

SUMMARY REPORT
Reconnaissance-Level Aquatic Biophysical Inventory
of the Tributaries to Stave Lake

The outlet of Stave Lake is located adjacent to the northern margin of the lower Fraser River floodplain, approximately 56 km east of Vancouver, British Columbia. The lake is some 30 km long and, from its outlet, extends northwards away from the Fraser River into the Pacific Ranges of the Coast Mountains. From the head of the lake, the upper Stave River continues to the north-northwest for an additional 49.5 km to its source at the Stave Glacier in the southeastern corner of Garibaldi Provincial Park.

Stave Lake itself has a drainage area of approximately 958 sq. km. Downstream of Stave Lake, the lower Stave River continues for about 9.3 km, through Hayward Lake, to its confluence with the Fraser River about 10 km west of Mission, B.C. This section of the river adds some 44 sq. km to complete the entire Stave River drainage area of 1 002 sq. km.

A reconnaissance-level aquatic biophysical inventory was conducted on the major tributaries to Stave Lake, including the upper Stave River, between August 5th to 7th and 10th to 13th, 1987, inclusive. Immediately prior to these stream surveys, Stave Lake itself was inventoried between July 28th and 31th, inclusive. The inventories of the lake and tributaries were requested by one of the provincial regional fisheries biologists in Surrey, B.C., and were intended to show the status of the Stave Lake fish populations and the extent to which the tributaries supported, or could support, spawning and rearing activities by fish resident in the lake.

The stream surveys were conducted as per Chamberlin, 1980. Data on the physical nature of the stream channels were collected at some 26 sites within the lake drainage area, with 6 being located on the mainstem Stave River, upstream of the lake, and the remainder on selected tributaries to the lake and upper Stave River. Fish sampling for presence/ absence was done at 23 of these 26 sites; the dry channels at the other three sites precluded fish sampling. The data collected at these 26 sites were entered on DFO/MOE Stream Survey Forms as per Stream Survey Field Guide (DFO/ MOE; 1989).

Aerial overviews via helicopter of the various stream channels, including

video tape records to aid in channel reach designation, were done on August 5, 6, and 7. Aerial colour photographs were taken at most of the sampling sites.

The aerial video tapes were subsequently reviewed, with data on reach parameters being transferred to additional Stream Survey Forms. The watershed boundaries for the Stave system and relevant tributaries were delineated on National Topographic Series 1:50 000 scale base maps (92 G/1, 8, 9, 10, 15, and 16), with, where appropriate, additional boundaries for surrounding water-sheds being transferred from existing 1:50 000 Aquatic Biophysical maps. In addition, the locations of reach boundaries, sample sites, obstructions to fish migration, and other pertinent stream features were added to the base maps, along with summaries of the reach parameters data.

The above-mentioned 1:50 000 base maps and Stream Survey Forms (both reach and site) form the bulk of the survey results and reference should be made to the maps and forms for the original data. To ease the perusal of these data, however, a brief summary for each tributary follows:

notes -

- 1) the Stave Lake reservoir was at maximum level at the time of survey; all of the following, unless otherwise indicated, are based on stream channels upstream of the reservoir high water mark; reservoir drawdown will expose the relic stream channels, where there may be additional potentials for salmonid spawning and rearing;
- 2) clearly, the ratings of salmonid spawning and rearing potentials are valid only for conditions similar to those present at the time of survey.

a) Stave River 100-0469

Overall, the Stave River upstream of Stave Lake (Reaches 6 through 20, inclusive) was rated relatively low for salmonid spawning and rearing potentials. With the possible exception of Reaches 6 and 7, channel substrates were dominated by larges and, in some cases, bedrock. While larger substrate materials can supply some instream cover for rearing and holding fish, they are generally not suitable for salmonid spawning. While there likely were pockets of fines and gravels scattered throughout, the overall amount of suitable spawning areas was probably still quite low. In the reaches where there were more fines and gravels, the reduced amount of larger-sized substrate materials,

coupled with the generally low amounts of large organic debris, would reduce the amount of rearing habitat in the face of relatively high water velocities.

