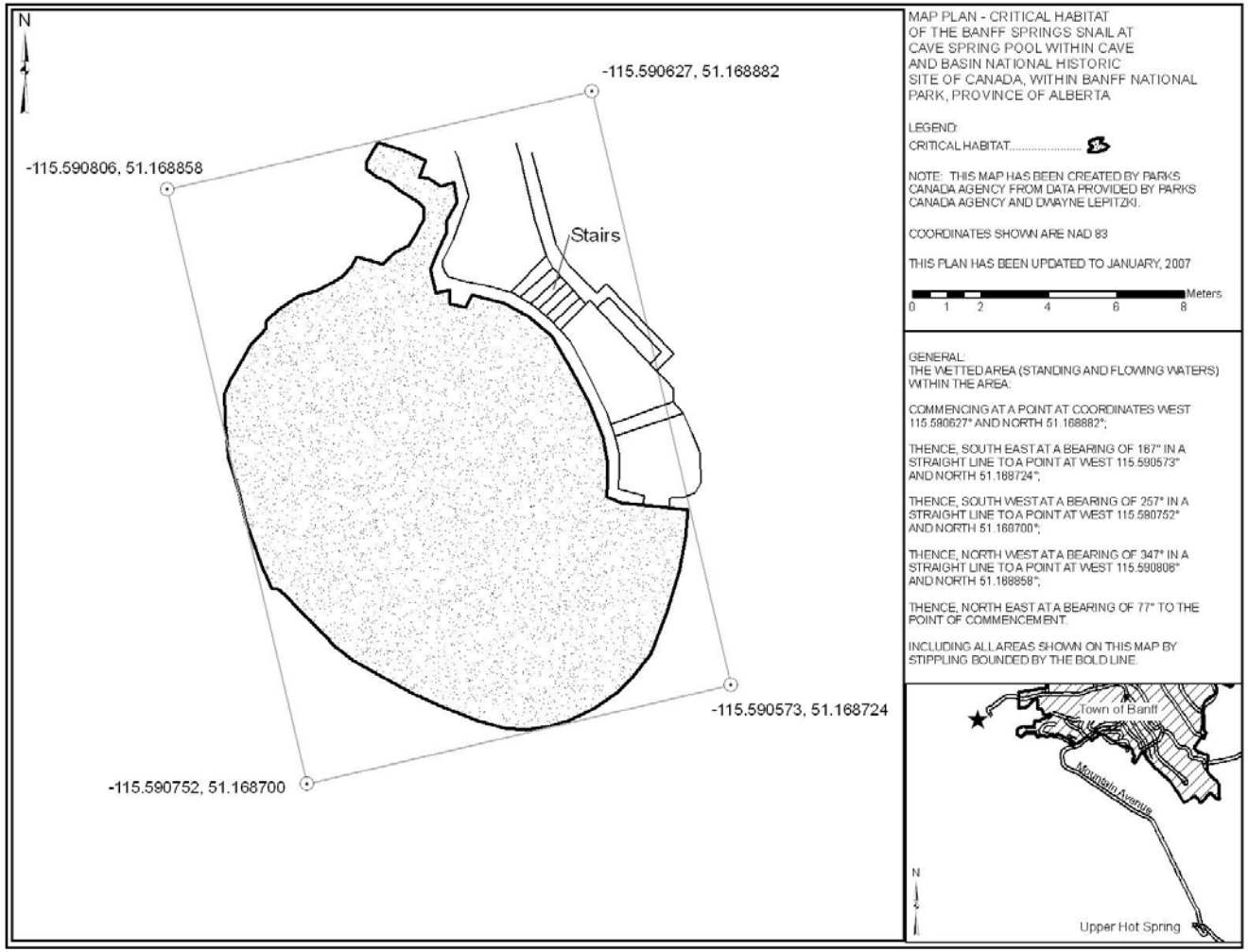

Figure 4g Critical Habitat for the Banff Springs Snail, Cave Spring Pool, Cave and Basin National Historic Site, Banff National Park (Site 7 on Figure 2).

