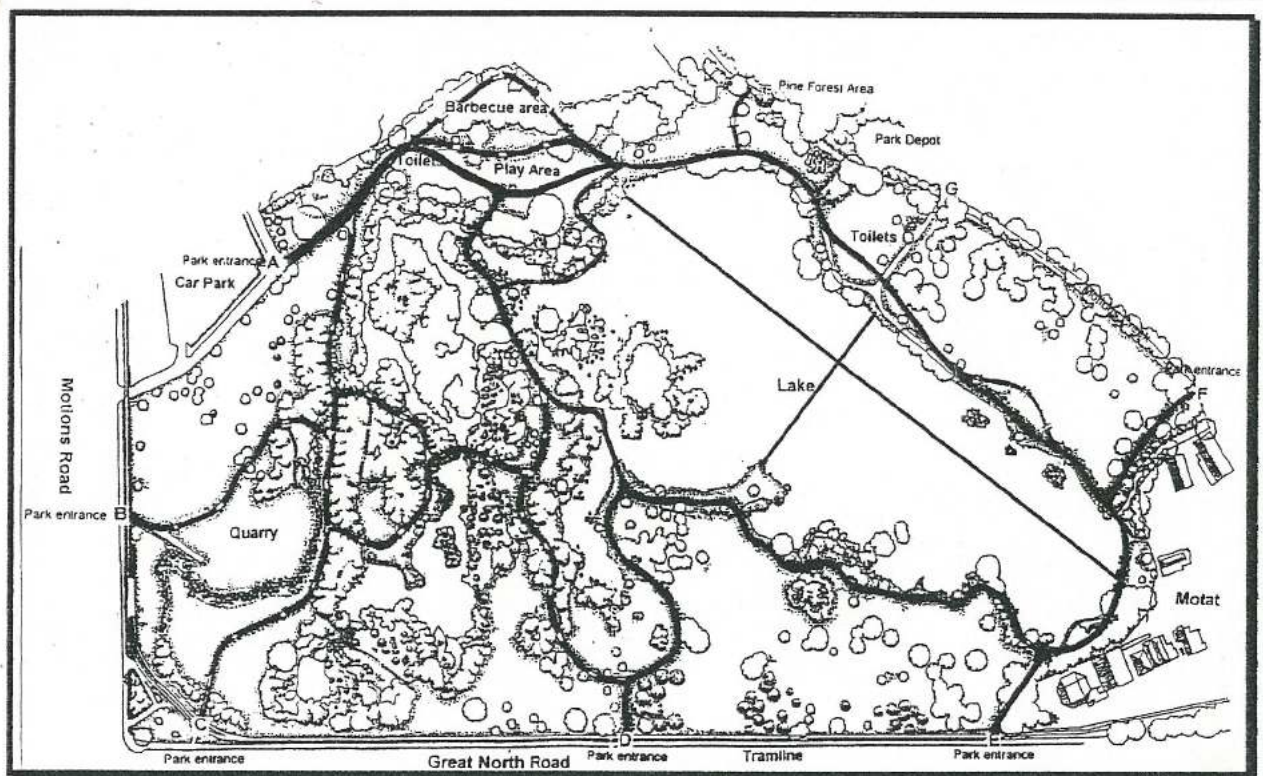


Macrophyte Survey in Western Springs Lake, Auckland to monitor the effect of Grass Carp.

First Survey, 21 October 1996



Western Springs Lake showing position of the two transects

Gray Jamieson Holdings Ltd 6 Savoy Road Orewa.
Tel 09 4265143 Fax 09 4265170

1 November, 1996

Weed Survey of Western Springs Lake

First survey, 21 October 1996

Introduction

This survey is the first survey to monitor the macrophyte levels as outlined in the report *Management and Security Plan for Monitoring the Effectiveness of Grass Carp in Controlling Aquatic Macrophytes in Western Springs Lake, Auckland* prepared by Gray Jamieson Holdings Ltd. The report outlined the method for determining the effectiveness of the grass carp in controlling the macrophytes.

This survey was carried out on 21 October 1996.

Stocking with grass carp

Two stockings of grass carp have occurred. The main release occurred on 30 September 1996 following an approval from the Minister of Fisheries when 1001 small grass carp were released (see photograph 1). The first release of three large carp into the Lake occurred three weeks earlier following an approval from the Minister of Conservation. The Park staff have noticed more small stalks of weed floating in the Lake and reported seeing two dead fish with wounds to the back of the head as a result of shags taking the fish. During the survey, sightings of the larger carp were made, but none of the smaller fish.

Method of assessing level of macrophytes removed.

The following is an extract from the report which outlined the method used.

A biannual survey, once in mid-spring and mid-summer will be carried out using the method described below to determine the change in the level of macrophytes in the Lake. As a backup, colour photographs will be taken during each survey. These photographs will be taken from the same position and angle to provide a visual record of the changes in macrophyte level. Ideally, the first survey will be conducted just prior to the introduction of the fish. However, this will depend on when the introduction will occur.

During each survey, two transects lines crossing the whole Lake from shore to shore will be set in position. One line will cover length of the Lake (about 412.2 m) and the other at right angles to this.

For the first survey, the origin and endpoint on the shoreline of these transect lines will be identified so that transect lines can be set in the same position for future surveys.

At five metre intervals along these transect lines, the Lake depth will be measured with a depth line and the height of the weed measured with a shot line. Measurements will be recorded in centimetres. Should the water clarity make locating the height of the macrophytes impossible, a hollow plastic tube with a clear perspex end will be employed. At the five metre intervals, the main macrophyte species will be identified, a proportion for each estimated and an assessment of the macrophyte density made. At the time of these surveys, water temperature (at 10 cm depth) and water clarity, measured by secchi disc will be recorded.

From the water depth and height of the macrophytes, the proportion of the area below the transect that consists of macrophyte will be calculated. From follow up surveys, the percentage change in macrophytes can be estimated. Dislodged surface-floating macrophytes will not be included in survey. As further surveys are conducted over successive years, a time-series of the level of macrophytes removed can be obtained. If the stocking levels of grass carp are correct, the level of macrophyte loss will increase as the fish grow, but will be tempered by natural mortalities. As the carp reach maximum size for the Lake, macrophyte consumption will decline.

This method assumes that grass carp will have a uniform effect on the macrophytes throughout the Lake and that the two transects lines selected are representative of the whole Lake. As a backup, the colour photographs will be used to support the results of the survey. Temperatures will indicate whether the fish will be feeding (they cease to feed below 10°C) and secchi disc readings will indicate whether algae production is increasing.

As this is the first survey undertaken, it is not possible to make an assessment of the effect the grass carp have had on the Lake until the next survey in summer. However, the reference points for the two transect lines have been identified and will be used for subsequent surveys.

Bottom depth and weed depth were determined using a plastic pipe about 20 mm in diameter with graduations marked on it. Measurements were taken to the nearest centimetre.

Reference points

For the transect along the length of the Lake, the starting point was at the northern end of the lake where the transect lines was tied to a tree stump close to the water's edge. The transect crossed the Lake to the southern end to a point next to a lamp post and tied onto a large boulder (see photograph 2).

The transect over the width of the Lake started at the boat ramp on the eastern edge by a post used to moor boats near the shore and crossed the Lake to a large flax bush on the other side.

The positions of the transect lines are shown on the map on the cover page.

The water level below the concrete verge just in front of the mooring post was identified as a reference point for the water level. For this survey, water level was 18 cm below the verge.

General description of macrophytes

The macrophytes at the time of this survey was almost entirely comprised of the oxygen weed, *Egeria densa* smothered in an extensive growth of filamentous algae. The filamentous algae not only covered the oxygen weed, but was floating on the surface in large mats supported by many small bubbles. These mats had covered much of the surface of the Lake but at the northern end, some had been gathered and removed by the use of a boat with a boom attached comprised of prongs extending into the water. The southern end of the Lake was still covered as can be seen by the photographs. The volume of the floating algae was not taken into account with this survey.

