Environmental Monitoring Report

Town of Hunts Point Eurasian Milfoil Project

Prepared for:

Town of Hunts Point

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EXECUTIVE SUMMARY

Environmental Monitoring Report
Town of Hunts Point Eurasian Milfoil Project

During the summer of 2003, Jones & Stokes assisted the Town of Hunts Point in conducting environmental monitoring, including an evaluation of the persistence and efficacy of the herbicide 2,4-D in Cozy Cove and Fairweather Bay, in Lake Washington. 2,4-D was applied over 77 acres in these coves because the lake is infested with Eurasian milfoil (*Myriophyllum spicatum*), an invasive aquatic plant species which is negatively impacting the beneficial uses at the lake. The overall intent of the project is to conduct surveys of milfoil biomass, 2,4-D residues in water, and assess water quality profiles both before and after herbicide application in these two bays. An approved Quality Assurance Project Plan (QAPP), prepared following detailed guidance provided by Ecology (2001) in the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, provides detailed technical specifications for how the project was performed.

This monitoring program is being conducted by the Town of Hunts Point with partial support from the Aquatic Weeds Management Fund administered by Ecology. The results of the study will be used to determine the effectiveness of 2,4-D against Eurasian milfoil in Lake Washington and to satisfy monitoring requirements in the State's Noxious Weed National Pollutant Discharge Elimination (NPDES) permit. Study results will also be used to determine potential impacts Eurasian milfoil may be having on water quality in dense milfoil beds. Data collected from this monitoring program will be useful in part for making future decisions regarding the most effective way to control Eurasian milfoil at Hunts Point as well as other locations.

Eurasian milfoil has been infesting Lake Washington waters since the 1970s. It is a state-listed Class B noxious aquatic weed that interferes with recreation and navigation and degrades fish and wildlife habitat. Shallow coves such as Cozy Cove and Fairweather Bay have been severely impacted by dense milfoil beds in these areas. Ecology has concluded that while eradication of milfoil in Lake Washington is not a realistic goal, it is possible to reduce this infestation to non-nuisance levels. Such a program is intended to protect public and environmental health, fish and other wildlife residing in and around Hunts Point, and to enhance the lake's recreational resources.

The primary goal of the project is to use a selective herbicide, 2,4-D, over a 77-acre treatment area to kill milfoil vegetation while allowing native aquatic plant communities to recolonize and reclaim their native habitat. Secondary goals of the project are to:

- monitor the effect of milfoil on Lake Washington water quality and aquatic habitat;
- monitor and evaluate the effect of 2,4-D on Lake Washington water quality and aquatic habitat; and
- monitor and evaluate the effectiveness (efficacy) of 2,4-D in controlling the milfoil infestation.

To assist in achieving these goals, aquatic biomass samples, dive transects, 2,4-D residue analysis in water, and water quality profiles were collected in areas of potential concern. The QAPP was designed to provide technical details for how the

environmental monitoring portion of the project would be executed to achieve project goals.

In summary, the following conclusions were derived based on data collected during summer 2003:

1) Aquatic plant biomass data collected both before and 30 days after treatment appear to clearly indicate that where the herbicide 2,4-D was applied, control of Eurasian milfoil in both Fairweather Bay and Cozy Cove appeared to be effective.

2) Dive transect observations made both before and 30 days after herbicide application generally corroborated the biomass data, where significant quantities of actively growing milfoil were only observed in areas that had not been treated with 2,4-D. Limited areas of actively growing milfoil were observed in areas of application, in particular on the western portion of Cozy Cove.

3) 2,4-D concentrations in Fairweather Bay generally corroborated calculated effective concentrations for treating milfoil. Composite samples showed that concentrations ranged from approximately 1,500 µg/L one day after treatment to 700 µg/L 5 days after treatment, suggesting that 2,4-D residues were present in the water column well after treatment was completed.

4) In Cozy Cove, where only the western portion of the bay was treated, composite 2,4-D concentrations were lower, ranging from 88.5 µg/L one day after treatment to 38.6 µg/L five days after treatment. These lower concentrations probably resulted from the fact that no 2,4-D was applied in the eastern portion of the bay.

5) These profiles also showed differences in DO between the bottom and water column surface. DO tended to rise more significantly at the bottom throughout the day.

6) Some differences in DO concentrations were detected between the July (pre-treatment) sampling and August (30 day post-treatment sampling). These differences may be due to a number of factors.

7) Many of the measured DO concentrations, both before and after treatment, in Fairweather Bay, Cozy Cove, and both of the Yarrow Bay control sites were measured at concentrations below Ecology's minimum WQS for DO in salmon core rearing areas of 9.5 mg/L.

8) Similarly, areas in both coves, including the Yarrow Bay control sites, were consistently measured at temperatures well above Ecology's guideline for salmon core rearing areas of 16ºC.

9) No evidence of deeper water depletion of DO was observed; differences between the upper water column and the bottom were inconsistent and, when noted, were slight.

10) Based on the overall preponderance of evidence, it appears that the treatment of Eurasian milfoil by 2,4-D was largely effective in both Fairweather Bay and Cozy Cove in the areas in which herbicide was applied. Limited areas of actively growing milfoil were observed in the western portion of Cozy Cove 30 days after the application.

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1 Introduction and Background

During the summer of 2003, Jones & Stokes assisted the Town of Hunts Point in conducting environmental monitoring, including an evaluation of the persistence and efficacy of the herbicide 2,4-D in Cozy Cove and Fairweather Bay, in Lake Washington. 2,4-D was applied over 77 acres in these coves because the lake is infested with Eurasian milfoil (*Myriophyllum spicatum*), an invasive aquatic plant species, which is negatively impacting the beneficial uses at the lake. The overall intent of the project is to conduct surveys of milfoil biomass, 2,4-D residues in water, and assess water quality profiles both before and after herbicide application in these two bays. An approved Quality Assurance Project Plan (QAPP), prepared following detailed guidance provided by Ecology (2001) in the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*, provides detailed technical specifications for how the project was performed (Appendix A).

This monitoring program is being conducted by the Town of Hunts Point with partial support from the Aquatic Weeds Management Fund administered by Ecology. The results of the study will be used by Ecology to determine the effectiveness of 2,4-D against Eurasian milfoil in Lake Washington and to satisfy monitoring requirements in the Noxious Weed National Pollutant Discharge Elimination (NPDES) permit. Study results will also be used to determine potential impacts Eurasian milfoil may be having on water quality in dense milfoil beds. Data collected from this monitoring program will be useful for making future decisions regarding the most effective way to control Eurasian milfoil at Hunts Point, and to potentially adjust the requirements for future herbicide permit applications.

Eurasian milfoil has been infesting Lake Washington waters since the 1970s. It is a state-listed Class B noxious aquatic weed that interferes with recreation and navigation and degrades fish and wildlife habitat. The deeper portions of the lake cannot support milfoil populations, but shallower coves such as Cozy Cove and Fairweather Bay (Figure 1) have been severely impacted by dense milfoil beds in the littoral zone, which extends evenly around the shoreline. Ecology has concluded that while eradication of milfoil in Lake Washington is not a realistic goal, it is possible to reduce the infestation in the shallower areas to non-nuisance levels. Such a program is intended to protect public and environmental health, fish and other wildlife residing in and around Hunts Point, and to enhance the recreational resources the lake provides to the community.

The primary goal of the project is to use a selective herbicide, 2,4-D, over a 77-acre treatment area to kill milfoil vegetation while allowing native aquatic plant communities to recolonize and reclaim their native habitat. Secondary goals of the project are to:

- monitor the effect of milfoil on Lake Washington water quality and aquatic habitat;
- monitor and evaluate the effect of 2,4-D on Lake Washington water quality and aquatic habitat; and
- monitor and evaluate the effectiveness (efficacy) of 2,4-D in controlling the milfoil infestation.

To assist in achieving these goals, aquatic biomass samples, dive transects, 2,4-D residue analysis in water, and water quality profiles were collected in areas of potential concern. An *Integrated Aquatic Vegetation Management Plan* (IAVMP; AquaTechnex

2002) was developed for the purpose of adopting the most effective strategy for controlling milfoil in Cozy Cove and Fairweather Bay. This document includes:

- a description of the milfoil project;
- a description of aquatic plant management goals, including the lake habitat and the Eurasian milfoil infestation;
- a discussion of public involvement, including a detailed discussion and evaluation of aquatic plant management control alternatives; and
- development of an integrated treatment action plan.

The QAPP was designed to accompany the IAVMP and provide technical details for how the environmental monitoring portion of the project would be executed to achieve project goals.

2 Summary of 2,4-D Herbicide Application

The littoral zone of Lake Washington in and around Hunts Point was treated with two formulations of 2,4-D on July 16, 2003. These formulations consisted of the dimethylamine salt (liquid formulation) and the butoxyethyl ester (granular formulation) of 2,4-D. The liquid formulation was used on approximately 50 acres in the inshore areas of the two coves where it was unlikely to be dispersed by currents and drift. The granular formulation was used in the deeper, more exposed areas that could potentially drift into areas where milfoil has not been targeted for control. More detailed discussions of these formulations were provided in Aquatechnex (2002).

Approximately 100 pounds per surface acre were applied for the 2,4-D granular formulation, and about 1.5 gallons per acre-foot for the liquid formulation. Using specific information about the herbicide formulations as well as generic assumptions regarding lake water depth, etc., water concentrations based on these rates of application were calculated for both formulations.

For the liquid formulation (DMA 4 IVM®), using label-specified information (formula composition of 46.3% 2,4-D dimethylamine salt active ingredient), the estimated water concentration is expected to be approximately 1.2 mg/L. For the granular formulation (AquaKleen®), using similar label-specified information (formula composition of 27.6% 2,4-D butoxyethyl ester active ingredient), the estimated water concentration is expected to be approximately 1 mg/L. These concentrations are expected to be effective for control of Eurasian milfoil at the specified treatment site. The environmental monitoring data described in this QAPP will serve to verify actual concentrations in the field, which will then be compared to literature toxicity values for freshwater aquatic life.

3 Overview of Environmental Monitoring

Table 1 summarizes the types of pre- and post-application environmental monitoring data that was collected by date and type of sampling, including the number of samples collected during each event. The four types of environmental monitoring and data collection included:

1) aquatic plant biomass samples collected by divers,

2) transects performed by divers to observe aquatic vegetation more qualitatively,

3) 2,4-D herbicide residues in water,

4) water quality profiles before and after herbicide application.

In addition, underwater photographs were taken to further document observations and support conclusions. Locations of sampling sites for each type of data collected are shown on Figure 1.

Table 1. Overview of Sampling Activities for Eurasian Milfoil Project (see Figure 1 for sampling locations)

Survey	Dive Transects and Milfoil Photo Points	Biomass sampling	2,4-D residue water samples		Water quality profiles
			test samples	*QA field duplicate*	
Baseline pretreatment (7/9/03)	Cozy Cove and Fairweather Bay	10 samples	1	0	DO (three measurements per day @ three water column depths), pH, temperature, turbidity, including dense milfoil and open water control sites
1,3,5 day post-treatment (one sample per cove)	no	no	8	1	0
30-day post treatment (8/16/03)	Cozy Cove and Fairweather Bay	10 samples	0	0	DO (three measurements per day @ three water column depths), pH, temperature, turbidity, including dense milfoil and open water control sites

3.1 Dive Surveys

Two types of dive surveys were performed. First, biomass sampling at pre-selected sites within the two coves (shown on Figure 1) were conducted both during the pre-application (baseline) survey and 30 days following the herbicide application. Biomass sampling was conducted by deploying 0.25 m^2 quadrats and cutting the aquatic vegetation from within the quadrat. Plants were placed in pre-labeled bags aboard the sampling boat, and subsequently separated by species to the extent possible. After drying, samples were weighed to measure aquatic plant biomass at each sample location.

In addition, divers also conducted visual dive transects to observe percent plant cover and distribution of milfoil in key areas throughout Fairweather Bay and Cozy Cove. These transects were performed to assist in better characterizing the extent of milfoil distribution both before and after herbicide application. GPS coordinates and depths were recorded to document these distributions.