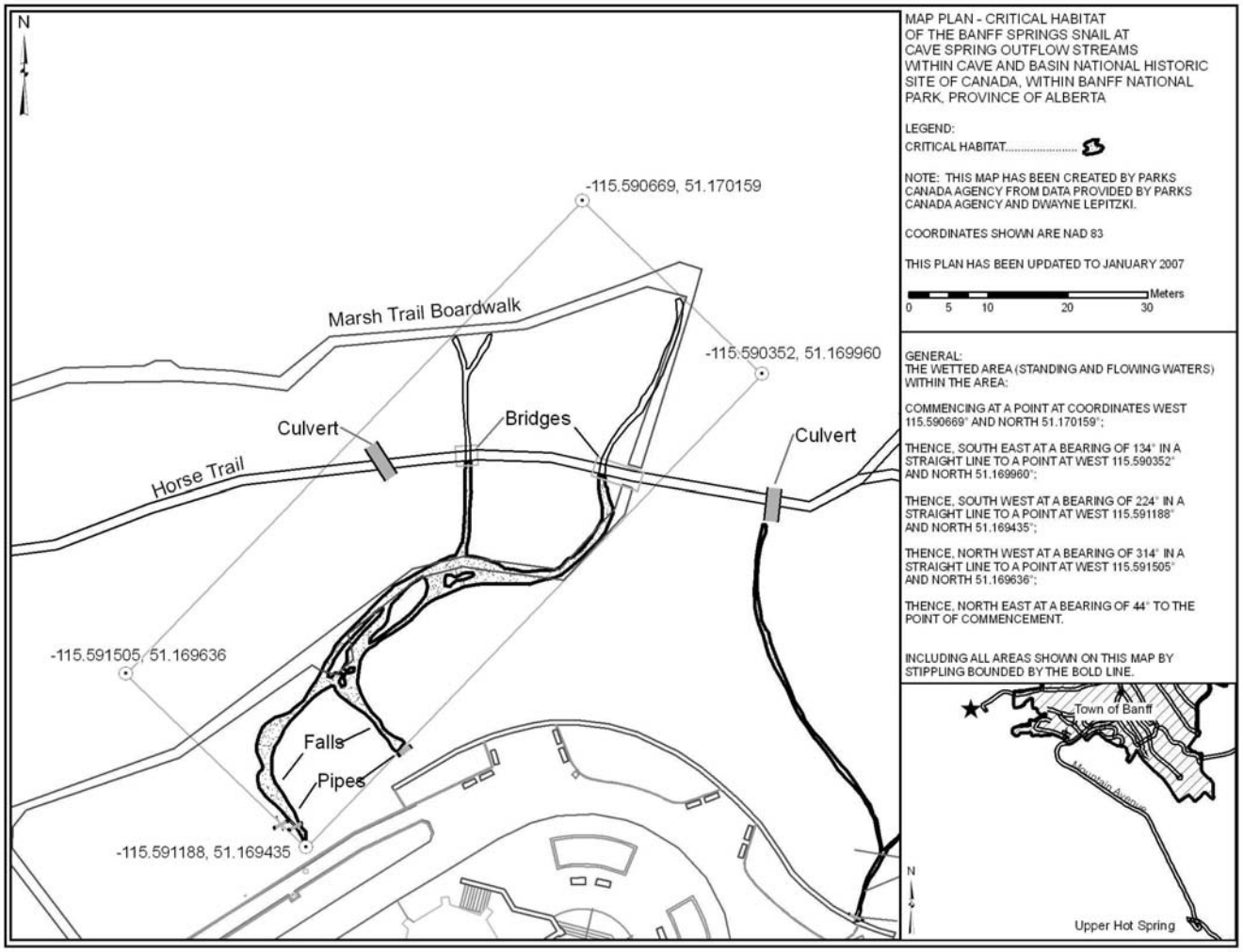

Figure 4h Critical Habitat for the Banff Springs Snail, Cave Spring Outflow Stream, Cave and Basin National Historic Site, Banff National Park.