The flow in the main channel of the Stave River was largely glacial in origin and was quite turbid at the time of survey despite the water in many of the tributaries of the upper Stave River being non-glacial and clear. The high turbidity was considered to be a further limitation on the potential for fish rearing and holding. Where side channels were present, they tended to be fed by smaller, clearer tributaries and, as a result, their flows were considerably less turbid than that of the main channel. It seems likely that, where fish populations are present, the side channel areas will be relatively heavily utilized as the potentials for salmonid rearing appeared to be low to moderate. Unfortunately, however, there were few areas of side channels as the Stave River channel was confined by steep valley walls. Notable exceptions were Reach 6 immediately upstream of Stave Lake (in the vicinity of the Winslow Creek confluence) and Reach 19 near the headwaters.

The distribution of fish populations in the upper Stave River is unclear, despite the sampling which occurred during this survey and the presence of historical information on file. Data from a 1972 regional inspection indicate that "side sloughs in lower part [of upper Stave River] produce good numbers of C.T. to 16" or 17" ", that "small cutthroat (4-9") were caught in the top part of the Stave and in the small tributary creeks", and that "Canyon areas further up river (10 mile) produce large dollies (10 lbs.)". On the basis of these notes, one might expect cutthroat trout to be present throughout the upper Stave River, from Stave Lake to Stave Glacier, and might expect Dolly Varden to be present at least as far upstream as the "canyon areas", which should be Reaches 12 and 14 as determined by this 1987 survey even though these two reaches are considerably more than 10 miles upstream of Stave Lake. However, although there were numerous barriers to fish migration within Reaches 12 and 14, the first apparent potential barriers were located much farther downstream in Reach 8 and, during the 1987 sampling, no fish were caught or seen at three electroshocking sites upstream of these barriers in Reach 8. Admittedly, the electroshocking difficulty was quite high due to an apparent low conductivity but the same equipment did detect small numbers of juvenile Dolly Varden at each of three other sampling sites downstream of Reach 8. On this basis, one

might conclude that fish populations were present only as far upstream as Reach 8. More comprehensive fish sampling will be needed to determine the extent of fish distribution in the upper Stave River.

b) Unnamed Creek 100-0469-124 (Rolley Lake Creek)

From the high water mark of the reservoir, approximately 600 m of this creek should be accessible to fish from Stave Lake. However, the large substrate and general lack of fines and gravels appeared to severely limit the potential for salmonid spawning. Although the large substrate likely provided some instream cover for rearing and holding fish, the potential for salmonid rearing was also likely low.

c) Unnamed Creek 100-0469-132

This creek flows into Stave Lake immediately adjacent to (south of) the outlet creek from Devils Lake. As with "Rolley Lake Creek", approximately 400 - 500 m of channel appeared to be accessible to Stave Lake fish before the gradient began to steepen considerably. Although the substrate was dominated by larges, there were some patches of fines and gravels suitable for spawning; in addition, some of the larges were in the small cobble range and could possibly be utilized by larger salmonids for spawning. On the whole, however, the potential for spawning was still quite low. The smaller size of the larges component of the substrate tended to limit the amount of instream cover and to reduce the rearing potential to low as well.

d) Unnamed Creek 100-0469-134 (Devils Lake Creek)

The entire length of this creek (approximately 2 000 m, including Devils Lake) appeared to be accessible to Stave Lake fish, despite there being major large organic debris accumulations at the outlet of Devils Lake. In the outlet creek, there was approximately 30% gravels in the substrate and a combination of boulders, deeper water, large organic debris, and terrestrial vegetation provided a fair amount of instream cover. Cutthroat trout fry were found in the creek and the potentials for salmonid spawning and rearing were rated as low to moderate. In addition, it was considered likely that Devils Lake provided a considerable amount of rearing habitat for juvenile fish.

