Review of Dioxins and Furans 1992 to 2006
Wildwood Landfill, Catalyst Paper Powell River

May 3, 2008
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Summary.

This first complete comparative review and analysis of the dioxin and furan results from 1993 to 2006 yields very simple and clear results.

The landfill dioxin and furan results are dominated by two main patterns.

Dioxin D8 is generally dominant throughout the landfill. Its highest results occur at the landfill's western toe above the slope.

Dioxin D6 and furan F6's very toxic results are found concentrated around well 89-5 at the eastern toe of the landfill above the slope to the lake.

A pattern of dominant dioxin D5 occurs only on the slope to the lake. This appears to originate with the asphalt capping of the landfill.

All three of the above dioxin and furan patterns are found at every grid line of the slope all the way down to the lake and are the only significant dioxin and furan patterns detected in Powell Lake.

The results strongly indicate that the dioxins and furans in the lake are originating with the present landfill.

The approximate 520,000 cubic metres of ash proposed for addition to the landfill has a different toxic dioxin and furan content exceeding much of the existing landfill's results. The proposal does not appear prudent.

1. Introduction

Macmillan Bloedel Ltd created a landfill in Wildwood, a residential area of Powell River in the 1960's. The landfill area runs to the edge of a slope to Powell Lake. Powell Lake serves as a recreational area for the community and a source of drinking water for a portion of its residents.

The landfill was used for fly ash, lime dregs and other undocumented waste, much of which is not completely identified as to type, quantity or location within the landfill. Hatfield indicates that the undocumented material could constitute a greater risk to underlying groundwater. On page 22 of their Nov 2007 report they state "Groundwater from the phase 1 and the mini-landfills eventually flows into the River. If contaminated, this water may result in impacts to biological organisms living in the river or human receptors ingesting the surface water…"

As the Hatfield report indicates "In 1992 when measurable concentrations of dioxins and furans were noted in drinking water at the filter-house, human health became an important issue."

A surface water sampling program was begun. The original landfill continued to operate until 1995.

Between 1992 and 1995 the analysis of landfill soil and well water samples identified various levels of dioxins and furans throughout the landfill and on the slope to Powell Lake.

The worst results were found at and around well 89-5 on the eastern toe above the slope to the lake. Background information on the severe toxicity around well 89-5 is first available in 1992 and 93. A Sept 1993 HBT Agra Limited report discusses a dense, heavier than water, viscous liquid found in the well 89-5 area. Its analysis found "very high levels of a number of contaminants". "The sample had extremely high levels of dioxins and furans as well as very high concentrations of organic compounds and tannins and lignins. Mercury levels were also high. Our working hypothesis is that the very high levels of organic compounds has enhanced solution of dioxins, furans and some other contaminants, probably from the ashes disposed of on site. The presence of this viscous liquid must be considered in the remediation plan for the site."

The highest available 89-5 analysis results are from 1993 with a very severe result of **3,500,000** pg/l total weight of dioxans and furans and a toxic TEQ result of 31,000 pg/l. Feb 94's and March 2004's results at 500,000 and 160,000 pg/l total weight of dioxins and furans are also very severe and have the same pattern.

The 1993 results are shown in Figures A16 and A17 of Appendix A.

For reference, the USEPA guideline for drinking water is a TEQ of 30 pg/l.

Section 36 of Canada's Fisheries Act prohibits the release into fish frequented waters (or a place or condition leading to those waters) of a deleterious substance.

The landfill was closed in 1995.

The July 2007 Golder Associates report states "At the time of closure, the southeastern portion of the Phase 1 landfill contained sand and gravel containing Bunker C oil and cutting oil. These materials were stored in a lined and covered cell and the

majority was used as aggregate for the asphalt cap discussed below." Closure of the Phase 1 landfill in 1995 consisted of covering the landfill with a low permeability asphalt cap.

After 1995, a lined "mini-landfill" was created in the north east corner of the original landfill. It was used until 2002 when Norske Canada Ltd, the 2002 owner, decided to transport fly ash to the United States for disposal. In 2006, the company resumed employing the "mini-landfill". By 2007 the "mini-landfill" was close to completely full.

Catalyst Paper has applied for an amendment to their Environmental Permit for a vertical extension of the existing landfill footprint area upward by an additional 20 metres. The main addition to the proposed landfill extension would be approximately 520,000 cubic metres, mainly fly ash.

There is a lot of data from landfill, slope and lake sampling from 1992 to 1996. The data is mainly from reports done by Agra Earth and Environmental Group.

From 1997 to 2006, Golder Associates Ltd was employed to develop the reports on the reduced landfill, slope and lake sampling.

Hatfield Consultants were employed for a November 2007 report.

The above reports cover a wide variety of subjects. This review will concentrate on the dioxin and furan results due to their toxicity and hazard to health.

The above reports state that the groundwater regime beneath the landfill is complex, consisting of numerous discontinuous aquifers. The Golder and Hatfield reports identify that some of the perched aquifers identified at the top of the slope to Powell Lake are at 11, 19, 29 and 38 metres depth. Groundwater is inferred to move laterally in the aquifers and vertically through the confining layers. Groundwater has been inferred to discharge to Powell Lake and within the bedrock layer is inferred to discharge as underflow to the lake.

In 1995, three recovery wells, 95-1, 8 & 9 were installed on the toe of the landfill at the slope to Powell Lake to try to capture and remove some of the toxins and leachate migrating down slope to the lake. They are situated approximately halfway across the toe's east-west line. Although they were successful in removing some of the landfill's dominant dioxins at high levels, they were not efficient at removing the more toxic dioxins and furans originating from around well 89-5. In 1999, three further recovery wells, 99-2, 4 & 5, were installed at and on the slope below well 89-5. Leachate recovery from 2000 to present has been concentrated on well 99-5, on the slope to the lake below well 89-5, with from 90 to 99% of the recovered leachate originating with this well.

On page 36 of their Nov 2007 report Hatfield states "Thus there is evidence to suggest that much of the dioxin/furan contamination observed in the River sediments were not a result of the landfill." Later on the same page they state "Dioxins/furans in the river sediments may be the result of the landfill, but they may also be due to atmospheric deposition from the mills boiler or other combustion sources. Because the ultimate source was likely the same (combustion of salt water impregnated wood chips in the

boiler), differentiation of the two potential sources based on congener profiles is not possible in this investigation."

It should be noted that the data from a 1992 Ministry of Environment report indicates that the boiler precipitator ash stored in the landfill was found to have dioxin and furan concentrations ranging from 2,227,000 to 2,449,000 pg/gram of ash.

The review of the dioxins and furans undertaken here includes the first detailed investigation of the 1992 to 2006 results under one cover. The graphical representation allows easy comparison of results. This allows the best possibility of identifying the levels and patterns of dioxins and furans in the landfill, on the slope to the lake and in the lake.

The more detailed analysis is included in Appendix A. Excerpts from Appendix A are brought forward here in the shorter report body.

2. Conclusions

This first complete comparative review and analysis of the landfill, slope and lake dioxins and furans and their patterns from 1993 to 2006 yields very simple and clear underlying results.

2.1 The landfill dioxin and furan results are generally dominated by dioxin D8. The highest D8 dominant results are at the landfill's western toe above the slope to the lake.

2.2 The exception to this is the eastern toe of the landfill above the slope to the lake where very toxic results, dominated by dioxin D6 and furan F6, are found around well 89-5.