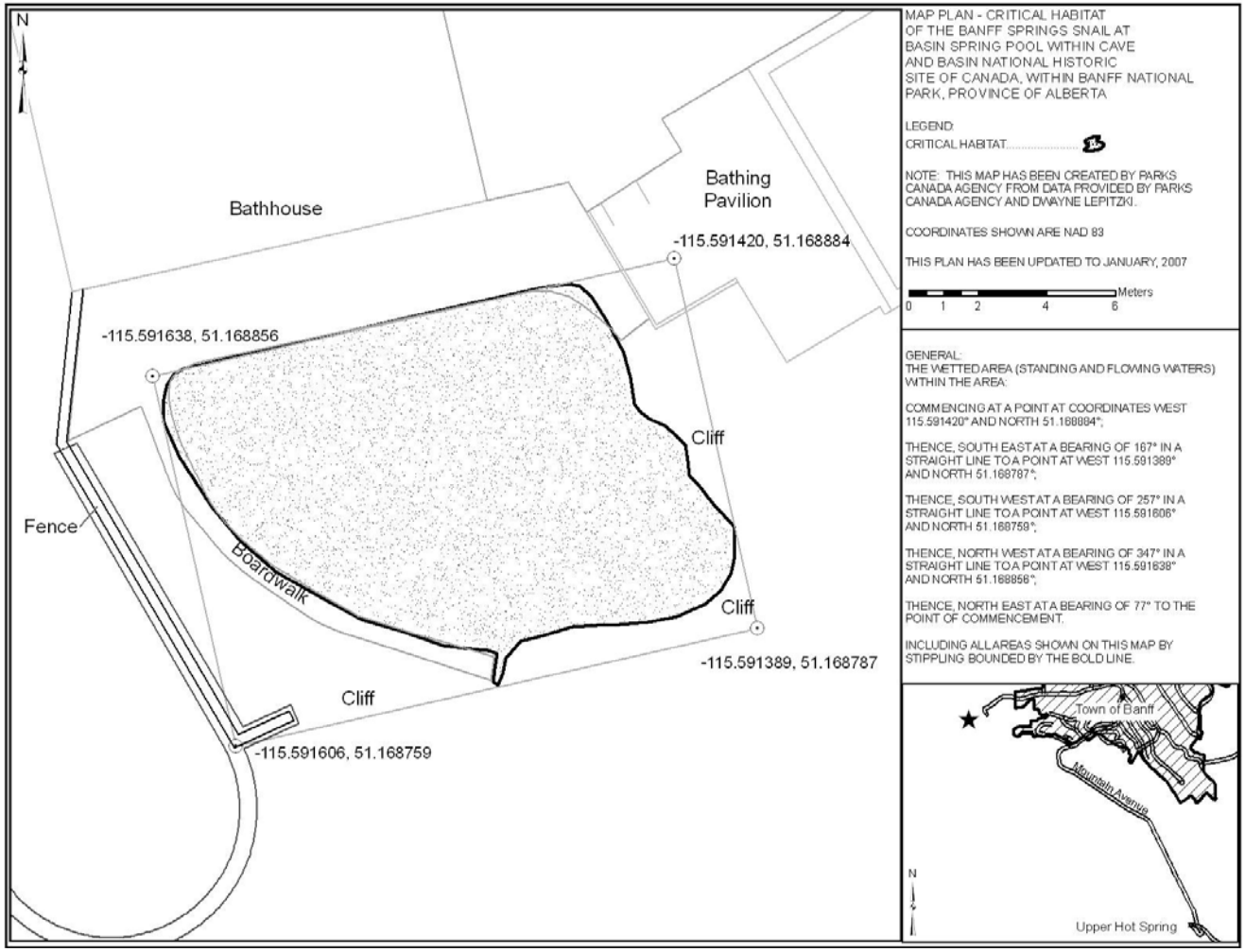

Figure 4i Critical Habitat for the Banff Springs Snail, Basin Spring Pool, Cave and Basin National Historic Site, Banff National Park (Site 6 on Figure 2).