e) Seventynine Creek 100-0469-166

Approximately 2 100 m of this creek, in three reaches, should be accessible to fish from Stave Lake. The substrate of Reach 1 contained sufficient gravels (30%) and small cobbles to have a low to moderate potential for salmonid spawning. Reaches 2 and 3, on the other hand, likely had minimal potentials for spawning, due to the high percentages of larges, including many boulders, in the substrate. Reach 1, with the smaller substrate and lacking virtually any other type of instream cover, likely had a relatively low potential for salmonid rearing; however, both cutthroat and rainbow trout juveniles were found in this reach, indicating that some rearing does occur. Reaches 2 and 3, with similar amounts of instream cover as Reach 1, likely did not offer a significantly greater potential for rearing.

It must be noted that the above-mentioned potentials for Reach 1 may be somewhat optimistic. This reach was located in an alluvial fan area and a fair degree of channel instability was observed. There was one major distributary present and a number of small avulsions were seen. In addition, the distributary was dry at the time of survey and there was only a trickle of water in the main channel. Even if some spawning did occur, egg-to-fry survival would probably be poor if the channel moved or dried up. Similarly, rearing may be limited to those areas close enough to Stave Lake such that any fish present could migrate to the lake during low flow periods.

f) Isle Slough 100-0469-171

Isle Slough was not treated in the same manner as most of the other tributaries to Stave Lake; the slough area was considered to have a somewhat different environment from that of Stave Lake and was designated as Reach 1 even though the area was not upstream of the reservoir high water mark. When the reservoir is at its maximum level, this reach will be totally inundated; as the water level is drawn down, the reach will gradually revert to the relic stream channel. At the time of survey, it was anticipated that the substrate of the slough area would be composed almost entirely of fines, with these fines covered by a considerable amount of large organic debris. As such, this reach was believed to have no potential for salmonid spawning no matter what the lake

level.

When the reservoir is at its maximum level, Reach 1 is a protected basin of the lake and likely has a relatively high potential for rearing, given the extensive areas of deep water "instream" cover. However, as the water level is drawn down, the deep water cover will gradually disappear, to be possibly replaced by some large organic debris in the small relic channel. While the large organic debris might provide good rearing habitat in the relic stream, the overall amount of rearing habitat would be considerably reduced from inundated conditions. As such, Reach 1 was considered as having a low potential for salmonid rearing during periods of drawdown.

Reach 2 of Isle Slough should be accessible for approximately 600 m from the high water mark of the reservoir (ie. upstream end of Reach 1). The amount of gravels in the substrate (50%) suggested at least a moderate potential for spawning, but reduced somewhat by the 20% fines which were also present. Similarly, the relatively high amount of instream cover also suggested at least a moderate potential for salmonid rearing. However, if Reach 1 does revert to a debris-choked channel during periods of reservoir drawdown as expected, access to Reach 2 of Isle Slough may be severely restricted.

g) Kearsley Creek 100-0469-185

For the most part, Kearsley Creek was very similar to Seventynine Creek. Approximately 2 500 m of stream, divided into three reaches, should be accessible to fish from Stave Lake. With mostly gravels and small cobbles in its substrate, Reach 1 was rated as having a low to moderate potential for salmonid spawning, with the recognition that egg-to-fry survival may be poor due to possible channel instability on an alluvial fan area (a major distributary was present). Crews from the Stave Lake Corrections Camp had channelized much of Reach 1 (both main and distributary channels), eliminating some of the instability but also virtually all of the instream cover. As a result, there was only a limited potential for salmonid rearing. Reaches 2 and 3 had increasing amounts of boulder-sized material in the substrates, hence a decreased potential for spawning and a slightly increased potential for rearing.