To further document this data, underwater photo points were also photographed at two sites each (one in shallower, denser milfoil beds, and the other in deeper, more open water) within Fairweather Bay and Cozy Cove. A weighted buoy was placed at the sites to allow for precise "before and after" location, and photographs were taken from several angles. The purpose of these buoy "sets" was to further evaluate the condition at each site both before and 30 days after the herbicide application to evaluate its efficacy in controlling milfoil.

3.2 Herbicide Residue Sampling in Lake Water

Lake water samples were collected for 2,4-D analysis before application, and 1 day, 3 days, and 5 days following herbicide application to document the rate of disappearance from the water column following application. Water samples were taken from the mid-water column at each of the five pre-selected sampling sites (per cove) shown on Figure 1, and composited to create a single sample for 2,4-D chemical analysis from each cove. Samples were collected from both inside and approximately 100 feet outside the treatment area (see Figure 1) to document the potential distribution of 2,4-D residues following application.

Table 2 shows the locations for each of the 2,4-D composite water samples collected. Samples included:

- one sample at Fairweather Bay during the pre-application (baseline) survey;
- three samples one day after the application (one for each cove, one each from both the "outside treatment" area for liquid and granular formulations, and one field duplicate for QA purposes);
- three samples three days after application (one for each cove, one from each "outside treatment" area); and
- two samples five days after application (one sample from each cove, one from the "outside treatment" area for liquid formulation only).

Table 2. 2,4-D Residue Water Sampling Design

Location	Number of Composite Samples			
	Baseline	Day 1	Day 3	Day 5
Cozy Cove	0	1	1	1
Fairweather Bay	1	1 + 1 (duplicate)	1	1
Outside treatment area (liquid formulation)	0	1	1	1
Outside treatment area (granular formulation)	0	1	1	0
TOTAL	**1**	**4 + 1 duplicate**	**4**	**3**

3.3 Water Quality Profiles

Water column profiles (measuring dissolved oxygen, pH, and temperature at each of three depths per sampling site) were conducted to document potential changes to water quality (i.e., aquatic habitat) before and after herbicide application, and to evaluate whether Ecology's surface water quality standards (WQS) had been exceeded during any of the collection periods.

To develop water quality profiles, water column samples were taken from three depths in the water column at each of the sampling sites in both coves (just below the surface, at mid-column, and one foot above the lake bottom). Identical water quality profiles were taken at two nearby "control" sampling points located in Yarrow Bay, consisting of a dense milfoil site and an open water site (see Figure 1) not subjected to herbicide application. Diurnal measurements were made two to three times throughout the day (beginning before sunrise and extending to the afternoon) to define fluctuations in dissolved oxygen (DO) and temperature in lake water.

3.4 Sampling Station Placement

In order to determine the sampling locations for biomass sampling, milfoil distribution, and water quality surveys, a stratified random sampling design was adopted. The 2001 milfoil survey was used as a baseline for known milfoil distribution, and grids were developed for the treatment areas within Fairweather Bay and Cozy Cove. General bathymetry for this part of Lake Washington was incorporated into the map to ensure that representative sampling would take place in both shallower and deeper waters. Grids were defined on 100-foot centers in both coves, to be applied to:

- superimposing GPS coordinates for subsequent mapping purposes,
- understanding the bathymetry at the site location,
- randomly assigning sampling locations for biomass and water quality sampling, and
- monitoring changes in milfoil distribution over time.

Five sampling stations each for Fairweather Bay and Cozy Cove were defined for biomass sampling, for 2,4-D residue analysis, and for water quality profiles (see Figure 1). It is important to occupy the same stations for each type of sampling because of the additional information provided to understand conditions at the site both before and after herbicide application. Table 3 shows the GPS (UTM) coordinates, sampling station designation, and average depth for each of the sampling stations occupied.

Table 3. Sampling Station Designation and GPS Coordinates

Sample ID	UTM X_COORD	UTM Y_COORD	Average Depth (ft)
FB–01	557696.7	5276457.4	9.7
FB-02	557628.1	5276729.8	10.6
FB-03	557564.6	5276819.5	10.6
FB-04	557411.4	5276845.6	8.8
FB-05	557466.4	5277060.6	13.8
FB–OT	557342.0	5277148.5	15.9
CC-01	558360.8	5276689.4	6.0
CC-02	558328.6	5276749.5	7.1
CC-03	558323.5	5276932.2	12.1
CC-04	558142.4	5276866.2	11.2
CC-05	558115.4	5276743.5	8.5
YB-01	559132.5	5277724.0	7.6
YB-02	559245.9	5277895.6	16.3

4 Results and Discussion

Following is a summary of the results obtained from the various environmental monitoring activities.

4.1 Aquatic Plant Biomass Data

Data from plant biomass was collected for the purpose of evaluating the effectiveness of herbicide treatment using a standardized metric. Table 4 shows the total biomass collected from the ten sites within Fairweather Bay (FB sites) and Cozy Cove (CC sites) both before and 30 days after the treatment. It also shows the percentage of milfoil relative to the total biomass. Appendix B shows the relative percentages of the other aquatic species measured at each site.

Table 4. Aquatic vegetation biomass survey results before and after 2,4-D treatment

Sample Date	Sample ID	TOTAL BIOMASS (oz)	Percent milfoil of total	Eurasian milfoil (oz)	Comparison of 7/9 to 8/15 (percent remaining 30 d after application)
7/9/03	FB01	41.0	24.6	10.1	0.0
7/9/03	FB02	1.8	33.3	0.6	0.0
7/9/03	FB03	0.8	37.5	0.3	66.7
7/9/03	FB04	9.1	3.3	0.3	166.7
7/9/03	FB05	4.8	95.8	4.6	102.2
7/9/03	CC01	16.0	30.0	4.8	0.0
7/9/03	CC02	6.2	98.4	6.1	98.4
7/9/03	CC03	14.3	100.0	14.3	155.9
7/9/03	CC04	9.8	98.0	9.6	1.0
7/9/03	CC05	11.1	99.1	11.0	0.0
8/15/03	FB01	3.7	0.0	0.0	
8/15/03	FB02	13.1	0.0	0	
8/15/03	FB03	10.9	1.8	0.2	
8/15/03	FB04	14.3	3.5	0.5	
8/15/03	FB05	5.8	81.0	4.7	
8/15/03	CC01	17.0	0.0	0.0	
8/15/03	CC02	9.5	63.2	6	
8/15/03	CC03	24.5	91.0	22.3	
8/15/03	CC04	5.8	1.7	0.1	
8/15/03	CC05	9.4	0.0	0	

Figure 2 is a histogram that depicts the "control" of milfoil by comparing aquatic biomass before and after herbicide treatment. From this figure it appears that effective control of Eurasian milfoil was obtained at most of the stations measured within Fairweather Bay using biomass as a metric. Also, control may not have been achieved at FB-04. This station is regarded as outside the treatment zone and thus herbicide concentrations would be expected to be lower at this site. Figure 2 also appears to indicate that effective control was achieved at CC-01, CC-04, and CC-05. It is noted that CC-02 and CC-03 were located well outside the zone of herbicide treatment. CC-01 is also located somewhat outside the treatment zone, but is close enough to zones of application that control may have been exerted due to some herbicide drift. Control of milfoil at CC-04 and CC-05 appears to be largely complete, suggesting that the herbicide application on the western portion of Cozy Cove was effective.

4.2 Dive Transects

Two sets of SCUBA transects were performed to help evaluate the effects of herbicide treatment. Locations of each of the transects are shown on Figure 1. Complete observation for each of the transects are provided in Appendix C. The first set of transects was performed in July 2003 as part of the pre-application baseline survey, and the second was performed in August 2003 one month after herbicide application. These transects were performed to obtain visual observations concerning the presence or absence of Eurasian milfoil and other aquatic species in Fairweather Bay and Cozy Cove. Observations made during these transects are important because they are effective in supplementing more quantitative measurements made during the diver-deployed biomass quadrats discussed above. Following is a brief discussion of the observations made during the July and August 2003 dive transects.

July transects. Transect CC-T1 was first performed on 7/9/03, about a week before herbicide application took place. This transect traversed Cozy Cove from east to west at the approximate midpoint of the cove. Observations indicated dense milfoil on the eastern portion of the transect, transitioning to patchy milfoil in mid-cove, and little to no milfoil on the western portion of the cove. Transect FB-T1 was first made on July 10, 2003, and traversed Fairweather Bay from east to west at the approximate midpoint of the cove. Observations disclosed little Eurasian milfoil on the eastern edge, but dense stands of milfoil were observed through the middle portion of the cove. As the transect progressed in a westerly direction, the milfoil became much more patchy, until on the far western side of the cove Eurasian milfoil only accounted for 5 to 10% of the total aquatic biomass.

August transects. Six dive transects were performed on August 14, 2003, one month after the herbicide application. Transects consisted of three each in Fairweather Bay and Cozy Cove (see Figure 1). Transect CC-T1 indicated Eurasian milfoil with frequent necrosis on the tips located along the eastern portion of the cove. More milfoil was observed at the west end of the transect. Transect CC-T1 was located at the northern edge of the treated area. As shown on Figure 1, Transect CC-T2 was located near the head (southern portion) of the cove. Very few actively growing milfoil shoots were observed on CC-T2. Stems with damaged or necrotic shoots were frequently observed in this area, suggesting that control of milfoil was effective. Transect CC-T3 indicated some healthy milfoil growing on the eastern portion of the cove, but as the transect progressed toward the west more necrotic or dead milfoil shoots were observed, with little actively growing milfoil.

Transect FB-T1 showed little actively growing Eurasian milfoil, suggesting that control was effective. Transect FB-T2, conducted at the head (southern portion) of the bay, indicated little or no presence of Eurasian milfoil. Transect FB-T3 generally confirmed the findings in that little or no live or actively growing milfoil shoots were observed.

This observation is consistent with the fact that no treatment was made on the western portion of Fairweather Bay because it is considered outside of the town of Hunts Point.

4.3 Underwater Photo Points before and after 2,4-D Treatment

Figure 1 shows four locations, two in Fairweather Bay and two in Cozy Cove, from which underwater photographs were taken before and after herbicide treatment. The photographs taken at the four photo points before application and 30 days after 2,4-D application are shown in Appendix D. In Fairweather Bay, Photo point FB1 is within the area of 2,4-D application and FB2 is slightly outside the area of application to the north. In Cozy Cove, photo point CC1 is outside the application area at the southeast end of Cozy Cove, while photo point CC2 is within the area of application.

At site FB1, the pre-treatment July photos (1 and 2) show a dominance of milfoil, while the post-treatment August photos (3 and 4) show a diversity of other species including coontail (*Ceratophyllum demersum*), elodea (*Elodea canadensis*), and tape grass (*Vallisneria americana*). No milfoil is in evidence. At site FB2, slightly outside the application area, milfoil is prevalent in both July (Photos 5 and 6) and August (Photos 7 and 8). A few small areas of dark, necrotic, stems can be seen in Photo 7, possibly from 2,4-D drift into this area. Photos 9, 10, 11, and 12 indicate healthy milfoil growing at photo point CC1 in both July and August. Although the photos taken at photo point CC2 are not clear, Photos 13 and 14 clearly show the presence of milfoil and thin leaved pondweed (*Potomogeton* sp.) in July. In August, milfoil at this location was mostly reduced to stems that were bare of leaves (Photo 16), while curly leaved pondweed (*Potomogetom crispus*) was apparently healthy (Photo 15).

4.4 2,4-D Herbicide Residue Composites

The purpose of this sampling was to provide information regarding the persistence of the two formulations of 2,4-D immediately following the treatment. Composite samples were taken for the five sampling stations in Fairweather Bay (FB01, FB02, FB-03, FB-04, and FB-05) and Cozy Cove (CC-01, CC-02, CC-03, CC-04, and CC-05) before the treatment (baseline survey), and then at intervals 1, 3, and 5 days following the treatment. In addition, a field duplicate was taken for Fairweather Bay to evaluate analytical instrument precision. Outside-treatment control sites were not composited, but sampled for both the liquid (FB-OTL) and granular formulations (FB-OTG) of 2,4-D to evaluate whether herbicide residues had drifted off the designated zone of application. Locations of all stations are shown on Figure 1.