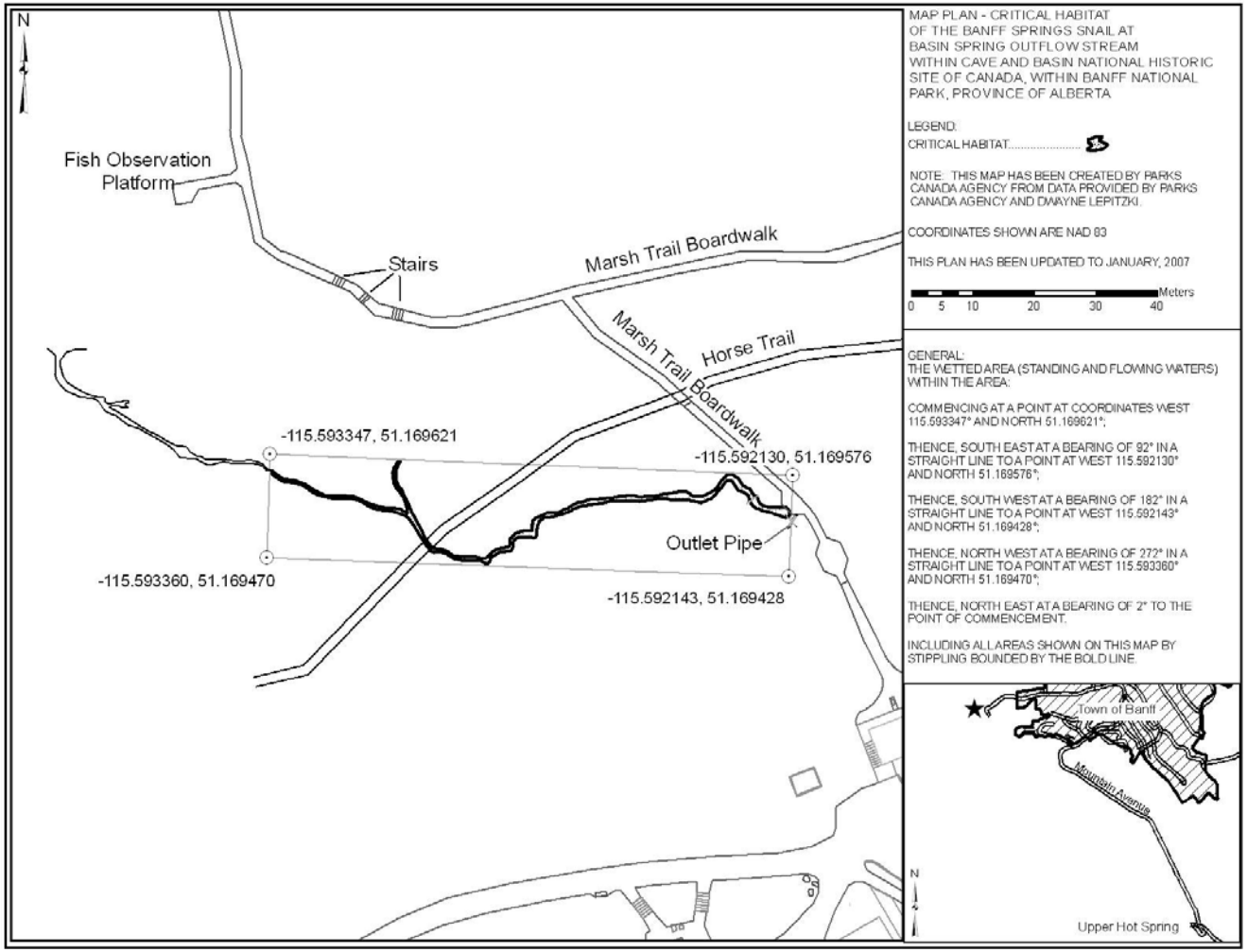

Figure 4j Critical Habitat for the Banff Springs Snail, Basin Spring Outflow Stream, Cave and Basin National Historic Site, Banff National Park.