The principal difference between Kearsley and Seventynine creeks was that Kearsley Creek was dry at the time of survey (both main and distributary chan-

nels). Staff at the corrections camp indicated that the creek has remained dry throughout much of the year in the past, including the winter rainy season. When dry, the creek clearly has no potentials for salmonid spawning and rearing and Stave Lake fish cannot access the limited areas of fish habitat in Reaches 2 and 3.

h) Unnamed Creek 100-0469-206 (Sayres Lake Creek)

Reach 1 of this creek rose in a series of boulder and bedrock falls from a point immediately upstream of the reservoir high water mark. There was only limited habitat available for resident fish and no possibility of access by Stave Lake fish.

The Stave Lake Corrections Camp was maintaining a hatchery rearing facility on Sayres Lake. Fish for the pens were being provided by the Fraser Valley Trout Hatchery.

i) Cardinalis Creek 100-0469-216

Cardinalis Creek was treated in a manner similar to Isle Slough in that the protected bay subject to periodic inundation was delineated as Reach 1. As such, this reach was rated as having no potential for salmonid spawning no matter what the reservoir level and a low to high potential for rearing, depending on the extent of inundation.

Reach 2 was accessible for approximately 2 100 m upstream of the limit of inundation of Reach 1. There was a considerable amount of instream cover and the potential for salmonid rearing appeared to be high. The substrate appeared to consist mostly of fines and the potential for spawning likely was limited throughout, except in the upper 20-25% of the reach.

Reach 3 had sufficient gravels in the substrate to provide a low to moderate potential for spawning and sufficient instream cover for a similar potential for rearing. A major cascade near the upstream end of Reach 3 appeared to block further access by Stave Lake fish; however, cutthroat trout were found upstream of the cascade, suggesting that a resident population probably was present throughout the upstream areas.

j) Cascade Creek 100-0469-221

Reaches 1 and 2, at least, of Cascade Creek were located on an alluvial

fan area. Reach 1 appeared to consist of a series of small, disconnected channels having substrates composed mostly of sands, with some gravels and larges. Many of the sandy deposit areas appeared to be dry and the upstream channel areas of Cascade Creek might not have been accessible to Stave Lake fish. Given the amount of sand in the substrate, the potential for salmonid spawning appeared to be quite low. The potential for rearing also appeared to be low due to a limited amount of instream cover and to the probability that many channel areas dry up.

The Reach 2 channel was more distinct and there was approximately 50% gravels in the substrate. Potentials for both spawning and rearing probably were low to moderate, limited somewhat by the amount of fines in the substrate, an apparently unstable substrate and channel, and a lack of instream cover.

Reach 3 had been channelized over its entire length and had dried up over the lower two-thirds of its length. The potential for salmonid spawning was likely minimal due to the substrate size (except in the lowest portion of the reach) and further severely limited by the lack of flow at certain times of the year. There was little instream cover except for substrate boulders in the upper portion of the reach and the potential for salmonid rearing was considered to be low as well.

A 30 m-high waterfall just beyond the upstream end of Reach 3 blocks access to the upper watershed, even if Stave Lake fish can proceed beyond the indistinct channels of Reach 1. However, the channel upstream of the falls had recently "flushed out" and there was limited fish habitat in any event.

k) Davis Creek 100-0469-228

Davis Creek should be accessible to Stave Lake fish over its entire length to Davis Lake, a distance of some 3 600 m. No obstructions were noted; however, the gradient of Reach 2 was somewhat steep and Stave Lake fish may not move much beyond Reach 1. A 1963 Davis Lake rehabilitation proposal indicated that a barrier would be built near the upstream end of Reach 1 but no such structure was seen during the aerial survey.

With 50% of its substrate consisting of gravels, Reach 1 likely had a moderate potential for salmonid spawning; however, the 30% fines which were also present likely will limit egg survival and fry emergence. There was lim-

ited instream cover and the potential for rearing was probably low.