Composite concentrations of 2,4-D were compared to the calculated effective concentrations of 1.2 mg/L (or 1,200 µg/L) for the liquid and 1.0 mg/L (or 1,000 µg/L) for the granular formulation. These values are based on known or estimated information specific to Fairweather Bay and Cozy Cove, and utilize label-specified rates of application to support the calculation. Table 4 shows the measured herbicide residue data in water and thus supports a point of comparison for evaluating the effectiveness of using the herbicide for control of Eurasian milfoil. Appendix E provides the analytical

data 2,4-D as prepared by North Creek Analytical laboratory.

As shown in Table 5, composite concentrations for Fairweather Bay were very close to the calculated concentration of 1,200 µg/L. One day following the application, concentrations were 1,570 and 1,060 for the Fairweather Bay and duplicate, respectively. After three days, concentrations had dropped to 693 and 960 µg/L, respectively; and after five days had declined to 81 and 716 µg/L, respectively. No QA, sampling or analytical problems were identified. Thus there is no obvious reason for the discrepancy between the sample and its duplicate five days after treatment. In general, these concentrations suggest that concentrations may have remained high enough in pockets of Fairweather Bay to continue to exert control of milfoil even several days after the application had taken place.

Concentrations for the Cozy Cove composites were systematically lower, consistent with the fact that treatment was limited to the western half of Cozy Cove. The eastern half of Cozy Cove is considered part of Yarrow Point, which does not allow treatment by aquatic herbicides. All of Cozy Cove was sampled using randomly selected sampling points. Because some samples were collected on the Yarrow Point (eastern) side of the cove, sample compositing resulted in lower overall concentrations, although concentrations on the western side of the cove are assumed to be higher, as indicated by more complete levels of control.

Table 5. 2,4-D Water Concentrations (µg/L) in Fairweather Bay and Cozy Cove

Location	Baseline	1-day after treatment	3-days after treatment	5-days after treatment
Cozy Cove	not analyzed	88.5	83.9	38.6
Fairweather Bay	0.1 U	1,570	693	81.2
Fairweather Bay (dupe)	0.1 U	1,060	960	716
Outside treatment area (liquid)	not analyzed	58.6	49.9	94
Outside treatment area (granular)	not analyzed	384	266	not analyzed

U = undetected at the specified reporting limit (0.1 µg/L doe 2,4-D)

4.5 Water Quality Profiles

Water quality profile sampling took place on July 11, 2003 (baseline conditions) and on August 16, 2003 (one month post-application). Measurements were taken at each of the ten water quality sampling locations shown on Figure 1, and also included two control (i.e., non-treated) locations in Yarrow Bay, consisting of a dense milfoil site and an open water site (see Figure 1). Water quality profiles were measured at three sampling depths for each of the stations, consisting of one foot above the bottom, mid-water column, and one foot below the water surface. Profiles were taken before dawn and later in the day on both dates to define the degree to which water quality would change on a daily basis.

Water quality parameters measured include temperature and dissolved oxygen (DO), and pH. The entire data set for each water quality profile, including both sampling dates, are shown in Appendix F.

DO Fluctuation in July and August. Appendix F provides the complete water quality profile data collected during these two months.

In general, DO concentrations in July increased slightly by an average of 0.81 mg/L at Fairweather Bay and 0.34 mg/L at Cozy Cove over the course of the day. The Yarrow Bay control sites DO did not vary as much as either of the two coves. It appears that the greatest increase in DO concentrations occurred at the bottom profiles, suggesting that rates of increased photosynthesis are greater at the bottom as the sunlight intensifies throughout the day.

Similar to the July data, DO concentrations measured in August increased throughout the day more markedly at Fairweather Bay than at Cozy Cove (1.03 mg/L and 0.72 mg/L, respectively). As with the July sampling the Yarrow Bay control sites did not vary as much as either of the two Hunts Point coves, although the dense milfoil control site (YB-01) varied much more than the deeper open water site. As with the July sampling, it appears that the greatest increase in DO concentrations occurred at the bottom profiles throughout the day.

Compliance with Ecology's DO Water Quality Standards (WQS). Ecology has set a WQS for minimum DO concentration for surface water of 9.5 mg/L for salmon core areas, including Lake Washington (WAC 173-201(a)). DO readings taken in both July and August frequently dropped below Ecology's minimum standard (see data in Appendix F). The minimum measured DO concentrations taken during any of the water quality profiles of 7/11/03 were 8.2 for Cozy Cove, 8.6 for the Yarrow Bay control sites, and 8.4 mg/L for Fairweather Bay. The minimum measured DO concentrations taken during any of the water quality profiles of 8/15/03 were 6.5 for Cozy Cove, 7.2 for the Yarrow Bay control sites, and 6.4 mg/L for Fairweather Bay. Temperatures varied little in the shallow sampling areas, but always exceeded the WQS for salmon core rearing areas (16ºC). Higher temperatures also affect DO concentrations, since DO solubility is inversely related to water temperature.

5 Conclusions and Recommendations

In summary, the following conclusions were derived based on the foregoing review and discussion.

1) Aquatic plant biomass data collected both before and 30 days after treatment appear to clearly indicate that where the herbicide 2,4-D was applied, control of Eurasian milfoil in both Fairweather Bay and Cozy Cove appeared to be effective. This method of measurement may be subject to considerable uncertainty due to the low sample size (n = 5 in each cove) as well as the small size of the quadrat ($0.1m^2$) used during the biomass sampling.

2) Dive transect observations made both before and 30 days after herbicide application generally corroborated the biomass data, where significant quantities of actively growing milfoil were only observed in areas that had not been treated with 2,4-D. Limited areas of actively growing milfoil were

observed in areas of application, in particular on the western portion of Cozy Cove.

3) Water composites from Fairweather Bay and Cozy Cove generally showed that herbicide residues were present in the water column at least five days after application.

4) 2,4-D concentrations in Fairweather Bay generally corroborated calculated effective concentrations for treating milfoil. Composite samples showed that concentrations ranged from approximately 1,500 µg/L one day after treatment to 700 µg/L 5 days after treatment, suggesting that 2,4-D residues were present in the water column well after treatment was completed.

5) Water quality profiles conducted at the bottom, the mid-column, and one foot below the water surface clearly showed changes in DO throughout the day during both the July and August samples (July sampling before the treatment, August sampling one month after treatment).

6) These profiles also showed differences in DO between the bottom and water column surface. DO tended to rise more significantly at the bottom throughout the day.

7) Some differences in DO concentrations were detected between the July (pre-treatment) sampling and August (30 day post-treatment sampling). These differences may be due to minimal sample size and frequency, changes in the instruments used, or simply that removal of milfoil through herbicide treatment would not lead to significant changes in DO in the water column.

8) Several of the measured DO concentrations, both before and after treatment, in Fairweather Bay, Cozy Cove, and the Yarrow Bay control sites were measured at concentrations below Ecology's minimum WQS for DO in salmon core rearing areas of 9.5 mg/L.

9) Similarly, areas in both coves, including the Yarrow Bay control sites, were consistently measured at temperatures well above Ecology's guideline for salmon core rearing areas of 16ºC.

10) No evidence of deeper water depletion of DO was observed; differences between the upper water column and the bottom were inconsistent and, when noted, were slight.

11) Based on the overall preponderance of evidence, it appears that the treatment of Eurasian milfoil by 2,4-D was largely effective in both Fairweather Bay and Cozy Cove in the areas in which herbicide was applied. Limited areas of actively growing milfoil were observed in the western portion of Cozy Cove 30 days after the application.

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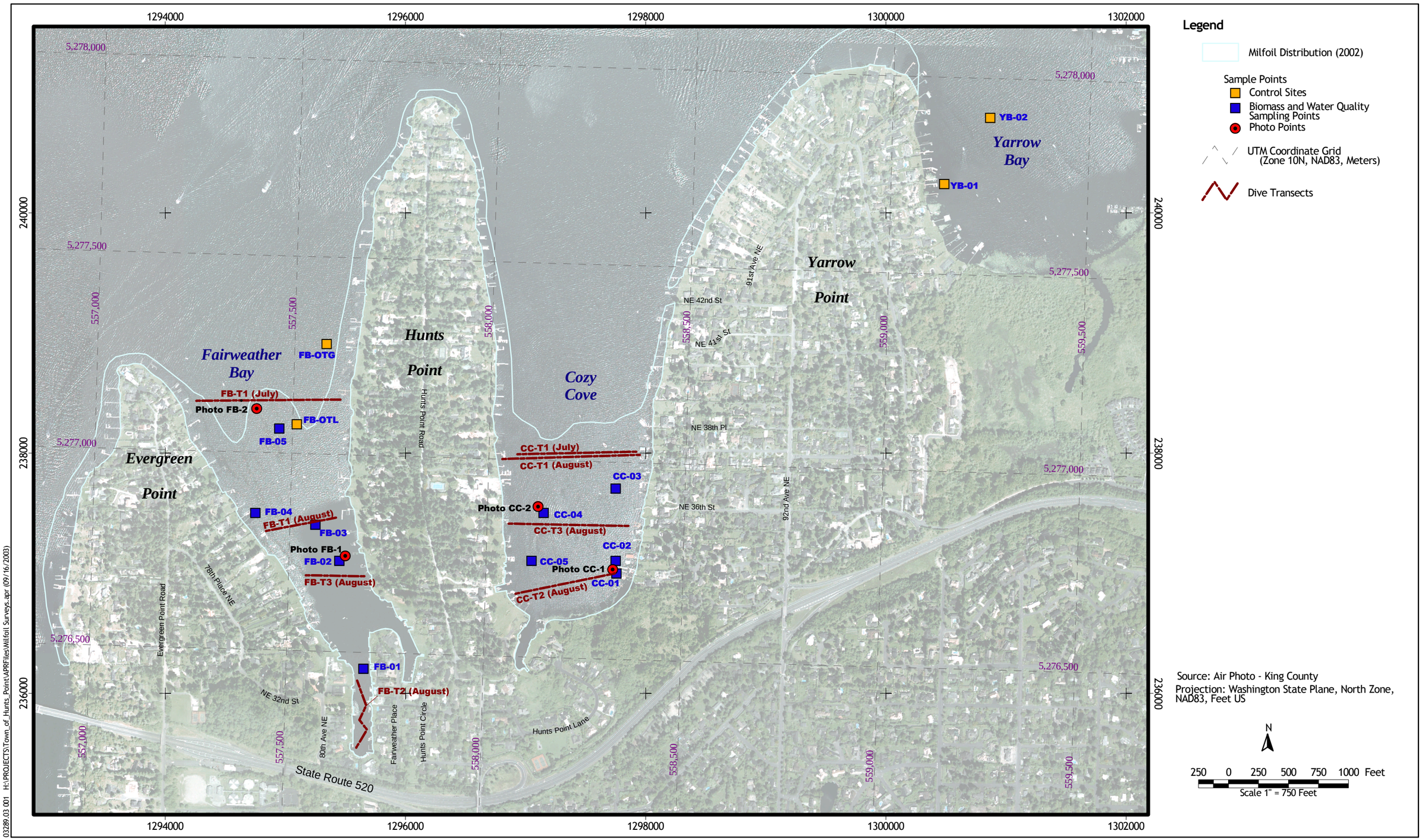
Figures



Legend

- Milfoil Distribution (2002)
- Sample Points
  - Control Sites
  - Biomass and Water Quality Sampling Points
  - Photo Points
- UTM Coordinate Grid (Zone 10N, NAD83, Meters)
- Dive Transects

Source: Air Photo - King County
Projection: Washington State Plane, North Zone, NAD83, Feet US