2.3 A pattern of dominant dioxin D5 and D4 results occurs on the slope to the lake without a clear landfill origin. Its strong appearance in 1995 suggests that it potentially originates with the asphalt capping of the landfill and the work at the toxic area around well 89-5 to incorporate some of its toxic soil and materials in the cap.

2.4 All three of the above dioxin and furan patterns are found all the way down the slope to the lake.

2.5 The three dominant patterns of Conclusions 2.1, 2.2 and 2.3 are the only significant dioxin and furan patterns detected in Powell Lake. The results strongly indicate that the dioxins and furans in the lake are originating with the present landfill.

2.6 The approximate 520,000 cubic metres of ash proposed for addition to the landfill has a different toxic dioxin and furan content exceeding much of the existing landfill's results. With Conclusion 2.5, this does not appear prudent.

2.7 The leachate Recovery wells installed in 1995 to attempt to intercept dioxins and furans migrating down the slope to the lake mainly captured high D8 dominated results from the landfill western toe. The leachate Recovery wells installed in 1999 were concentrated at attempting to intercept the dioxins and furans from the very toxic area around well 89-5. They have been partially successful in achieving this. The 1995 recovery wells usage has been largely discontinued after 1999.

2.8 The most complete landfill and slope sampling was from 1993 to 1995. From 1996 onwards the sampling and analysis was substantially reduced. For example, the serious results found at the landfill western toe at well 89-3 were last sampled in 1995. The present sampling on the slope concentrates on the centre of the slope. What has been occurring on the western and eastern sides since 1995 is unknown.

3. Discussion of Results

3.1 Background

In order to more clearly understand the dioxin and furan data discussed in the report a basic understanding of the dioxin and furan families and their toxicities is useful.

Dioxins occur in 5 families (D4 to D8) and furans in 5 families (F4 to F8). Each family has a varying number of molecular forms. The less chlorinated forms of each group are D4 and F4. They have the largest families of molecular forms, only one of which is toxic. At the other end of the spectrum, D8 and F8 are fully chlorinated, have only one form and it is toxic.

With the exception of F5's high toxicity of one form, the toxicity decreases with increasing chlorination from D4 to D8 and from F4 to F8.

The number of forms in each family, the number and % of toxic forms and their toxicity is summarized in Figure1.

Dioxin and Furan Family Make-up and Toxicity				
Family	No. of forms	No. of toxic forms	% of toxic forms	TEQ (toxicity)
Dioxin D4	33	1	3%	1.0
Dioxin D5	25	1	4%	0.5
Dioxin D6	13	3	23%	0.1
Dioxin D7	2	1	50%	0.01
Dioxin D8	1	1	100%	0.001
Furan F4	43	1	2.3%	0.1
Furan F5	28	2	7%	0.05/0.5
Furan F6	22	4	18%	0.1
Furan F7	4	2	50%	0.01
Furan F8	1	1	100%	0.001

Figure 1 - Dioxin & Furan Family and Toxicity Table

Two picograms per litre (pg/l) of D8 would have a toxicity of 0.002 pg/l TEQ, (2 x 0.001).

Two pg/l of D6 would be expected to have a toxicity of 0.046 pg/l TEQ (2 x 0.23 x 0.1).

The above table is for fully developed dioxins and furans. There are several versions of these families, in part, depending on how mirror images are tabulated .

In real life the entire family is almost never fully developed in any combustion or similar process. In addition, the accuracy of analysis of this data introduces another margin of error.

The above examples are intended as a guide to understanding the change between the Total dioxin and furan graphs and the TEQ toxicity graphs which follow in the report.

Dioxins and furans contain the most toxic molecules known. They are considered so toxic and deleterious because, in large part, they damage DNA. It is the only group of molecules where a toxic equivalency (TEQ) is assigned on the basis of affinity for DNA.

For reference when considering the results shown here and in Appendix A, the USEPA guideline for drinking water is a TEQ of 30 pg/l.

The Figures display Dioxin & Furan results. The left graph generally illustrates the total dioxans and furans in each family. The right graph is generally their TEQ values for the toxic forms.

For the transition from total weight to the TEQ value please see the additional graphs and discussion with Figures A8 & A9 and A16 and A17.

The Ministry of Environment provided some important 1992 information including the results of dioxin and furan analysis of the 1992 precipitator ash in the landfill. Please see this information in the table in Appendix B.

3.2 The Landfill (before the toe)

The most toxic results in the landfill are unfortunately concentrated at the toe above the slope to Powell Lake.

The majority of the other landfill results are lower than at the toe and are dominated by D8 dioxin. Please see Appendix A's items 1.2 to 1.4 on pages 2 to 5 for more thorough results and discussion.

Note that, except for well 93-2, none of these landfill wells are sampled after 1994 in the available data. This creates a void of information as to what is occurring in the landfill.

A sample result is well 93-2. Well 93-2 is on the north edge of the landfill. Its Dec 2000 results for depth B are shown in Figure 2 below.

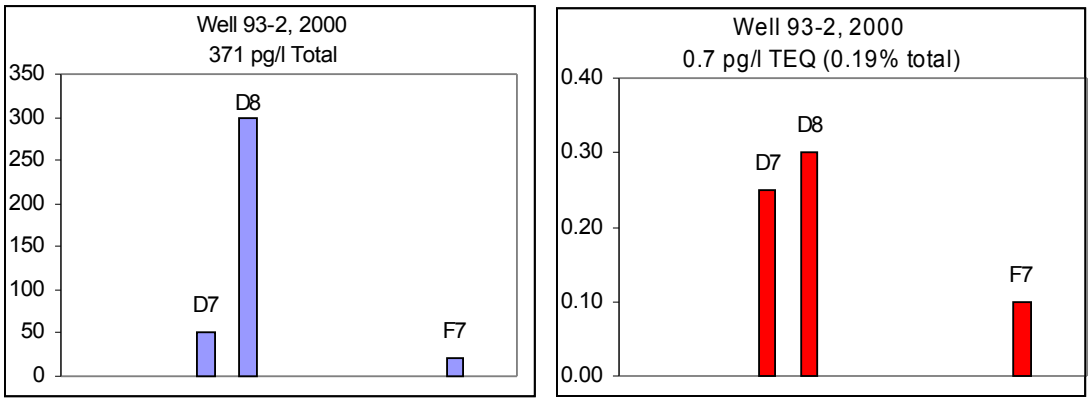

Figure 2 – Total Weight of all Dioxins and Furans and TEQ of Toxic Dioxins and Furans Well 93-2 Depth B Dec 2000

In Figure 2, the 2000 results for 93-2B are dominated by D8 dioxin. The TEQ graph result reflects the higher toxicity of D7 compared to D8.

3.3 The Toe of the Landfill

Please see Appendix A's item 1.5 on pages 5 to 14 for more thorough results and discussion.

The western toe of the landfill is dominated by the highest dioxin D8 results found in the landfill. This is best displayed by well 89-3's Jan 1994 results below in Figures 3 and 4.

In the available data 89-3 was sampled six times: once in 1992, Dec 93, twice in 1994 in Jan and April and twice in 1995 in May and July. The April 1994 result is a low result dominated by D8. The remaining five sample are very high results, all dominated by D8. This important well was not analyzed after 1995.