Although the water was clear, it was not possible to see the Lake bottom because of the blanket of filamentous algae. However when inserting the measuring pipe, it was evident the macrophytes remained dense under the mat of filamentous algae. There were occasional small spikes of oxygen weed almost reaching the surface and covered in algae. When estimating the height of the weed, a point representing the average height close to the transect line was taken.

The floating mats of filamentous algae diminish the aesthetic appearance of the Lake and when this algae decomposes, it can produce an unpleasant odour.

Both filamentous algae and the oxygen weed are plants consumed by grass carp.

Photographs

As a backup, photographs were taken to show the extent of macrophytes in the Lake. A series of four photographs were taken after the survey at key reference points. In subsequent surveys, photographs from these same points will be taken to provide a pictorial representation of the effect of the grass carp in controlling the macrophytes. The photographs are presented on pages 6 and 7.

Results

Temperature of the Lake was 19.4°C. Weather at the time of the survey was warm and overcast, but no rain. The westerly wind was very slight and fading.

For the lengthwise transect (which was 410.55 metres long), total area under the transect to the bottom is 671.2 square metres. The macrophyte area covered 504.7 square metres of this area. This means that 75.2% of the total area under the transect to the bottom contains macrophytes (excluding floating material). For each 5 metre section, the mean weed area was 74.6(±12) %.

For the widthwise transect (which was 115.4 metres long), total area under the transect is 207.1 square metres and the total macrophyte area is 158.5 square metres. This means that 76.5% of the total area under the transect to the bottom contains macrophytes (excluding floating material). For each 5 metre section, the mean weed area was 73.9(± 13) %.

The diagrams on pages 8 and 9 provide a pictorial representation of the macrophyte area for each transect. Note that the scale used for transect distances and depth are not the same. This is to provide a better picture of the macrophyte levels.

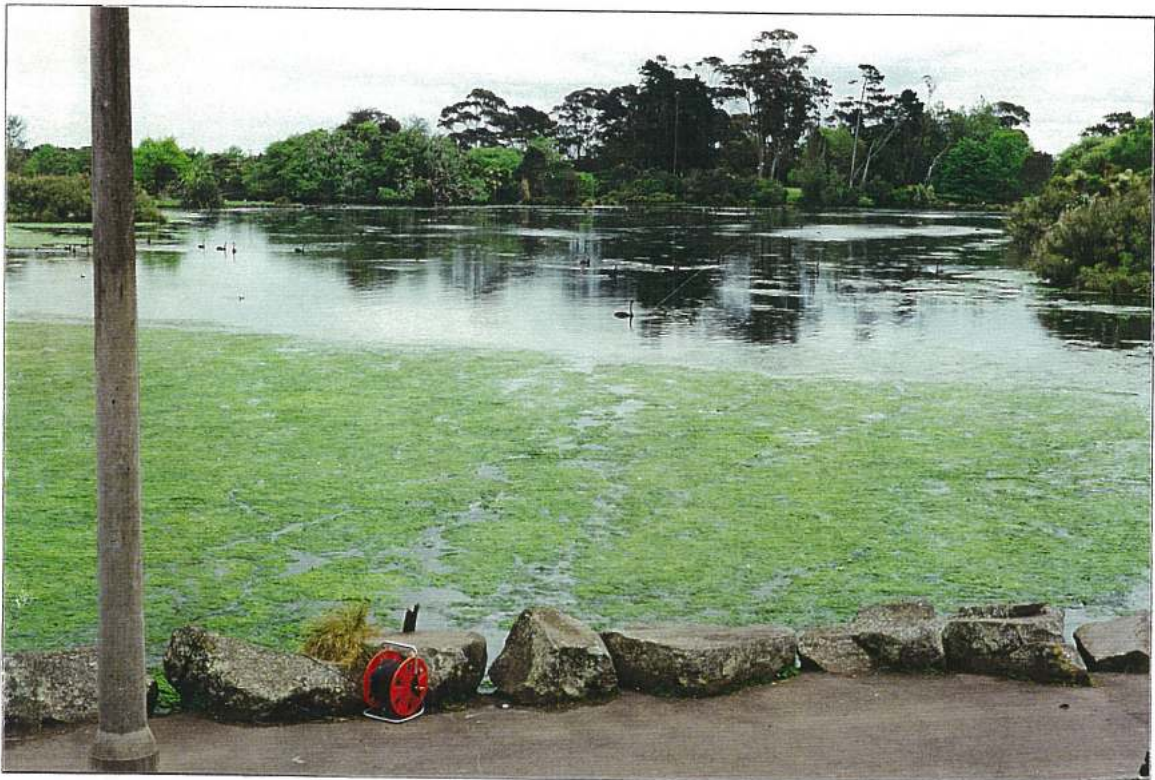
Conclusion

The carp have only been in the Lake for 21 days and clearly would not have had time to make an appreciable affect on the macrophytes although more stalks of weed have been observed floating on the lake. There is clearly a very high productivity of macrophytes in the Lake as the filamentous algae is currently covering all the oxygen weed and most of the surface despite frequent removal of the surface-floating material. The carp are still small but will now be actively consuming plants and growing quite quickly with the warmer weather and abundant food supply.

The carp will probably appear to have had little effect on the macrophytes by the time of the next survey in summer but the next transect survey should start to show their impact.



Grass carp being released into Western Springs Lake on 30 September 1996.



The transect line across the length of the Lake (taken from the Southern end).

Reference Photographs



Reference Photograph 1: Southern end by transformer. Note extensive mats of filamentous algae.



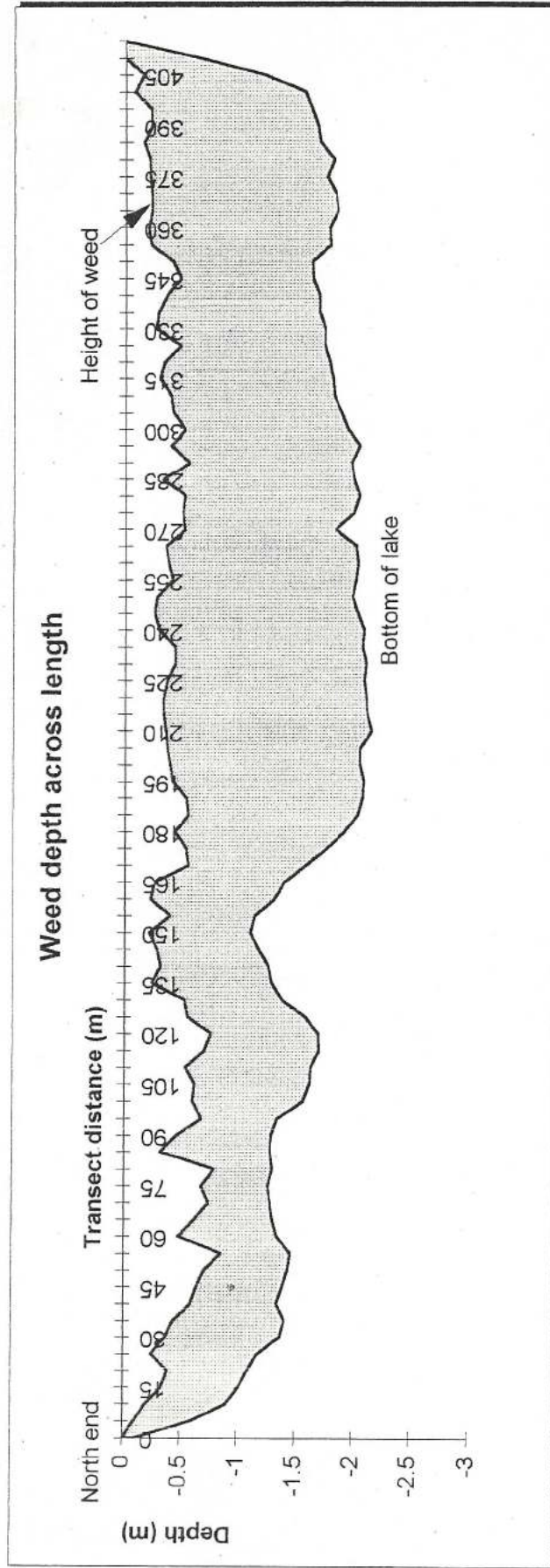
Reference photograph 2: on bridge over larger outlet. The filamentous algae can be seen in the foreground and in the next bay.