N

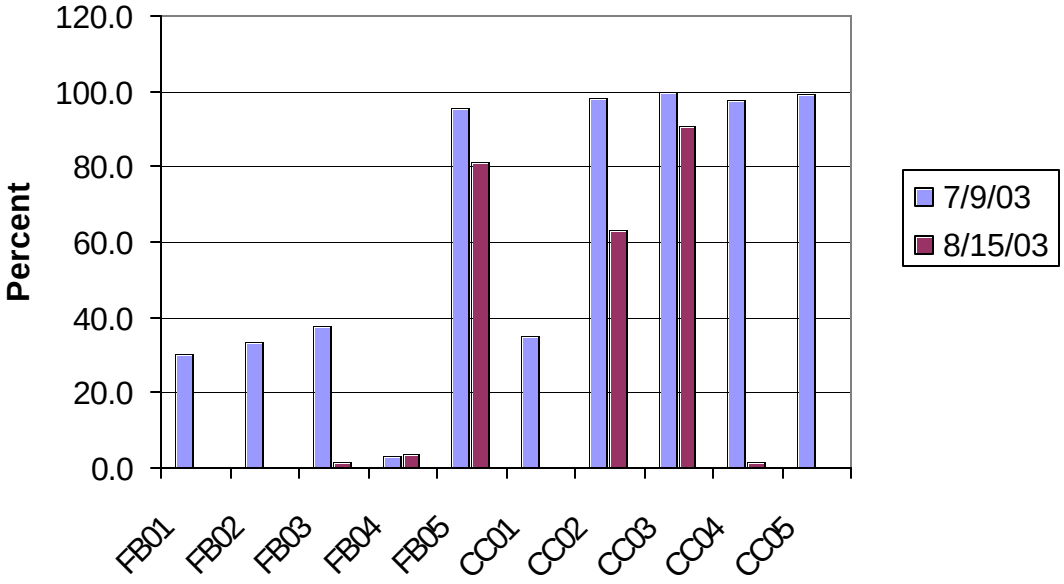
250 0 250 500 750 1000 Feet
Scale 1" = 750 Feet

03289.03 001 H:\PROJECTS\Town_of_Hunts_Point\APRFiles\Milfoil Surveys.apr (09/16/2003)

Jones & Stokes

Figure 1
Site Map Showing Milfoil Distribution and Sampling Locations, July and August 2003

Figure 2. Comparison of percent milfoil before and after the 2,4-D treatment (7/9/03 vs 8/15/03)



Appendix A. Quality Assurance Project Plan (QAPP)

Final

Quality Assurance Project Plan

Town of Hunts Point Eurasian Milfoil Project:
Environmental Monitoring in Lake Washington

Jones & Stokes

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July 2003

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Abstract

During the summer of 2003, Jones & Stokes will assist the Town of Hunts Point in conducting environmental monitoring, including an evaluation of the persistence and efficacy of the herbicide 2,4-D in Cozy Cove and Fairweather Bay, in Lake Washington. 2,4-D will be applied over 77-acres in these coves because the lake is infested with Eurasian milfoil (*Myriophyllum spicatum*), an invasive aquatic plant species, which is negatively impacting the beneficial uses at the lake. The overall plan is to conduct surveys of milfoil biomass, 2,4-D residues in water, and assess water quality profiles both before and after herbicide application in these two bays.

This monitoring program is being conducted by the Town of Hunts Point with partial support from the Aquatic Weeds Management Fund administered by Ecology. The results of the study will be used by Ecology to determine the effectiveness of 2,4-D against Eurasian milfoil in Lake Washington and to satisfy monitoring requirements in the Noxious Weed National Pollutant Discharge Elimination (NPDES) permit. Study results will also be used to determine potential impacts Eurasian milfoil may be having on water quality in dense milfoil beds. Data collected from this monitoring program will be used by the Town of Hunts Point to make future decisions regarding the most effective way to control Eurasian milfoil, and by Ecology to potentially adjust the requirements for future herbicide permit applications.

Project Description/Problem Statement

Eurasian milfoil has been infesting Lake Washington waters since the 1970s. It is a state-listed noxious aquatic weed that interferes with recreation and navigation and degrades fish and wildlife habitat. The deeper portions of the lake cannot support milfoil populations, but shallower coves such as Cozy Cove and Fairweather Bay (Figure 1) have been severely impacted by dense milfoil beds for years in the littoral zone, which extends evenly around the shoreline. Lake Washington is a heavily used residential and recreational lake. During summer months the lake experiences especially high levels of recreational use.

Ecology has concluded that while eradication of milfoil in Lake Washington is not a realistic goal, it is possible to reduce the infestation in the shallower areas to non-nuisance levels. Such a program is intended to protect public and environmental health, fish and other wildlife residing in and around Hunts Point, and to enhance the recreational resources the lake provides to the community.

The primary goal of the project is to use a selective herbicide, 2,4-D, over a 77 acre treatment area to kill milfoil vegetation while allowing native aquatic plant communities to recolonize and reclaim its native habitat. Secondary goals of the project are to:

- monitor the effect of milfoil on Lake Washington water quality and aquatic habitat;
- monitor and evaluate the effect of 2,4-D on Lake Washington water quality and aquatic habitat; and

- monitor and evaluate the effectiveness (efficacy) of 2,4-D in controlling the milfoil infestation.

To achieve these goal, biomass samples, 2,4-D residue samples, and water quality profiles will be taken in areas where milfoil has been removed or reduced as well as in areas where milfoil has not been controlled.

An *Integrated Aquatic Vegetation Management Plan* (IAVMP; AquaTechnex 2002) was developed for the purpose of adopting the most effective strategy for controlling milfoil in Cozy Cove and Fairweather Bay. This document includes:

- a description of the milfoil project,
- a description of aquatic plant management goals, including the lake habitat and the Eurasian milfoil infestation,
- a discussion on public involvement, including a detailed discussion and evaluation of aquatic plant management control alternatives, and
- development of an integrated treatment action plan.

This Quality Assurance Project Plan (QAPP) is designed to accompany the IAVMP and provides the details for how the environmental monitoring portion of the project will be executed to achieve the project goals listed above. The QAPP follows detailed guidance provided by Ecology (2001) in the *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies*.

Description of Herbicide Application

The littoral zone of Lake Washington in and around Hunts Point will be treated with two formulations of 2,4-D on July 16, 2003. The limitations and advantages of each of these formulations is discussed in the alternatives evaluation provided in Aquatechnex (2002). These formulations consist of the dimethylamine salt (liquid formulation) and the butoxyethyl ester (granular formulation) of 2,4-D. The liquid formulation will be used on approximately 50 acres in the inshore areas of the two coves where it is unlikely to be dispersed by currents and drift. The granular formulation will be used in the deeper, more exposed areas that could potentially drift into areas where milfoil has not been targeted for control. Every effort will be made so that the two formulations do not overlap on one another.

Approximately 100 pounds per surface acre will be applied for the 2,4-D granular formulation, and about 1.5 gallons per acre foot for the liquid formulation. Using specific information about the herbicide formulations as well as generic assumptions regarding lake water depth, etc., water concentrations based on these rates of application were calculated for both formulations.

For the liquid formulation (DMA 4 IVM®), using label-specified information (formula composition of 46.3% 2,4-D dimethylamine salt active ingredient), the estimated water concentration is expected to be approximately 1.2 mg/L. For the granular formulation (AquaKleen®), using similar label-specified information (formula composition of 27.6% 2,4-D butoxyethyl ester active ingredient), the estimated water concentration is expected

to be approximately 1 mg/L. These concentrations are expected to be effective for control of Eurasian milfoil at the specified treatment site. The environmental monitoring data described in this QAPP will serve to verify actual concentrations in the field, which will then be compared to literature toxicity values for freshwater aquatic life.

The 2,4-D material will be supplied and applied by Aquatechnex, a company licensed for aquatic weed herbicide application. The specific protocol for applying each of the materials is shown on the labels for each of the selected products. The timing of the herbicide application is designed to take place in a single day when the water temperature is warm and the milfoil is growing at a rapid rate.

Acute toxicity information for common freshwater aquatic organisms is shown on Table 1 below, and environmental fate and chemistry information (solubility, partition coefficients, half-lives, etc.) is provided in Table 2.

Table 1. Acute toxicity values for 2,4-D (Corps, 2003a and b)

2,4-D dimethylamine salt	
Species	**LC_{50} (mg/L)**
Lake trout	35-36
Rainbow trout	>100
Bluegill sunfish	123-230
Fathead minnow	245-458
Amphipod (*G. fasciatus*)	>100
2,4-D butoxyethyl ester	
Species	**LC_{50} (mg/L)**
Lake trout	35-56
Bluegill sunfish	1.1-1.3
Fathead minnow	2.5-4.2
Amphipod (*G. fasciatus*)	4.5-8.3
Cladoceran (*Daphnia magna*)	4.5-9.1

Table 2. Physical and chemical properties of 2,4-D

Properties	**Values**	**Sources**
CAS Registry Number	94-75-7	EPA, 2003
Water Solubility	0.5 g/L at 20^{o}C	EPA, 2003
Henry's Law Constant	1.02 x 10^{-8} atm m^3/mol	EPA, 2003
BCF	0.003 – 7	EPA, 2003
Log K_{ow}	2.81	EPA, 2003
Log K_{oc}	19.6 – 109.1	EPA, 2003
Dissipation	**Half-life**	**Sources**
Degradation in water	10 to >50 days	EPA, 2003
Degradation in sediments	<1 month	Birmingham and Colman, 1985
Photolysis	2-4 days	EPA, 2003

Overview of Environmental Monitoring

Table 3 summarizes the pre- and post-application environmental monitoring to be conducted by date and type of sampling, and includes the number of samples to be collected during each event. At this point, it is not known whether the 60-day or 90-day surveys will be conducted, and thus no sampling numbers can be assigned to those events. The three types of sampling to be performed include plant biomass collected by divers, 2,4-D herbicide residues in water collected from the sampling boat, and water quality profiles also collected from the boat. Sampling sites are shown on Figure 1. Following is a more specific description of how each of the three types of sampling will be conducted.

Table 3: Overview of Sampling Activities for Eurasian milfoil project (see Figure 1 for sampling locations)

Survey	**Dive Transects and Milfoil "Sets"**	**Biomass sampling**	**2,4-D residue water samples**		**Water quality profiles**
			test samples	*QA field duplicate*	
Baseline pretreatment (7/9/03)	Cozy Cove and Fairweather Bay	10 samples	1	0	DO (three measurements per day @ three water column depths), pH, temperature, turbidity, including dense milfoil and open water control sites
1,3,5 day post-treatment (one sample per cove)	no	no	8	1	0
30-day post treatment (8/16/03)	Cozy Cove and Fairweather Bay	10 samples	0	0	DO (three measurements per day @ three water column depths), pH, temperature, turbidity, including dense milfoil and open water control sites
60-d Optional (9/16/03)	Cozy Cove and Fairweather Bay	10 samples	TBD	TBD	DO, pH, temperature, turbidity
90-d Optional 10/16/03	Cozy Cove and Fairweather Bay	10 samples	TBD	TBD	DO, pH, temperature, turbidity

Note: TBD = To Be Determined

Dive surveys. Two types of surveys will be performed by divers. First, biomass sampling at pre-selected sites (shown on Figure 1) will be conducted both during the pre-application (baseline) survey and 30 days following the herbicide application. Biomass sampling will be conducted by deploying 0.25 m^2 quadrats and cutting the aquatic vegetation from within the quadrat. Roots will not be removed from the sediment, with vegetation contained within each quadrat cut above the sediment surface. These plants will be placed in pre-labeled bags aboard the sampling boat, and

subsequently separated by species to the extent possible. They will then be spun dry in mesh bags. After drying, samples will be weighed to approximate plant biomass at each sample location.

In addition, divers will be deployed to assist in better characterizing the extent of milfoil distribution both before and after herbicide application. GPS readings will be taken and depth recorded to carefully document where milfoil occurs that may be beyond current

Location	**Number of Samples**			
	Baseline	**Day 1**	**Day 3**	**Day 5**
Cozy Cove	0	1	1	1
Fairweather Bay	1	1 + 1 (duplicate)	1	1
Outside treatment area	0	1	1	0
TOTAL	**1**	**3 + 1**	**3**	**2**

Table 4. 2,4-D Residue Water Sampling Design

maps or charts. These readings will then be used to prepare detailed charts and maps depicting milfoil distribution before and after herbicide application. To assist in this evaluation, diver-deployed "sets" will be placed at two sites each (one in shallower, denser milfoil beds, and the other in deeper, more open water) within Fairweather Bay and Cozy Cove. A weighted buoy will be placed at the sites and photographed from several angles. The purpose of these "sets" is to evaluate the condition at each site both before and 30 days after the herbicide application to evaluate its efficacy in controlling milfoil (as well as other aquatic plants).

Herbicide residue sampling in lake water. Lake water samples will be collected for 2,4-D analysis before application, and 1 day, 3 days, and 5 days following herbicide application to document the rate of disappearance from the water column following application. Water samples taken from the mid-water column (using a Niskin sampler) of the five pre-selected sampling sites (per cove) shown on Figure 1 will be composited to create a single sample for 2,4-D chemical analysis from each cove. Samples will be collected from both
inside and approximately 100 feet outside the treatment area (see Figure 1) to document the potential distribution of 2,4-D residues following application. Samples will be collected from a boat and will not require diving.