2.5.2 Examples of activities likely to result in destruction of the critical habitat.

Activities that may lead to the destruction of critical habitat include:

- Pipes and valves plugging with bacterial growth resulting in water level fluctuations or drying or flooding of streams
- Failure of water flow control components such as valves, pipes, and pool liners may lead to flooding, drying, stranding or death of snails
- Removal, trampling, or movement, of substrates (i.e. microbial mat, rocks, sticks, etc.) may lead to disturbance and stranding of snails
- Trampling of the riparian zone could result in the removal of ground cover and erosion of soil into thermal spring habitat altering the physiochemistry and microbial community
- Disturbance or break-up of floating mats may lead to stranding of snails and fragmentation of habitat
- Alteration of water physiochemistry by siltation or chemicals from human skin leads to water turbidity and possibly death of snails
- Introduction of foreign objects (e.g., ice chunks or litter) could result in fragmentation of habitat or become inappropriate substrates for snail colonization
- Boardwalk maintenance including repair and replacement of components, removal of snow and ice results in debris within the thermal spring environment and physiochemical changes to the thermal springs

Operational and maintenance activities at the C&BNHS that may threaten critical habitat are addressed in a series of protocols and form part of the exemption addressed under Section 83 (4) of SARA (See Section 2.11).

2.5.3 Schedule of studies

The origin cave, areas underneath the boardwalk, and Billy's Pool at the Lower C&B have not been thoroughly surveyed for snails (Figure 4e). Using the precautionary principle, critical habitat for the Lower C&B has therefore been extended to include these areas as they may contain snails. Actions have been presented to re-evaluate the CH at the Lower C&B pending new information from expanded population surveys. These tasks are expected to be completed by 2010.

The Upper Hot and Gord's springs will need to be monitored for sustainable and appropriate habitat parameters and a source of snails determined prior to the re-establishment of snail populations to these springs. A flow trend evaluation will

be completed by 2009 and the feasibility of re-establishing snail populations at these sites completed in 2010 (see Table 4).

2.6 Existing and Recommended Approaches to Critical Habitat Protection

All habitats of Banff Springs Snail are in Banff National Park. The species and its critical habitat are protected under the *Canada National Parks Act* (*S.C. 2000, c.32*) and the *Species At Risk Act* (*S.C. 2002, c.29*). Parks Canada is the sole jurisdictional authority to ensure the continued survival and existence of this species. Banff Springs Snail and its habitat are also afforded protection under the *Fisheries Act* (*R.S. 1985, c. F-14*), as per the definition of "fish" under this Act. Although the Minister of the Environment under SARA is the competent minister for individual species in or on federal lands administered by PCA, the *Fisheries Act* still applies.

The juxtaposition of the snail's thermal spring critical habitat within Banff National Park and the Cave and Basin National Historic Site requires that recovery can only be achieved if both Commemorative and Ecological Integrity are fully integrated. The following conditions will be applied to activities involving the C&BNHS:

- Every effort will be made to consider activities and solutions that enhance both ecological and commemorative integrity objectives;
- All reasonable alternatives to the activity that would reduce the impact on the Banff Springs Snail are considered and the best solution is adopted;
- All feasible measures are taken to minimize the impact of the activity on the Banff Springs Snail; and
- The activity does not jeopardize the survival or recovery of the species.