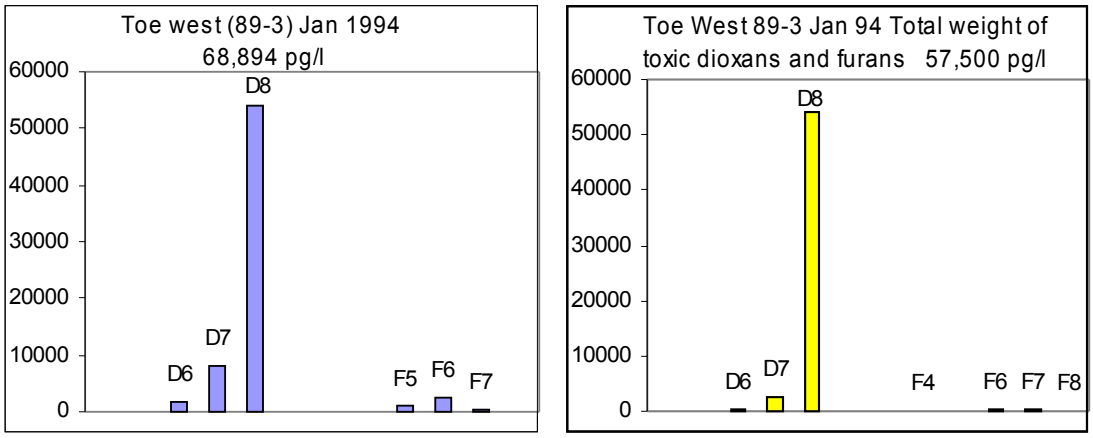

Figure 3 – Total Weight of all Dioxins and Furans and Total Weight of Toxic Dioxins and Furans Toe Well 89-3 Jan 1994

Jan 1994's results are very high at 68,894 pg/l total and strongly dominated by D8. As the only form of D8 is toxic, the total toxic weight graph on the right is even more strongly dominated by D8.

Again, considering the very high results and its position on the toe above the slope to the lake, the lack of data from this well after 1995 is puzzling.

The yellow total toxic weight results are shown here to allow comparison with well 89-5 results in Figures 6 and 7.

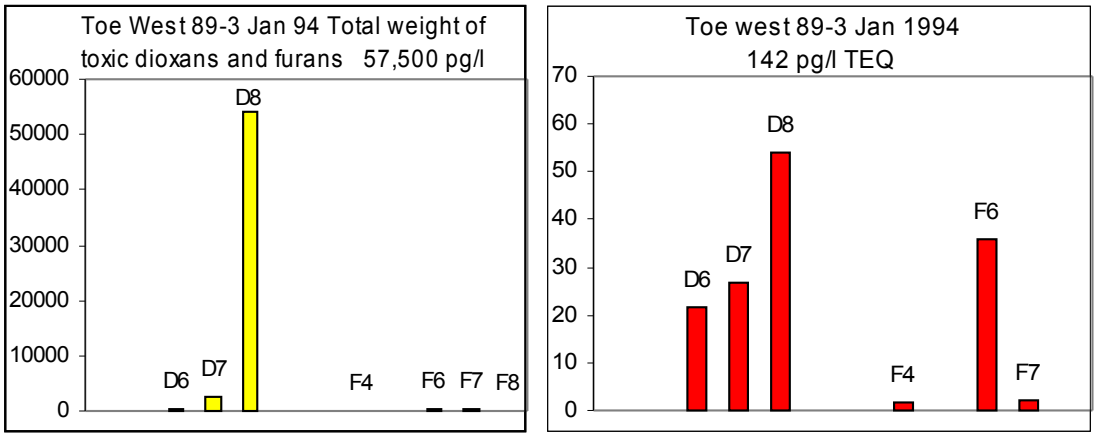

Figure 4 – Total Weight and TEQ of Toxic Dioxins and Furans Toe Well 89-3 Jan 1994

Fortunately D8, although at high total levels, is the least toxic of the dioxins and the TEQ is thus relatively low at 142 pg/l.

The results slowly change in a generally steady pattern across the toe to the eastern side.

Halfway across the toe are the leachate recovery wells 95-1, 8 & 9 installed in 1995. They were successful in removing some of the high D8 dominant results while in predominant use from 1995 through 2000.

This is shown by their Nov 1995 result in Figure 5.

These wells are not sampled after Dec 2000. After Dec 2000, the leachate recovery was concentrated on 1999's wells 99-2, 4 & 5 which are more targeted at collecting leachate from the more toxic area of the landfill surrounding well 89-5.

The samples are from Nov 95, Dec 97, Dec 98, Dec 99 and Dec 2000. The 1995, 98, 99 and 2000 results are similar and generally dominated by D8 as would be expected with the results seen at the western toe at wells 89-2 and 89-3. The Nov 95 results are shown in Figure A12.

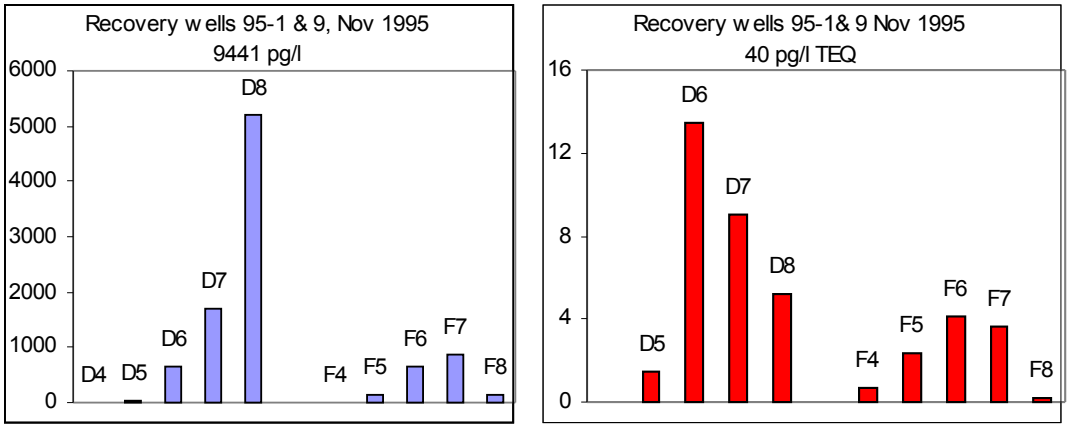

Figure 5– Total Weight of all Dioxins and Furans and TEQ of Toxic Dioxins and Furans Recovery Wells 95-1 & 95-9 Nov 1995

In Figure 5 the total result is strongly dominated by D8 as expected from these two more westerly recovery wells. The higher TEQ toxic results for D6 and D7 reflect their 100 and 10 times higher levels of toxicity compared to D8.

The eastern toe of the landfill is dominated by the most toxic results found in the landfill. This is best displayed by well 89-5's Jan 1994 results below in Figures 6 and 7.

89-5 is near the eastern edge of the landfill. It justifiably has the most samples among the landfill toe wells due to the severe toxic results around this well.

Background information on the severe toxicity around well 89-5 is first available in 1992 and 93. A Sept 1993 HBT Agra Limited report discusses a dense, heavier than water, viscous liquid found in the well 89-5 area. Its analysis found "very high levels of a number of contaminants". "The sample had extremely high levels of dioxins and furans as well as very high concentrations of organic compounds and tannins and lignins. Mercury levels were also high. Our working hypothesis is that the very high levels of

organic compounds has enhanced solution of dioxins, furans and some other contaminants, probably from the ashes disposed of on site. The presence of this viscous liquid must be considered in the remediation plan for the site."

The July 2007 Golder Associates report states "At the time of closure, the southeastern portion of the Phase 1 landfill contained sand and gravel containing Bunker C oil and cutting oil. These materials were stored in a lined and covered cell and the majority was used as aggregate for the asphalt cap discussed below." Closure of the Phase 1 landfill in 1995 consisted of covering the landfill with a low permeability asphalt cap.