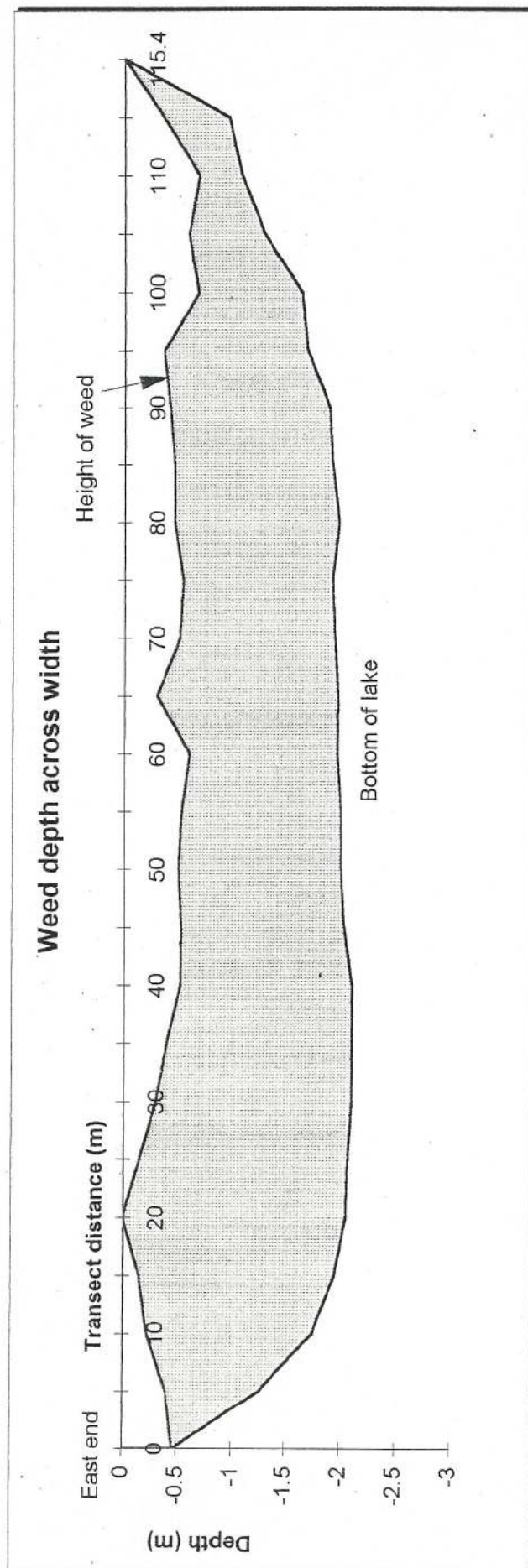


Reference photograph 3: At post by boat ramp. Some of the oxygen weed can be seen reaching the surface.



Reference Photograph 4: By small outlet. Filamentous algae visible in the foreground.





Macrophyte Survey in Western Springs Lake, Auckland to monitor the effect of Grass Carp

Sixteenth Survey, 2 September 2010



Recreational activities at Western Springs Lake

NZ Waterways Restoration Ltd, 6 Savoy Road Orewa Tel 09 4265143 Fax 09 4265170

26 September 2010

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Weed Survey of Western Springs Lake

Sixteenth survey, 2 September 2010

Purpose

The purpose of this report is to present the results of the sixteenth survey carried out on Western Springs Lake on 2 September 2010, to compare these results with previous surveys, to report on any unusual observations during the survey and to make recommendations on actions to be taken following the completion of this report. This report follows a similar format to previous reports.

Introduction

This survey is the sixteenth survey to monitor the macrophyte levels as outlined in the report *Management and Security Plan for Monitoring the Effectiveness of Grass Carp in Controlling Aquatic Macrophytes in Western Springs Lake, Auckland* prepared by Gray Jamieson Holdings Ltd. The report outlined the method for determining the effectiveness of the grass carp in controlling the macrophytes.

Summary of previous surveys

The dates the previous surveys were carried out are:

First	21 October 1996
Second	31 January 1997
Third	20 March 1997
Fourth	25 August 1998
Fifth	4 October 1999
Sixth	4 October 2000
Seventh	14 December 2001
Eighth	27 December 2002
Ninth	31 October 2003
Tenth	3 November 2004
Eleventh	23 October 2005
Twelfth	4 September 2006
Thirteenth	12 November 2007
Fourteenth	3 September 2008
Fifteenth	8 October 2009

Annual surveys of the aquatic plants in Western Springs Lake have been undertaken since 1996. Prior to the release of grass carp, extensive mats of floating weed were common sights on the lake and several times over the warmer months, weed harvesting boats were employed to remove the weed. The first release of grass carp into the lake occurred in late September 1996 when 1004 grass carp were released. The carp were able to remove the weed by August 1998 and has not been a problem since. Weed beds re-appeared around the seventh survey, but were controlled by the release of more carp. Since that time, the weed beds have not returned.

Despite the removal of the aquatic weeds, the water in the lake has remained largely clear and has often been clear to the lake bottom. Sometimes water clarity was reduced slightly by the growth of planktonic algae, but never developed into blooms. There are some silver carp (which filter out algae) in the lake, but it is not known what effect they are having on the levels of algae.

Regular netting surveys have been undertaken to remove pest fish from the lake. These are undertaken to remove koi, catfish, goldfish, tench and perch. Grass carp have also been removed from time to time. Details of the fish removed from the lake have been reported in the annual reports.

General description of macrophyte beds in previous surveys

The following are extracts from reports on previous surveys describing the nature of the macrophytes at the time of the survey.

First survey

The macrophytes at the time of this survey were almost entirely comprised of the oxygen weed, *Egeria densa* smothered in an extensive growth of filamentous algae. The filamentous algae not only covered the oxygen weed, but also were floating on the surface in large mats supported by many small bubbles. These mats had covered much of the surface of the lake but at the northern end, some had been gathered and removed by the use of a boat with a boom attached comprised of prongs extending into the water. The southern end of the lake was still covered.

Second survey

At the time of the second survey, 102 days after the first, the situation had dramatically changed. No filamentous algae could be seen around the lake and none was observed when samples of macrophytes along the transect lines were examined. No *Egeria* could be seen around the shores of the lake and very few stalks of *Egeria* were observed floating on the surface. The lakebed around the shore did not have any other macrophytes present except for algae growing on the surface of the rocks. No *Egeria* or other macrophytes were observed reaching to surface of the lake - even in the deeper parts of the lake. Normally at this time of the year, *Egeria* has covered a large proportion of the surface of the lake and many small white flowers can be seen.

Macrophyte samples taken from the bottom along the transect showed that the *Egeria* was in good condition as the growing tips had no signs of decay or damage and there was no sign of filamentous algae attached as in the first survey. The *Egeria* however was not as dense as in the previous survey. This was particularly noticeable in the southern end of the lake where the plant was least dense.

Third survey

The situation with the macrophytes had changed only slightly to that reported for the second survey. There was no evidence of filamentous algae and no *Egeria* could be seen around the shores. *Egeria* was in good condition with healthy growing tips.

While the *Egeria* levels were slightly deeper in this survey compared to the second survey, the *Egeria* was much less dense - about 30% of that in the second survey. Some small beds of pondweed, *Potamogeton* were observed.

Fourth survey

Macrophytes, particularly *Egeria* have been largely removed from the lake and steps should be taken to remove some grass carp.