The substrate of Reach 2 was dominated by larges and there was limited cover; the potentials for spawning and rearing were likely low. Reach 3, on the other hand, appeared as if it would be heavily utilized by the fish population in Davis Lake; the substrate seemed suitable for spawning and there was some instream cover.

l) Weatherhead Creek 100-0469-243

Weatherhead Creek was treated in a manner similar to Isle Slough and Cardinalis Creek; the protected bay subject to periodic inundation was delineated as Reach 1. As such, this reach was rated as having no potential for salmonid spawning no matter what the reservoir level and a low to high potential for rearing, depending on the extent of inundation.

Reach 2 had low potentials for spawning and rearing, with a substrate comprised of 50% larges and limited instream cover available. In addition, there were concerns about an unstable substrate and channel and low flows. The lower 800 m of Reach 3 was accessible, up to a 4 m-high water-fall, but there was limited fish habitat; the channel upstream and downstream of the falls had recently "flushed out".

m) Lost Creek 100-0469-251

Approximately 1 400 m of Lost Creek should be accessible to Stave Lake fish, up to a 3 m-high waterfall in a canyon at the lower end of Reach 3; however, fish habitat in this stretch of channel was quite limited. Lost Creek was similar to Seventynine and Kearsley creeks in that Reach 1 was located on an alluvial fan area. The stream had been channelized to protect residences at the mouth of Lost Creek and there was little instream cover for rearing fish. Similarly, there was only a small amount of gravel in the substrate and the potential for salmonid spawning was also relatively low.

In Reach 2, the material comprising the substrate was quite large and there was limited instream cover; the potentials for salmonid spawning and rearing were low to minimal. Upstream of the barriers in Reach 3, the channel had also recently "flushed out" and there was limited fish habitat, although rainbow trout were found at both sample sites in this section. A major tributary of Lost Creek (Unnamed Creek 100-0469-251-457) was also sampled at a

point approximately 400 m upstream of its confluence with Lost Creek but no fish were caught at this site.

n) Foam Creek 100-0469-265

Access to Foam Creek by Stave Lake fish appeared to be blocked by a waterfall right at the high water mark of the reservoir. At the maximum reservoir level, the falls were still almost 2 m high. Upstream of the falls, the gradient was very steep, although stepped; there was little gravel in the substrate; and only 20% instream cover. Fish habitat was limited and the potentials for salmonid spawning and rearing were low at best.

Outside of Morgan and Florence lakes upstream, Reach 2 was the only area which offered reasonable amounts of fish habitat, although even here the potential for spawning was still relatively low due to the high percentage of fines in the substrate.

o) Salsbury Creek 100-0469-311

Only approximately 1 400 m of the entire Salsbury/Terepocki drainage were accessible to Stave Lake fish. Upstream of Reach 1 of Salsbury Creek, the main-stem channel rose over a steep, boulder/bedrock cascade that extended for almost 1 500 m. Similarly, upstream of Reach 1 of Salsbury Creek, there was only 200 m of accessible channel on Terepocki Creek before it too began to climb steeply over a boulder/talus slope. This talus area was considerably shorter than the one on Salsbury Creek but ended at the base of a 40 m-high waterfall.

The accessible portion of this system (Reach 1 of Salsbury and the lower 200 m of Terepocki creeks) had a substrate comprised mostly of boulders, with some bedrock. While there were some pockets of gravels suitable for salmonid spawning, the overall potential was rated as low. The larger boulders in the substrate did provide some instream cover, though, and the potential for rearing was rated as being low to moderate, although only sculpins were located during fish sampling just upstream of Stave Lake.

In addition, this portion of the drainage may only be accessible at certain times. There was a large amount of log debris at the mouth of Salsbury Creek at the time of survey. As the reservoir level drops, this debris will

likely come to rest in the relic channel and may block access to the creek by fish from the lake.