It should be noted that several contaminants (eg creosote) makes the more highly chlorinated forms, such as D8, difficult to detect. (Environment Canada EPS-5-AR-81-2).

In the available data well 89-5 was sampled 18 times from 1992 to 2006.

The highest available results are from 1993 with a very severe result of **3,500,000** pg/l total weight of dioxins and furans and a TEQ result of 31,000 pg/l.

Feb 94's and March 2004's results at 500,000 and 160,000 pg/l total weight of dioxins and furans are also very severe and have the same pattern.

The 1993 results are shown in Figures 6 and 7.

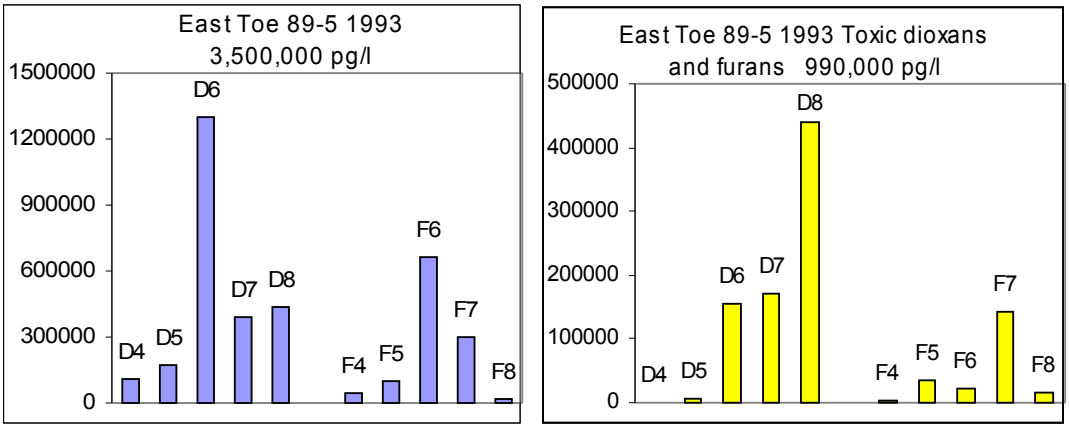

Figure 6– Total Weight of all Dioxins and Furans and Toxic Dioxins and Furans East Toe Well 89-5 1993

In Figure 6, the very severe results at well 89-5 are dominated by D6 and F6. This differs from the more common landfill pattern of dominance by D8.

As in D8 the only form is the toxic form, D8 continues to dominate the total toxic dioxin and furan results in the right graph. This continues the D8 pattern seen at the western toe in Figures 3 & 4.

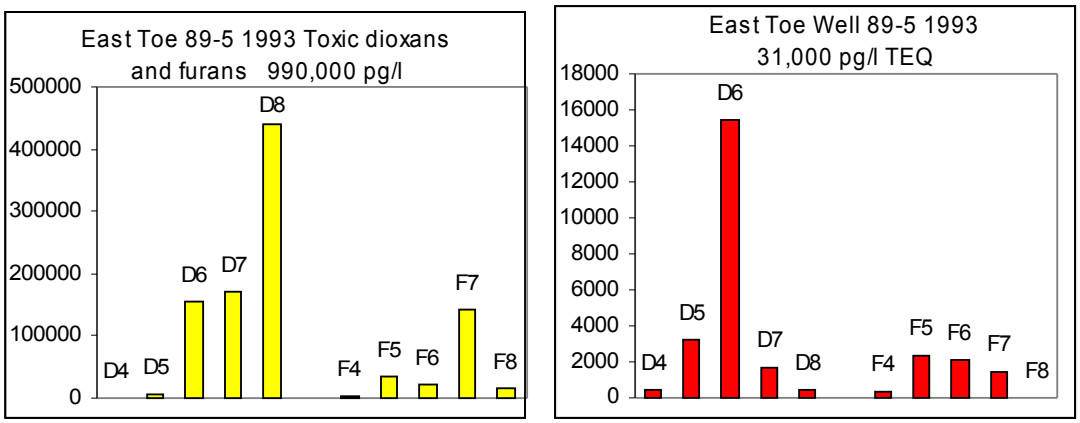

Figure 7– Total Weight and TEQ of Toxic Dioxins and Furans East Toe Well 89-5 1993

In these very severe results, the TEQ is dominated by D6. D6 is 100 times more toxic than D8.

The problems at well 89-5 continue to the present.

Excluding the abnormal Nov 2003 results discussed in Appendix A, the 11 sample results for total dioxins and furans from April 1994 to 2006 are displayed together in Figure 8.

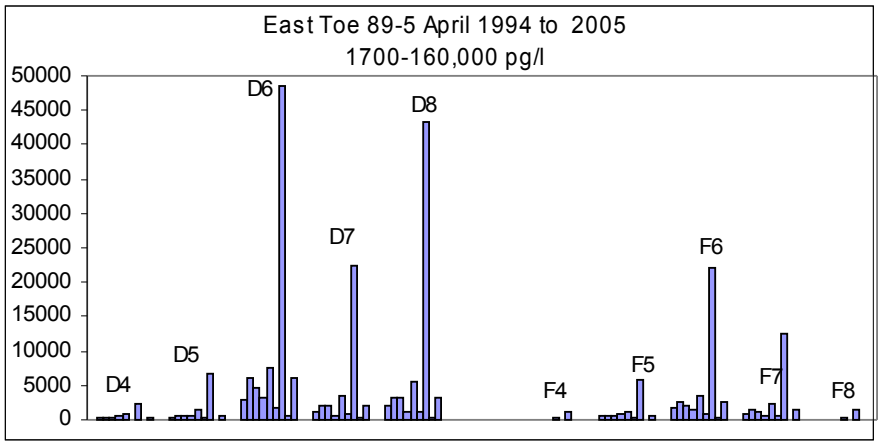

Figure 8– Total Weight of all Dioxins and Furans East Toe Well 89-5 from April 1994 to 2006

Figure 8 shows an ongoing similar pattern over 11 years with continued dominance by D6 dioxin and the F6 furan. The March 2004 results are very severe and more similar, in level to those of 1993 and Feb 1994.

The singular higher D4, D5, D7, D8, F8 and F7 results are all associated with Dec 2004's single sample and very high D6 and F6.

Figure 8 indicates that the high toxic contamination surrounding landfill well 89-5 is an ongoing undiminished problem since 1994.

3.4 The Slope to the Lake

Please see Appendix A's items 2.1 to 2.5 on pages 15 to 32 for more thorough results and discussion.

After 1995-6, the available data on the slope is generally limited to wells down the centre of the slope.

What is occurring on the western edge of the slope below the high results at wells 89-2 & 3 is unknown. The same applies to the eastern edge of the slope below the toxic results at well 89-5.

With the installation of the 99-2, 4 & 5 recovery wells in 1999, the leachate recovery has concentrated on well 99-5. It has high water recovery rates and is below the very toxic area around well 89-5.

In 2003 a volume of 2505 cubic metres of leachate was removed from the landfill with over 99% of this recovered from well 99-5. Typical more recent % of recovery rates from well 99-5 are: 2002 – 97%, 2003 – 99%, 2005 – 93%, 2006 – 86% and 2007 – 90%.

With the commissioning of these wells, particularly 99-5, less emphasis was given to pumping from the 1995 recovery wells 95- 1, 8 & 9 more directly below the western toe.

The mix of wells 99-2, 4 & 5 was sampled seven times, once per year, generally in Dec, from 2000 to 2006.

The 2000 to 2005 total results can be seen in Figure 9 below. The 2006 results are very low and not shown.