Fifth survey

No *Egeria* was observed along the transect lines or around the shore. However, small clumps of the pondweed, *Potamogeton crispus* were evident in the lake.

Sixth survey

The biomass of pondweed, *Potamogeton crispus* had increased dramatically in February this year and covered a large part of the lake surface. With the addition of more grass carp, it has been reduced and is now reaching a height of only 30 cm from the lake bottom in a few places. A thin blanket of pondweed covers most of the bottom of the lake. Some short stems of *Elodea canadensis* were also observed floating in the lake, but none was seen growing on the lakebed.

Seventh survey

Although the biomass of macrophytes was at a satisfactory level, there was an extensive amount of macrophytes covering an estimated 65% of the lake surface. Much of this plant material was not rooted. Most of this material was pondweed and oxygen weed with filamentous algae growing among the stems.

Part of the reason for this was due to one outlet being blocked thus preventing the material flushing out of the lake. The outlet was blocked to allow some stormwater maintenance work to be carried out in Motions Creek.

Eighth survey

Most of the macrophytes had been removed from the lake and the only aquatic weeds seen were hard-stemmed plants around the shore and very small quantities of milfoil.

Ninth survey

Very little macrophyte material now remains in the lake and there may be a need to remove some grass carp. Water clarity was the highest since the second survey.

Tenth survey

The results of the transect surveys show that there has been no re-emergence of aquatic plants since the last survey. However, filamentous algae was abundant in a band about 3-5 metres from the shoreline around the lake. The bryophytes attached to the vertical sides of the berm around the shoreline were also abundant.

Eleventh survey

Again, the results of the transect survey show that there has been no re-growth of aquatic plants. Filamentous algae are still abundant as can be seen in the underwater photograph on page 20. Water clarity was such that the secchi disc was visible on the lake bottom at each point it was measured.

Twelfth survey

The results of this survey were similar to the 11th survey, but filamentous algae were more abundant and more noticeable along most of the bottom of the lake, except for the deeper areas.

Thirteenth survey

Again, no growth of weeds had occurred, although a few stems of pondweed species were observed floating in the lake. The biomass of filamentous algae was considerably reduced and there was a slight algal bloom noticeable in the lake.

Fourteenth survey

There were still no weed present in the lake and filamentous algae have virtually disappeared. Water clarity was good, with little sign of planktonic algae in the lake.

Fifteenth survey

The situation was the same as the last two surveys. There was little evidence of filamentous algae, but water clarity was a little less than the last survey due to planktonic algae.

Pest fish survey

On 16 September 2010, the annual pest fish survey was undertaken in the lake. This involved setting nine cloth gill nets and ten baited fyke nets overnight in the lake. The following table details the catch:

Species	Number	Comment
Grass carp	1	Killed
Silver carp	11	4 had died over night, but all were large and in good condition. Live fish were released into the lake.
Bullhead catfish	322	Caught in the fyke nets and killed. All were adults, except for one which was 7.5 cm long
Goldfish	32	All adults, caught in fyke nets. Killed.
Eels	many	All were released except for two which were retained to check on lesions

The number of catfish caught in the lake is cause for concern. NZWR recommends that another survey be undertaken as soon as possible to remove as many adult catfish from the lake using baited fyke nets. While juvenile catfish can pass through fyke nets, eels are able to prey on them. If the adult catfish are removed, there will be fewer fish that can spawn. A follow-up survey should then be undertaken after two or three months when juvenile fish not caught in the first survey will be big enough to be caught in the next survey. While not all catfish will be caught, if baited fyke nets are used in future annual surveys, the numbers will dwindle and a significant drop in the catch of catfish should be observed.

No koi were caught, but survey staff saw seven large koi in the lake. It appears koi have learnt to avoid the nets. NZWR recommends that during the netting survey for catfish, an electric fishing machine be employed to capture the koi, using nets to confine them to a portion of the lake.

Stockings and removals of grass carp and silver carp from the lake

No grass carp or silver carp have been released into the lake since the last survey. One grass carp caught in the nets was removed and killed. No carp were observed during the weed survey. Three large grass carp were observed during the pest fish survey and park staff reported about 30 large grass carp present in the clear water to the west of the main bridge.

Waterfowl in and around the lake

Although no census was undertaken, the numbers of waterfowl on the lake appeared to be at normal levels. Ducklings, signets and baby coots were common around the lake (see photograph on page 11).

Methods**Weed transects**

Reference points identified in the first survey for the transect lines were used for this survey. Macrophyte abundance was determined using the method described in Appendix one. The position of these transects is shown in the map on page 11. At every 50-metre interval along the transect line, a secchi disc was lowered into the water. A small grapnel was used to check for any weed on the lake bottom.

Photopoints

The four sites identified during the first survey for reference photographs (referred to as photopoints) were located. Photographs of the lake were taken in the same direction as the reference photographs for previous surveys. These photographs were taken to show the change in the level of surface-reaching macrophytes (if any) in the lake in addition to the results from the transect lines. The photographs from survey one, the last three surveys and this survey are presented from page 14 onwards. Photopoints for other surveys are presented in previous survey reports.

Results**Summary of transect data**

The following two tables compare the amount of plant material for the two transects for all the surveys.

In this survey, aquatic plant and filamentous algae were not observed. Water was not as clear as in previous surveys, but secchi disc readings were still around one metre.

Lengthwise transect (410.44 metres)

Date of survey	Total area under transect (m ²)	Total weed area under transect (m ²)	Proportion of area covered by weed	Mean % area for each 5m section
21 October 96	671.2	504.7	75.2%	74.7 (±12)%
31 January 97	624.7	251.6	40.3%	37.3 (± 11)%
20 March 97	636.7	242.6	38.1%	35.7 (± 10)%
25 August 98	603.0	0	0.0%	0.0%
4 October 99	620.0	0	0.0%	0.0%
4 October 00	639.6	19.0	3.0%	3.3 (± 7)%
14 December 01	650.6	167.2	25.7%	25.8 (±23)%
27 December 02	653.3	0	0.0%	0.0%
31 October 03	650.7	0	0.0%	0.0%
3 November 04	619.2	0	0.0%	0.0%
23 October 2005	651.8	0	0.0%	0.0%

4 September 06	651.8	6.3	1.3%	1.0%
12 November 07	635.5	0	0.0%	0.0%
3 September 08	619.2	0	0.0%	0.0%
8 October 09	650.0	0	0.0%	0.0%
2 September 10	656.0	0	0.0%	0.0%

Widthwise transect (115.4 m)

Date of survey	Total area under transect (m ²)	Total weed area under transect (m ²)	Proportion of area covered by weed	Mean % area for each 5m section
21 October 96	207.1	158.5	76.5%	73.9 (±13)%
31 January 97	185.6	82.5	44.4%	40.3 (±15)%
20 March 97	190.2	80.1	42.1%	38.1 (±14.3)%
25 August 98	187.2	0	0.0%	0.0%
4 October 99	190.0	0	0.0%	0.0%
4 October 00	200.7	0	0.0%	0.0%
14 December 01	192.4	77.6	40.3%	28.9 (±14.4)%
27 December 02	190.7	0	0.0%	0.0%
31 October 03	195.6	0	0.0%	0.0%
3 November 04	190.7	0	0.0%	0.0%
23 October 2005	189.8	0	0.0%	0.0%
4 September 06	180.2	2.2	1.2%	1.3%
12 November 07	186	0	0.0%	0.0%
3 September 08	198.7	0	0.0%	0.0%
8 October 09	192.3	0	0.0%	0.0%
2 September 10	192.9	0	0.0%	0.0%

The total areas under the transect lines vary depending on the water level. Lower water levels will mean the area under the lines will be less.

The diagrams on pages 18-21 provide a pictorial representation of the macrophyte area for each transect for the first survey and the last three surveys as well as this survey (the diagrams for previous transects can be seen in previous reports). Note that the scale used for transect distances and depths are not the same for the lengthwise and widthwise transects. This is to provide a better picture of the macrophyte levels. Where the area under the transect diagram is clear, it means there is no weed present or there is insufficient weed to show on the graph.