Table 4 shows the locations for each of the 2,4-D water samples to be collected. Figure 1 shows each of the locations to be sampled. Samples include:

- one sample at Fairweather Bay during the pre-application (baseline) survey,
- three samples one day after the application (one for each cove, one from the "outside treatment" area, and one field duplicate for QA purposes),
- three samples three days after application (one for each cove, one from the

"outside treatment" area), and
- two samples five days after application (one sample from each cove)

Water quality profiles. The purpose of the water column profiles for both conventional parameters and 2,4-D residues is twofold: (1) to define the behavior of 2,4-D before and after application to Lake Washington waters, and (2) to document changes to water quality (i.e. aquatic habitat) before and after herbicide application.

To document water quality profiles, water column samples will be taken from three depths in the water column at the pre-selected sampling sites in both coves, which are just below the surface, at the approximate midpoint, and near the bottom. Comparable water quality profiles will be taken at two nearby "control" sampling points (near Yarrow Point; see Figure 1) that have *not* been subjected to herbicide application. One of these sites The water quality parameters to be measured include temperature, pH, and dissolved oxygen profiles measured at three intervals from surface to bottom at each site. Diurnal measurements will be made three times throughout the day (sunrise, noon, and afternoon) to define fluctuations in dissolved oxygen in lake water. Lake water turbidity will also be monitored.

Study Design

In order to determine the sampling locations for biomass sampling, milfoil distribution, and water quality surveys, a stratified random sampling design was adopted. The 2001 milfoil survey was used as a baseline for known milfoil distribution, and grids were developed for the treatment areas within Fairweather Bay and Cozy Cove. General bathymetry for this part of Lake Washington was incorporated into the map to ensure that representative sampling would take place in both shallower and deeper waters. Grids were defined on 100-foot centers in both coves, to be applied to :

- superimposing GPS readings for subsequent mapping purposes,
- understanding the bathymetry at the site location,
- randomly assigning sampling locations for biomass and water quality sampling, and
- monitoring changes in milfoil distribution over time.

Station Locations

Figure 1 shows the locations for each type of environmental samples to be collected. Five sampling stations each for Fairweather Bay and Cozy Cove were defined for biomass sampling, for 2,4-D residue analysis, and for water quality profiles. It is important to occupy the same stations for each type of sampling because of the additional information provided to understand conditions at the site both before and after herbicide application. Table 5 shows the GPS (UTM) coordinates, sampling station designation, and average depth for each of the sampling stations to be occupied.

Table 5: Sampling Station Designation and Coordinates

Sample ID	UTM X_COORD	UTM Y_COORD	POINT_ID	Average Depth (ft)
FB–01	557696.7	5276457.4	29-20	9.7
FB-02	557628.1	5276729.8	20-18	10.6
FB-03	557564.6	5276819.5	17-16	10.6
FB-04	557411.4	5276845.6	16-11	8.8
FB-05	557466.4	5277060.6	09-13	13.8
FB–OT	557342.0	5277148.5	06-09	15.9
CC-01	558360.8	5276689.4	22-42	6.0
CC-02	558328.6	5276749.5	20-41	7.1
CC-03	558323.5	5276932.2	14-41	12.1
CC-04	558142.4	5276866.2	16-35	11.2
CC-05	558115.4	5276743.5	20-34	8.5
YB-01				7.6
YB-02				16.3

Project Responsibilities

Project responsibilities have been assigned as follows:

- Pre-application 10-day notice of herbicide application – AquaTechnex
- Preparation of QAPP – Jones & Stokes
- Biomass Sampling/Analysis --- Jones & Stokes
- Pre- and Post-Treatment Water Quality Monitoring --- Jones & Stokes
- 2,4-D application (7/16/03) --- Aquatechnex
- Project Public Outreach/Education --- Town of Hunts Point

Schedule

The projected timeline for the project is as follows:

- July 7, 2003 – Finalize QAPP
- July 9, 2003 – Conduct baseline assessment for biomass and water quality
- July 16, 2003 – Conduct 2,4-D application
- July 17, 2003 – 1-day post-application water quality sampling

- July 19, 2003 – 3-day post-application water quality sampling
- July 21, 2003 – 5-day post-application water quality sampling
- August 15, 2003 – 30 day post-application aquatic plant distribution and biomass sampling survey
- Fall 2003 – Prepare Environmental Monitoring report

- Summer 2004/2005 – Later phases of Milfoil Control project (not yet defined)

Field and Laboratory Procedures

Field Procedures

Aquatic plant biomass. Data will be collected by generally following procedures outlined in Parsons (2001). Species composition data will be collected during each sampling event. A list of species observed during sample collection will be maintained. Field personnel will make notes of visually observed additional species that may be present in the littoral zone that may not have been sampled using the diver quadrat sampling method. Notes on species abundance and vigor will also be collected.

Aquatic plant biomass data will be collected from 10 randomly selected points shown on Figure 1. All sampling points will be navigated to by using the field GPS unit. Divers will cut and collect all plant matter above the bottom in a 0.25 m^2 quadrat. The samples will be brought to the boat and transferred to a labeled plastic bag. After they are air-dried overnight in the lab the samples will be sorted by species to the extent possible. Records will be maintained of the sample number, species present, and overall weight.

In addition, the general distribution of milfoil and other aquatic plants will be noted during field operations within the littoral zone. All species observed, in addition to general location and approximate water depth, will be recorded in the field logbook.

Water quality. Samples for water quality profiling will be taken at approximately three depths in the water column. Field measurements will be taken for temperature, pH, turbidity, dissolved oxygen using a calibrated Hydrolab Multiprobe or other appropriate measurement devices.

2,4-D residue analysis. 2,4-D residue samples will taken using a Niskin sampler from the approximate mid-point in the water column, and composited from pre-selected sampling locations in each cove. The samples will be placed in 1 L high-density amber PVC bottles and individually enclosed in zip-lock bags to prevent cross-contamination. The samples will be stored on ice at 4° C and delivered to the contract lab via courier the next business day, in compliance with the seven day holding time specified for 2,4-D. Samples will be analyzed at the contract laboratory for 2,4-D only.

Laboratory Procedures

Water quality samples will be analyzed for 2,4-D by a contracted laboratory that is accredited by Ecology (North Creek Analytical Laboratory). The laboratory will follow all procedures prescribed by EPA Method 8151A as well as its own internal QA/QC procedures.

Data Quality Objectives

The following is a description of measurement quality objectives for 2,4-D that is consistent with the EPA method 8151A. Accuracy, as measured by the percent recovery of blank spike, should be within 50 and 146%. Precision, as quantified by the relative percent difference of the matrix spike to the matrix spike duplicate, should be less than or equal to 46%. Bias, as quantified by the percent recovery of matrix spike, should fall within 50 to 150%. The analytical reporting limit for 2,4-D is expected to be 1.0 µg/L. This is well below Ecology's drinking water action level for 2,4-D of 70 µg/L.

Table 6 shows the measurement quality objectives, including stated accuracy, precision, and reporting limits for the Hydrolab® used for evaluating water quality profiles.

Table 6. Measurement Quality Objectives for Hydrolab® (Hydrolab, 2003)

Parameter	Accuracy	Precision	Reporting Limit
pH	0.2 SU	0.01 SU	2 - 12 SU
DO	0.2 mg/L	0.01 mg/L	0 - 20 mg/L
Temperature	0.2 ^{o}C	0.01 ^{o}C	-5 - 50 ^{0}C
Turbidity	5% / 1 NTU	0.01 NTU	0 - 1000 NTU

Quality Control Procedures

Field Quality Control

Water quality. The following procedures will be implemented to reduce cross-contamination of the water quality samples, including collecting samples to the extent possible from untreated areas first, and individually enclosing samples in zip-lock bags.

2,4-D water samples will be placed in a one liter amber container and stored at 4^{o}C until it is shipped to the lab. The holding time for the sample is 7 days.

One in ten samples will be collected in duplicate and submitted to the laboratory blind to assess overall precision. Appearance of plant or sediment material in the samples, difficulties obtaining samples, or any field conditions potentially affecting the results will be recorded. All field instrumentation will be properly calibrated before each sampling event.

Aquatic plant samples. The plant biomass samples will be collected according to the methods described in the Field Procedures section. The biomass samples will be sorted and dried as soon as possible to avoid deterioration.

Lab Quality Control

Analysis of 2,4-D in water will follow quality control criteria for EPA Method 8151A in addition to routine laboratory QA/QC procedures. The laboratory to be conducting the chemical analyses for 2,4-D is North Creek Analytical in Bothell, WA. These criteria include requirements for holding times, instrument calibration, procedural blanks, spiked sample analysis, precision data, and laboratory control sample analysis.

Data Review and Validation

All data will be assessed to ensure that the Data Quality Objectives were met. If the data are determined to be valid, they will assist in determining the future permitted use of 2,4-D as an aquatic herbicide for milfoil control in Washington.

Water quality and 2,4-D analytical data will be reviewed by Jones & Stokes personnel prior to submittal to Ecology. The water quality data will be reviewed in the field for accuracy, and ensuring that all quality control guidelines were followed. The results will be compared to QC results and the measurement quality objectives. Any necessary data qualifiers will be assigned at this time. Once the data are submitted to Ecology, the project manager (Kathy Hamel) will conduct a final review.

The aquatic plant data will be reviewed by Jennifer Parsons at Ecology. Any necessary data qualifiers will be assigned.

Data management. The 2,4-D analysis data will be entered on a form provided for this purpose by Kathy Hamel, and the other water quality data will be provided to Ecology in an Excel spreadsheet. All aquatic plant biomass data will be entered into an Excel or Access database and reviewed for accuracy.

Environmental Monitoring Report

All data will be reviewed for quality as specified in the QAPP. In conducting this review, Jones & Stokes will follow guidance prescribed for *laboratory QC* (check standards, analytical duplicates, matrix spikes, laboratory blanks) and *field QC* (replication, sample splits, field blanks, etc.).

After completing the 2003 environmental monitoring surveys and reviewing/analyzing the field data, Jones & Stokes will prepare a draft monitoring report which will contain detailed findings, conclusions and recommendations for monitoring during future treatment years (especially 2004 and 2005). Findings and recommendations from this report are expected to support optimized integrated management of Eurasian milfoil during subsequent years.