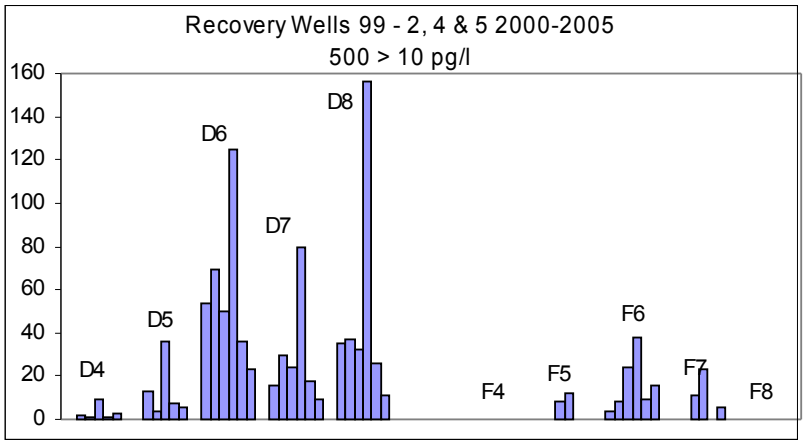

Figure 9– Total Weight of all Dioxins and Furans
Recovery Wells 99-2, 4 & 5 2000 to 2005

Figure 9's total dioxin and furan results are low considering the location below the very toxic area around well 89-5. This appears mainly due to dilution with well 99-5's high water recovery rate.

The generally dominant D6 and F6 pattern matches the results from well 89-5 seen in Figures 6, 7 & 8.

The main exception to this pattern is in 2003 where D8 is dominant although the more toxic D6 and F6 remain high. This may be due to an influx of D8 dioxins from the western toe area.

The most important aspect of these results is that the toxic dioxins and furans from the landfill area around 89-5 are moving down the slope.

2003's results are the highest. The results then improve yearly to 2006. It is unclear whether this is due to dewatering of the toxic area around 89-5 or this is due to increasing dilution with increasing water flow and recovery rates.

The latter is the better possibility as dewatering of the toxic 89-5 area would leave its more highly toxic dioxins and furans in place.

D8 on the slope

Slope well results with a dominant or strong underlying dioxin D8 component are common on the slope to the lake. Please review Appendix A.

This is already seen in the recovery well 99-2, 4 & 5's results in Figure 9 above.

Three additional graphical results are included here.

Well AH6 is adjacent to Recovery well 99-5 and slightly above Section H-H.

In the available data AH6 was sampled fifteen times. Only one sample, Jan 94, was identified as from Depth A at 10 metres. It is shown in Figure 10 below.

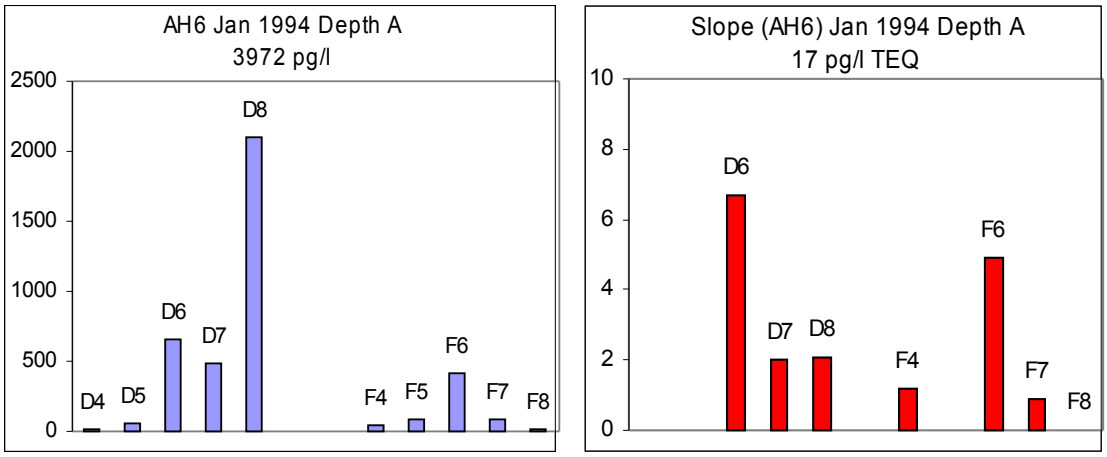

Figure 10– Total Weight of all Dioxins and Furans and TEQ of Toxic Dioxins and Furans Slope Well AH6 Depth A Jan 1994

Slope well AH6 is below toe wells 89-4 and 89-5. It is also in the low point of Section H-H's contour line. AH6's total results are clearly dominated by D8 similar to most of the landfill. The relatively more toxic components of D6 and F6 dominate the TEQ results.

Nov 95's results at the lower depth B are similar.

AH3 is halfway down the slope. It is a shallow 10 metre deep well.

In the available data AH3 was sampled 18 times from 1992 to 2006.

Well AH3's Dec 2000, 2001, 2002, Nov 2003, Nov 2004 and 2005 sample results are shown in Figure 11. No dioxins and furans were detected in Dec 2006.

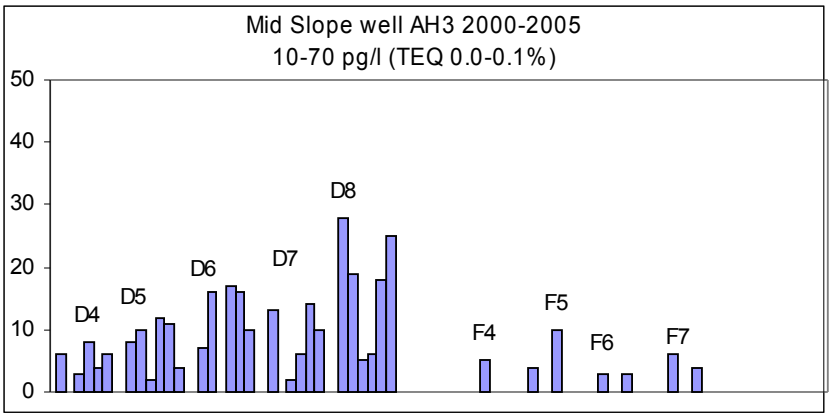

Figure 11– Total Weight of all Dioxins and Furans
Mid Slope Well AH3 2000 to 2005

Generally, the 2000 to 2005 results are much lower than those seen previously at this well. This likely reflects the increased leachate recovery rate with the advent of recovery wells 99-2, 4 & 5, particularly 99-5 in 2000. D8 is the most common dominant dioxin or furan.

An important D8 result is at the Springs at the slope bottom and at lake level. The Spring results are varied. The variation is best summarized and includes:

- 3 sample results dominated by high levels of D5
- 9 sample results with D8 detected alone or dominant at low to mid range levels
- 14 sample results with low levels of individual dioxins and furans (<50 pg/l) generally dominated by D8 or D5 with one high D6 result.

The 9 sample results with D8 detected alone or dominant at low to mid range levels are in Figure 12 below. The first two graphed samples are from Spring 2 in 1992 and April 1994 with all the subsequent samples from Spring 1.