2.7 Performance Measures

Evaluation of the overall approaches to recovery set out in this strategy will be largely accomplished through routine monitoring of the status of snail populations, hydrologic regimes, and habitat trends through time. The Recovery Strategy/Action Plan will be reviewed in five years to evaluate the progress on stated objectives and actions, and to identify additional approaches and changes that may be required.

Progress in meeting stated objectives and actions will be assessed against these targets:

- Extant and re-established snail populations show ongoing persistence and sustainability over time;
- Critical Habitat is fully protected
- Monitoring is showing reduction or elimination of human disturbance;
- The effects of dominant natural threats are minimized (e.g., limited or low quality habitat, population lows, etc.);
- Snail habitat within outflow streams at the C&BNHS is enhanced and monitoring shows that snail populations are self-sustaining (2008/09);
- The evaluation for reconfiguring the Lower C&B Spring outflow pool and stream is completed by 2009;
- The feasibility assessment of re-establishing snails at the Upper Hot and Gord's springs is completed by 2009-10;
- Surveys showing an increase in staff and visitor awareness of snail ecology and associated threats to its survival (2008);
- The research implementation program has obtained results to urgent questions and is ongoing;
- C&BNHS management and the Banff Springs Snail Recovery Strategy & Action plan respect Ecological and Commemorative Integrity values.

2.8 Effects on Other Species

Recent surveys show that thermal springs in BNP harbour high numbers of rare species among several taxa. In addition to the Banff Springs Snail, survey work found two rare damselflies, 28 rare mosses (including one new provincial record), three rare liverworts, and a high diversity of algal species. At least two vascular plant species appear to have been extirpated and one species of fish (the Banff longnose dace) have become extinct since the 1890s. The high level of species rarity, and fact that impacts have already resulted in extirpation and extinction, suggest that the thermal spring ecosystems are a sensitive habitat and many associated species would benefit from their protection.

Effects on other species were addressed in the Strategic Environmental Assessment and the reader is referred to this section of the document.

2.9 Recommended Approach for Recovery Implementation

The single species approach was chosen for the recovery of the Banff Springs Snail due to its distinct habitat requirements and threats. Also, the Banff Springs Snail is the only COSEWIC-listed mollusc in this area.

The entire habitat of the Banff Springs Snail is found within BNP which is managed by the PCA under the CNPA. A key provision of this Act states that "Maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks."

While recovery is administered by one jurisdiction, the juxtaposition of the snail's thermal spring habitat within BNP and the C&BNHS requires that recovery can only be achieved if both Ecological and Commemorative Integrity are fully integrated. Accountabilities outlined in the *Species at Risk Act*, *Canada National Parks Act* and the *Fisheries Act* and guidance from the BNP Management Plan and the C&BNHS Management Plan provide the overall direction for the Banff Spring Snail recovery strategy and action plan.

2.10 Socio-economic Evaluation of Action Plan

The Banff Spring Snail Recovery Strategy/Action Plan proposes a wide range of actions to address strategic objectives for the protection, recovery and restoration of the endangered Banff Springs Snail. Recovery of a species at risk and protection and restoration of critical habitats associated with the thermal spring ecosystem on Sulphur Mountain in BNP will positively impact ecological integrity and enhance opportunities for appreciation of such special places and species by visitors and the general public. A key challenge in implementing this strategy and action plan will be in protecting and restoring snail populations and thermal spring habitats while maintaining commemorative integrity at the C&BNHS. The Sulphur Mountain hot springs were central to the creation of Canada's national park system. Natural and cultural features associated with the springs are preserved and presented at the C&BNHS. While public use and enjoyment of the site, which exceeds 100,000 visitors per year, creates challenges for protection of both cultural and natural resources including the Banff Springs Snail and its habitat, it also provides opportunities to interpret and present the important cultural and natural history values of the birthplace of Canada's national park system.