Secchi disc levels

A secchi disc is a simple way to measure water clarity in a lake. This disc is lowered into the water until it is no longer visible. The distance it can be seen provides a relative measurement of the water clarity. For this survey, the water was not as clear as the previous two surveys, as there was a slight algal bloom in the lake.

	Lengthwise	Widthwise
First survey	(weed and algae too thick to use secchi disc)	
Second survey	104-152 cm	138-160 cm
Third survey	56-69 cm	70-78 cm
Fourth survey	60-75 cm	73-79 cm
Fifth survey	Clear to the bottom	Clear to the bottom
Sixth survey	100-124 cm	100-103
Seventh survey	Clear to the bottom	Clear to the bottom
Eighth survey	77-96 cm	85-89 cm
Ninth survey	98-104	107-108 cm
Tenth survey	141, or clear to the bottom	145, or clear to the bottom
Eleventh survey	All readings clear to the bottom	All readings clear to the bottom
Twelfth survey	All readings clear to the bottom	All readings clear to the bottom
Thirteenth survey	84-88 cm	83-84 cm
Fourteenth survey	130, or clear to the bottom	Clear to the bottom
Fifteenth survey	83-109 cm	103-112 cm
Sixteenth survey	79.5-120 cm	125 to clear to the bottom

Other water quality measurements

The water level was 28.0 cm below the bund at the shoreline by the boat ramp. This is slightly higher than the last survey. Water temperature was 15.7°C

Weather

Weather was overcast and cool. At the start of the survey (8:15 am), there was no wind, but this slowly increased to 10kt southwest wind by 10:15 am.

Security

All the security screens were checked. They were in place and intact. They were mostly clear with some twigs and feathers on the grill.

Photographs at the photopoints

The photographs taken at photopoints for surveys 1, 12, 13, 14, 15 and 16 are presented on pages 14 to 17. The photographs taken during the first survey show macrophytes reaching the surface and extensive mats of filamentous algae floating on the water surface. Since the release of grass carp into the lake, this has not occurred again except to a small degree when survey seven was undertaken.

Other comments

Repairs had to be made to the transect rope, as it was too short for the lengthwise transect.

Discussion

Aquatic plants and filamentous algae were not observed during the survey. There was evidence of an increase in levels of planktonic algae, but were only marginally higher levels than the levels in the previous survey.

The results of this survey indicate that the lake has remained clear of aquatic plants for the last five years. The population of waterfowl has largely remained constant during this time, although this may be partly due to the public feeding them with bread.

Catfish numbers are a concern and further pest fish surveys should be undertaken to remove them. If their numbers are not controlled, they will become abundant and may increase turbidity in the lake through their habit of disturbing bottom sediments while foraging for food. Electric fishing equipment will need to be used to capture koi, as they are now wary of the nets.

Conclusion

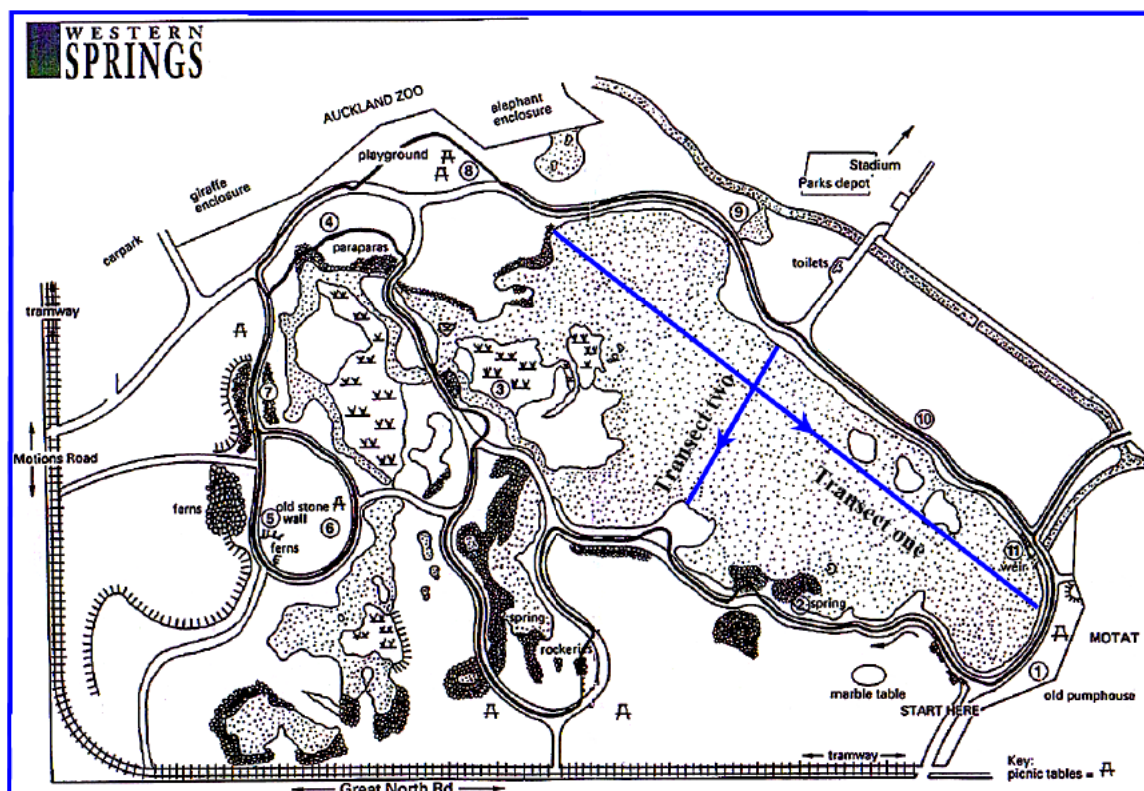
The aquatic plants have still not re-established in the lake. However, water clarity is good and water quality remains high. Waterfowl appeared healthy, at normal levels and many were breeding. Attempts should be made to reduce catfish numbers and an electric fishing machine used to remove koi.

Recommendations

NZ Waterways Restoration Ltd recommends the following actions be taken:

1. Undertake a pest fish survey as soon as possible using baited fyke nets to remove as many catfish as possible.
2. Use electric fishing equipment to capture koi in the lake, as these fish are now wary of set nets. Electric fishing can be undertaken at the same time as the fyke nets are used.
3. In about 2-3 months, undertake a further pest fish survey using baited fyke nets to capture catfish not caught in the previous survey.
4. The removal of pest fish from the lake should continue on an annual basis and catfish numbers monitored.
5. A further weed survey should be conducted next spring using the same methodology as for this survey.

Map of the lake showing transect lines



A family of Australian coots

Appendix one

Method of assessing level of macrophytes removed.

The Operational Plan prepared for this lake after approval was granted to release grass carp outlined the method used for assessing macrophyte levels. The following outlines this method: -

A biannual survey, once in mid-spring and mid-summer will be carried out using the method described below to determine the change in the level of macrophytes in the lake. As a backup, colour photographs will be taken during each survey. These photographs will be taken from the same position and angle to provide a visual record of the changes in macrophyte level. Ideally, the first survey will be conducted just prior to the introduction of the fish. However, this will depend on when the introduction will occur.

During each survey, two transect lines crossing the whole lake from shore to shore will be set in position. One line will cover length of the lake (about 412.2 m) and the other at right angles to this.

For the first survey, the origin and endpoint on the shoreline of these transect lines will be identified so that transect lines can be set in the same position for future surveys.

At five metre intervals along these transect lines, the lake depth will be measured with a depth line and the height of the weed measured with a shot line. Measurements will be recorded in centimetres. Should the water clarity make locating the height of the macrophytes impossible, a hollow plastic tube with a clear Perspex end will be employed. At the five metre intervals, the main macrophyte species will be identified, a proportion for each estimated and an assessment of the macrophyte density made. At the time of these surveys, water temperature (at 10 cm depth) and water clarity, measured by secchi disc will be recorded.