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Appendix B. Detailed Aquatic Biomass Data Showing All Species Collected

Appendix B: Detailed Aquatic Biomass Data Showing All Species Collected

Sample Date	Sample ID	Percent Milfoil	TOTAL BIOMASS (grams)	Species Code													
				Egda	Elca	Egda & Elca	Mysp	Dead Mysp	Chspp	Pocr	Popr	TL Pospp	Pospp	Vaam	Naspp	Nispp	Cede
7/9/2003	FB01	30.33	944.0	164.4	53.9	218.3	286.3	0.0	402.6	0.0	0.0	36.9	0.0	0.0	0.0	0.0	0.0
7/9/2003	FB02	33.33	51.0	0.0	0.0	0.0	17.0	0.0	0.0	0.0	0.0	0.0	34.0	0.0	0.0	0.0	0.0
7/9/2003	FB03	37.50	22.7	0.0	0.0	0.0	8.5	0.0	11.3	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0
7/9/2003	FB04	3.30	258.0	0.0	0.0	0.0	8.5	0.0	0.0	0.0	0.0	241.0	0.0	8.5	0.0	0.0	0.0
7/9/2003	FB05	95.83	136.1	0.0	0.0	0.0	130.4	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/9/2003	CC01	34.78	391.2	0.0	62.4	62.4	136.1	0.0	5.7	5.7	0.0	164.4	0.0	2.8	2.8	11.3	0.0
7/9/2003	CC02	98.39	175.8	0.0	0.0	0.0	172.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.8	0.0
7/9/2003	CC03	100.00	405.4	0.0	0.0	0.0	405.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/9/2003	CC04	97.96	277.8	0.0	0.0	0.0	272.2	0.0	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7/9/2003	CC05	99.10	314.7	0.0	0.0	0.0	311.8	0.0	0.0	0.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0
8/15/2003	FB01	0.00	104.9	0.0	0.0	28.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.8	56.7
8/15/2003	FB02	0.00	371.4	0.0	0.0	229.6	0.0	0.0	0.0	0.0	0.0	5.7	0.0	0.0	0.0	19.8	116.2
8/15/2003	FB03	1.83	309.0	0.0	0.0	14.2	5.7	0.0	0.0	0.0	289.2	0.0	0.0	0.0	0.0	0.0	0.0
8/15/2003	FB04	3.50	405.4	0.0	0.0	5.7	14.2	0.0	0.0	5.7	0.0	337.4	0.0	42.5	0.0	0.0	0.0
8/15/2003	FB05	81.03	164.4	0.0	0.0	0.0	133.2	0.0	0.0	0.0	0.0	2.8	0.0	2.8	22.7	0.0	2.8
8/15/2003	CC01	0.00	481.9	0.0	0.0	28.3	0.0	0.0	0.0	5.7	0.0	85.0	0.0	198.4	153.1	0.0	11.3
8/15/2003	CC02	63.16	269.3	0.0	0.0	0.0	170.1	0.0	0.0	51.0	0.0	0.0	0.0	22.7	17.0	5.7	2.8
8/15/2003	CC03	91.02	694.6	0.0	0.0	0.0	632.2	0.0	0.0	62.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8/15/2003	CC04	1.72	164.4	0.0	0.0	0.0	2.8	155.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.0
8/15/2003	CC05	0.00	266.5	0.0	0.0	2.8	0.0	0.0	0.0	141.7	0.0	2.8	0.0	0.0	39.7	79.4	0.0

Species Codes:

Egde: *Egeria densa* (Brazilian elodea)
Elca: *Elodea canadensis* (common waterweed)
Mysp: *Myriophyllum spicatum* (Eurasian milfoil)
Chspp: *Chara species* (muskgrasses, stonewort)
Pocr: *Potomogeton crispus* (curly-leaved pondweed)
Popr: *Potomogeton praelongus* (white-stemmed pondweed)
TLPospp: Thin leaved *Potomogeton* species (thin leaved pondweed species)
Pospp: *Potomogeton* species (pondweed species)
Vaam: *Vallisneria americana* (tapegrass)
Naspp: *Najas* species (water-nymph)
Nispp: *Nitella* species (Nitella species)
Cede: *Ceratophyllum demersum* (coontail, hornwort)

Appendix C. Dive Transect Data Observed in July and August 2003

Hunts Point Eurasian Milfoil Control Project

Dive transect data for July 2003

Cozy Cove	
CC T1	
East to West	
7/9/2003	

Transect No.	Distance (feet from west end) Start	End	Depth at Start (ft)		Notes
CC T-1.1	990	shore	5	11	half milfoil, half *Potomogeton crispus*
CC T-1.2	880	990	11	13	all Eurasian milfoil (*M. spicatum*)
CC T-1.3	790	880	13	14	mostly *P. crispus*
CC T-1.4	725	790	14	15	all Eurasian milfoil (*M. spicatum*)
CC T-1.5	735	725	17	17	sparser Eurasian milfoil (*M. spicatum*)
CC T-1.6	315	735	15	15	sparser Eurasian milfoil with distinct patches
CC T-1.7	200	315	14	14	Sparsely distributed large plants of *M. spicatum* (1plant/10m2) transitioning to dense coverage
CC T-1.8	70	200	14	14	sparser patches of Eurasian milfoil; *P. crispus* starting to appear
CC T-1.9	0	70	12	11	90% *Potomogeton crispus* to completion of transect (W shore of Cozy Cove)
CC T-1.10	Shore	0	11	5	70% *Potomogeton crispus, 10%* thin leaf, 20% E. milfoil to completion of transect (W shore of Cozy Cove)

Hunts Point Eurasian Milfoil Control Project

Dive transect data for July 2003

Location: Fairweather Bay
Transect: FB T-1
Direction of survey: West to East
Date: 7/10/03

Distance (feet from west end)

Transect No.	Start	End	Depth at Start and End		Notes
FB T-1.1	0	95		**6**	**Mostly** *P. crispus* with some *Elodea*; no *M. spicatum*.
FB T-1.2	95	325	12	14	Mostly *M. spicatum*
FB T-1.3	325	575	14	15	Mostly *M. spicatum*; improved visibility (about 12')
FB T-1.4	575	805	15	11	Solid *M. spicatum* midway through water column
FB T-1.5	805	1035	11	15	Solid *M. spicatum* midway through w.c.; shallower in middle of channel
FB T-1.6	1035	1105	15	15	Approx. 20% *P. crispus, 80% M. spicatum*.
FB T-1.7	1105	1200	15	13	Equal mixture *P. crispus* with *Elodea* and thin-leaf; approx. 10% *M. spicatum*.
FB T-1.8	1200	Shore	13	9	P. crispus mixed with *Elodea* and thin-leaf; approx. 5% *M. spicatum*.

Hunts Point Eurasian Milfoil Control Project

Post project milfoil survey

Location: Cozy Cove

Transect: CC T1

Direction of survey: West to East

Date: 8/14/2003

Distance (feet from west end)		Depth		
Start	End	Start	End	Notes
0	115	5	11	*Potomogeton crispus*
115	280	11	13	90-95% *Myriophyllum spicatum* , 5-10% *Potomogeton praelongus,* trace *P. crispus*
280	400	13	14	Bare with traces of *Elodea canadensis, Najas, and M. spicatum*
400	450	14	14	*M. spicatum*
450	520	14	13	Bare
520	585	13	14	Sparsely distrubuted large plants of *M. spicatum* (1plant/10m2, 40% coverage)
585	700	14	14	Dense *M. spicatum* (5-7 plants /m2). Small to large plants. Some *P. praelongus*
700	745	14	14	*M. spicatum* with necrosis on tips or along portions of meristem only (see photo).
745	810	14	15	Sparse to dense *M. spictum* (up to 5-7 plants /m2).
810	1075	15	11	*M. spicatum* with necrosis on tips only.
1075	1150	11	9	Mostly *P. crispus* with occassional *M. spicatum* and White-stem *Potomogeton* .

Hunts Point Eurasian Milfoil Control Project

Post project milfoil survey

Location: Cozy Cove

Transect: CC T2

Direction of survey: East to West

Date: 8/14/2003

Distance (feet from west end)		Depth		
Start	End	Start	End	Notes
840	768	5	6	*Valisneria americana* 80%, *M. spicatum* 20%(dead stems with growing branches)
768	700	6	6	*V. americana* 40%, *M. spicatum* stems 60%, only 20% with live branches
700	599	6	6	*V. americana* 30%, *M. spicatum* 50%(dead stems, 10% with growing branches), 20% *P. crispus*
599	478	6	6	*V. americana* 40%, *M. spicatum* stems 60%(<5% with growing branches)
478	386	6	6	*P. crispus* 70%, *V. americana* 10%, dead *M. spicatum* 20% (5-10% with new growth)
386	314	6	7	*V. americana* 70%, *M. spicatum stems* 20% (<5% live), *P. crispus* 10%.
314	268	7	7	*P. praelongus* 100%
268	116	7	6	*Ceratophyllum demersum* 30%, *Elodea canadensis* 50%, *Najas* 10%, *Potomogeton sp.* 10%, *M. spicatum* <5%
116	0	6	6	*E. canadensis* 70%, *Najas* 20%, *thin leaved Potomogeton sp.* 10%, *M. spicatum* <5%, many clumps of filamentous algae.

Hunts Point Eurasian Milfoil Control Project

Post project milfoil survey

Location: Cozy Cove
Transect: CC T-3
Direction of survey: East to West
Date: 8/14/2003

Distance (feet from west end)		Time		Depth		
Start	End	Start	End	Start	End	Notes
1000	*		1057	5	5	90% *Vallisneria americana* , trace of *Elodea canadensis*
*	*	1057	1101	5	8	Thin-leaved *Potomogeton, Myriophyllum spicatum* .
*	*	1101	1107	8	9	95% *M. spicatum* , 5% thin-leaved *Potomogeton*
*	*	1107	1106	9	9	*M. spicatum* , *P. praelongus* dominates
*	*	1106	1108	9	9	*M. spicatum* , *P. praelongus. Transition to M.spicatum* dominated, but mostly stems only.
*	470	1108		9		*P. crispus* dominates.
470	315		1112		8	50% *V. americana, M. spicatum* (stems only)
315	225	1112	1114	8	8	*M. spicatum* (mostly dead), *P. crispus* and *P. praelongus*
225	160	1114	1117	8	7	95% *P. crispu* s, 5% dead *M. spicatum*
160	125	1117	1119	7	7	Mostly dead *M. spicatum* with some new shoots, some healthy *Ceratophyllum demersum* .
125	80	1119	1121	7	7	Dense *C. demersum* , and narrow-leaved *Potomogeton* , little *M. spicatum* .
80	0	1121	1122	7	7	Filamentous algae, *V.americana*
	0	1122	1126	7	7	*P. crispus* to dolphin, then bare to shore.

* Inadequate sattelite coverage for GPS data collection.

Hunts Point Eurasian Milfoil Control Project

Post project milfoil survey

Location:	Fairweather Bay
Transect:	FB T-1
Direction of survey:	East to West
Date:	8/14/2003

Distance (feet from west end)		Depth		
Start	End	Start	End	Notes
590	390	6	6	*Elodea, P. prealongus* ; no *M. spicatum* .
390	275	6	8	*Vallisneria americana, C. demersum* , 1 loose *M. spicatum* fragment.
275	190	8	9	*Vallisneria americana, with patches of P. prealongus*
190	0	9	10	Mostly *P. crispus* with some *P. prealongus* and narrow-leaved *P* .. 50% covered with dead *M. spicatum* , but with a few new live shoots.
0	shore	10	6	Patches of *V. americana* and narrow-leaved P. . 50% covered with sickly (not totally dead) *M. spicatum* .

Hunts Point Eurasian Milfoil Control Project

Post project milfoil survey

Location:	Fairweather Bay, Southern Inlet
Transect:	FB T2
Direction of survey:	Zigzag from South to North
Date:	8/14/2003

Distance (feet from south end)		Depth		
Start	End	Start	End	Notes
0	275	<7	<7	Dense *Elodea* and *Ceratophyllum demersum*, no *Myriophyllum spicatum*.
275	630	<8	<8	Primarily *Ceratophyllum demersum*, and *Elodea* with some *Potomogeton praelongus*. No *M.* spicatum.

Hunts Point Eurasian Milfoil Control Project

Post project milfoil survey

Location: Fairweather Bay

Transect: FB T-3

Direction of survey: West to East

Date: 8/14/2003

Distance (meters from west end)		Depth		
Start	End	Start	End	Notes
0	56		7	*Vallisneria americana, P. crispus, P. prealongus* , and dead *M. spicatum* stems
56	100	7	7	Primarily P. prealongus
100	160	7	8	*P. prealongus* , some dead *M. spicatum* with occassional new growth
160	235	8	9	Dense *P. prealongus* , no *M. spicatum*
235	280	9	9	Dense *Ceratophyllum demersum* , no *M. spicatum*
280	340	9	10	Dense *P. prealongus* , no *M. spicatum*
340		10	10	Dense *Ceratophyllum demersum* , no *M. spicatum*
	415	10	10	Mix of *C. demersum* , *Elodea* , and *P. prealongus* , no *M. spicatum* . (60 % of bottom covered)
415	475	10	7	*V. americana* , narrow-leaved *P* , 80-90% coverage
475	500	7	5	*Elodea;* some narrow-leaved *P* , some *P. prealongus* . Trace of unrooted *M. spicatum* .

Appendix D. Selected Underwater Photographs

Photo 1. Photo point FB1, July 10, 2003.

Photo 2. Photo point FB1, July 10, 2003.