Proposed actions seek a balanced approach to reducing or eliminating threats to snail populations and habitats through protection and enhancement,

enforcement, and education. Raising awareness through education and information is seen as the primary tool to improve both park staff and public understanding of issues surrounding snail protection and recovery and gain compliance with protection measures. Monitoring of snail populations and habitat since 1996 has shown a significant decline in human-caused disturbance in response to protection and education measures. Additional actions are proposed to enhance protection and messaging, particularly at the C&BNHS which is the primary location where visitors can observe thermal springs environments under controlled circumstances. Direct interaction with thermal spring environments is discouraged in order to protect these sensitive environments and species. Touching the warm waters is, however, an important part of the overall sensory experience for visitors, particularly in the Cave Spring. While some actions are proposed to restrict visitor access to sensitive thermal springs, e.g., additional handrail pickets on boardwalks adjacent to thermal spring habitat, other actions are proposed to provide opportunities for visitors to touch thermal water under appropriate and controlled conditions so as not to negatively impact snail populations, thermal water or sensitive cultural resources. It is proposed that the evaluation of opportunities to touch thermal water be integrated with the C&BNHS Management Plan Review in 2006 so as to effectively meet natural and cultural resource protection objectives while continuing to provide a positive visitor experience.

2.11 Activities Eligible for an Exemption under Section 83(4) of the Species at Risk Act

Subsection 83(4) of SARA allows for certain activities to be exempt from the general prohibitions of SARA, provided the activities are permitted in recovery strategies, action plans or management plans. In order for this provision to be applicable, individuals must be authorized under an Act of Parliament, such as the CNPA, to carry out such activities. Subsection 83(4) can be used as an exemption, to allow activities which have been determined to not jeopardize the survival or recovery of the species.

The activities described below are permitted to take place under subsection 83(4) of SARA. They are also authorized by or under the CNPA.

2.11.1 Operational and emergency maintenance activities at the C&BNHS

This recovery strategy and action plan permits operational and emergency maintenance activities at the C&BNHS, as described below that may incidentally affect Banff Springs Snails and their critical habitat. Parks Canada employees and any other persons may engage in these activities if (1) they are trained for those purposes and (2) they are authorized to carry out those activities by the Superintendent of BNP or by the C&BNHS Site Supervisor.

The specific activities that are permitted in this recovery strategy / action plan and terms and conditions associated with them are detailed in Table 5 as follows:

Table 5 Terms and Conditions for operational and emergency maintenance activities at the C&BNHS.

Activity Authorized	Authorized Persons	Terms and Conditions
Moving snails that are stranded due to a sudden change in water levels at the Cave and Basin pools	C&BNHS staff BNP Aquatic Specialist Principal Researcher	Persons engaging in this activity will: • Take a bucket designated for the purpose of moving snails • Carefully fill it with thermal water while avoiding disrupting snails and snail habitat • Gently flush snails back into the pool environment • Report all incidents to the Site Supervisor of the C&BNHS The Site Supervisor will maintain a log of all incidents and report them to the BNP Dispatch in a timely manner.
Removing Foreign Objects (garbage, cameras, etc) – that are floating	C&BNHS staff BNP Aquatic Specialist Principal Researcher	Persons engaging in this activity will: • Take a mechanical reaching device to carefully remove the object from the surface of the water • Inspect the floating object for snails, and if found, carefully flush snails with thermal water back into the pool environment • Inspect the floating object for eggs, and if found, return the floating object to the pool until the eggs are hatched • In no circumstances enter thermal springs habitat to remove an object • Report all incidents to the Site Supervisor of C&BNHS The Site Supervisor of C&BNHS will maintain a log of all incidents and report them to the BNP Dispatch in a timely manner.
Removing Foreign Objects (garbage, camera etc) that are sunken	C&BNHS staff BNP Aquatic Specialist Principal	Persons engaging in this activity will: • Carefully attempt to remove sunken objects from thermal spring water using a mechanical reaching device as