From the water depth and height of the macrophytes, the proportion of the area below the transect that consists of macrophyte will be calculated. From follow up surveys, the percentage change in macrophytes can be estimated. Dislodged surface-floating macrophytes will not be included in the survey. As further surveys are conducted over successive years, a time-series of the level of macrophytes removed can be obtained. If the stocking levels of grass carp are correct, the level of macrophyte loss will increase as the fish grow, but will be tempered by natural mortalities. As the carp reach maximum size for the lake, macrophyte consumption will decline.

This method assumes that grass carp will have a uniform effect on the macrophytes throughout the lake and that the two transect lines selected are representative of the whole lake. As a backup, the colour photographs will be used to support the results of the survey. Temperatures will indicate whether the fish will be feeding (they cease to feed below 10°C) and secchi disc readings will indicate whether algae production is increasing.

Location of transect reference points

For the transect along the length of the lake, the starting point was at the northern end of the lake where the transect line was tied to a tree stump close to the water's edge. The transect crossed the lake to the southern end to a point next to a lamppost and tied onto a large boulder.

The transect over the width of the lake started at the boat ramp on the eastern edge by a post used to moor boats near the shore and crossed the lake to a large flax bush on the other side.

New Zealand Map Grid references, WGS 84				
	Start		End	
	Northing	Easting	Northing	Easting
Transect one	6480417.8	2663986.2	6480174.3	2664315.7
Lat / long	36° 51.907' S	174° 43.358' E	36° 52.034' S	174° 43.584' E
Transect two	6480355.2	2664152.9	6480262.2	2664084.1
Lat / long	36° 51.935' S	174° 43.475' E	36° 51.996' S	174° 43.439' E

The positions of the transect lines are shown on the map in this report. The shores at the end-points of the transect lines are composed of small vertical embankments. Consequently the transect lengths remain constant as water level varies.

The water level below the concrete verge just in front of the mooring post was identified as a reference point for the water level. This level can range from 16 to 30 cm below the verge.

Location of photopoints

Photo 1

Taken from green transformer at southern end of lake. Transformer is just on your right facing the lake (lean on to keep position). Viewer line at water level. Standard lens. Aimed at gap at other end of lake. ASA 100 film. Speed 60, F stop 16. Compass bearing is 318°.

Photo 2

From middle of wide bridge, rail of bridge is just in front of you. Viewer line at water level. Standard lens. Aimed at seat on other side below big tree at other side of lake. ASA 100 film. Speed between 60-125, F stop 16. Compass bearing is 230°.

Photo 3

Above post at boat ramp to large flax bush on other side. Viewer line at water level. Standard lens. ASA 100 film. Speed 125, F stop 16. Compass bearing is 190°.

Photo 4

Taken from small outlet, leaning on rail at bend on left side of outlet (as you face lake). Taken towards tree on other side by itself. Viewer line at water level. Standard lens. ASA 100 film. Speed 60, F stop 16. Compass bearing is 238°.

Photos to be taken at about 15:00 hrs.

New Zealand Map Grid references			WGS 84	
	Easting	Northing	Latitude	Longitude
Photopoint 1	2664318.4	6480157.6	36° 52.039' S	174° 43.590' E
Photopoint 2	2664311.8	6480198.5	36° 52.011' S	174° 43.583' E
Photopoint 3	2664152.9	6480355.2	36° 51.935' S	174° 43.475' E
Photopoint 4	2664112.7	6480424.5	36° 51.900' S	174° 43.449' E

Photopoints (Page 1)

Photopoint one



Photopoint two



First survey, 21 October 1996



Twelfth survey, 4 September 2006



Thirteenth survey, 12 November 2007

Photopoints (page 2)

Photopoint one



Photopoint two



Fourteenth survey, 3 September 2008



Fifteenth survey, 10 October 2009



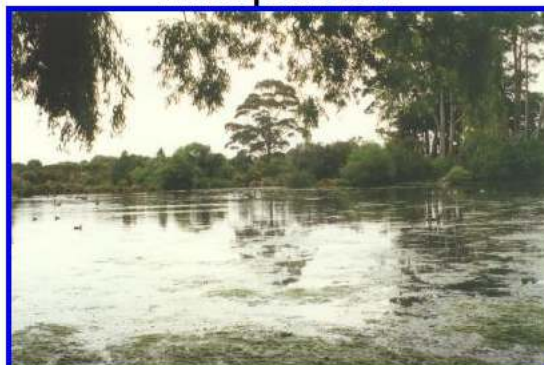
Sixteenth survey, 2 September 2010

Photopoints (page 3)

Photopoint three



Photopoint four



First survey, 21 October 1996



Twelfth survey, 4 September 2006



Thirteenth survey, 12 November 2007

Photopoints (page 4)