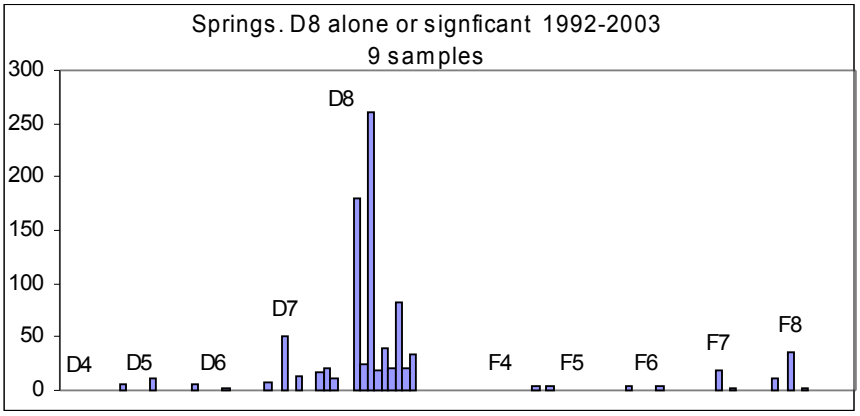

Figure 12– Total Weight of all Dioxins and Furans Springs 1 & 2 1992 to 2003

This is the most commonly expected result at the springs with the common D8 dominance in the landfill, at the western toe and on the slope to the lake.

D6 – F6 on the slope

Slope well results with a dominant or strong underlying dioxin D6 – F6 component originating from the well 89-5 area are also found on the slope to the lake. Please review Appendix A.

This is again already seen in the recovery well 99-2, 4 & 5's results in Figure 9 above. Two additional slope result samples are included here.

Figure 13 displays AH6's Dec 2006 results from Depth B at 20 metres.

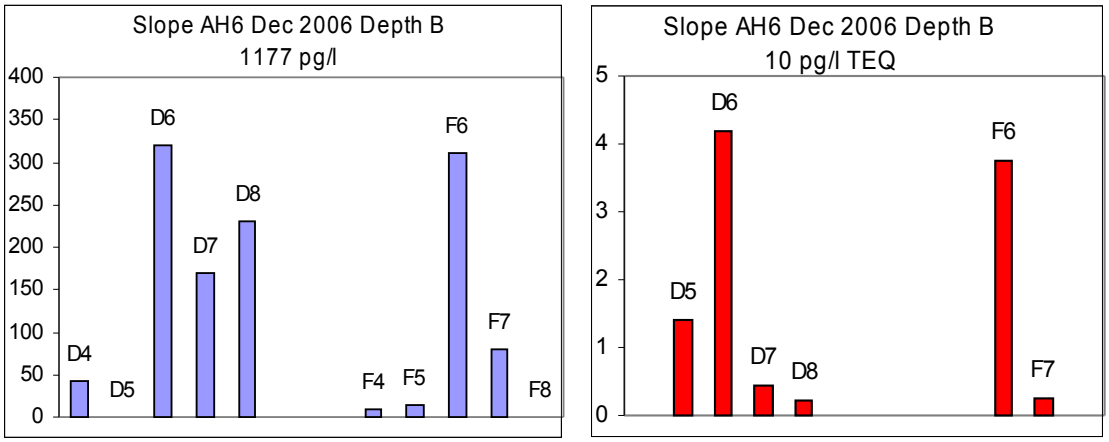

Figure 13– Total Weight of all Dioxins and Furans and TEQ of Toxic Dioxins and Furans Slope Well AH6 Depth B Dec 2006

Slope well AH6 is below toe wells 89-4 and 89-5. It is also in the low point of Section H-H's contour line. These AH6's results are similar to those of the more toxic area around well 89-5.

Well 94-1 is further down the slope from AH6. Its Depth 2 at 50 metres has 2 samples in March and April 94.

April 94's Depth 2 (50m) results are displayed in Figure 14 below.

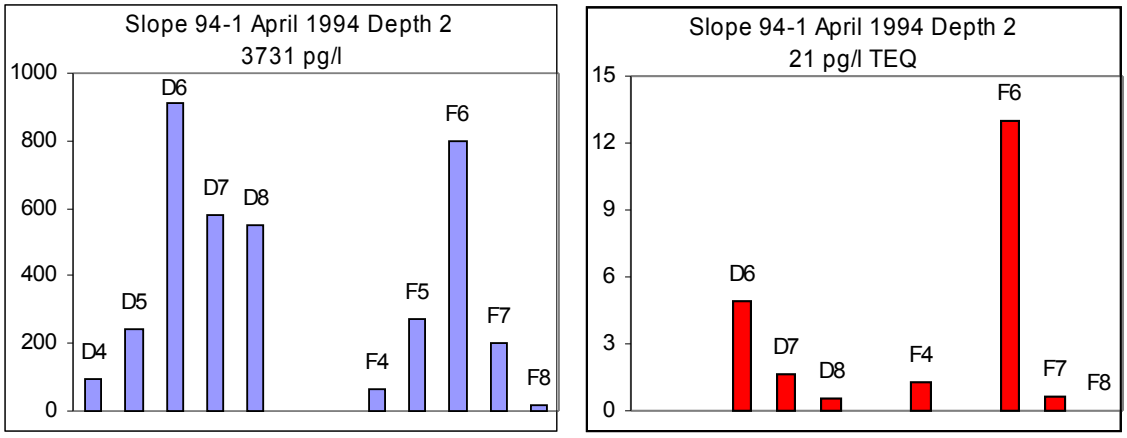

Figure 14– Total Weight of all Dioxins and Furans and TEQ of Toxic Dioxins and Furans Slope Well 94-1 Depth 2 April 1994

In April 94 well 94-1's Depth 2 result has the full range of dioxins and furans with D6 and F6 at the highest levels. As this well is below well 89-5 which strongly displays this pattern compared to the more common D8 dominance of the landfill this is, in some ways, the more expected result.

Importantly, D6 and F6 are also found at the Springs at the bottom of the slope and lake level. They are at higher than normal levels in 1992 at Spring 4 in Figure A39 in the Appendix. They also appears at other dates and springs at lower levels in Figure A39. They also appear at significant levels at Spring 1 in 1993.

D5 on the slope

Slope well results with a dominant or strong underlying dioxin D5 component, often accompanied by D4, generally make a strong appearance on the slope to the lake in 1995 often reducing in severity by the end of 1995 but persisting lower on the slope at later dates. Please review Appendix A.

This is again already seen in the recovery well 99-2, 4 & 5's results in Figure 9 above. As this pattern appears only on the slope and appears to be related to the 1995 capping of the landfill, four additional slope result samples are included here.

Well AH4's July 1995 and Nov 1995 total results can be seen in Figure 15.

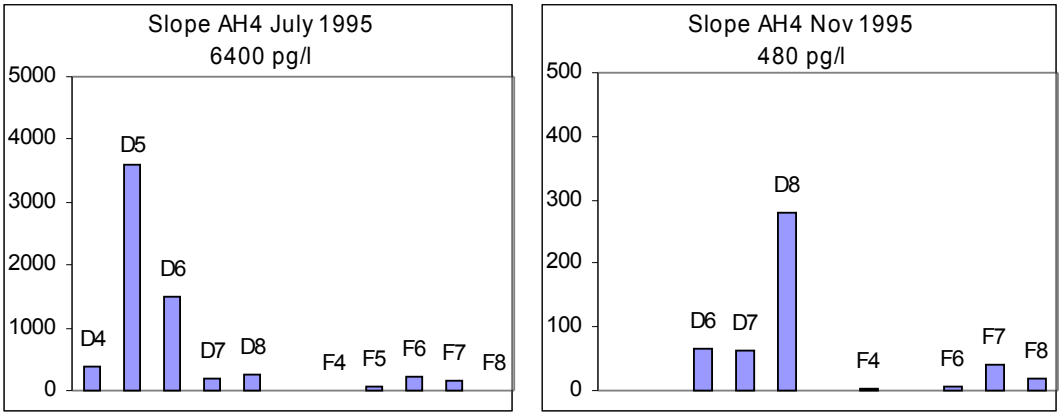

Figure 15– Total Weight of all Dioxins and Furans
Slope Well AH4 July & Nov 1995

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In Figure 15 well AH6's July 95 results are dominated by D5. As discussed with well 94-1 this is an unusual result. By Nov 1995 the results in the right graph return to a more normal, for the landfill, D8 dominant result. The furans are low and variable.