	Researcher	long as it is safe to do so without disruption to the microbial mat, the edge of the pool or stream, or bottom substrate. • Inspect the sunken object for snails, and if found, carefully flush snails with thermal water back into the pool environment • In no circumstances enter thermal springs habitat to remove an object • Report all incidents to the Site Supervisor of C&BNHS The Site Supervisor of C&BNHS will maintain a log of all incidents and report them to the BNP Dispatch in a timely manner.
Cleaning Billy's Pool Drain	C&BNHS staff BNP Aquatic Specialist Principal Researcher	If the grate is determined to be blocked with debris and snails are present, persons engaging in this activity will: • Carefully inspect the debris for snails and if found, pick snails by hand and place in suitable containers (designated for the purpose of moving snails) with thermal spring water • Transfer snails onto the vegetation in the appropriate habitat within Billy's Pool area • Under some circumstances where it is necessary to physically enter the thermal water environment, snails immediately upstream of the grate are removed and relocated to appropriate habitat within Billy's Pool area • Report all incidents to the Site Supervisor of C&BNHS The Site Supervisor of C&BNHS will maintain a log of all incidents and report them to the BNP Dispatch in a timely manner.
Cleaning the Cave and Basin pool pipes and valves	C&BNHS staff BNP Aquatic Specialist Principal Researcher	If the pool pipes are determined to be blocked with debris and snails are present, persons engaging in this activity will: • Carefully inspect the debris for snails and if found, pick snails by hand and place in suitable containers (designated for the purposes of moving snails) with thermal spring water • Return snails to the pool

		• Adjust valves and clean pipes to maintain water level • Flush stranded snails back into the pool • Report all incidents to the Site Supervisor of C&BNHS The Site Supervisor of C&BNHS will maintain a log of all incidents and report them to the BNP Dispatch in a timely manner.
Water removal for interpretation purposes	C&BNHS staff	Persons engaging in this activity will: • Take a bucket designated for this purpose • Carefully fill it with thermal water while avoiding disrupting snails and snail habitat • Dispose of water in the waste water system

2.11.2 Justifications for activities carried out at the C&BNHS

Four populations of the endangered Banff Springs Snail inhabit highly controlled and built environments within the C&BNHS. This poses significant challenges for Parks Canada: managing critical habitat of an endangered species while at the same time maintaining a National Historic Site. The C&BNHS is culturally and historically significant representing the birthplace of Canada's national park system. It contains infrastructure that directs thermal spring water through a complex and intricate system of pipes, valves, drains, and artificially maintained 'pools'. Much of this infrastructure is critical habitat for the Banff Springs Snail and must be maintained for both ecological and commemorative values.

Clear procedures and protocols have been developed by Parks Canada to mitigate the effects of operational and emergency maintenance activities at the C&BNHS. They provide direction to employees and other persons adequately trained and authorized by the Superintendent of BNP or by the C&BNHS Site Supervisor on how to inspect and monitor areas of the NHS where the Banff Springs Snail occur, as well as how to respond to specific situations.

Alternatives to the various operational and emergency maintenance activities were considered during protocol and procedure development and alternatives with the least impact to snails, habitat and cultural resources were chosen.

The thermal springs and populations of Banff Springs Snail associated with the C&BNHS are integral to the ecological and commemorative values of the site. Proper infrastructure maintenance is vital to the long-term protection and sustainability of snail critical habitat as well as irreplaceable cultural resources and will not jeopardize the survival or recovery of the species. Although snails may inadvertently be harmed or killed as the permitted activities are implemented, it is not expected that this would jeopardize the survival or recovery of the species. Regular population and habitat monitoring since the procedures and protocols were implemented in 2000 has shown the C&BNHS populations and habitat to be self-sustaining. The operational and emergency maintenance procedures and protocols are designed to protect snails and habitat as well as cultural resources and therefore do not jeopardize the survival or recovery of the species.

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