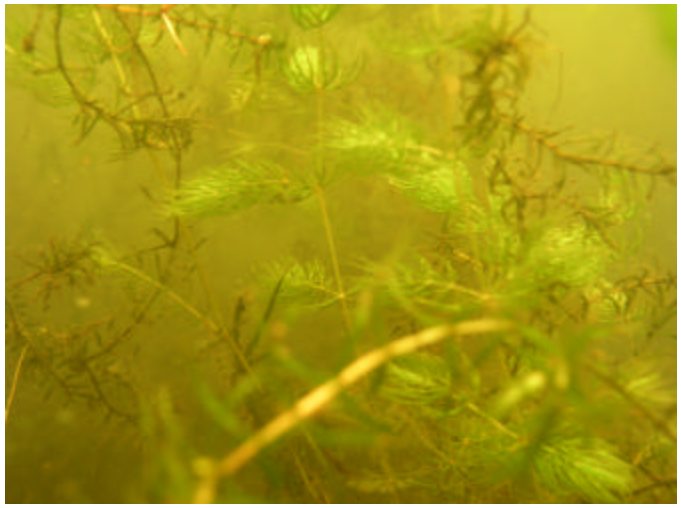

Photo 3. Photo point FB1, August 14, 2003

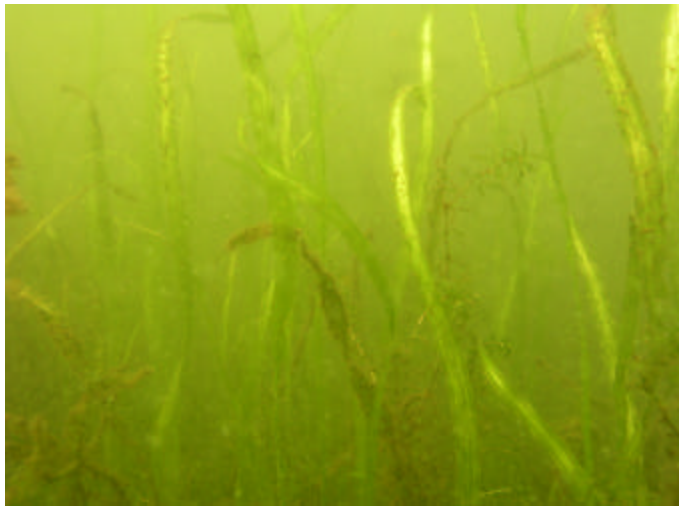

Photo 4. Photo pint FB1, August 14, 2003.

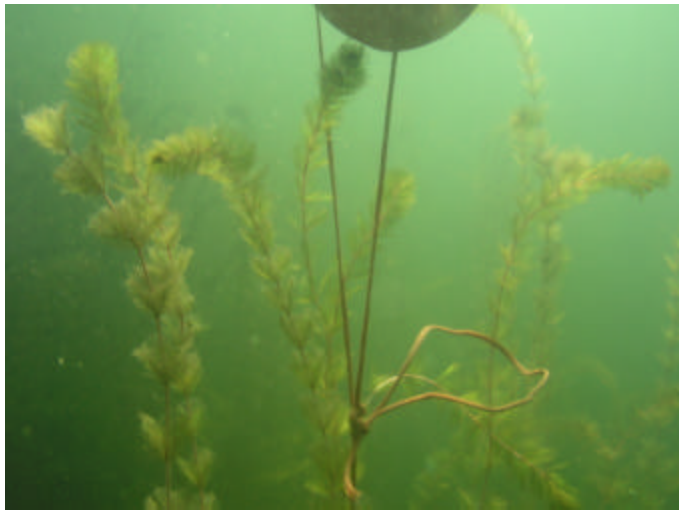

Photo 5. Photo point FB2, July 10, 2003

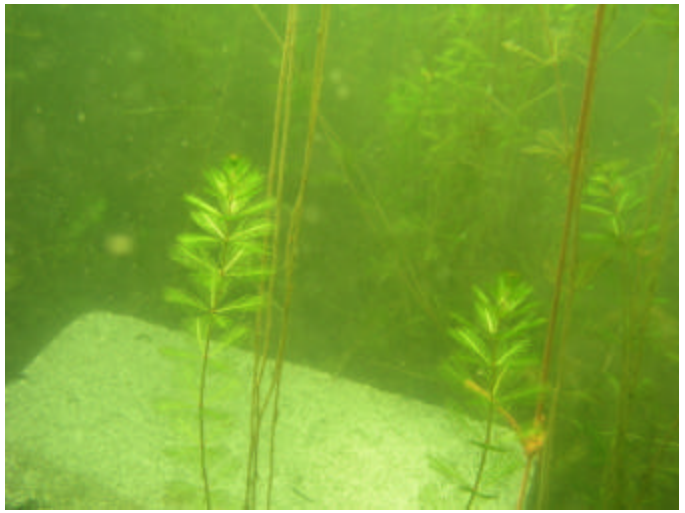

Photo 6. Photo point FB2, July 10, 2003.

Photo 7. Photo point FB2, August 15, 2003

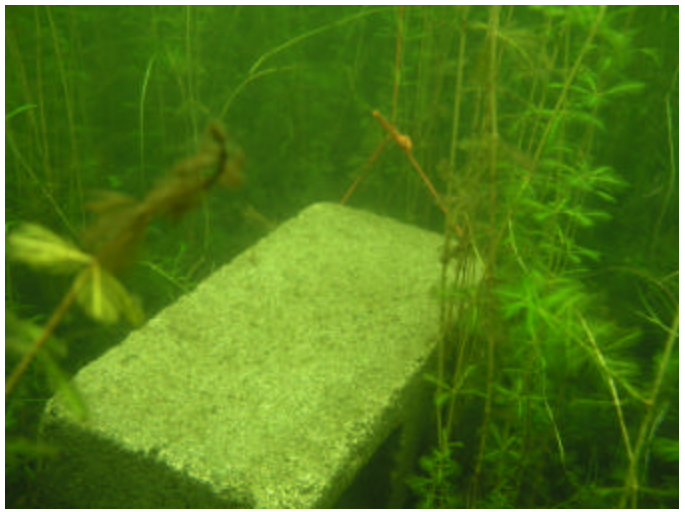

Photo 8. Photo point FB2, August 15, 2003.

Photo 9. Photo point CC1, July 11, 2003.

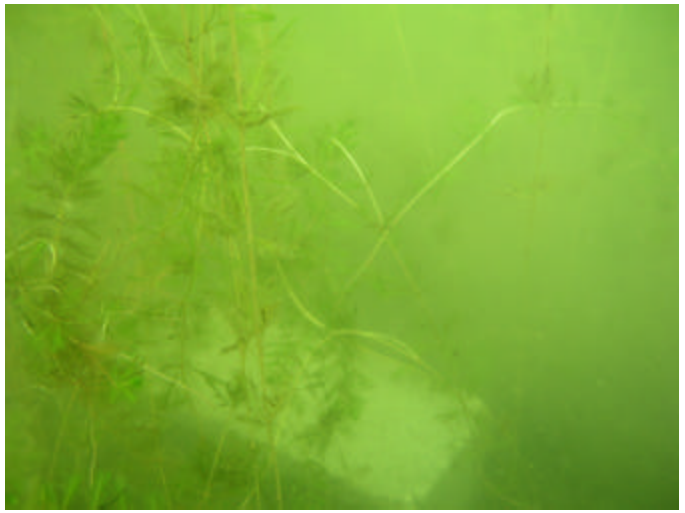

Photo 10. Photo point CC1, July 11, 2003.

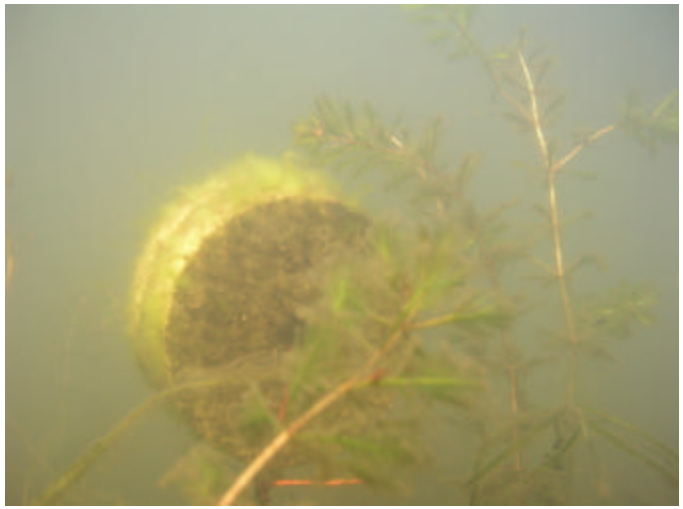

Photo 11. Photo Point CC1, August 14, 2003.

Photo 12. Photo Point CC1, August 14, 2003.

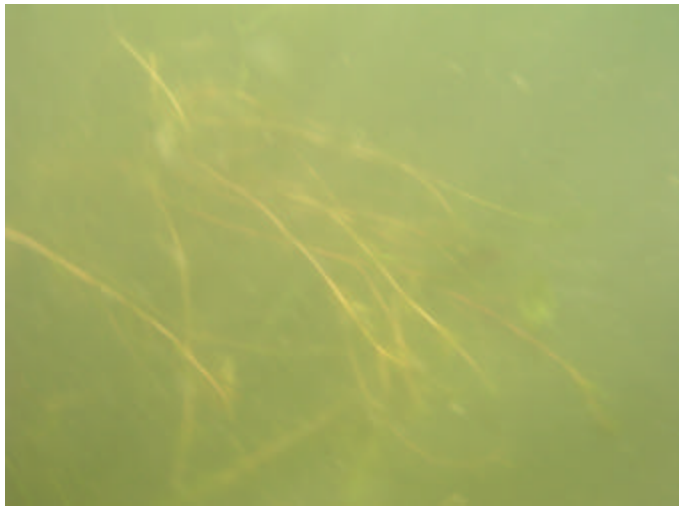

Photo 13. Photo point CC2, July 11, 2003.

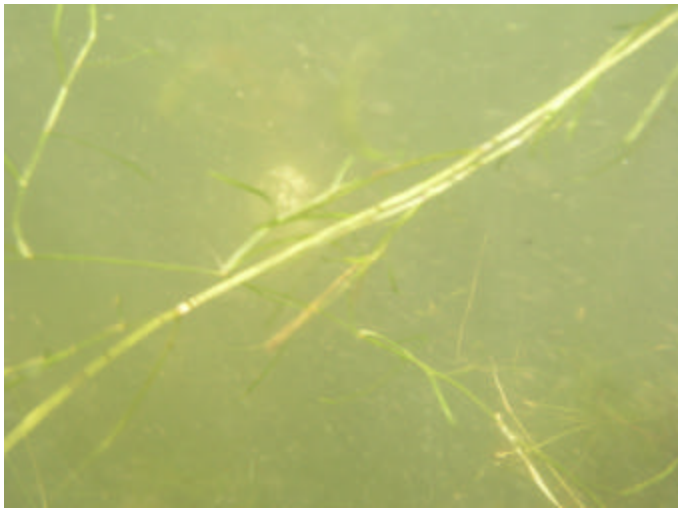

Photo 14. Photo point CC2, July 11, 2003.

Photo 15. Photo point CC2, August 14, 2003.

Photo 16. Photo Point CC2, August 14, 2003.