This pattern in 1995 occurs with some regularity further down the slope. It appears that it may be related to the capping of the landfill in 1995 and the work around well 89-5 incorporating some its toxic landfill material into the cap with the D5 running off the new cap and onto the slope.

This change, irrespective of source, illustrates the flow down the slope.

AH3 is a shallow 10 metre deep mid slope well. It was sampled 18 times from 1992 to 2006.

The 1994 to 1997 results show a variety of patterns. The Jan and April 1994, May, July and Nov 1995 and Dec 1997 results are shown in Figure 16 below. There was no available data for 1996.

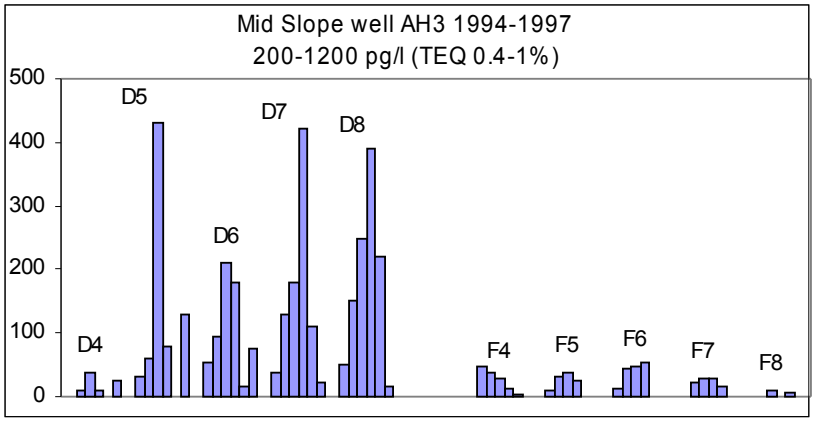

Figure 16– Total Weight of all Dioxins and Furans
Mid Slope Well AH3 1994 to 1997

In 1995 a very high D5 appears in May, begins to die away in July and is again gone by Nov 1995. This appears to match the pattern of high D5 dominance appearing on the slope in 1995 with the capping of the landfill as seen in Figure 15 at well AH4. D5 levels increase in 1997 but do not approach the May 1995 result.

D6 - F6 and D8 remain the most consistent underlying patterns, likely originating with down slope contamination from the well 89-5 area for the D6 –F6.

See Appendix A for a discussion of D7.

94-16, a lower slope well, was sampled 33 times. The May, July and Nov 1995 results for depth M at 30 metres are displayed in Figure 17.

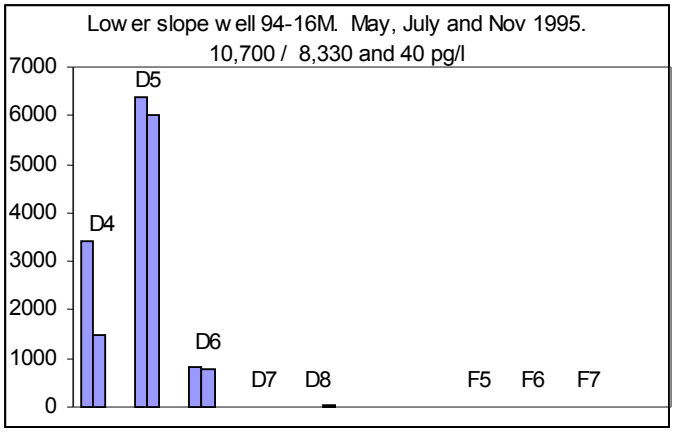

Figure 17– Total Weight of all Dioxins and Furans
Lower Slope Well 94-16 Depth M May, July & Nov 1995

In the 1995 results for well 94-16 at Depth M, D5 suddenly dominates in May, decreases slightly in July and disappears in November where low levels of D8 dominate. This continues to match the 1995 pattern seen at several places on the slope to the lake and continues to potentially be associated with the capping of the landfill. 94-16's Depth U and L 1995 results are similar.

Although the Spring results are varied, 3 sample results are dominated by high levels of D5.

The July 1995, Dec 1997 and July 2002 results with higher levels of D5 are shown in Figure 18.

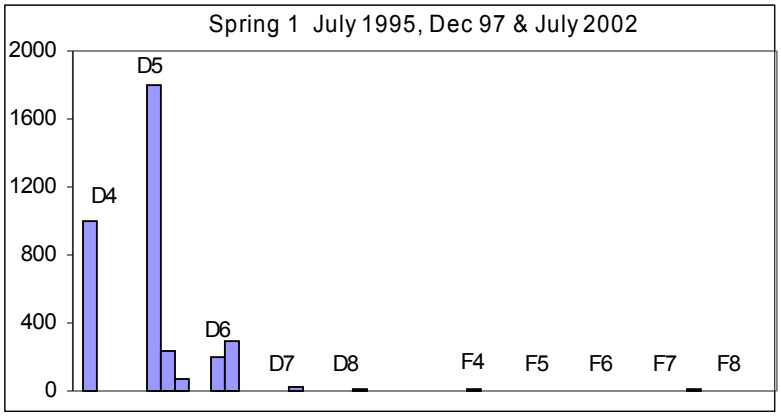

Figure 18– Total Weight of all Dioxins and Furans
Spring 1 July 1995, Dec 1997 & July 2002

Figure 18's very high July 1995 D5 result was seen at several slope locations and coincides with the capping of the landfill and the work around well 89-5 to incorporate some of its toxic surrounding soil in the cap.

The lesser but still high Dec 1997 and July 2002 results likely reflect D5's migration down the slope.

The importance of the above D8, D6 –F6 and D5 results is not only their appearance at these levels on the slope but their migration all the way down the slope to the springs by the lake.

3.5 Powell Lake

In the available data, water from Powell Lake was sampled 30 times.

The lake is a remarkably large dilution source and the results are generally low as would be expected. Due to the high dilution only the more dominant landfill and slope dioxins or furans are detected.

The were no dioxins or furans detected in 16 samples. See Appendix A for the list. The Aug 2000 sample with D8 is higher in the blank is omitted. See the Appendix for other slight data irregularities.

Six samples contain mainly or only D8, the generally dominant landfill result. They are from March 1998, June and Aug. 1999, Dec. 2000, Jan 2003 and Dec 2005.

These samples range from a total D8 detected of 2.8 pg/l in Dec 2005 to 36 pg/l in June 1999 and average 19.6 pg/l total D8. When Dec 1998's 100 pg/l D8, discussed below, is included the detected D8 average climbs to 31.1 pg/l.

D5 or D4 are detected alone or dominant in six samples: June 2000, June and Sept 2001 (both just D4), Jan (D5 with D4) and Oct 2002 (D5) and in Aug 2006 (D5 with low D4). D5 appears in the blank in June 2000 - the sample is kept. D5 is commonly detected on the slope to the lake below the landfill, often at high levels and in combination with D4.

More strikingly, the results found at the springs at the bottom of the slope are dominated by D5, often with accompanying D4 and by D8 as seen in the preceding Figures A37 to A39 in Appendix A.