Photopoint three



Photopoint four



Fourteenth survey, 3 September 2008



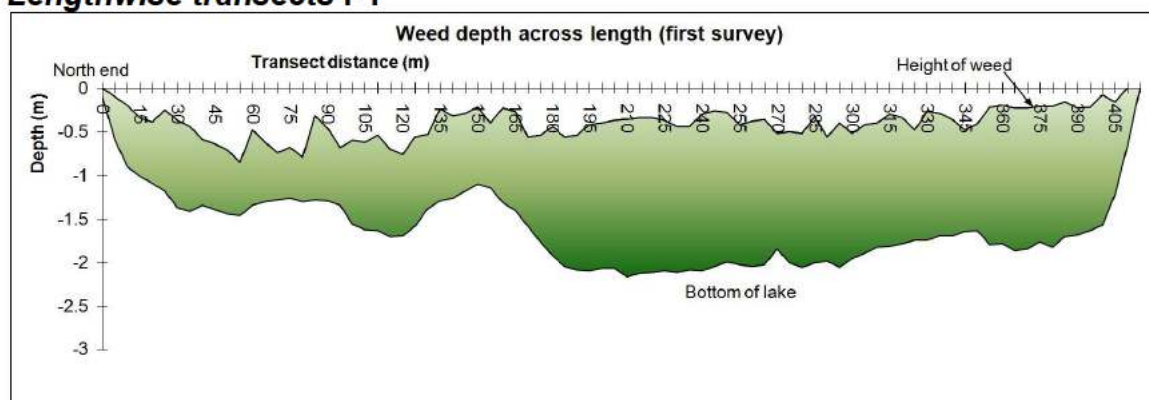
Fifteenth survey, 10 October 2009



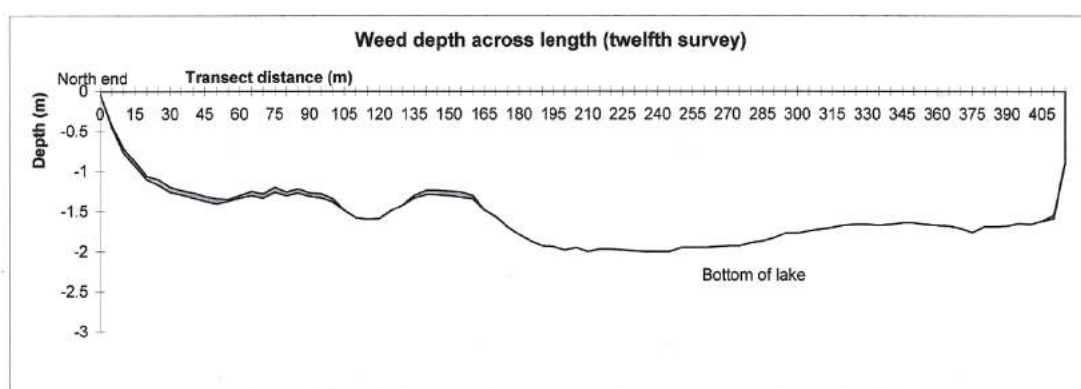
Sixteenth survey, 2 September 2010

Macrophyte transects

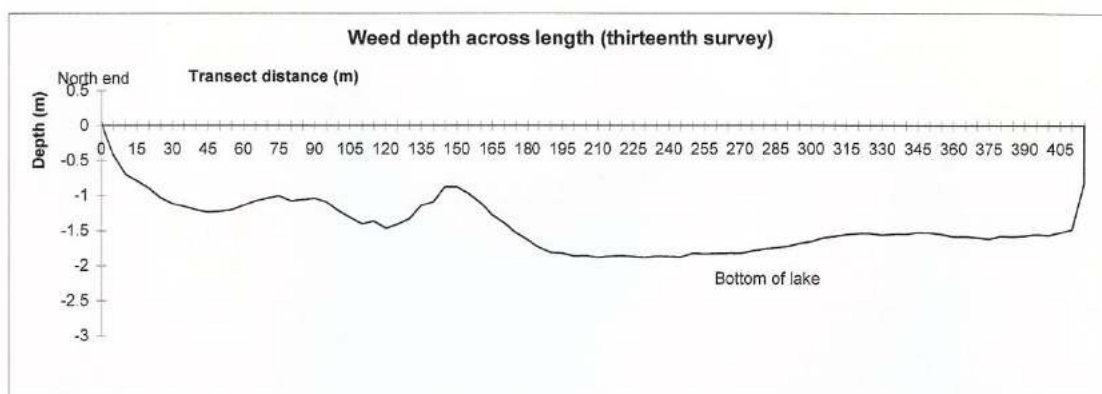
Lengthwise transects P1



First survey 21 October 1996



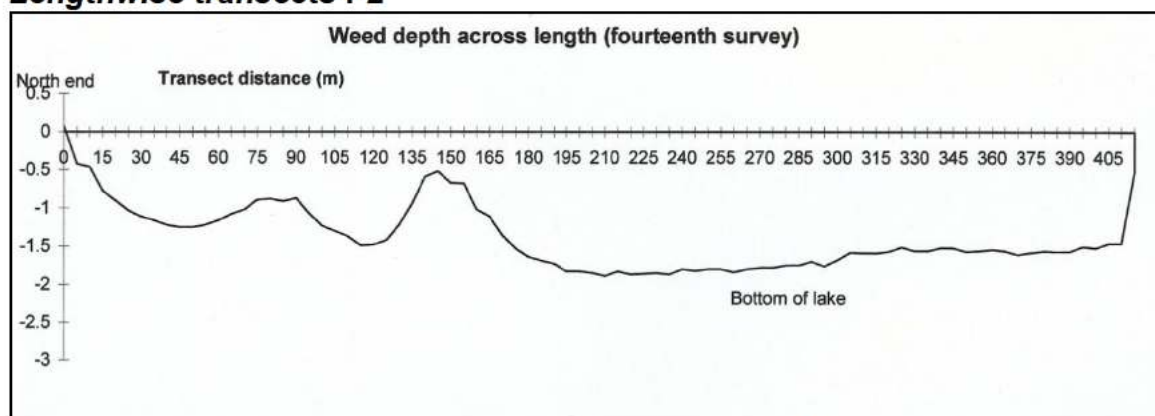
Twelfth survey, 4 September 2006



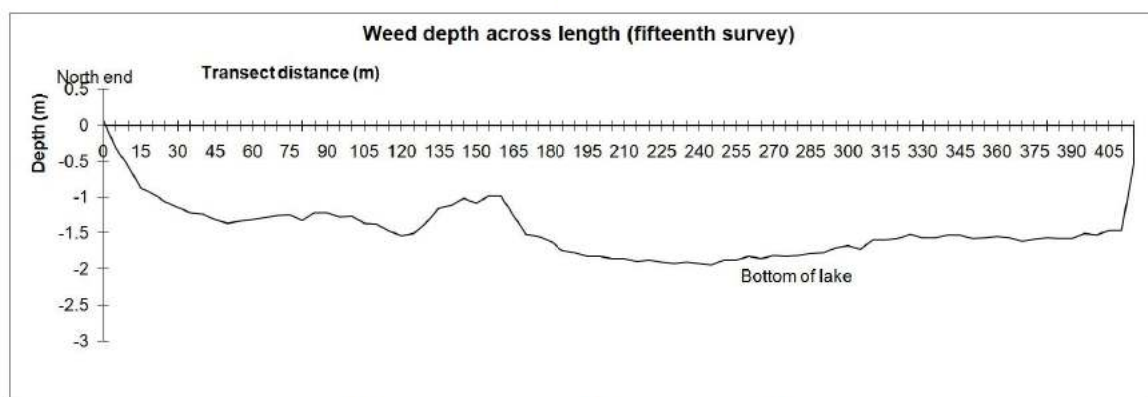
Thirteenth survey, 12 November 2007

Macrophyte transects

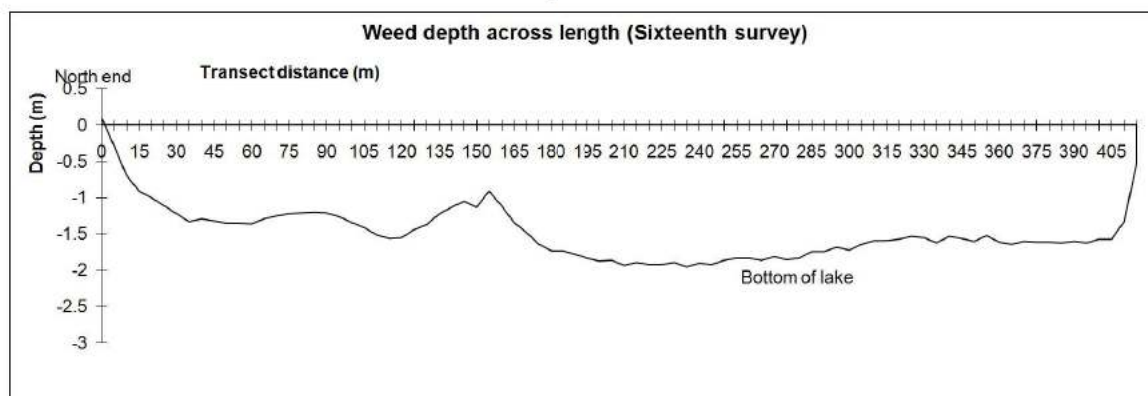
Lengthwise transects P2



Fourteenth survey, 3 September 2008



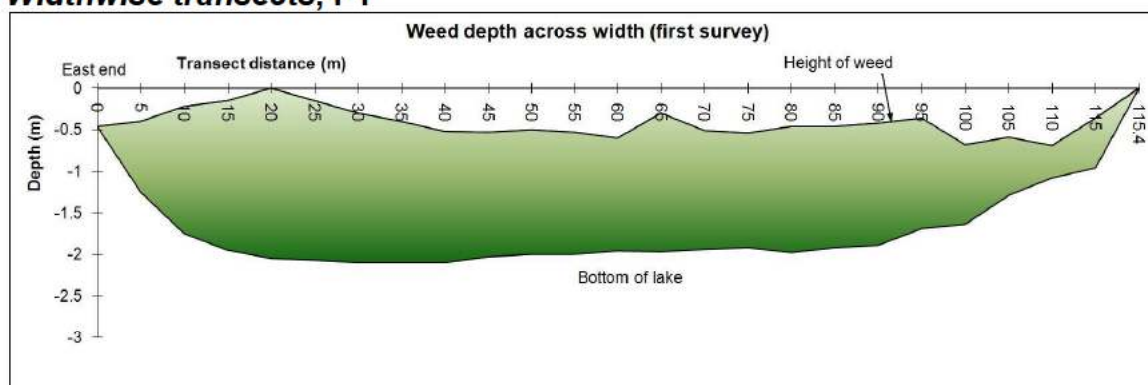
Fifteenth survey, 10 October 2009



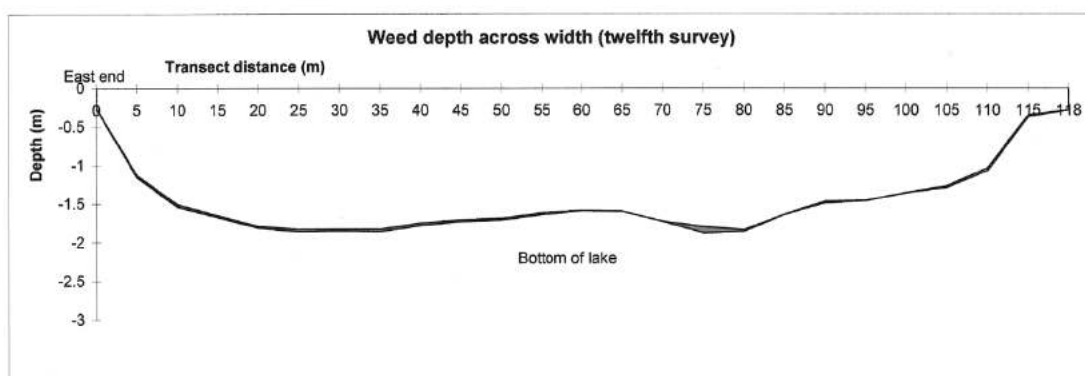
Sixteenth survey, 2 September 2010

Macrophyte transects

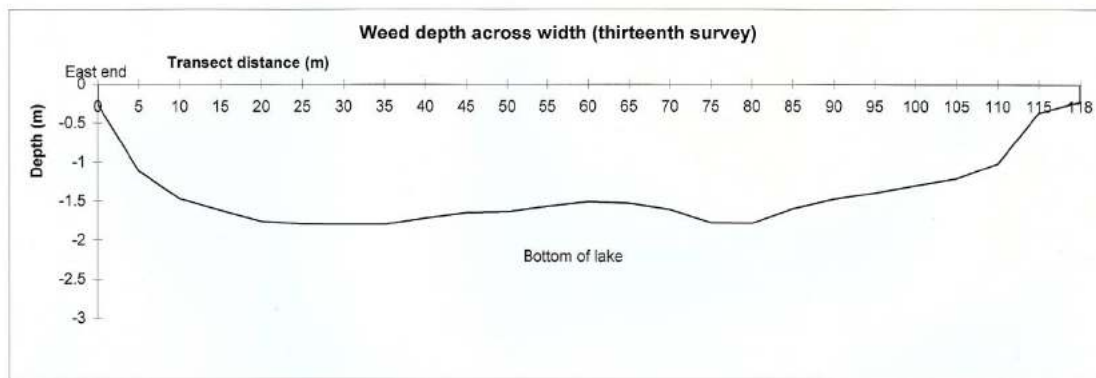
Widthwise transects, P1