Appendix E. Analytical Data for 2,4-D in Water

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Portland 9405 SW Nimbus Avenue, Beaverton, OR 97008-7132
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Anchorage 2000 W International Airport Road, Suite A-10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Jones & Stokes	Project: Hunts Point	
11820 Northup Way, Suite E300	Project Number: Not Provided	**Reported:**
Bellevue, WA/USA 98005-1946	Project Manager: Allan Chartrand	07/29/03 16:39

Chlorinated Herbicides by EPA Method 8151A

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
FB-01 (B3G0327-01) Water Sampled: 07/11/03 12:00 Received: 07/11/03 17:15									X
2,4-D	ND	1.00	ug/l	1	3G15005	07/15/03	07/18/03	EPA 8151A	
Surrogate: 2,4-DCAA	*55.4 %*	*20-136*			"	"	"	"	
FB-01 (B3G0327-01RE1) Water Sampled: 07/11/03 12:00 Received: 07/11/03 17:15									O-08
2,4-D	ND	1.00	ug/l	1	3G22001	07/22/03	07/28/03	EPA 8151A	
Surrogate: 2,4-DCAA	*55.5 %*	*20-136*			"	"	"	"	

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes, Project Manager

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907.563.9200 fax 907.563.9210

Jones & Stokes	Project: Hunts Point	
11820 Northup Way, Suite E300	Project Number: Not Provided	**Reported:**
Bellevue, WA/USA 98005-1946	Project Manager: Allan Chartrand	07/29/03 17:07

Chlorinated Herbicides by EPA Method 8151A

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
CC-01D (B3G0421-01) Water Sampled: 07/17/03 10:00 Received: 07/17/03 16:15									
2,4-D	**88.5**	20.0	ug/l	20	3G19001	07/19/03	07/26/03	EPA 8151A	
Surrogate: 2,4-DCAA	*112 %*	*20-136*			"	"	"	"	
FB-01D (B3G0421-02) Water Sampled: 07/17/03 11:00 Received: 07/17/03 16:15									
2,4-D	**1570**	500	ug/l	500	3G19001	07/19/03	07/26/03	EPA 8151A	
Surrogate: 2,4-DCAA	*%*	*20-136*			"	"	"	"	*S-01*
FB-01D DUPE (B3G0421-03) Water Sampled: 07/17/03 11:00 Received: 07/17/03 16:15									
2,4-D	**1060**	250	ug/l	250	3G19001	07/19/03	07/26/03	EPA 8151A	
Surrogate: 2,4-DCAA	*%*	*20-136*			"	"	"	"	*S-01*
FB-0TL-01D (B3G0421-04) Water Sampled: 07/17/03 12:00 Received: 07/17/03 16:15									
2,4-D	**58.6**	20.0	ug/l	20	3G19001	07/19/03	07/26/03	EPA 8151A	
Surrogate: 2,4-DCAA	*110 %*	*20-136*			"	"	"	"	
FB-0TB-01D (B3G0421-05) Water Sampled: 07/17/03 12:00 Received: 07/17/03 16:15									
2,4-D	**384**	50.0	ug/l	50	3G19001	07/19/03	07/26/03	EPA 8151A	
Surrogate: 2,4-DCAA	*69.9 %*	*20-136*			"	"	"	"	

G

North Creek Analytical - Bothell

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Jeff Gerdes

Jeff Gerdes, Project Manager

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541.383.9310 fax 541.382.7588
Anchorage 2000 W. International Airport Road, Suite A10, Anchorage, AK 99502-1119
907.563.9200 fax 907.563.9210

Jones & Stokes	Project: Hunts Point	
11820 Northup Way, Suite E300	Project Number: Not Provided	**Reported:**
Bellevue, WA/USA 98005-1946	Project Manager: Allan Chartrand	08/01/03 12:28

Chlorinated Herbicides by EPA Method 8151A

North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
FB01-3D (B3G0494-01) Water Sampled: 07/18/03 11:00 Received: 07/21/03 16:55									
2,4-D	**693**	100	ug/l	100	3G24017	07/24/03	07/30/03	EPA 8151A	
Surrogate: 2,4-DCAA	*110 %*	*20-136*			"	"	"	"	
FB01-Dup (B3G0494-02) Water Sampled: 07/18/03 11:00 Received: 07/21/03 16:55									
2,4-D	**960**	100	ug/l	100	3G24017	07/24/03	07/30/03	EPA 8151A	
Surrogate: 2,4-DCAA	*110 %*	*20-136*			"	"	"	"	
CC-01 3D (B3G0494-03) Water Sampled: 07/18/03 10:00 Received: 07/21/03 16:55									
2,4-D	**83.9**	10.0	ug/l	10	3G24017	07/24/03	07/29/03	EPA 8151A	
Surrogate: 2,4-DCAA	*105 %*	*20-136*			"	"	"	"	
FB0TL 3D (B3G0494-04) Water Sampled: 07/18/03 11:00 Received: 07/21/03 16:55									
2,4-D	**49.9**	5.00	ug/l	5	3G24017	07/24/03	07/29/03	EPA 8151A	
Surrogate: 2,4-DCAA	*84.1 %*	*20-136*			"	"	"	"	
FB0T9 3D (B3G0494-05) Water Sampled: 07/18/03 11:00 Received: 07/21/03 16:55									
2,4-D	**266**	50.0	ug/l	50	3G24017	07/24/03	07/30/03	EPA 8151A	
Surrogate: 2,4-DCAA	*95.1 %*	*20-136*			"	"	"	"	

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes

Jeff Gerdes, Project Manager

Jones & Stokes	Project: Hunts Point	
11820 Northup Way, Suite E300	Project Number: Not Provided	**Reported:**
Bellevue, WA/USA 98005-1946	Project Manager: Allan Chartrand	08/01/03 12:31

Chlorinated Herbicides by EPA Method 8151A
North Creek Analytical - Bothell

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
CC01-5d (B3G0499-01) Water Sampled: 07/21/03 10:30 Received: 07/21/03 16:55									
2,4-D	**38.6**	5.00	ug/l	5	3G24017	07/24/03	07/29/03	EPA 8151A	
Surrogate: 2,4-DCAA	*81.6 %*	*20-136*			"	"	"	"	
FB01-5d (B3G0499-02) Water Sampled: 07/21/03 11:00 Received: 07/21/03 16:55									
2,4-D	**81.2**	10.0	ug/l	10	3G24017	07/24/03	07/29/03	EPA 8151A	
Surrogate: 2,4-DCAA	*90.0 %*	*20-136*			"	"	"	"	
FB01-dupe (B3G0499-03) Water Sampled: 07/21/03 11:00 Received: 07/21/03 16:55									
2,4-D	**716**	100	ug/l	100	3G24017	07/24/03	07/30/03	EPA 8151A	
Surrogate: 2,4-DCAA	*110 %*	*20-136*			"	"	"	"	
FBOTL (B3G0499-04) Water Sampled: 07/21/03 11:00 Received: 07/21/03 16:55									
2,4-D	**94.0**	10.0	ug/l	10	3G24017	07/24/03	07/29/03	EPA 8151A	
Surrogate: 2,4-DCAA	*97.0 %*	*20-136*			"	"	"	"	

North Creek Analytical - Bothell

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Jeff Gerdes

Jeff Gerdes, Project Manager

Appendix F. Water Quality Profile Data Collected in July and August 2003

WATER QUALITY PROFILE DATA

Hunts Point Eurasian milfoil project

APPENDIX F

		Time			Temperature (oC)			DO (mg/L)			pH		
Stn. No.	**Depth (ft.)**	**AM**	**PM1**	**PM2**	**AM**	**PM1**	**PM2**	**AM**	**PM1**	**PM2**	**AM**	**PM1**	**PM2**
Pre-Application Sampling 7/11/03													
CC-01	surface 1'	5:16	13:20	15:52				8.6	8.6	8.5			
	mid 2'							9	8.2	8.8			
	bottom 5'					21.8	23	8.6	7.7	8.4		7.27	7.35
CC-02	surface 1'	5:25	14:13	16:00				9.4	8.7	8.7			
	mid							9.2	8.3	9.5			
	bottom				22.5	21.4	23	8.2	7.6	9.8		7.13	7.51
CC-03	surface 1'	6:42	14:18	16:20				9.3	9.1	9.5			
	mid							9.4	9.5	10.4			
	bottom				20.4	20.5	22	9.2	9.5	10.2		7.42	7.54
CC-04	surface 1'	6:30	13:45	16:13				8.8	8.9	9.1			
	mid							10.1	9.2	9.7			
	bottom				20.6	21	22	7.9	9	10.8		7.5	7.49
CC-05	surface 1'	6:20	14:04	16:07				9	8.9	8.8			
	mid							9.6	9.2	9.9			
	bottom				22.8	21.6	22	10.3	9.8	9.6		7.56	7.56
YB control 1	surface 1'	6:55	11:30	15:22				10.35	10.35	9.8			
dense milfo	mid							10.05	10.05	10.5			
	bottom				22	22	22	9.5	9.5	10.7		7.54	7.55
YB control 2	surface 1'	7:00	11:41	15:38				9.4	9.4	8.9			
open water	mid							9.2	9.05	9.1			
	bottom					22	22	9.5	9.1	10.2		7.42	7.43
FB-01	surface 1'	5:35	12:24	16:40				9.6	9.3	10.7			
	mid							9.9	10.3	11.3			
	bottom				22	22	23	9.6	10.2	13		7.84	7.92
FB-02	surface 1'	5:46	12:30	16:47				9.4	9.7	9.8			
	mid							9.6	9.4	10			
	bottom				22	22	22	10.2	8.4	10.8		7.45	7.45
FB-03	surface 1'	5:55	12:40	16:51				9.7	9.3	10.1			
	mid							9.9	9.3	10.5			
	bottom				21	22	22	9.1	9.7	10.3		7.55	7.6
FB-04	surface 1'	6:00	12:50	17:00				9.7	9.1	9.7			
	mid							9.7	9.1	9.7			
	bottom				22	22	22	9.8	10.1	9.8		7.42	7.6
FB-05	surface 1'	6:13	12:56	17:07				9	9.1	9.4			
	mid							9.1	8.9	9.3			
	bottom				20.8	22	21	9.6	8.7	9.2		7.5	7.48

WATER QUALITY PROFILE DATA

Hunts Point Eurasian milfoil project

APPENDIX F

		Time		Temperature		DO (mg/L)		pH	
Stn. No.	**Depth (ft.)**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Post Application Sampling (8/15/03)									
CC-01	surface 1'	5:40	14:30	23.4	23.98	7.1	7.44	7	7.11
	mid 2'			23.4	23.98	7.01	7.25	6.92	7.13
	bottom 5'			23.35	23.42	6.93	7.75	6.93	7
CC-02	surface 1'	6:00	14:37	23.57	23.94	7.06	7.6	7.09	7.36
	mid 3'			23.57	23.92	7.16	7.7	7.15	7.27
	bottom 5'			25.14	23.57	6.5	8	7.19	7.26
CC-03	surface 1'	6:15	14:44	23.4	23.69	7.92	8.28	7.69	7.7
	mid 4'			23.4	23.02	8.08	8.52	7.61	7.88
	bottom 7'			23.36	22.61	7.09	7.6	7.23	6.97
CC-04	surface 1'	6:25	~14:54	23.46	23.73	7.31	7.83	7.03	7.13
	mid 4'			23.45	22.74	7.31	8.25	7.02	7.6
	bottom 7'			23.45	22.75	7.45	8.55	6.98	7.57
CC-05	surface 1'	6:30	~15:00	23.5	24.03	6.82	7.58	6.83	7.05
	mid 3'			23.51	23.8	6.8	7.8	6.77	7.1
	bottom 5'			23.51	23.56	6.74	7.87	6.73	7.23
YB control 1	surface 1'	6:41	14:07	23.28	23.55	7.45	8.26	7.44	7.72
dense milfo	mid 2'			23.24	23.52	7.29	8.32	7.35	7.68
	bottom 4'			23.23	23.47	7.16	7.97	7.22	7.82
YB control 2	surface 1'	6:53	14:17	23.04	23.26	8.23	8.58	7.78	7.98
open water	mid 7'			22.91	22.44	7.83	8.59	7.47	7.78
	bottom 16'			22.83	22.32	8.2	7.67	7.41	7.57
FB-01	surface 1'	7:09	15:15	23.57	24.3	7.39	8.48	7.23	7.81
	mid 4'			23.57	23.87	7.32	8.19	7.18	7.83
	bottom 7'			23.56	23.55	6.42	6.48	7.02	6.6
FB-02	surface 1'	7:16	~15:22	23.37	24.12	8.25	9.08	7.76	8.15
	mid 4'			23.37	24	8.23	8.99	7.76	8.09
	bottom 8'			23.36	23	8.13	8.92	7.72	8.01
FB-03	surface 1'	7:23	~15:29	23.28	24	7.85	8.85	7.61	8.18
	mid 4'			23.28	23.5	7.96	8.94	7.62	8.07
	bottom 7'			23.27	22.8	8.03	9.06	7.69	8.1
FB-04	surface 1'	7:29	~15:36	23.17	23.75	7.98	9.62	8.09	8.4
	mid 3'			23.17	23.3	7.79	9.7	7.85	8.38
	bottom 6'			23.15	23.3	7.74	9.28	7.73	8.4
FB-05	surface 1'	7:35	~15:43	22.94	23.55	8.04	8.69	7.5	7.98
	mid 5'			22.56	22.7	7.93	8.75	7.52	7.87
	bottom 11'			22.28	22.44	7.1	8.61	6.93	7.85