Reach 2 of Salsbury Creek had no fish habitat. Upstream of Reach 2, however, the gradient became quite gentle in the section up to Salsbury Lake. In this Reach 3, there was a considerable amount of instream cover and approximately 70% gravels in the substrate. While there were also 30% fines in the substrate as well, the fines generally were restricted to patches and it appeared that salmonid spawning should be relatively successful in the gravel areas. Overall, the potentials for spawning and rearing seemed to be at least moderate or higher. Given that both kokanee and rainbow trout have been stocked into Salsbury Lake, Reach 3 of the creek should be relatively heavily utilized by Salsbury Lake fish.

Upstream of the 40 m-high falls, Reach 1 of Terepocki Creek was entrenched in bedrock for approximately an additional 2 900 m. Fish habitat was generally limited to some bedrock-controlled pools and adjacent areas. The potentials for salmonid spawning and rearing were likely low. Upstream of Reach 1, the other reaches had generally been "flushed out"; fish habitat was again limited and the potentials for spawning and rearing appeared low, although rainbow trout (likely downstream migrants from Kenyon Lake) were located just upstream of the confluence of the unnamed creek from Kenyon Lake.

The unnamed creek from Kenyon Lake was quite steep and available fish habitat was limited although salmonids were seen in pools at the lower road crossing. A small waterfall at the outlet of Kenyon Lake likely prevents fish stocked into the lake from utilizing the channel downstream of the outlet; however, there was virtually no fish habitat in the immediate vicinity of the lake in any event.

p) Glacier Creek 100-0469-378

Approximately 2 500 m of Glacier Creek, in two reaches, appeared to be accessible to Stave Lake fish, although this distance is dependent on the extent to which the creek dries up. Some 500 m of the upper half of Reach 2 were dry at the time of survey. With some 40% gravels in the substrate of Reach 1, the potential for salmonid spawning appeared to be moderate; however, the channel and substrate appeared quite unstable and, if spawning were to occur, the

egg-to-fry survival would likely be low. Similarly, there was virtually no instream cover in Reach 1 and the potential for rearing was minimal.

q) Tingle Creek 100-0469-396

Up to 6 000 m of Tingle Creek should be accessible to Stave Lake fish despite the presence of a number of small cascades throughout Reaches 2, 3, and the lower half of 4. Beyond this 6 000 m, large sections of the channel were dry at the time of survey.

Reach 1 of Tingle Creek appeared to potentially be one of the best salmonid spawning areas available to Stave Lake fish. There was a considerable amount of gravels in the substrate and not an excessive amount of fines. Although the channel was somewhat inundated at the time of survey, drawdown of the reservoir should still leave large areas of the channel wetted. The potential for spawning was rated as being high; however, there was little instream cover and the potential for rearing did not appear to be greater than low.

The only possible hinderance to spawning use was that of access. The drop-off from the outer edge of the delta was very steep and, at low reservoir levels, the structure and gradient of the exposed relic channel may limit access at certain times of the year.

Reaches 2, 3, and 4 had substrates composed mostly of larges but still with significant amounts of gravels in some locations. Instream cover was somewhat limited but the potentials for both salmonid spawning and rearing appeared to be low to moderate. The small cascades appeared passable and Stave Lake fish should be able to utilize these reaches. However, it must be noted that no fish were located at the sampling site at the lower end of Reach 4, in what was relatively good fish habitat. It is possible that the extent of channel drying, under drought conditions, may be greater than that seen at the time of survey.

r) Roaring Creek 100-0469-437

This creek offered no habitat for Stave Lake fish. A steep, boulder cascade started at the high water mark of the reservoir and extended upstream for 1 400 m (Reach 1). Reach 2 had limited fish habitat available for a resident population, either if such a population was present at the time of survey or if

fish were to be stocked at some future date. Upstream of Reach 2, there was another cascade and a sheer, bedrock falls some 180 m high. There was approximately 50 m of channel immediately downstream of Blinch Lake that seemed capable of providing a small amount of fish habitat, if Blinch Lake were to be stocked.