First survey 21 October 1996



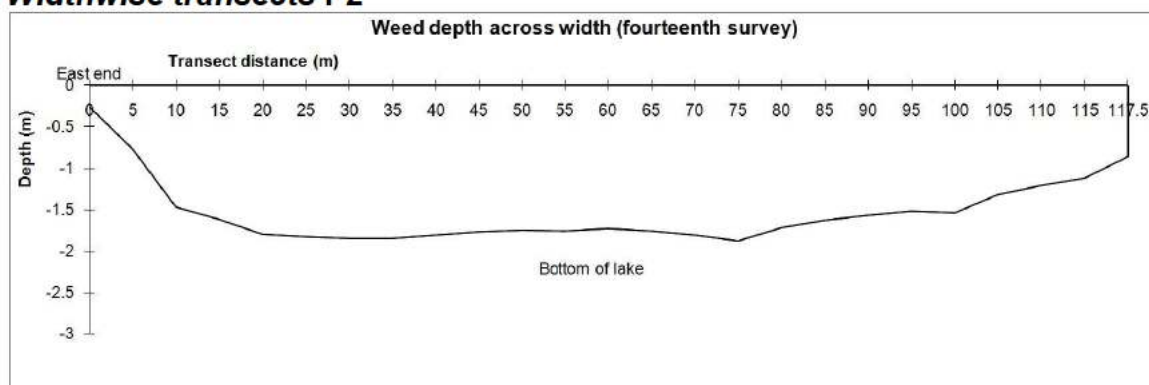
Twelfth survey, 4 September 2006



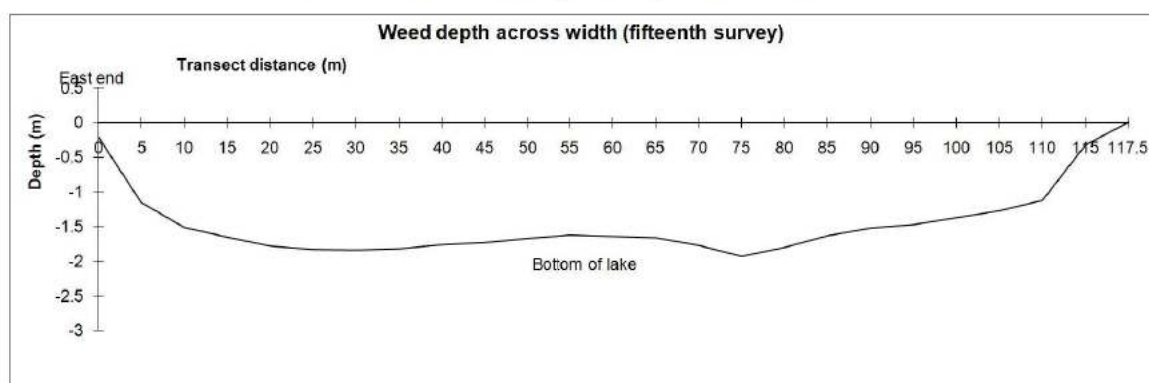
Thirteenth survey, 12 November 2007

Macrophyte transects

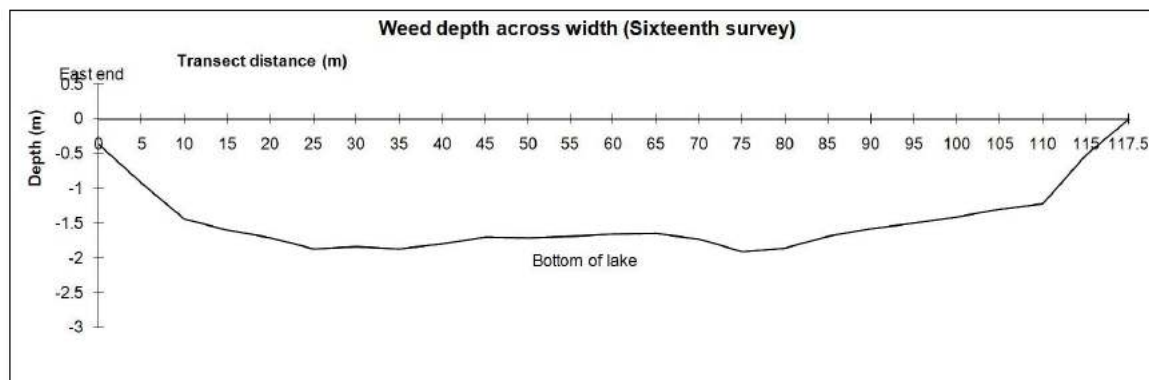
Widthwise transects P2



Fourteenth survey, 3 September 2008



Fifteenth survey, 8 October 2009



Sixteenth survey, 2 September 2010

These graphs show the level of aquatic plants below the transect lines in the ponds. The x-axis is the distance along the surface of the pond (in metres) from the start of the transect line. The y-axis is the water depth. The shaded or green portion is the area the weed comprises. Where the shaded portion reaches the x-axis, the weed is reaching the surface. If there is no shading present, there is either no weed present, or the level is too small to register in the graph.