When combined with the landfill and slope results, it is remarkably simple to conclude that the dioxins detected in the lake are originating from the landfill.

Some evidence of D6-F6 dominant results from the very toxic area around landfill well 89-5 would be expected. Considering the high dilution in the lake, the Dec 98 results appear to answer the expectation and are seen below in Figure 19.

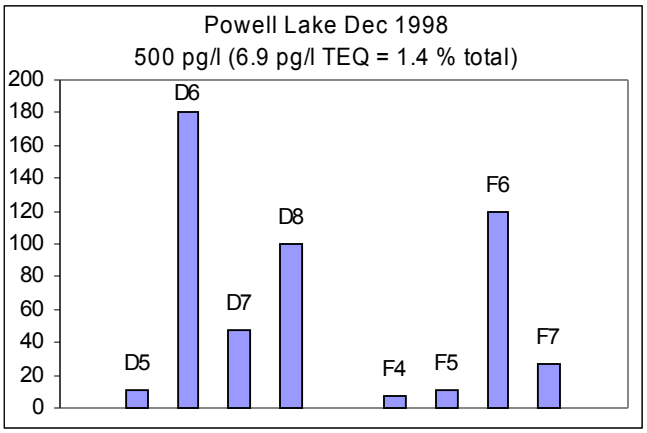

Figure 19– Total Weight of all Dioxins and Furans
Powell Lake Dec 1998

Figure 19's high lake results (for the lake) are dominated by the D6 – F6 pattern found at the toxic area around well 89-5. Note that D8 is also high.

It must be noted that these results, at 500 pg/l, are 7.8 times higher than the next highest lake total dioxin and furan result of 64.1 pg/l in Jan 2002. However, they do occur in 1998 prior to the 1999 installation of recovery well 99-5. The 1995 leachate recovery wells' data indicates that they did not recover D6 – F6 dominated toxins originating from the well 89-5 area. See Figures A12 and A13 in Appendix A.

Well 99-5 recovers some of the very toxic material originating from the well 89-5 area. December is quite often a high rainfall and groundwater flow month. Recovery well 99-5, below 89-5, shows a pattern of pulsing or slugging high levels of D6 – F6 as can be seen in the 2003 results in Figure A23. Well 89-5 itself also shows a pattern of pulsing or slugging high levels of D6 – F6 as can be seen in the March 2004 results in Figure A19 in Appendix A.

It is therefore possible that a large slug of 89-5 area toxins made its way to the more quickly flowing water recovery area around the future well 99-5 area and to the lake in this period. It could then preferentially be carried by the river flow to the mill filter house where these lake samples were generally taken.

These results are similar to the very toxic results found at well 89-5 in Figure A16 and remarkably similar to the results found on the slope to the lake below well 89-5 at well 94-2 in Figure A21 and well AH6 in Figure A28 in Appendix A.

This is another striking indication that the dioxins and furans detected in the lake are originating from the landfill.

4. Proposal for Landfill Extension

Catalyst Paper has applied for an amendment to their Environmental Permit for a vertical extension of the existing landfill footprint area upward by an additional 20 metres. The main addition to the proposed landfill extension would be approximately 520,000 cubic metres, mainly fly ash.

The results of analysis of a 2007 sample of the ash are shown below in Figures 20 and 21. Note that these results are for 1 gram of ash.

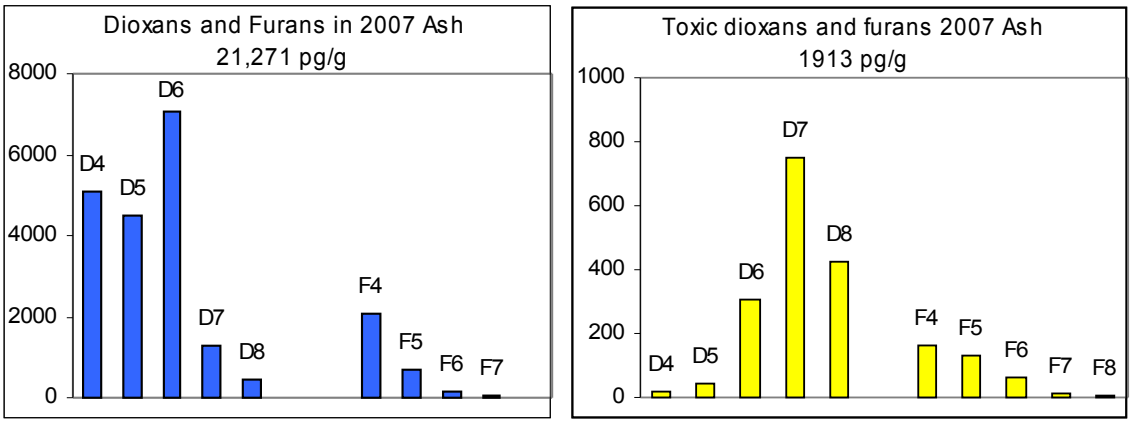

Figure 20– Total Weight of all Dioxins and Furans and Toxic Dioxins and Furans 2007 Ash

The total ash results in the left graph are dominated by the less fully chlorinated D4, D5 and D6 dioxins and F4 furan. The toxic weights in the right graph are not dominated by these dioxins and furans due to their toxic form's low % of their respective families. Please refer to Figure 1 at the start of the report. Conversely D7 and D8 are high in the right graph due to their toxic form's high % of their respective families.

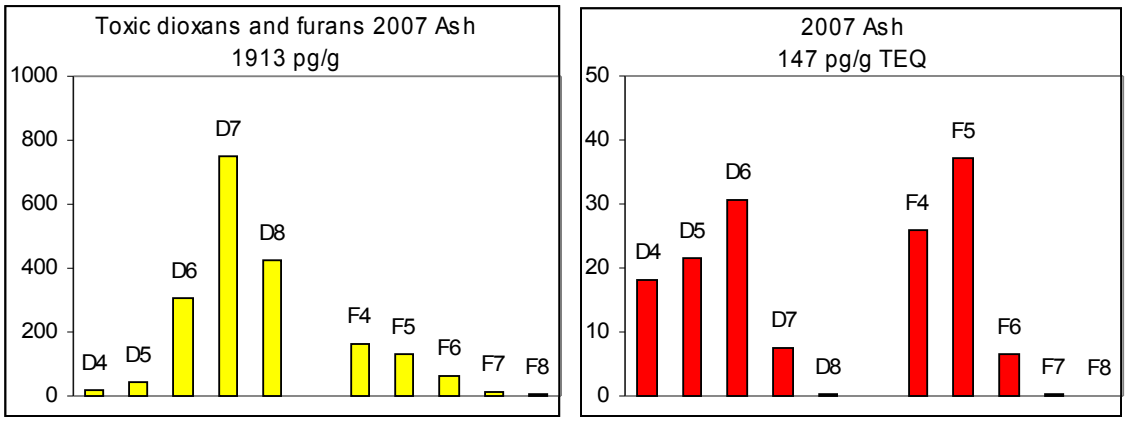

Figure 21– Total Weight and TEQ of Toxic Dioxins and Furans 2007 Ash

The toxicity TEQ results in the right graph are different than anything found in analysis of the existing landfill or slope data. The more toxic D4, D5 and D6 dioxins and F4 and F5 furans are dominant.

With results already seen in this report and Appendix A in the landfill, the slope to the lake and the lake, the addition of 520,000 cubic metres or approximately 1 trillion grams of this ash to the landfill does not appear to be prudent.