s) Winslow Creek 100-0469-463

At one time, Winslow Creek may have been the best spawning area available to Stave Lake fish. However, the channel had, like many others in the watershed, apparently recently "flushed out". The substrate of Reach 1 consisted mostly of larges, although there was still approximately 20% gravels, and there was limited instream cover. The potentials for salmonid spawning and rearing appeared to be low, perhaps low to moderate, but it must be noted that trout fry were located at both of the sampling sites in Reach 1.

In contrast, the major distributary from Reach 1 appeared to have retained more gravels in its substrate and a greater amount of instream cover. The potentials in at least this distributary likely were moderate or better.

Reach 2 likely never offered more than a low potential for spawning, even before the channels "flushed out", with it having a substrate composed almost entirely of larges; on the other hand, the larges in the substrate provided a fair amount of instream cover and Reach 2 appeared to have a low to moderate potential for rearing.

In contrast, the short Reach 3 downstream of Winslow Lake and Winslow Lake (Reach 4) itself appeared to have retained a moderate to high potential for rearing. Similarly, Reach 5 upstream of Winslow Lake, with 50% gravels in its substrate, seemed to have retained at least a moderate potential for salmonid spawning, although the channel appeared somewhat unstable and subject to drying near the upper end of the reach.

Reach 1 of the unnamed tributary joining Winslow Creek just downstream of Winslow Lake climbed up and around landslides from both valley walls. Some gravels and instream cover suggested low potentials for salmonid spawning and rearing. Upstream of the landslides, the gradient decreased and Reach 2 had some good fish habitat; however, no fish were located at the sampling site in Reach 2. A small falls at or near the lower end of Reach 1 may be a barrier,

preventing the establishment of a population and access by Stave Lake fish.

t) Unnamed Creek 100-0469-634

This creek offered virtually no habitat for Stave Lake or Stave River fish. Indeed, there was very limited habitat available for a resident population of fish, either if such a population was present at the time of survey or if fish were to be stocked at some future date. No fish sampling was attempted during this survey, mainly due to time constraints, but also because no fish population was expected at the time of survey. Most of the available habitat was restricted to the two lakes near the headwaters (Reaches 6 and 9). If the lakes were to be stocked (if presently barren as expected), Reach 7 would provide some limited spawning and rearing habitat for the lower lake; similarly, the upper end of Reach 8 (between the falls and the outlet of the lake) would provide some stream habitat for the upper lake.

The major tributary to this creek (Unnamed Creek 100-0469-634-305) was very much the same; most of the fish habitat was restricted to the two lakes near the headwaters. The lower lake had some associated stream habitat; the upper lake did not appear to have any.

u) Unnamed Creek 100-0469-689

Similarly, this creek provided no habitat for Stave River fish and, being upstream of apparent barriers on the Stave River, no habitat for Stave Lake fish. Reach 1 rose steeply right from the Stave River. Reach 3 had a much lower gradient and some fish habitat was available if a resident population was present. Again, however, no sampling was undertaken during this survey as no fish were expected to be present. The small lake (Reach 5) might also support a small fish population if it were to be stocked.

v) Unnamed Creek 100-0469-729 (Thomas Lake Creek)

Reach 1 had a steep gradient but its 500 m of channel should be accessible to Stave River fish, if a population was present upstream of the apparent barriers in Reach 8 of the Stave River; however, the potentials for salmonid spawning and rearing were both minimal to low (mostly larges in substrate and very limited instream cover). Reach 2 was a steep, boulder cascade with a num-

ber of major waterfalls and there was little fish habitat present.

Thomas Lake (Reach 3) is reported to have been stocked in 1961 with rainbow trout. The main inlet stream had some fish habitat available and this population of fish may still exist. Reach 4 had a moderate potential for salmonid spawning (40% gravels in substrate) and a low to moderate potential for rearing (20% instream cover). The lower half of Reach 5 should also be accessible to Thomas Lake fish, if any still exist, but the potentials here were reversed from Reach 4 (low spawning-20% gravels, mostly larges in substrate; moderate rearing-40% instream cover). The smaller lake upstream cannot be accessed by Thomas Lake fish and nothing is known about it.

w) Stoney Creek 100-0469-924

Reach 1 and the lower portion of Reach 2 of Stoney Creek should be accessible to Stave River fish if a population exists but fish habitat was quite limited and the potentials for salmonid spawning and rearing were both low (steep gradient, little gravel in substrate, limited instream cover). Upstream of the barriers, there still was only limited habitat available for any resident fish population, if one exists, although none was expected at the time of survey. A short, unsurveyed section between Reach 5 and a small pond may provide some salmonid spawning habitat.

SUMMARY

Overall, the tributaries to Stave Lake did not provide more than a small amount of salmonid spawning and rearing habitat for the fish of Stave Lake. For the most part, the tributaries to the lake had been impacted by recent storm events which had resulted in the stream channels being "flushed out". Much of the gravels in the channel substrates had been washed out of the streams, leaving substrates composed mainly of larges. The boulder-sized materials provided some rearing habitat (instream cover) but virtually no spawning habitat.

In some cases, the gravels had been completely flushed out of the streams into the lake. In other cases, such as Seventynine, Kearsley, and Lost creeks, the fines and gravels had been deposited in an alluvial fan at the lake shoreline. Where this had occurred, there were areas in the first reaches of these

tributaries where the potential for salmonid spawning was somewhat higher; however, the alluvial fans suffered from channel and substrate instability and from water flows which went subsurface near the upstream ends of the fans. The result was dry or nearly dry channels at the time of survey, conditions which were expected to exist for certain periods of the year on an annual basis. If spawning did occur, egg-to-fry survival would likely be quite reduced. In addition, the nearly dry channels provided almost no rearing habitat for those species whose fry remain in creeks for at least the first year of life.

Some tributaries, such as Isle Slough and Cardinalis and Weatherhead creeks, provided small areas with moderate potentials for salmonid spawning immediately upstream of first reaches that were inundated by high reservoir water levels at the time of survey. It appeared that these first reaches would provide good, protected rearing areas during periods of inundation but that, during periods of drawdown, the potential for salmonid rearing would be reduced to low or minimal due to the disappearance of deep water cover. In addition, it was suspected that, depending on the amount of sunken large organic debris which may be exposed in the relic stream channels as water levels drop, fish passage to the potential spawning areas in the second reaches may be blocked.

The most promising tributaries appeared to be the lower ends of Tingle and Winslow creeks and the Stave River itself. In the case of Tingle Creek, the first reach had good amounts of gravel and instream cover. However, the drop-off at the outer edge of the delta was very steep and, at low reservoir levels, the good spawning area may be inaccessible to Stave Lake fish. In addition, there was some concern at the time of survey as to the extent to which the channel dries up during drought periods; no fish were located at a sampling site in an area which should be accessible to Stave Lake fish or which should support a resident fish population.

In the case of Winslow Creek, the main channel had been somewhat flushed out, but there were some side channels and at least one distributary which had retained some good fish habitat with moderate or better potentials for salmonid spawning and rearing. In addition, the apparently good area for spawning immediately upstream of Winslow Lake should also be accessible to Stave Lake fish.

The main channel of the Stave River was quite turbid and did not appear to

provide too much fish habitat, particularly for rearing. As with Winslow Creek, however, there were many side channels in the vicinity of Stave Lake and the confluence of Winslow Creek/Stave River which had clearer water and areas of substrate suitable for salmonid spawning. The entire complex of channels in this area deserves further, more intensive, investigation to determine its true potential.

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